Bridging Actors in Sustainable Innovation for Developing Countries?

Partnerships, Social Construction of Technology and Solid Waste Management in Vietnam and Uganda

Christensen, David

DOI (link to publication from Publisher):
10.54337/aau300040596

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

BRIDGING ACTORS IN SUSTAINABLE INNOVATION FOR DEVELOPING COUNTRIES?

PARTNERSHIPS, SOCIAL CONSTRUCTION OF TECHNOLOGY AND SOLID WASTE MANAGEMENT IN VIETNAM AND UGANDA

BY
DAVID CHRISTENSEN

DISSERTATION SUBMITTED 2018

AALBORG UNIVERSITY
DENMARK

BRIDGING ACTORS IN SUSTAINABLE INNOVATION FOR DEVELOPING COUNTRIES?

PARTNERSHIPS, SOCIAL CONSTRUCTION OF TECHNOLOGY AND SOLID WASTE MANAGEMENT IN VIETNAM AND UGANDA

by

David Christensen

AALBORG UNIVERSITY
DENMARK

Dissertation submitted

.

Dissertation submitted:	November 2018
PhD supervisor:	Prof. Arne Remmen, Aalborg University
PhD committee:	Associate Professor Carla Smink (chair.) Aalborg University
	Associate Professor, PhD Rikke Lybæk Roskilde University
	Director, PhD Michael Yhdego Environmental Resources Consultancy
PhD Series:	Technical Faculty of IT and Design, Aalborg University
Department:	Department of Planning

ISSN (online): 2446-1628
ISBN (online): 978-87-7210-352-5

Published by:
Aalborg University Press
Langagervej 2
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

Printed in Denmark by Rosendahls, 2018

David Christensen

Part-time Lecturer, Aalborg University & Associate Lecturer, Copenhagen Business Academy

Phone: +45 21184097

Address: Frederiksværksgade 66B, 1.
3400 Hillerød

Email: damc@plan.aau.dk

I am an environmental management and CSR specialist with streaks of innovation management and international development in the mix. Hands-on experience with sustainable business development projects and volunteer work. As an experienced university educator, I am all about motivating students to learn though hands-on problem based approaches to solving sustainability issues.

EXPERIENCE

Copenhagen Business Academy

May 2018 - Present

Lektor (Associate Lecturer)

Teaching at the 2-year Academy Profession degree program in Environmental Technology at our campus in Hillerød within the subjects of Environmental Management Systems (EMS) and Corporate Social Responsibility (CSR), on Climate Change and Energy, on Investment Theory for Environmental Technologies, Environmental Communication, Project Management and Waste and Resources. Also international coordinator and environmental manager of our ISO 14001 system at our campus.

Aalborg University

February 2015 - Present

Ekstern lektor (Part-time Lecturer)

- Teaching, supervision and semester coordination activities for the Danish-language BSc program in Urban, Energy and Environmental Planning in Copenhagen - Teaching for the BSc program in Techno-Anthropology in Aalborg and Copenhagen - Supervision at the MSc program in Environmental Management & Sustainability ScienceAdjunkt (Assistant Lecturer), Environmental Coordinator, International Coordinator at Copenhagen

Copenhagen Business Academy

August 2014 - April 2018 (3 years 9 months)

Adjunkt (Assistant Lecturer)

Teaching at the 2-year Academy Profession degree program in Environmental Technology at our campus in Hillerød within the subjects of Environmental Management Systems (EMS) and Corporate Social Responsibility (CSR), on Climate Change and Energy, on Investment Theory for Environmental Technologies, Environmental Communication, Project Management and Waste and Resources. Also project manager of so-called "development project" on ISO 14001 implementation at our Hillerød campus.

Aalborg University

December 2010 - January 2015 (4 years 2 months)

PhD Fellow / Part-time Lecturer

As a PhD Fellow attached to the Sustainability, Innovation and Policy (SIP) research group at Aalborg University, my research work is directly embedded within the activities of the Access2Innovation project as a whole. Using interdisciplinary action-research methods with Constructive Technology Assessment (CTA) as my overall theoretical framework, I borrow from management science, sustainability science, innovation studies/innovation managment and development studies in my work. I am supervised by Professor Arne Remmen, who has been a pioneer in CTA in the Danish context.

Access2innovation

December 2010 - January 2015 (4 years 2 months)

Program Manager

Access2Innovation is a publicly funded project that aims to co-innovate solutions in developing countries through collaboration between development NGO's, universities and businesses. The focus is on a user-driven approach with development NGO's as the needs assessors and entry points for business to enter frontier markets through sustainable Base-of-the-Pyramid business models. Access2Innovation works within the three thematic areas of Renewable Energy, Food Security and Water & Sanitation. In addition, through partner NGO's CARE International and MS Action Aid Denmark, the project is primarily focused on applying its network-based business innovation framework on products and services aimed at Tanzania and Uganda. As Program Manager, I am primarily responsible for socio-technical considerations in technology transfer as well as constructive technology assesmnents in order to inform the decisions made by the actors in the innovation processes.

Aalborg University

2008 - December 2010 (3 years)

Research Assistant

I was attached to the research group on Sustainability, Innovation and Policy (SIP) at the Department of Development and Planning, where I participated in ongoing project activities as well as strategic project start-up activities, primarily focused on partnerships with developing countries. I conducted supervision duties for student groups and individual thesis writers primarily within our Environmental Management master program, and also co-supervised engineering students at the Basic Year in Engineering, Science and Medicine (specializations in Electronic Systems and Internet Technologies & Computer Systems).My teaching was primarily within the course on Technology Transfer, with a particular focus on theoretical and practical applications of Logical Framework Analysis in international technology transfer projects and programs. I was also Environmental Coordinator at the university, supporting the university's efforts in improving environmental performance among its wide range of activities. This included assisting in setting up a formalized environmental management system (EMS) for the entire organization. As Research Assistant, I was in position to conduct a PhD study with a focus on clean technology and socially responsible innovation at the Base-of-the-Pyramid (BOP) in developing countries.

Universidad Nacional de Costa Rica

February 2007 - November 2007 (10 months)

Guest Researcher (Master Thesis)

In a challenging environment which required the acquisition of user-level Spanish from a zero basis point, I conducted independent master thesis research overseen by the International Economic Policy Center for Sustainable Development (CINPE) at Universidad Nacional de Costa Rica on the sustainable performance of firms within the Costa Rican electronics sector. This was the groundwork for my master thesis, "Sustainable Systems of Innovation? A Study of Globalization, FDI and Sustainable Performance in the Costa Rican Electronics Sector led by Intel"

SunPower Philippines

July 2006 - December 2006 (6 months)

Intern (Environment, Safety & Health Unit)

Together with another visiting intern from Aalborg University, I was responsible for conducting initial feasibility studies for the implementation of an environmental management systems at the company based on the ISO 14001 standard. This included conducting a gap analysis, assessing the production facility's environmental aspects and identifying significant impacts, and working with both produciton line staff as well as staff from the Environmental, Safety and Health (ESH) unit.

EDUCATION

Aalborg Universitet

2009 - 2011

Master of Social Science, Development and International Relations,

Aalborg Universitet

2002 - 2008

Master of Science in Engineering, Environmental Management,

Skanderborg Amtsgymnasium & HF Kursus

1999 - 2002

Upper Secondary School Diploma, Math Line,

Bangkok Patana School

1995 - 1996

ENGLISH SUMMARY

This PhD thesis presents the results of a PhD study into partnership innovation for developing countries, how technology is socially constructed and how inclusive and sustainable solutions can be co-constructed. The PhD draws empirically from case studies that have been part of the *access2innovation* initiative within Solid Waste Management (SWM) in Vietnam and Uganda, respectively. *Access2innovation* facilitates partnership innovation processes among different kinds of actors and was engaged in such projects within renewable energy, water and sanitation and agriculture in the 2011-2014 period in which the research took place. Motivations for the research are addressing knowledge gaps regarding sustainability in business modeling and technology development in developing countries, as well as highlighting considerations towards inclusivity across cultures and geographical contexts, i.e. social equity and participation. The research is also motivated by seeking to inform partnership innovation processes through a socio-technical understanding, complementary to managerial and entrepreneurial-focused research interests.

The Vietnam case study is based on action research and participant observation in order to study a partnership from within, while the Uganda case study involves a socio-technical analysis of a SWM system in a particular district in order to study relevant considerations for partnership innovation given such framework conditions. Constructive Technology Assessment (CTA) is employed as a methodology and its application with regard to developing countries is developed in the research. The PhD thesis incorporates four scientific papers in different parts of the thesis.

The thesis contains four parts: **Part I** (Introduction), which contains a contextual positioning of the research; **Part II** (Research Design), which includes the main research question and sub-questions as well as a methodology-focused scientific paper; **Part III** (Results and Analysis), which contains the rest of the scientific papers included in the PhD thesis based on the Vietnam and Uganda case studies; and **Part IV** (Conclusion) which addresses the main research question based on the findings, and adds perspectives with respect to the Sustainable Development Goals (SDG's).

In **Part I**, three chapters form the contextual positioning of the research. *Chapter 2* contains an elaboration on inclusive and sustainable innovation in developing countries. Inclusivity is developed conceptually, and the literature on Base of the Pyramid (BoP) and social business is reviewed. The chapter also includes various examples of Danish companies attempting different strategies to address the BoP. In *Chapter 3, access2innovation* is introduced, an initiative which has sought to support innovative business and technology in a number of application areas. The initiative's origins, development, inner workings and specific projects are detailed herein. *Chapter 4* is a review of SWM in developing countries particularly through a socio-

technical perspective, and details SWM in relation to BoP business modeling and technology development.

In **Part II**, two chapters link the contextual positioning in the preceding chapters with the overall scientific basis for the PhD thesis. *Chapter 5* contains an articulation of the thesis' main research questions and sub-questions, clarifying the research focus on inclusivity and sustainability in partnership innovation with respect to thematic positioning, project positioning and professional positioning respectively. *Chapter 6* contains an elaboration of the theories of science behind the research, i.e. the ontology and epistemology of the thesis which rests upon social constructivism. As well, the methodology is elaborated, consisting of the thesis' two pillars of Social Construction of Technology (SCOT) and Constructive Technology Assessment (CTA). Paper 1, a scientific paper on CTA, is inserted into this chapter which contains an elaboration of how CTA can be fitted for supporting decision-making processes in developing countries by being networked and based on involvement of citizens and a wide range of actors in the same manner as *access2innovation* operates. Finally, the methods applied in the different studies are explained.

In **Part III**, the analyses which form the core of the PhD thesis are presented as three chapters containing individual stand-alone papers, each preceded by an introductory text denoted as 'highlights'. The chapters cover both the Vietnam and Uganda case studies. In *Chapter 7* the earliest stage of the Vietnam case study is presented and is considered from a CTA perspective. Additionally, the potentials and limitations of *access2innovation* are reflected upon, relating to the ability of the set-up to support goal alignment among interested partners but where this is not guaranteed. Paper 2 is inserted here. In *Chapter 8* the Vietnam case study is examined until its conclusion, which was the dissolution of the partnership and abandoning of the business concept. Paper 3 is inserted here. In *Chapter 9*, a district-level SWM system in Uganda is analyzed with the aim of identifying sustainable pathways for partnership innovation. Paper 4 is inserted here.

In **Part IV**, the findings from the different papers contained in the thesis are bound together to answer the main research question. In *Chapter 10* the five sub-questions structure how the main research question is addressed. SCOT concepts can help provide an understanding of how technology is socially constructed in partnership innovation for developing countries. As well, knowledge and understanding of socio-technical systems, structuring for proactive intake of knowledge through CTA and bridging through balancing of representation among actors can help facilitate that co-construction of inclusive and sustainable partnership innovation processes. Finally, the PhD thesis ends with perspectives about future directions for research with an outset in Danish development cooperation, *access2innovation*, and the Sustainable Development Goals (SDG's) which at the global level act as guideposts which lay emphasis on partnerships for further integration of the goals through action by different groups of actors.

DANSK RESUME

Denne Ph.d.-afhandling indeholder resultaterne af et Ph.d.-studie inden for partnerskabsinnovation målrettet udviklingslande, om hvordan teknologi bliver socialt konstrueret og hvordan inklusive og bæredygtige løsninger kan blive samkonstrueret. Ph.d.-en trækker empirisk på casestudier, der har været en del af initiativet *access2innovation* inden for affald i både Vietnam og Uganda. *Access2innovation* tilvejebringer partnerskabsbaserede innovationsprocesser iblandt forskellige typer af aktører, og havde sådanne projekter inden for vedvarende energi, vand og sanitet samt fødevareproduktion i 2011-2014, som var den periode hvori forskningen fandt sted. Den bagvedliggende motivation for forskningen er at adressere videnshuller ift. bæredygtighed i forretningsmodeller og teknologiudvikling i udviklingslande, og at understrege betydningen af inklusion på tværs af kulturer og geografisk kontekst, dvs. social ligestilling og deltagelse. Forskningen er også motiveret ved et ønske om at bidrage til viden om partnerskabsbaserede innovationsprocesser ud fra en socio-teknisk forståelse som komplementært perspektiv set i forhold til ledelses- og iværksætterorienterede forskningsinteresser.

Vietnam casestudiet baserer sig på aktionsforskning samt deltagerobservation for at kunne studere partnerskabet indefra, mens Uganda casestudiet indebærer en socio-teknisk analyse af et affaldssystem i et specifikt distrikt for at kunne studere relevante forhold for partnerskabsinnovation under de givne rammebetingelser. Konstruktiv teknologivurdering anvendes som metodologi, og i forskningen udvikles der på overvejelser omkring dens anvendelse ift. udviklingslande. Ph.d.-en indeholder fire videnskabelige artikler forskellige steder i afhandlingen.

Afhandlingen indeholder fire dele: **Del I** (Introduktion) som indeholder en positionering af forskningen inden for forskellige kontekstuelle områder; **Del II** (Forskningsdesign) som indeholder problemformuleringen og underspørgsmål samt en metodologi-fokuseret videnskabelig artikel; **Del III** (Resultater og Analyse), der indeholder de resterende videnskabelige artikler i Ph.d.-afhandlingen baseret på Vietnam og Uganda casestudierne; og **Del IV** (Konklusion) der svarer på problemformuleringen, og har perspektiver set i forhold til de globale bæredygtighedsmål.

I **Del I** udgøres den kontekstuelle positionering af tre kapitler. I *Kapitel 2* uddybes begreberne inklusiv og bæredygtig innovation i udviklingslande. Inklusion udvikles konceptuelt, og litteraturen gennemgås inden for 'Base of the Pyramid' (BoP) samt sociale virksomheder. Kapitlet indeholder også forskellige eksempler på hvordan danske virksomheder har forsøgt sig med forskellige strategier for at tilgå BoP'en. I *Kapitel 3* introduceres *access2innovation*, som er et initiativ der har forsøgt at støtte innovative forretninger og teknologi inden for en række områder. Initiativets baggrund, udvikling, interne forhold og specifikke projekter er indeholdt heri. *Kapitel*

4 indeholder en gennemgang af litteratur inden for affald i udviklingslande. Kapitlet har et særligt socio-teknisk perspektiv og sætter affald i relation til BoP forretningsmodeller samt -teknologiudvikling.

I **Del II** er der to kapitler, der linker den kontekstuelle positionering i de foregående kapitler med den overordnede, videnskabelig basis for Ph.d.-afhandlingen. *Kapitel 5* indeholder problemformuleringen samt underspørgsmål, og klarlægger fokusset på inklusion og bæredygtighed i partnerskabsinnovation set i relation til den positionering, der er gjort i forhold til hhv. tema, projekt og fagområde. I *Kapitel 6* er der en uddybning af den videnskabsteori der ligger bag forskningen, dvs. overvejelser omkring ontologi og epistemologi med afsæt i socialkonstruktivisme. Hertil uddybes metodologien, hvilket udgøres af to hovedelementer, hhv. teknologiens sociale konstruktion omtalt som SCOT, og konstruktiv teknologivurdering omtalt som CTA. Paper 1, den videnskabelige artikel om CTA, indsættes i kapitlet her hvor det uddybes hvordan CTA kan tilpasses så det støtter beslutningsprocesser i udviklingslande ved at være netværksbaseret, og ved at det lægger op til borgernes involvering samt at forskellige aktører involveres, på samme måde som *access2innovation* fungerer. Til sidst forklares om de metoder, der anvendes i de forskellige studier.

I **Del III** indgår de analyser, der tilsammen udgør kernen i Ph.d.-afhandlingen. Dette gøres gennem tre kapitler, der indeholder en videnskabelig artikel hver, og som hver især indledes med introduktion kaldt for 'highlights'. Kapitlerne dækker over både Vietnam og Uganda casestudierne. I *Kapitel 7* præsenteres den tidligste fase i Vietnam casestudiet, hvilket overvejes ud fra et CTA-perspektiv. Herudover reflekteres der på mulighederne og begrænsningerne i *access2innovation* ift. initiativets evne til at støtte fælles målsætninger iblandt partnere. Paper 2 indsættes her. I *Kapitel 8* undersøges Vietnam casestudiet frem til dets slutning, hvor der skete en opløsning af partnerskabet hvor dets forretningskoncept blev opgivet. Paper 3 indsættes her. I *Kapitel 9* analyseres på et affaldssystem i Uganda i et distrikt med henblik på at identificere bæredygtige muligheder inden for partnerskabsinnovation. Paper 4 indsættes her.

I **Del IV** bindes resultaterne fra de forskellige videnskabelige artikler i afhandlingen sammen for at kunne besvare problemformuleringen. I *Kapitel 10* gøres dette gennem strukturen angivet ved de fem underspørgsmål. SCOT-koncepter kan hjælpe med at forstå teknologiens konstruktion i partnerskabsbaserede innovationsprocesser i udviklingslande. Hertil kan inklusive og bæredygtige partnerskabsbaserede innovationsprocesser støttes gennem en forståelse af socio-tekniske systemer, en struktureret og proaktiv tilvejebringelse af viden gennem CTA og gennem brobygning mellem aktører vha. balanceret repræsentation. Ph.d-afhandlingen slutter med perspektiver på videre forskning med udgangspunkt i dansk udviklingssamarbejde, *access2innovation* og de globale bæredygtighedsmål. Her lægges der vægt på, at partnerskaber med forskellige grupper af aktører kan sikre en videre integrering af målene.

ACKNOWLEDGEMENTS

"Life happens."

This PhD thesis has been part of a journey that has taken a perplexing amount of time to complete. Whenever I've been asked about why my journey has taken so long, I've usually responded with a grimace and the above. To me, the statement captures how the travails of a PhD researcher are intertwined with a personal story. All the complexities involved with life at large have come into play during the eight years of my PhD, but I can say I am wiser for the experience. I am thankful to the following people who have contributed in different ways along my path.

Access2innovation. A secretariat, network, institutional infrastructure, action research initiative or project. Whatever term is used to describe it, what is important is that there are *people* involved at the heart of *access2innovation* who have played a huge role. Thank you to Jacob Ravn, Head of Secretariat, for allowing me the rare opportunity to work hands-on within the areas of sustainability, innovation and international development that I am passionate about. To Ivan Butler and Astrid Pinholt Søndergaard, PhD colleagues who have shared parts of the journey with me, thank you for widening my disciplinary horizon. To Lasse Frimand Jensen, Ole Stein, Jakob Brodersen and Signe Leth, thank you for our collaboration through your various functions at the secretariat. Funding was provided *access2innovation* by the Danish Ministry of Science, Technology and Innovation and by EU funds through Væksthus Northern Jutland, so my acknowledgement goes to these funding sources for having the vision to support something so unique and important.

Access2innovation extends to many different organizations from various sectors that are too numerous to list. Thank you to all. For the activities that I was involved in personally, I extend my thanks to those in my Vietnam case study, including Bjarne Larsen at Komtek Miljø, and Christian Kruse and Mads Jensen at CARE Denmark. To Leu Tho Bach at the National University of Civil Engineering in Hanoi, I am appreciative of you co-authoring a paper with me. With respect to the activities in Uganda, my thanks to Job Mutyaba from WWF Uganda for your friendship, and thank you too, Victoria Nabankema, for the same.

Being a PhD student naturally connects you to a research environment. In my case this was the Department of Development and Planning at Aalborg University. Among past and present colleagues, my thanks first and foremost go to Professor Arne Remmen, my supervisor with the thankless task of getting me to finish. If there were a word in any language that combined "thank you" and "apologies", I would use it here. Your patience is humbling. I thank others as well: Jens Müller, retired but never tired, for being a mentor of sorts in the early PhD years; Associate Professor Søren Kerndrup for giving feedback on some of my material. Postdoc Kirsten Schmidt for

looking out for me at Aalborg University in Copenhagen, helping me get settled and for the heart-to-heart talks about working-life stress. Patrick Driscoll, for friendship, reading through a paper of mine and for sharing PhD life lamentations. To the cohorts of PhD students at our department, I am thankful our paths have crossed and we could lean on each other in various ways: Anja Wejs, Kristen Skelton, Roberto Rivas Hermann, Yan Yang, Rikke Marie Moalem, the list goes on and on. Internationally, I am especially thankful to the folks at UC Davis and MIT for the D-Lab experiences we had: Kurt Kornbluth, Bryan Pon, Amy Smith and Victor Grau Serrat, your enthusiastic teaching about practical solutions in international development was a joy to witness.

I have had the privilege of connecting to so many students along the way, not only at Aalborg University but at *access2innovation* partner institutions like Copenhagen Business School and University of Copenhagen. Thank you to all. I've come to realize that teaching and facilitating teaches myself in turn, and that education will always be one of my passions in life. Special thanks to the former students at the M.Sc. program in Sustainable Cities at Aalborg University in Copenhagen whom I supervised and who ended up co-authoring a paper with me: David Drysdale, Kenneth Hansen, Josefine Vanhille and Andreas Wolf. That some of you have went on to become my colleagues at the university as PhD students and beyond has been fantastic to see.

At some point along the line during my PhD, I substituted my main employer with Copenhagen Business Academy (Cphbusiness) while maintaining a connection to Aalborg University as part-time lecturer. At Cphbusiness, there are people who have supported me and have given a sympathetic ear to hearing about my PhD work, not least Kasper Dirckinck-Holmfeld who knows a thing or two about it. Thank you for constructive critique! And to my manager, Annette Thromsholt, I thank you for your understanding. Mike Bloch-Levermore, I appreciate the English corrections on that paper of mine, buddy.

Family deserves special mention throughout all of this. I became a family man early on during the PhD process, and this brought a special set of challenges and learning opportunities. We pulled through, though. I have an awesome wife and an incredible kid in Therese and Frederik Christensen, respectively, without whom this whole endeavor would have been meaningless. I hope to do you both proud. To my father Aage Christensen, who was born in 1929 and still going strong, I find it interesting that the subject matter of this PhD – waste management issues in developing countries – isn't too far removed from your own work in this field as a consulting engineer in the Philippines in the 1980's. If I can do you proud with this, I would be honored.

Sorrowfully, the sole member of my family who carried the PhD degree passed away before I could finish. To Dr. Kevin Kimmage, PhD in development economics from the University of Cambridge: *"You will never walk alone."*

TABLE OF CONTENTS

TABLE OF FIGURES

CHAPTER 1. INTRODUCING THE PHD THESIS

The topic of this PhD thesis is how partners can work together to develop sustainable solutions in developing countries. This chapter provides an explanation of the title and key concepts used throughout the thesis. It also provides a historical background for the subject, situating partnerships within Danish development cooperation. This leads to an explanation of the research focus, centered on experiences with partnership innovation in the *access2innovation* initiative with emphasis on the social construction of technology. Finally, the structure of the thesis is explained.

1.1. KEY CONCEPTS

With *bridging actors*, the title refers to promoting collaborative exchanges between different kinds of partners in *partnership innovation*, i.e. business and technological innovation processes in partnerships. Participants in such partnerships are usually dissimilar, and their collaboration is not circumstantial but can be facilitated and managed. Ravn (2012, 2015) highlights that innovation can occur when bridging organizational domains, i.e. their knowledge, practices, competencies and networks. Bridging is associated with brokering in networks (Hargadon, 2002; Long, Cunningham and Braithwaite, 2013), and also relates to addressing differences of understanding between the 'North' and 'South' in multi-stakeholder-partnerships (Biermann et al., 2007).

The title also puts *innovation* at center stage. This refers to the process of creating solutions of societal or customer value that puts it beyond an idea or invention. The concept's classic meaning covers products and services and is derived from economics (Fagerberg, Mowery and Nelson, 2006). Innovation in this thesis also relates to Joseph Schumpeter's conception of creative destruction, i.e. changing ways of doing things to break with existing structures (Schumpeter, 1942), though whereas Schumpeter saw large corporations as the innovative firms engaged with this on a macroeconomic scale (Lazonick, 2006), the research emphasis in this thesis is on partnership innovation involving smaller kinds of organizations, and not businesses exclusively.

The thesis emphasizes the multifaceted nature of solutions building as a social process. The conditions in developing countries add an order of complexity. *Sustainability* in partnership outcomes can be tricky, i.e. addressing environmental protection, social equity and profitability. How partnerships can lead to sustainable outcomes remains an area of engagement at the global stage (Network for Business Sustainability, 2013; Gray and Stites, 2013). Goal 17 of the Sustainable Development

Goals (SDG's) launched by the United Nations is a topical example which highlights the importance of the question, specifically addressing implementation and revitalization of a global partnerships for sustainable development at all levels and by all actors (United Nations Economic and Social Council, 2017).

The relationship between partnerships, innovation and sustainability have been an area of engagement in the Danish setting as well as the global stage. As the thesis investigates this relationship from a Danish standpoint with focus on developing countries, the following will lay out this context by explaining how Danish development cooperation has dealt with business and partnerships from a historical and policy-making perspective through to today.

1.2. DANISH DEVELOPMENT COOPERATION, BUSINESS AND PARTNERSHIPS

In Danish development cooperation, partnerships have been promoted through various support instruments for technology transfer and export promotion throughout the past few decades. Bridging actors in the public and private sector through innovative partnership instruments was a 'buzzword' at one point, touted by Denmark's Minister for Development Cooperation (Ravn 2012) and in official policy documents (Ministry of Foreign Affairs of Denmark, 2011). One such instrument was the Business-to-Business (B2B) program[1], which was evaluated for the 2006-2011 period in which it operated. In this evaluation, long-term results were not found to have been sustainable, defined as follows (Ministry of Foreign Affairs of Denmark, 2014):

- Partnerships have not survived as commercially successful businesses after disbursement from the program.
- Knowhow transfers have not improved on local company performance especially in environmental aspects and CSR[2].

The evaluation highlighted the B2B program's lack of developmental impact in terms of local community spillovers, while employment generation and diffusion of technology and knowhow failed to materialize in a significant way (Ministry of Foreign Affairs of Denmark, 2014). The contribution to poverty reduction was *"less than warranted"*, and it was concluded that the *"effect on job creation and sustainable growth in developing countries has not been sufficient"* (Ministry of

[1] The B2B program sought to contribute to poverty reduction by promoting economic growth and social development in developing countries through partnerships primarily between Danida program countries and Danish businesses (Danish Ministry of Foreign Affairs, 2014). The program entailed support to partnerships in the 3 phases (*Contact*, *Pilot* and *Project* phase).

[2] Corporate Social Responsibility.

Foreign Affairs of Denmark, 2014; Große-Puppendahl, Byiers and Bilal, 2016). This evaluation came out while the B2B instrument's successor program, the Danida Business Partnerships (DBP) program, was running and led it to be put on hold and eventually phased out.

In a reflection on Danish development cooperation throughout 50 years 1962-2012, the Ministry of Foreign Affairs of Denmark (2012) has admitted to a difficult history. A recurring critique has been leveled at conflicting objectives (Ministry of Foreign Affairs of Denmark 2012): does Danish development cooperation seek to promote development, or commercial self-interest[3]? Danish businesses were until the 1980's primarily involved as project and program suppliers. This provided them with a lucrative role, but one that was also maligned (Ministry of Foreign Affairs of Denmark 2012). In the 1990's, private sector development received particular attention (Degnbol-Martinussen and Engberg-Pedersen, 2003), and it was during this period that the first private sector support instruments were rolled out such as the Private Sector Development (PSD) program and later the B2B program.

This expanded the role of business in international development policy, and during the 00's this was pushed further when additional instruments were introduced such as the Public Private Partnership (PPP) and the Innovative Partnerships for Development (IPD) programs. These instruments sought to promote broader partnerships than ones solely between companies, and sought to advance strategic CSR and socially responsible innovation (Ministry of Foreign Affairs of Denmark, 2014). Succeeding these programs, the Danida Business Partnerships (DBP) program was introduced in 2011 and was similar in set-up to the B2B program[4] but allowed for multiple partners and the choice of a local partner in a developing country that could be a company, farmer, cooperative, civil society organization, a university or research institute or a public authority (Ministry of Foreign Affairs of Denmark, 2013). However, as mentioned the B2B evaluation suspended the DBP program and ultimately led to it being phased out.

Despite the DBP program phase-out, the Danish tradition of support instruments toward businesses and partnerships continues. The current iteration is termed Danida Market Development Partnerships (DMDP), and was launched in 2016 to last until 2020. According to the Ministry of Foreign Affairs of Denmark (2016), this instrument takes point of departure in joint core competencies of private business and non-commercial actors in 'shared value' business models. Non-commercial actors

[3] In other words, Danida itself acknowledges recurring critique levelled at whether Danish development cooperation primarily is directed towards benefitting Danish interests, and socio-economic development in developing countries secondarily.

[4] As with the B2B program, the Danida Partnerships Facility included 3 phases (Partner Identification, Preparation and Implementation phase) that were similar in scope.

Partnership Programme results framework
Five key indicators

1. Employment creation (decent jobs) for women, men and youth
2. Beneficiaries reached and creation of sustainable income opportunities
3. Viability of the project's business case (long-term sustainability)
4. Awareness of responsible business conduct and capacity to work with RBC in the partnerships
5. Investment leverage (additional capital raised)

On top of this, each project will have more project specific outcomes related to e.g. nutrition, environment, farming practices etc., all with direct links to the SDGs.

Figure 1 - DMDP indicators (Ministry of Foreign Affairs of Denmark, 2016)

include e.g. civil society organizations, academia, government institutions and international organizations. The SDG's are the framework for the instrument's contribution to sustainable economic growth in developing countries, specifically Goal 17 and in particular Goal 8 on promoting sustainable and economic growth, which has been used as reference point for developing indicators for the instrument (Ministry of Foreign Affairs of Denmark, 2016). The indicators can be seen on Figure 1 and are derived from SDG Goal 8. Further, the intervention logic and theory of change is illustrated in Figure 2, showing the interrelationships between inputs, outputs, short- and long-term outcomes and impacts as well as how the SDG-derived indicators are integrated (Ministry of Foreign Affairs of Denmark, 2016).

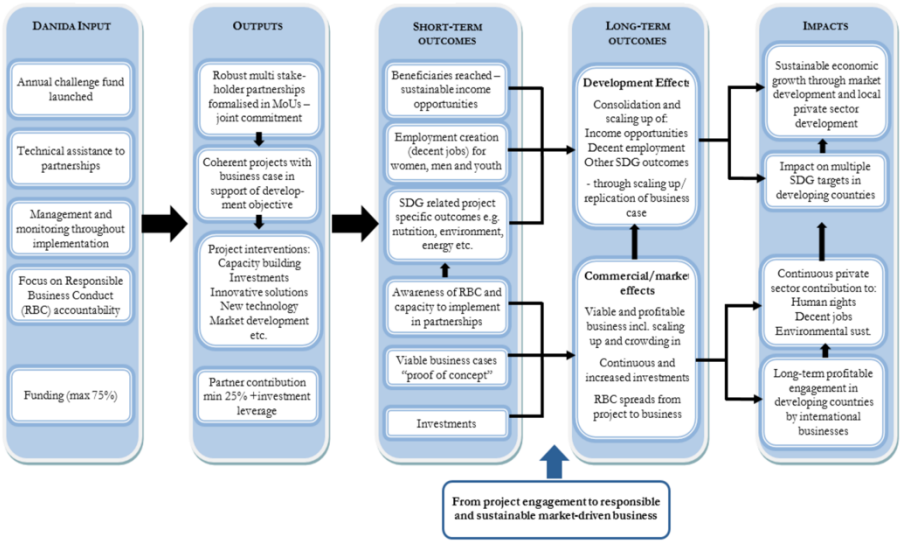


Figure 2 - DMDP intervention logic and theory of change (Ministry of Foreign Affairs of Denmark, 2016)

With regards to lessons learned, the instrument has been reconfigured to focus on 'robustness' of partners and partnerships, including their knowledge and capacity to engage in potentially difficult markets (Ministry of Foreign Affairs of Denmark,

2016). Its focus is on fewer but larger projects compared with previous instruments, and a more 'pronounced' emphasis on contributing to addressing developmental challenges by integrating indicators derived from SDG Goal 8 and supporting the long-term outcome of 'responsible and sustainable market-driven business' (Ministry of Foreign Affairs of Denmark, 2016).

An open question is whether the Danida Market Development Partnerships instrument will differ in practice from previous experiences. Early 2017, the first 5 partner consortia candidates within a budget frame of DKK 40 million were made public, see Table 1. Each has a commercial and non-commercial partner, a new prerequisite in the instrument. With relatively few invited consortia under the 1st call given the budget frame, there will be fewer but larger projects supported.

Table 1 - Invited partnership consortia for under the 1st call of the Danida Market Development Partnerships instrument (Ministry of Foreign Affairs of Denmark, n.d.).

Partners	Objective
VedvarendeEnergi and Vestas Wind Systems*	Support sustainable mini-grid development and production of wind turbines in Kenya
CARE Danmark and Christian Hansen A/S*	Enhancing crop yields and profitability in Kenya through biological plant protection
Landbrug & Fødevarer/SEGES and Arla*	Market-driven sustainable growth in dairy sector – The Milky Way Partnership in Nigeria
DIEH and Bestseller*	Improving productivity, quality and working conditions in Myanmar garment industry
Global Alliance for Improved Nutrition and Arla Food Ingredients Group*	Ethiopian dairy market development partnership

* Asterisk denotes 'key business partner'.

1.3. ACCESS2INNOVATION AND THE RESEARCH FOCUS

In the Danish context, there is a continued interest in supporting partnerships for international development objectives. The SDG's have become prominent for current institutional support to partnerships (Ministry of Foreign Affairs of Denmark, 2016). As for the partnerships themselves, increased attention has been given toward bridging actors across different organizational domains. The program document for the Danida Market Development Partnerships instrument, for instance, states:

"… pooling complementary resources, capabilities and knowledge… [can] *foster new business models that align commercial and social interests"*

"... partners [that] *utilize their core competencies with focus on joint value creation have the potential to bring transformational change."*

(Ministry of Foreign Affairs of Denmark, 2016)

However, the program document is policy-oriented and does not elaborate on the justification for such claims. The proposition of sustainable solutions in developing countries through partnerships therefore presents itself as an area of research. This PhD study approaches the topic through experiences and knowledge from a project called *access2innovation* that has supported innovative partnerships in developing countries. *Access2innovation* is a network that brings business, academia and NGO's together to develop products and services within humanitarian relief and international development. It has existed since 2007 with a focus on business model innovation[5].

In my research, the specific area of study is how *technology* is shaped in partnerships. Actors in an *access2innovation* partnership typically identify a market opportunity and co-develop a solution that can eventually result in a realized business model. Business modeling is an important perspective for the company or entrepreneur because they typically bear the greatest risk in an investment. Previous *access2innovation* case studies in humanitarian relief have focused on the business modeling aspect (Ravn 2012) and how companies develop solutions under conditions of uncertainty (Butler, 2017). The results of which are elaborated in Chapter 3 and Chapter 5.

The research presented in this thesis, however, investigates partnerships a little differently, and has a focus on the social shaping or co-construction of technology. *Technology* comprises material and non-material elements. Investigating how technology is constructed involves considerations about the social factors that influence its design and use. Here technology is seen through a socio-technical perspective, which e.g. Koch and Caradonna (2006) apply to technology and business model development in developing countries. With this concept of social construction, my research is based on a *constructivist* standpoint, and draws particularly on the SCOT[6] approach's interest in how relevant social groups attribute meaning to technology (Bijker, Hughes and Pinch, 1987). The business modeling aspect is just one of a number of aspects when multiple actors are involved in a partnership innovation process.

The SCOT concept emerged in the late 1980's as a branch of STS[7] studies, and as a research approach is ordinarily societal (macro) in scale though has recently found

[5] See website: www.access2innovation.com

[6] Social Construction of Technology.

[7] Science, Technology and Society.

innovation management applications (Bijker, 2015). Using a SCOT understanding, I investigate social construction in the partnership innovation processes of specific *access2innovation* projects (see 'bridging actors in Chapter 1.1), and in investigating co-constructed solutions as part of larger social and technological systems. In this respect in relation to international development, there is a need to pay particular attention to the interests of poor and disenfranchised groups. The PhD thesis aims to address this by having a broader perspective than the entrepreneur and business model-centered one: A perspective that is sensitive toward local settings, which I conceptualize as a research interest in 'inclusive innovation'. The overall research question is as follows:

How is technology socially constructed in partnership innovation for developing countries? How can inclusive and sustainable innovation in developing countries be co-constructed?

The empirical basis for this PhD thesis is a couple of *access2innovation* partnerships that I have taken part in as action researcher and participant-observer. I have made use of a methodology based on Constructive Technology Assessment (CTA) as a basis for investigating the partnerships (further detailed in **Paper 1**): this has involved e.g. socio-technical mapping, experimentation and dialog.

Access2innovation has supported partnerships and innovation projects within renewable energy, water and sanitation, and agriculture in the period 2011-2014 (the timeframe I was involved in the initiative). From these broad headings, the project launched activities within solid waste management in Vietnam and Uganda that I took part in, at times supported by students and fellow researchers.

The partnership in Vietnam evolved from an NGO initiative to being headed by a business until it finally dissolved following a feasibility study and internal and external challenges to its partnership composition.

The initiative in Uganda never fully materialized as a partnership: Instead, we analyzed the social and technological system in a chosen urban setting, and laid out pathways that future partnerships could take.

The cases studies investigate the social construction of technology in two ways: The Vietnamese study is seen from within a partnership, and the Ugandan study prior to one. The studies are therefore not set up for direct comparison but address the research question through different settings and timeframes in solid waste management partnerships.

1.4. STRUCTURE OF THE THESIS

The PhD thesis is article-based, and the research question is investigated through published work on the *access2innovation* case studies in Vietnam and Uganda dealing with partnerships at varying stages. The thesis is structured in four parts: *I: Introduction*, *II: Research Design*, *III*: *Results and Analysis* and *IV: Conclusion*.

Part I: Introduction provides an in-depth presentation of the thesis topic, which covers a state-of-the-art review on innovation and sustainable technologies in developing countries. It elaborates on the *access2innovation* project and solid waste management in developing countries.

Part II: Research Design goes into thesis' research aim and associated research questions. It includes the philosophies of science grounding of the thesis and the methodology used in the research, based on the first of the four articles (**Paper 1**).

Part III: Results and Analysis is comprised of the three articles that deal with the Vietnamese and Ugandan case studies (**Papers 2, 3 and 4**). Each of the articles is paired with introductory text denoted as 'highlights'.

Part IV: Conclusion presents a reflection on the research questions, outlines the contribution of the thesis and identifies further directions for research.

The structure of the thesis is illustrated in Figure 3.

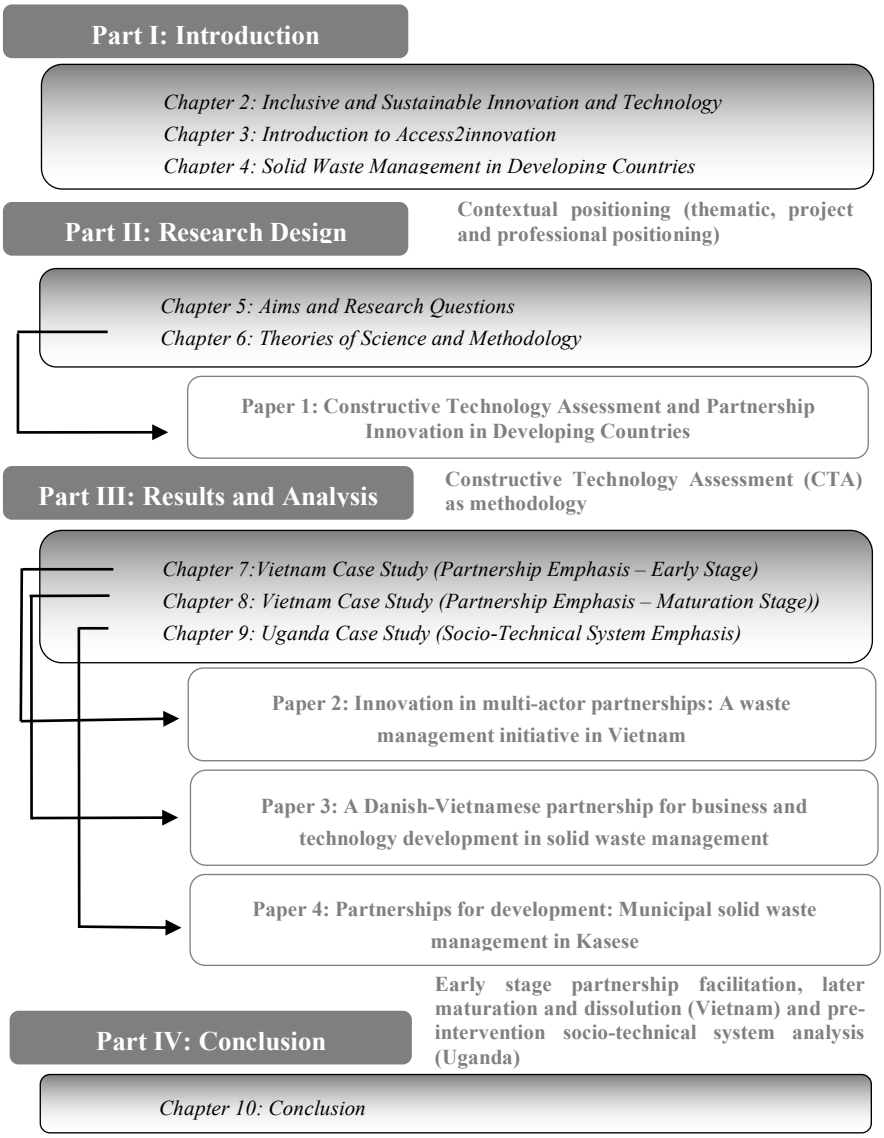


Figure 3 - The structure of the PhD thesis

They papers themselves are presented below:

Paper 1 - Book Contribution (Submitted)

Christensen, D., Remmen, A. (Forthcoming) Constructive Technology Assessment and Partnership Innovation in Developing Countries. Submitted book chapter for *Technology Assessment (TA) in Techno-Anthropological (TAN) Perspectives*, eds. L. Botin & T. Børsen, IOS Press, Lexington Books or Aalborg University Press (TBC)

Paper 2 – Book Contribution (Published)

Christensen, D. (2014) Innovation in multi-actor partnerships: A waste management initiative in Vietnam. In: Bolay J., Hostettler, S., Hazboun, E. (Eds.) *Technologies for Development: A Way to Reduce Poverty?* Springer International Publishing, Cham, pp. 147-158

Paper 3 – Journal Article (Published)

Christensen, D., Bach, L.T. (2015) A Danish-Vietnamese partnership for business and technology development in solid waste management, *Resources, Conservation and Recycling* 105 (2015): 123-133

Paper 4 – Journal Article (Published)

Christensen, D., Drysdale, D., Hansen, K., Vanhille, J., Wolf, A. (2014) Partnerships for development: Municipal solid waste management in Kasese, Uganda, *Waste Management & Research* 32 (11): 1063-1072

Throughout the research process a number of various conference papers have been produced. These have not been included in the PhD thesis, as they have served either as preliminary drafts for the included papers or fall outside the scope of the thesis. The excluded papers are:

- Christensen, D. 2012. Innovation in Collaborative Networks: A Waste Management Initiative in Vietnam. Paper presented at the 2012 Technologies for Development conference (2012 Tech4Dev International Conference), Lausanne, Switzerland May 29-31, 2012

- Christensen, D., Vanhille, J., Wolf, A., Hansen, K., Drysdale, D. 2013. Pathways, Pitfalls and Opportunities in Partnerships for Development: Municipal Solid Waste Management in Kasese, Uganda. Paper presented at the 8th Conference on Sustainable Development of Energy, Water and Environment Systems (SDEWES 2013), Dubrovnik, Croatia, September 22-27, 2013

- Christensen, D., Remmen, A. New Modes of Constructive Technology Assessment for Developing Countries. Paper presented at the Sustainable Innovation 2013 conference, Epsom, United Kingdom, November 4-5, 2013

- Butler, I., Christensen, D. Disruptive Co-Creation? Some Experiences in Fostering Innovative and Sustainable Business Models for Emerging Markets. Paper presented at the Sustainable Innovation 2013 conference, Epsom, United Kingdom, November 4-5, 2013

- Christensen, D. Business Development of Solid Waste Treatment Technology and Bio-Fertilizer Production through a Danish-Vietnamese Partnership. Paper presented at the Asia Pacific Industrial Engineering and Management 2013 conference (APIEMS 2013), Cebu City, The Philippines, December 3-6, 2016

PART I – INTRODUCTION

This part consists of:

- *Chapter 2: Inclusive and Sustainable Innovation and Technology*
- *Chapter 3: Introduction to Access2innovation*
- *Chapter 4: Solid Waste Management in Developing Countries*

The purpose of Part 1 is to motivate and introduce the background for the PhD topic on partnerships for sustainable solutions in developing countries, with emphasis on technology and solid waste management.

Chapter 2 provides State-of-the-Art of the thesis' main subject matter: it problematizes innovation in developing countries highlighting the proposition of inclusive and sustainable markets and business and sustainable technology development. Chapter 3 provides the background for the *Access2innovation* project that the PhD research was embedded in. Chapter 4 centers on solid waste management as the focal environmental problem complex in the thesis, going into conceptual frameworks such as circular economy and ISWM[8] with relevance for partnerships.

[8] Integrated Sustainable Solid Waste Management (sic).

CHAPTER 2. INCLUSIVE AND SUSTAINABLE INNOVATION AND TECHNOLOGY

This chapter elaborates on the subject of inclusive and sustainable innovation and technologies with respect to developing countries. First, the issue of inclusivity in a market and developing country context is introduced. The chapter then investigates different conceptual understandings of the issue – respectively, the Base of the Pyramid (BoP) and Social Business. A number of different Danish experience in developing countries are then described and analyzed with respect to a sustainable business innovation framework, covering both multinational companies and small-and-medium-sized enterprises. The chapter ends with a reflection on the role of technology.

2.1. INNOVATION, INCLUSIVITY AND MARKET-BASED SOLUTIONS FOR THE POOR

Innovation in developing countries is subject to numerous challenges with respect to meeting the most basic demands of the poor. Developing countries often struggle with such conditions as resource scarcity, poor infrastructure and weak institutions (see e.g. Srinivasa and Sutz, 2008; Kandachar and Halme, 2008). Technological developments go against conventional wisdom and 'bloom', however. Widespread ICT[9] uptake in Africa is one of the famous examples of so-called technological 'leapfrogging' going back more than a decade (Kimenyi and Moyo, 2011). The adoption of ICT to suit specific local circumstances has had a positive multiplier effect on for instance conducting business, as in the case of mobile banking systems like M-Pesa in Kenya[10] (van der Boor, Oliveira and Veloso, 2014). This type of mobile phone innovation has had beneficial impacts for the poor. It shows that innovation can occur or even be stimulated by constrained conditions. In other areas such as renewable energy, low-carbon 'leapfrogging' technologies present a sustainable innovation pathway in Sub-Saharan Africa (Mahama, 2016).

Sources of innovation may be domestic, external or some form of combination, including through partnerships. The wider *dissemination* of an invention or idea, once it gains a foothold, is closely linked with markets. Innovations most often gain uptake through commercialization, and in some cases reinforce or enable markets as with M-

[9] Information and Communication Technologies

[10] https://www.mpesa.in

Pesa. A question then is: If innovation in developing countries is to be 'market-based', how is it possible to foster *inclusive* innovation that is sensitive toward the poor and disenfranchised, and to the issue of asymmetrical power relations among stakeholders? The implicit tensions in this question are a cornerstone upon which this thesis is based.

There *is* awareness about these issues in business studies. Here 'inclusive' is generally about reaching the poor and generating a positive development impact while striving for financial viability (Mendoza and Thelen, 2008). In a further definition it covers new ideas that enfranchise the poor particularly with respect to social and economic well-being up to the process of commercialization (George, McGahan and Prabhu, 2012). This second definition specifies the development impact from a market-based solution to mean an uplifting of the overall welfare of the poor, and their involvement in innovation processes as early as the conception of an idea.

2.2. THE BASE OF THE PYRAMID APPROACH

The above ideas about development impacts and inclusivity have taken time to gain foothold in the business literature on international development. One well-known strand of studies has centered on the *Base of the Pyramid* (BoP), popularized by C.K. Prahalad together with Allen Hammond and Stuart Hart (Prahalad and Hammond, 2002; Prahalad and Hart, 2002). There is a vast, overlooked business potential at the poorest and most underserved segment of the world's population estimated at 4 billion people (London 2016). In his seminal BoP piece *The Fortune at the Bottom of the Pyramid*, Prahalad (2004) claimed that tapping into this segment should allow businesses to pursue profits while also fundamentally improving living conditions.

Business practitioners in the North and multinational enterprises were initially proposed as the most important BoP innovators, but were also required to re-think business operations (Prahalad and Hammond, 2002; Prahalad 2004). BoP venturing for multinational enterprises meant creating buying power, shaping aspirations, improving access and tailoring local solutions (Cannatelli, Masi and Molteni, 2012).

Critics took this as 'selling to the poor' negatively, rejecting what was meant to be one of the catchphrases of the BoP approach (Hammond and Prahalad 2004). 'Selling to the poor' was, instead of a rallying cry, seen as form of corporate imperialism that imposed a consumption-based understanding of local needs and aspirations (Simanis and Hart, 2008). Some critics believed the BoP proposition to be a harmless illusion at best, but a potentially dangerous delusion riddled with inaccuracies and fallacies (Karnani, 2005).

The controversy continued and over time, the focus on multinational enterprises became de-emphasized (Kolk, Rivera-Santos and Rufín, 2014). Their supposed capability to develop profitable business and development was seldom backed up by

success stories. According to Duke (2013), established firms in developed countries have over the years run into 'brick walls' in getting a return on investment when seeking BoP market entry. Some factors have included insufficient market knowledge, funds for customer education, purchasing power, difficult regulatory conditions or poor partnering (Duke, 2013. The main factor is argued to have been an over-extension in relation to a firm's core capabilities (Duke, 2013).

Co-venturing with the poor as *business partners* has marked a shift in the BoP approach notably in the *Base of the Pyramid Protocol* by Simanis and Hart (2008), which prescribes a 'BoP 2.0' based on deep dialog and direct, mutually beneficial relationships based on shared commitment. More recently, there is recognition of the possibilities for more varied approaches, including the potential of smaller firms and social enterprises as drivers of BoP venturing (Kolk, Rivera-Santos and Rufín, 2014), including new roles for civil society organizations, government and cross-sectorial partnerships. Hart and Cañeque (2015b) map out the following evolution of the BoP concept including propositions for a current 'BoP 3.0' version which is distinguished from 'BoP 2.0' by emphasizing the involvement of further actors and setting up partnerships and networks:

Table 2 - Evolution of the Base-of-the-Pyramid (BoP) concept (inspired by Simanis and Hart, 2008; Hart and Cañeque, 2015b).

Base-of-the-Pyramid 1.0	Explorative 'finding a fortune' efforts at the BoP, 'selling to the poor'
Base-of-the-Pyramid 2.0	Co-creating products and value propositions with communities, bottom-up innovation, sustainable 'green leap' technologies, 'business co-venturing'
Base-of-the-Pyramid 3.0	Open innovation and 'wisdom of the crowd', innovation ecosystems, cross-sector partnership networks, sustainable development frameworks, innovation for 'the last mile' with complementary partners

Latest developments in BoP point to having arrived at a more nuanced view on the target customer segment, as indicated in Table 1. More than customers, the poor are to be seen as partners and a source of innovation through co-creation. There are also developments that offer up more complex ways of rolling out BoP ventures. These involve collaboration of multiple actors in eco-systems and partnership frameworks. One example of this is the *access2innovation* project (Ravn, 2015), further elaborated in Chapter 3.

What remains unclear is whether more comprehensive frameworks lead to improved inclusivity of the poor. Being a customer or 'source of innovation' could be said to restrict the role of local people and communities. Simanis and Hart (2008) make it clear that going from BoP 1.0 to 2.0 involves moving from considering the poor as consumers to users. But does BoP 3.0 involve further steps aimed at empowerment? In this respect Nahi (2016) distinguishes between different forms of BoP co-creation in a systemic review of the topic:

- *Efficiency-seeking* co-creation (focus on business model development)
- *Sustainability-seeking* co-creation (hearing varied groups of people*)*
- *Empowerment-seeking* co-creation (sharing decision-making processes with local communities)

There is considerable range in terms of inclusivity in BoP ventures, from arms-length cooperation to processes of social transformation (Nahi 2016). Partnerships and networks are emphasized in BoP 3.0, and for partnering with the poor, opportunities are seen for concepts such as 'open innovation' (Hart and Cañeque, 2015b):

"We are still in the early stages of acquiring the skills necessary for effective co-creation and mutual value creation. Looking ahead, however, open innovation may represent a whole new arena for BoP innovation, drawing on the "wisdom of the crowd" to spawn previously unimagined solutions. Indeed, participatory, grassroots innovations may take BoP business to a whole new level in the years ahead."

BoP 3.0 thus acknowledges the role that the poor can play in mutual value creation through e.g. open innovation, participatory and grassroots approaches. If these kinds of activities in fact lead to 'sharing decision-making processes with local communities', then there is a case for BoP 3.0 to encompass a movement from *efficiency-seeking* co-creation to *empowerment-seeking* co-creation as understood by Nahi (2016). But as admitted by Hart and Cañeque (205b), we are still in the early stages of BoP 3.0. In remains interesting to pose to question: Does inclusivity of the poor become lost in the muddle of interests and interactions in 'BoP 3.0' operations? We return to this question in the discussion of the empirical findings in this thesis.

2.3. THE SOCIAL BUSINESS APPROACH

Aside from BoP, market-based solutions in developing countries have been covered in other, related strands of studies. One such body of literature deals with *social business*, popularized especially by Mohammad Yunus who pioneered micro-financing models for reaching the poor with Grameen Bank in Bangladesh (Yunus, 2008; Yunus, 2010; Yunus, Moingeon and Lehmann-Ortega, 2010). Micro-finance is a noteworthy example of a successful break with the conception that there is no case for business with the poor. Based upon the success of Grameen Bank, Mohammad Yunus has advocated for social business models as an alternative to traditional capitalist business: The first premise for a social business is pursuing a societally

beneficial objective. The second premise is for profits to be re-invested into expanding the social business instead of paying off shareholders. Social businesses are thereby generally distinct from (most) conventional businesses because of social purpose, but also distinct from (most) civil society organizations because they accrue capital.

Yunus' perspectives lend support to social businesses in developing countries as well-equipped vehicles for beneficial social change. The most successful and promoted cases include several self-sufficient social business units under the Grameen 'family' of organizations[11]. One notable example is Grameen Shakti, which has been based on disseminating renewable energy technologies in rural off-grid communities in Bangladesh (Wimmer, 2012). In Grameen Shakti's social business model, which reached a million installations as early as 2013 (pv magazine, 2013), the business has grown organically over the years based on long-term relationship building with local communities. As a result, Grameen Shakti has come up with a few innovative elements to its business model, such as the use of in-house trained women technicians to train and speak to groups of rural women on e.g. system maintenance.

While BoP could be argued to represent a Northern perspective to market-based solutions and the poor, the social business approach could be said to represent its Southern counterpart. Delineations are not always clear: it *is* possible for a sustainable and inclusive business in a developing country to be both a BoP venture and a social business. What is more important is the realization that *inclusivity* and *business development* is a possibility and not a contradiction. In the BoP approach, there has been a struggle with handling the poor as more than consumers particularly in BoP 1.0 and 2.0 while 3.0 has 'grassroots' propositions that are still in the early stages of being demonstrated. In contrast, inclusivity and business development has been fundamental in the operations of social businesses. Both understandings offer interesting propositions on ecosystems and partnership networks in developing countries, i.e. business operations based on a socially beneficial purpose and use of complementary partners from a systems perspective.

2.4. EXPERIENCES WITH DANISH ENTERPRISES

There have been a handful of Danish attempts at innovative business venturing in developing countries over the past decade – distinct from 'conventional' business operations in earlier decades. Many cases have involved partnerships in some form. The following highlights the experiences of some Danish multinational enterprises as well as some smaller ventures. A framework for discussing the cases in relation to

[11] Some examples include *Grameen Telecom and Grameen Phone, Grameen Shakti* (energy), *Grameen Kalyan*/Grameen Wellbeing (health clinics and health insurance), *Grameen Fisheries, Grameen Shikka*/Grameen Education and *Grameen Uddog* (textiles) (Yunus, 2010).

sustainable innovation is provided in Figure 4. Developed by the Network for Business Sustainability in Canada and based on a systemic review by researchers mainly at the University of Exeter (Adams et al., 2012), the framework highlights important aspects with respect to assessment and planning of sustainable business operations. The framework covers the following 3 stages, which I argue draw parallels with the Base-of-the-Pyramid 1.0, 2.0 and 3.0 approaches in Table 2:

Figure 4 - A 3-stage framework for sustainable business innovation (Network for Business Sustainability, 2013).

Operational optimization in Figure 4 is termed an "Eco-Efficiency" approach in which the innovation objective is compliance, efficiency and "doing the same things better". The innovation outcome is reduction of harm, and incremental improvements to "business as usual" is characteristic of the firm's relationship with innovation itself. I argue that *operational optimization* corresponds to BoP 1.0 because BoP 1.0 has been based on incremental changes and improvements to (multinational enterprise) business operations as sufficient to access the "fortune" at the BoP.

Organizational transformation in Figure 4 as an approach has the headline "New Market Opportunities" attached to it. The innovation objective is "doing good by doing new things" through novel products, services and business models, and creating "shared value" is the innovation outcome. With respect to innovation and its relationship to the firm, this is seen as tied with a fundamental shift in purpose. I argue that that *organizational transformation* corresponds to BoP 2.0 because of the similarities between product development and "shared value" intentions, and the aspect of co-creating products and value propositions with communities inherent in BoP 2.0.

Systems building is the third approach in Figure 4 and titled "Societal Change". Here, not only is the innovation objective "doing good by doing new things", but "with others" is added to this with the realization that businesses can impossibly achieve this alone. The innovation outcome is the creation of positive impact, and the way that innovation is related to the firm is that it extends beyond the firm as a driver for broader institutional change. I argue that the partnership aspect in particular makes *systems building* comparable with BoP 3.0. As well, I argue that BoP 3.0 corresponds to *systems building* due to the broader societal focus instead of an internally firm-centric one.

Grundfos Lifelink

One of the Danish cases is Grundfos, a pump supplier that has been developing a commercial model for delivering water services in rural villages. Kenya has been the focal point for these efforts, and a particular business unit (named *Lifelink*) has been set up solely for it. Andersen (2011, 2013) has documented the case including the numerous steps and challenges Lifelink has had to overcome throughout its innovation process.

Lifelink has since 2009 established a number of systems in Kenya in which solar photovoltaic driven pumping facilities provide access to water (Andersen, 2011). Lifelink's systems also include a mobile phone and chip-token based micropayment scheme for end-users. Technical system integrity is monitored online from Denmark, and the payment scheme allows for local contribution towards maintenance (Andersen, 2011). The Lifelink idea is heavy on engineering and technology provision, but the venture has also had an awareness of being dependent on commercial, NGO and public sector partners for the cultural and business sensitivity required for the solution to work (Andersen, 2011). Dealing with disparate partners has been challenging however, for instance with NGO's because of miscalculated interest on their part in a commercial undertaking. End-users also presented a problem (Andersen, 2011). Lifelink found it difficult to convince communities to accept the idea of a payment scheme linked to a water pumping station, and many end-users continued to collect their own surface water despite the lower water quality. It became recognized that the venture's activities risked being perceived as disrupting rural community life. Lifelink attached an anthropologist to understand the cultural context as part of a learning process, and learned that the local value attached to clean water from Lifelink's pumping stations differed from own assumptions. Instead of being seen as a necessity, local communities saw the water offered as supplementary to their existing water sources, e.g. from a local river. Water from existing sources, while not as hygienic, is still preferred in local communities due among other factors to poor awareness on hygiene issues. Lifelink's response to dealing with such challenges has been to adjust assumptions, lower expectations for revenue and develop an adaptable model that has helped increase the number of systems from 30 in 2011 to 70 in 2013. The venture has developed enough to expand to India in 2015 (Grundfos 2015).

Cleanstar Mozambique

Launched by the multinational Danish enzymes producer Novozymes in late 2011, Cleanstar Mozambique was a venture that was ultimately aborted after restructuring in late 2013 and undergoing voluntary liquidation in mid 2014 (Novozymes, 2014). Nevertheless, the case is noteworthy for its ambition and for some of the lessons learned.

Figure 5 - The Cleanstar Mozambique concept (Novozymes, n.d., elaborated version in Appendix A).

The scope of the venture covered a wide range of development issues illustrated in Figure 5: food security, energy access and improved health. To begin, Novozymes together with partners directly invested a controlling share in a local business partner (Cleanstar Mozambique) and supplied managerial capabilities to assist in rolling out a commercial agroforestry and bio-ethanol based business concept (Mård 2011, personal interview). Cleanstar Mozambique was additionally supplied with technology, connections, credibility and 'financial savvy' (Dasgupta and Hart, 2015).

In the concept, premium cassava is introduced to smallholder farmers for livelihood diversification and use in ethanol production, which is then used in ethanol cooking stoves to reduce indoor air pollution and charcoal demand causing deforestation (Stringer et al., 2014). The farmers are supported with basic inputs and technical assistance to implement restorative agroforestry practices on their own land, and

benefit from increased food production with the surpluses sold to the company (Bogdanski, 2012). Smallholder farmer incomes were expected to increase threefold or more at the outset. The ethanol stoves were sold at retail points operated directly by the venture, including urban centers where charcoal use is widespread. Cleanstar Mozambique oversaw sourcing, transport, production, distribution and retail. Local communities participated in project design allowing the venture to address local concerns (Stringer et al., 2014), but Cleanstar Mozambique – later redubbed NewFire Africa after a restructuring in 2013 – never managed discernible large-scale impact (Gasparatos et al., 2015). Cleanstar Mozambique went as far as building an ethanol production facility near Beira capable of producing 2 million litres/year, and in the 2007-2012 period more than 1,000 farmers adopted the model, having purchased over 33,000 cookstoves and 1 million litres of cassava-based ethanol (Dasgupta and Hart, 2015).

However, Cleanstar Mozambique experienced complications, including security concerns in the province where the project operated. Later the financial viability of the venture became challenged. According to sustainability business news website TriplePundit (2014), sales were called into question due to consumer non-acceptance of stoves, although Cleanstar Mozambique disputed this and pointed to high fees and costs involved with the business operation as the main issue. This meant that high costs had to be passed on to consumers against the intention of the business concept. Additionally, a fresh round of investment in 2013 forced the venture to suspend agro-forestry and ethanol production to focus on cookstoves, which according to Dasgupta and Hart (2015) was a myopic decision focused on short-term gains and did not support the strengths of the business idea: Embracing complexity with a 'value ecosystem' or 'innovation ecosystem' for inclusive and sustainable business so as to deliver value to local people and communities in multiple ways.

Discussion of Grundfos Lifelink and Cleanstar Mozambique

Lifelink and Cleanstar Mozambique represent Danish experiences with multinational enterprise-led BoP venturing. Each case has run into challenges in the meeting with end-users, in partnering and management of business operations and technologies. From a sustainability perspective – positive environmental effects as well as profitability and inclusivity of the poor – Danish multinationals have been adapting their businesses but have not fully achieved sustainable outcomes.

In the Lifelink and Cleanstar Mozambique cases, *Organizational Transformation* best captures how they have been faring. The companies have experimented in tapping new market opportunities via novel products, services and business models within water provision and bio-ethanol. However, neither case has successfully scaled their operations, for which collaboration with other partners within a systems-framework is necessary. Dasgupta and Hart (2015) however argue that the incipient idea behind the Cleanstar Mozambique case was fundamentally one based on embracing

complexity. Had the venture been able to continue with its original concept, it would likely be characterized as a *Systems Building* business

Baisikeli, MYC4, Ruby Cup and Lifestraw

Efforts by Small and Medium-sized Enterprises (SME's) from Denmark comprise another set of experiences in business innovation in developing countries. Such smaller-scale efforts rarely share 'classic' BoP characteristics, and many are entrepreneurial in nature (Als, 2010). Government support schemes like the Danida Business Partnerships facility have played a prominent role in supporting SME efforts. Because SME's account for 95% of the private sector, their experiences are important but have been under-emphasized in the BoP literature (Remmen and Ravn, 2009). The following are some Danish SME examples that have cause-based missions in line with Yunus' social business approach, or are what are referred to as BoP 'hybrid organizations' that primarily pursue a social mission but rely significantly on commercial revenue for sustaining operations (Hockerts, 2015):

- *Baisikeli* (http://baisikeli.dk): A limited private company that runs a bicycle repair shop in Copenhagen and also provides affordable bicycle transportation in Mozambique for improved income and access to education.

- *MYC4* (http://www.myc4.com): An internet-based platform for connecting investors with microloans, featuring the ability to set own interest rates and compete with co-investors for most favorable loan arrangements.

- *Ruby Cup* (http://www.ruby-cup.com): A student start-up founded in 2011 based on disseminating a silicon-based menstruation cup for addressing menstrual hygiene in Africa.

- *Lifestraw* (http://lifestraw.com): The name of a product developed by the company Vestergaard Frandsen for addressing the effects of poor hygiene and sanitation related to water consumption in disaster situations. The product is a tube with a filtering system that reduces the risk of disease and contaminants.

According to Hockerts (2015), Danish BoP hybrid organizations often struggle with commercializing a product/service according to conventional business strategies. However, a number of coping strategies are turning these traditional weaknesses into strengths, what Hockerts sees as a shift from *antagonistic* assets to *complementary* assets. *Complementary* assets are combined resources required for value generation[12] (examples are brand-name, technical know-how and skilled personnel), while *antagonistic* assets are resource combinations that make business operations more

[12] Similar to the conception of 'bridging actors' in Chapter 1.1.

difficult in a traditional sense and are often avoided (Hockerts, 2015). Hybrid organizations, according to Hockerts, go out of their way to work with assets that are not complementary and instead engage in a strategy of 'resource misfit'. This includes (Hockerts, 2015):

Identifying hidden complementarities
BoP hybrid example: Lifestraw

This strategy is focused on identifying previously unexploited complementarities, which is illustrated through Lifestraw's parent company Vestergaard Frandsen, which traditionally was a textile producer which developed capabilities for producing highly effective filters and found a use in humanitarian markets, where the company had already been producing blankets.

Developing new complementarities
BoP hybrid example: Baisikeli

This strategy is focused on finding ways for beneficiaries to learn valuable skills, which is illustrated through Baisikeli which does not only deliver used bicycles to Africa but has trained local bicycle mechanics and supported bicycle shops, thereby contributing to development of bicycle repair infrastructure.

Eliminating need for complementarities
BoP hybrid examples: Lifestraw, Ruby Cup, Baisikeli

This strategy deals with reducing complexity of products through 'frugal' design and innovation. As an example, in its product development, Vestergaard Frandsen emphasizes long-term durability, no spare parts and that electricity is not required. Similarly, Ruby Cup is based on medical grade silicone that can be used for years and is an alternative to menstrual hygiene products that need to be resupplied constantly and require disposal facilities.

Creating demand for antagonistic assets
BoP hybrid examples: MyC4, Baisikeli

In this strategy the focus is creating 'reverse appeal' for antagonistic assets through storytelling, which MyC4 establishes through its platform whereby clients/investors are able to imagine a personal link with their lenders. As well, Baisikeli has a specialized bicycle design that it leases to big corporations in Denmark in a way that appeals to improving CSR image; after the end of their lease, the bicycles are sent to hospitals in Africa.

Using partnerships to achieve distribution complementarities
BoP hybrid examples: Lifestraw, Ruby Cup

In this strategy the focus is on reaching markets via access to distribution channels with e.g. charities and business. Vestergaard Frandsen does not for instance sell directly to customers but distributes the LifeStraw through governments and humanitarian organizations, much the same as Ruby Cup. Both preferred to sell

directly to the BoP, but found it advantageous with organizations like these buying in bulk and then distributing through own networks.

As of 2018, most the mentioned BoP hybrids characterized by Hockerts (2015) are still operating and carrying our BoP-oriented activities. With *Baisikeli* this is apparent when visiting their website and seeing their 'Bikes for a Better World' program centrally positioned in their external communication. *Ruby Cup* has its main office in Barcelona currently, and its products can be bought at sales points in Europe, Africa, South America, Asia and Oceania. In May 2018 it has been running a 'Buy 1, Give 2' campaign for its product. Vestergaard Frandsen now has several *LifeStraw* product lines for both recreational and humanitarian purposes and has both individual and 'community' water filtration units. MyC4 has been experiencing legal challenges, however, although its website is still running. As explained by its founder (Eriksen, 2016), MyC4's local microloan partner in Kenya had been suspected of fraud, and information about legal proceedings against this local partner has been provided on an ongoing basis for years until present on MyC4's official blog (see https://myc4.wordpress.com).

Discussion of Baisikeli, MYC4, Ruby Cup and Lifestraw

Danish BoP-oriented SME's have had the opportunity to build their business operations in accordance with a fundamental social mission and innovative concept. In the 3-stage framework for sustainable business innovation (Figure 4), these SME's appear to have several 3rd stage *Systems-building* ("Societal Change") characteristics as argued in the following:

1. Their i*nnovation objective* aligns poorly with the "doing the same things better" or "doing good by doing new things" characteristics of the 1st and 2nd stages in the model, respectively. Their focus is on positive impacts and on doing these in collaboration with others, even in the case of the arguably larger BoP hybrid example Vestergaard Frandsen and its LifeStraw product, which reaches the BoP through distribution channels accessed through partnerships. Baisikeli, Ruby Cup and MyC4 likewise do not operate in a vacuum but reach their objectives through involving others.

2. Their *innovation outcome* focus is linked with their mission of affecting lives at the BoP with their products/services in the way that they can, i.e. access to improved transportation, microloans, menstrual hygiene products and clean water. These are not innovation outcomes that solely have to with lessening harm, but tackle fundamental needs at the BoP and seek net positive impact in alignment with the 3rd stage in the model.

3. The characteristics of *innovation's relationship to the firm* is elucidated through Hockerts (2015) as a relationship that clearly extends beyond the firm in many cases when the SME's employ the different strategies for

turning *antagonistic* assets into *complementary* ones. SME's are arguably more vulnerable than multinationals due to fewer resources, and thus more inclined to seek strategies for addressing their antagonistic assets, including seeking partnership collaboration in a systems-framework. This again aligns most closely with the 3rd stage in the model.

Fan Milk

The covered experiences so far represent two main approaches: 'classic' BoP venturing led by multinational enterprises, and the emergent BoP social business (or hybrid organization) venturing mainly led by SMEs. Aside from these, numerous Danish businesses have had decades-long presence in developing countries using *conventional* business strategies, and some have sought to address poverty alleviation, through Corporate Social Responsibility (CSR) efforts[13] supported by the various support instruments to business and partnerships in Danish development cooperation. A rare Danish example of a conventional business managing scale and success among low-income groups is *Fan Milk.* A first-mover in Western Africa, Fan Milk became a household name in the region after establishing itself as a provider of frozen dairy and juice products from the 1960's onwards. The innovation is its street vendor-based distribution system based on bicycles with integrated coolers (Fawcett and Waller, 2015), which has ensured the employment of thousands of low-skilled workers in its operations. However even despite its longstanding presence and success in Africa, Fan Milk suffered severe losses in 2013, and through a large, structured takeover has been fully acquired by the French Danone corporation as of 2016[14] (FødevareWatch, 2016).

Discussion of Fan Milk

Although Fan Milk was acquired by another set of owners in 2016, this doesn't detract from the business expanding its operations to neighboring countries. In relation to the sustainable business innovation framework (Figure 4), this case could be characterized as aligned with the *Organizational Transformation* stage. The company approached a new market early on and used first-mover advantage to develop a brand and dairy product portfolio fitted to West African market conditions. In the *innovation objective*, the business has been notable for the focus on its distribution system and

[13] Some examples include aquaculture in Ghana for local food production and employment by *Royal Danish Fish*, or efforts toward improving smallholder farmer conditions in cocoa production by the *Toms* confectionary company.

[14] The takeover made Danish Emborg family, who owned the business, among the richest in the North Jutland region with more than 350 million DKK in assets (Løcke, 2017).

has achieved a mutual value-sharing *innovation outcome* by being inclusive towards low-skilled workers and strengthening their livelihood base.

Altogether, Danish experiences various BoP, hybrid business and conventional strategies have led to some results with regard to sustainability and innovation – though without fully achieving the propositions in BoP 3.0 and the *Systems Building* 3rd stage in the sustainable business innovation framework. However, it is worthy to note that SME's – the BoP hybrid organizations as per Hockerts (2015) – do display some characteristics in alignment of the 3rd stage.

2.5. THE ROLE OF TECHNOLOGY IN SUSTAINABLE INNOVATION

What is the role of technology in innovation for developing countries, and can it be a driver for inclusivity and for sustainability? Technologies are seldom treated separately in empirical studies or conceptual framings dealing with product or service innovation targeting the poor. They are instead embedded in a host of socio-technical issues such as user needs, culture and values to be taken into account when designing BoP strategies and business models (Kandachar and Halme, 2008). According to Ravn (2012), technology is a vital aspect, amongst others, in product and service innovations for developing countries covering:

- *Technology* (engineering, production techniques and processes, basic research)
- *Users* (culture, values, family structures and local knowledge)
- *Market* (regulation, structural conditions, actors within government, NGO's and international organizations)
- *Business strategy* (organization, management, distribution)

These aspects have certainly been at play in the previous examples of Danish businesses in developing countries. The *technology* aspect has taken many different forms, including: Interconnecting engineering components for water provision, biotechnology applied toward decentralized renewable energy and improved agricultural practices, and refrigeration integrated into a distributed supply chain. Other examples include a well-known technical solution for personal transport (bicycles), production of low-cost and hygienic menstrual pads, and use of advanced filters for a novel handheld water purification product. In each example, the degree of success of the technology in a market-based solution is socially dependent, e.g. with respect to the interfacing with users and communities, and with business partners. Market conditions and a firm's business strategy are clearly key aspects as well.

In this understanding, *technology* is linked with social and market conditions. There are tangible manifestations of technology, but the way technology interacts with social and market conditions determines success. In international development

circles, the need for conciliation of viewpoints between technology-centered and socially-centered approaches has been recognized since at least the 1990's (Heeks, 1995), and the importance of social embeddedness for technological change processes has been emphasized as well (Kuada, 2003). Kandachar and Halme (2008) and Ravn (2012) can be seen as elaborations of this discussion. With regards to *sustainability*, Figure 6 is built on Figure 4 and shows a continuum of sustainable business dimensions.

Figure 6 - Dimensions of sustainable business (Network for Business Sustainability, 2013).

In Figure 6, the different dimensions are:

- The *innovation focus* (from technology towards people)
- The *firm's view in relation to society* (from insular towards systemic)
- The *extent to which innovation extends across the firm* (from stand-alone towards integrated)

While the 2nd and 3rd dimensions emphasize taking part in systems building beyond the firm and integrating innovation activities comprehensively within the firm, the 1st dimension focuses on the role of technology and clearly underlines it as socially embedded. Technology is part of the focus in an innovation process, but can only be a measure of sustainability if the social dimension is included. An *inclusive* technology could in other words be taken to be a prerequisite for a *sustainable* technology. Here, the range of inclusivity in co-creation processes by Nahi (2016) is helpful for an elaboration; from arms-length cooperation and focus on business model development to processes of social transformation and shared decision-making with communities[15].

Sustainability covers the environmental dimension as well as the social and economic. Concerning environmental aspects in particular, Hart (2005, 2011) has proposed that

[15] It should be noted that the typology used by Nahi (2016) for classifying different levels of inclusivity becomes a bit muddled when combined with the technology-people continuum according to the Network for Business Sustainability (2013). In Nahi's classification, *sustainability* is only the middle stage, a step beyond *efficiency-seeking* but subsumed within *empowerment-seeking*.

BoP innovation provides the basis for so-called 'green leap' strategies (see Table 2), which focus on the incubation and commercialization of *disruptive* green technologies to address environmental challenges in developing economies. Through green technology leapfrogging, adverse environmental effects associated with traditional, unsustainable and consumption-based development are avoided. Hart further argues that the difficult infrastructural conditions in developing countries are not a hindrance to green leap BoP innovation. To the contrary, Hart argues that these conditions provide an ideal 'testing ground' for developing environmentally sustainable products and technologies. In a further elaboration of the relationship between green (clean) technologies and the BoP, Stuart L. Hart together with Mark Milstein have developed the "Sustainable Value Framework" (Hart, 2011), seen in Figure 7. Here, meeting unmet needs at the BoP and clean technology deployment are seen as complementary future-oriented firm strategies which are linked with disruptive innovation and addressing poverty, inequity and population growth.

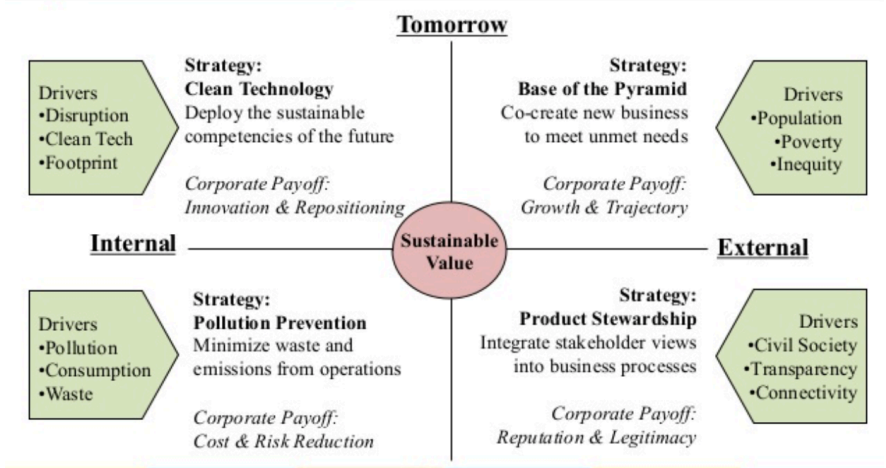


Figure 7 - The Sustainable Value Framework (Hart, 2015c).

2.6. CHAPTER SUMMARY

This chapter first covered innovation in developing countries, in which opportunities for technological leapfrogging were highlighted. Inclusive innovation was discussed as tied with being sensitive to the poor and disenfranchised, as well as asymmetrical power relations among stakeholders.

The chapter then covered the BoP and social business approaches to business innovation. BoP propositions have evolved over time from selling to the poor as customers (BoP 1.0) to co-creation (BoP 2.0) to building more complex innovation ecosystems, cross-sector partnerships and sustainable development frameworks (BoP 3.0). Additionally, a range of co-creation practices were highlighted from an emphasis

on business modeling to "hearing" various groups of people to sharing decision-making processes with local communities. In social business, business development is based on long-term relationships with local communities. Social businesses pursue a social purpose as a main priority, while accrued capital is reinvested instead of e.g. paid to shareholders. BoP and social business represent different strategies, and there are no clear distinctions between them and hybrid combinations are possible.

Afterwards, Danish business' experiences in developing countries was discussed with respect to a sustainable business innovation framework. Through case studies of multinational enterprises (Grundfos Lifelink, Cleanstar Mozambique), SME's (Baisikeli, MYC4, Ruby Cup, Lifestraw) and a conventional business with particular success in West Africa (Fan Milk), it was found that the business operations contained several innovative features – however none have fully achieved BoP 3.0 or *Systems Building* principles.

Finally, the chapter contained a discussion about the role of technology in developing country business innovation. Technology is seen linked with social and market conditions, and fostering inclusive innovation is integral to developing a sustainable business.

The focus in this PhD thesis is how technology is socially constructed in developing country partnerships. In other words, how is technology socially co-constructed between the firm, users and other stakeholders involved? The thesis further pays particular consideration toward how inclusive innovation can be co-constructed. This is part of the relationship between the firm and its partners which focuses on the direct relationship with users (alternately beneficiaries and local communities) in the developing countries. Inclusive innovation is seen here as a significant part of the social dimension of sustainability. In this connection, the sustainable business innovation framework points to people-centered, societally systemic and comprehensively firm-embedded innovation as key (Network for Business Sustainability, 2013). However, while the Danish company cases give an overview about Danish strategizing in developing countries, more research is needed to underpin these propositions and directly address the PhD thesis aim. For this reason, the following chapter will go into details on the *access2innovation* empirical foundation for the thesis.

CHAPTER 3. INTRODUCTION TO ACCESS2INNOVATION

Inclusive innovation can be seen as integral toward addressing the poor and, as argued in Chapter 2, also when seeking sustainable outcomes. The matter of *how* rests on being people-centered, embedding innovation within a firm and seeking systemic integration with society. In BoP 3.0 strategies aimed at challenges in the developing world, 'systemic societal integration' covers innovation ecosystems and cross-sector partnership networks. However, there have only been limited experiences with applying such approaches – Danish or otherwise. In the following chapter, the research project is presented upon which this PhD thesis is based. *Access2innovation* is a Danish BoP 3.0 initiative (Ravn 2015) that has sought to support innovative business and technology in a number of application areas. The foundations of this PhD thesis are the experiences from being part of *Access2innovation*.

3.1. THE INITIATIVE

"*The commercial approach to poverty reduction."*
- *Access2innovation* marketing catchphrase, 2011-present

Access2innovation is an initiative of Danish origin that has been applying a partnership and network approach to innovation in developing countries and humanitarian relief since 2007 until present. In this timespan, the initiative has evolved in terms of its organizational set-up and in the configuration of partners that have collectively formed its network. Today, it is a stand-alone, membership-based organization and a 'commercial foundation': a form of Danish legal entity with a number of requirements to its governance structure. *Access2innovation* previously went through a number of years being a personality-driven initiative and later a non-registered network organization supported by grant funding via either Aalborg Municipality or Aalborg University. The aim has been consistent throughout: To test and develop ways to use strategic partnerships across sectors to meet market opportunities and challenges in developing countries and in humanitarian relief. This has also included a mandate to carry out research based on the initiative's partnership innovation processes and the tools and methods applied and refined. The key sectors involved are shown in Table 3.

Table 3 - Key sectors involved in the Access2innovation initiative and the chosen strategic focus.

Sector	***Strategic Focus***
Civil Society	International development or humanitarian relief NGO's with branch offices in Denmark
Business	National business membership organizations (chambers of commerce); National specialist technical business networks (e.g. within water and renewable energy technologies); Individual businesses (primarily SME's) primarily located in the North Denmark Region
Academia	Universities in Denmark; Other higher education institutes in Denmark (e.g. University Colleges)
Public Institutions	Local municipalities primarily located in the North Denmark Region; Local municipalities located in countries of operation (primarily Uganda)

Access2innovation has cultivated a national network of partners and global reach, yet the initiative has also had a distinct regional domestic orientation. It has prioritized engagement with businesses in the North Denmark Region due to project manager ties, institutional ties[16] and conditions placed upon grant funding disbursal. Regional orientation also reflects intentional alignment with Danish public programs for supporting regional business development. Regionally focused *Growth Houses* were established in 2007 as hubs in a wider support ecosystem for enterprise growth in Denmark to follow up on a national globalization strategy (OECD, 2013). *Access2innovation* assistance to firms has been part of these hub' support toward business internationalization and entering new markets, and has thereby been included in the package of services provided by the Growth House servicing the North Denmark Region[17] (*Væksthus Nordjylland*). This is noteworthy because it shows that being involved in innovation ecosystems can have domestic and international dimensions; being embedded within and supported by the Growth House system may support Northern partners being involved in such innovation ecosystems in developing countries as well.

[16] Particularly Aalborg University and Aalborg Municipality located here.

[17] Another region, the Region of Southern Denmark, was originally involved at *Access2innovation's* inception, see Ravn (2012).

3.2. ORIGINS AND DEVELOPMENT

The origins of *Access2innovation* go back to Jacob Ravn, an entrepreneurially minded, former Brussels-based EU lobbyist working for the North Denmark Region who later became a Programme Officer for the Danish Red Cross on international refugee repatriation.

Jacob Ravn began the *Access2innovation* initiative in 2007 as an action research project to address 1) calls for cross-sectorial collaboration between NGO's, businesses and authorities, and 2) experienced innovation shortcomings within the NGO sector (Ravn, 2012).

Based on the successful facilitation of 4 partnerships in 2007-2011 centered on humanitarian relief applications involving the NGO DanChurchAid[18], Jacob Ravn expanded the initiative to become Project Manager for an *Access2innovation* secretariat in 2011-2014 bolstered by regional development and national research funding. With this expansion, a BoP focus was added to humanitarian relief. The *access2innovation* scope expanded from post-disaster settings with e.g. a United Nations agency and NGO focus, to development issues with the poor as customers, partners and beneficiaries. Though this scope became more challenging, *access2innovation* facilitated a number of partnership innovation cases in East Africa within agribusiness, renewable energy and water/sanitation in addition to humanitarian relief[19] (see Table 5). Most cases were concentrated in Uganda, and during the period 2011-2014 I was attached to the initiative as Programme Officer with focus on solid waste management projects and as contact person for CARE Denmark, one of our NGO partners.

In 2014, I left *access2innovation* while the third and current stage of its development took shape. Articles of association were signed establishing a commercial foundation in late 2015. Building upon encouraging results in Uganda, *access2innovation* has spread wider in East Africa whilst address new thematic focal areas within aquaculture and logistics. Partly, these new focal areas have been identified to link better with existing stronghold business capabilities in the North Denmark Region.

[18] Successfully launched commercial ventures included SkyWatch, which produces unmanned aerial drones for various terrain surveying applications and ViewWorld, a mobile phone application for assisting aid and development workers with data collection and reporting.

[19] See www.access2innovation.com/cases

3.3. TRIPLE AND QUAD HELIX FRAMEWORKS

How *access2innovation* has evolved is shown in Table 4 in further detail. The selection of sectors for involvement has been expanded along the way from a 'triple-helix' model that did not initially include public authorities in a formal role, to a 'quad-helix' model. Public authorities were initially not directly involved in partnership innovation processes as their role was seen as setting institutional framework conditions. However, the secretariat realized that involving municipalities in the North and South could strengthen partnership networks in developing countries. The best example involved the World Wildlife Fund (WWF), where *access2innovation* focused a number of partnership innovation projects in the Kasese District in Eastern Uganda in support of WWF activities. *Access2innovation* mobilized businesses from Denmark as well as local municipalities from the North Denmark Region to support Kasese District in achieving 'champion district' status in terms of clean energy[20], which was a local priority. Thus, a number of the previously mentioned 24 partnership innovation cases were based on Kasese District as a locality for testing business concepts and technologies. WWF and local authorities were involved in many of the cases.

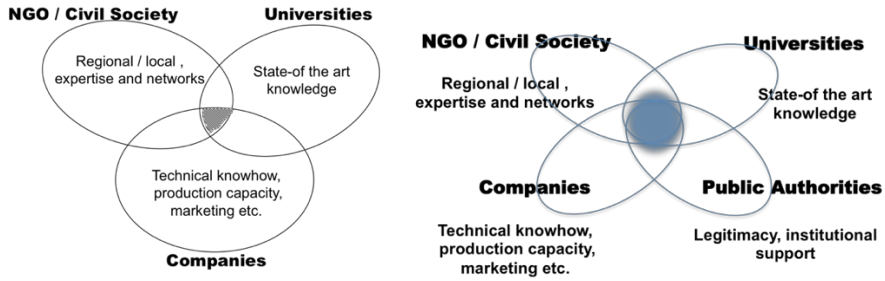


Figure 8 - Triple and Quad Helix sector configurations in access2innovation.

The 'Triple-Helix' or 'Quad-Helix' designations used in *access2innovation*, illustrated in Figure 8, are only loosely related to the triple helix innovation model proposed by Leydesdorff and Etzkowitz (1998) and further refined (Etzkowitz and Leydesdorff, 2000; Etzkowitz 2008), including for developing countries (Saad and Zawdie, 2011). The triple helix model refers to university-industry-government interactions and is usually applied as a macroeconomic analytical construct for studying innovation processes. While inspired by the framing of cross-sectorial collaboration as a driver for innovation, *access2innovation*'s model is different for two main reasons:

[20] For more information on the Champions District initiative, see http://wwf.panda.org/wwf_news/?254236/Champion-District

- The triple helix model's societal scale is argued to have limited practical application as a conceptual framework in a small number of partnership innovation studies.

- Civil society is not usually included in the triple helix model, but is here seen as vital for capturing innovation dynamics in developing countries

Table 4 – Evolution of the Access2innovation initiative[21].

Access2innovation stage	Period	Organizational Set-Up	Thematic Areas	Geographic Focus	Sectorial Focus[1]	Inclusion and Sustainability Focus
Access2innovation 1.0	2007-2011	Person-driven; Supported by grant funding	Humanitarian settings	No geographic focus	'Triple Helix' Civil Society, Business, Academia	Commercially sustainable business models
Access2innovation 2.0	2011-2014	Secretariat-driven; Non-registered organization situated at Aalborg University and Aalborg Municipality; Supported by grant funding	Agribusiness, water/sanitation and renewable energy in development cooperation and humanitarian settings	Uganda (peripherally, Vietnam)	'Triple Helix'/'Quad-Helix' Civil Society, Business, Academia, Public Institutions (added approximately 2012)	Commercially sustainable business models Environmentally sustainable technologies Social Impact
Access2innovation 3.0	2014-present	Secretariat-driven; Membership-based organization; Supported by membership fees and grant funding	Agribusiness, water/sanitation and renewable energy in development cooperation and humanitarian settings (forays into new areas e.g. aquaculture and logistics)	East Africa (primarily Kenya and Uganda)	'Quad-Helix' Civil Society, Business, Academia, Public Institutions	Commercially sustainable business models Environmentally sustainable technologies Social Impact

[21] *Access2innovation* material is inconsistent about naming conventions for its sectorial foci. *Civil society*, *Business* and *Academia* are currently the most promoted terms but others are often used, e.g. *NGO's*, *companies* and *universities* (see Figure 8).

Some studies have advanced a similar argument that civil society should be included in the triple helix model, particularly when the focus is on sustainability and developing countries. Yang and Holgaard (2012) have studied Danish and Chinese companies and called for explicit focus on civil society groups, because these have been able to form the foundations for eco-innovation processes. Kimatu (2016) finds that in African developing countries, university-industry-government interactions have been limited or even lacking and have, in his explanation, not served as a mechanism for generating knowledge-based employment. A number of studies indicate that the triple helix model is insufficient, and that including civil society or 'the user' holds potential for making it more applicable, sustainable or 'citizen-centered':

"The civil society serves as the voice of the citizen and could make development to be more human-sensitive and in the cultural context of the communities."

The advancement of the triple helix to include the civil society as the fourth component makes a quad helix. This inclusion aids in raising the voice of the user of the innovations so as to cater for mainly the social and environmental needs on a global scale."

(Kimatu, 2016)

Including civil society as a sector in the *access2innovation* helix frameworks has its own issues, however. As seen on Figure 4, civil society is equated with NGO's, which has also been the emphasis in the partnership innovation projects. To a large extent, the *access2innovation* assumptions about the role of NGO's can be explained by the NGO career background of the people involved in its launch: According to Ravn (2012), NGO's possess insight into the needs and challenges in developing countries as well as knowledge and networks of high relevance to business development activities. With these presumptions, NGO's have therefore been provided with a role as intermediaries to local communities. By acting as gatekeepers and 'translators' of user needs, the presumptions dismiss that NGO's are not omniscient, or do not always act in the interests of the poor. Including civil society addresses a weakness in the triple helix model and positions *access2innovation* activities better in terms of inclusivity of poor. However, there is an implicit danger in over-reliance on NGO's to speak on behalf of civil societies if the local communities are not provided with their own voice and involved in partnership ecosystems, in the spirit of BoP 3.0 propositions.

3.4. INCLUSION AND SUSTAINABILITY

"Save the World. Make Money. Repeat."

- *Access2innovation*-organized conference heading, 2016

Sustainability has been a stated *access2innovation* objective especially from the 2011-2014 period and onward. As indicated in Table 3 in the final column, the initial 2007-2011 priority was proving the concept and the commercial viability of spin-off ventures resulting from partnership innovation processes. Based on the success of the first phase, Ravn (2012) then suggested that the following one would seek sustainability and inclusivity (framed as a 'bottom-up approach') much more actively. The research agenda laid out a number of sustainability-focused themes, including the need to look into the following (Ravn, 2012):

- Sustainable business models in BoP markets
- Sustainable commercial technology transfer in BoP markets
- Capacity development for developing sustainable solutions (disruptive innovations)

However what did it mean for *access2innovation* with respect to the three dimensions of sustainability? The ambition to launch commercially viable businesses has been clear from the outset. Once *access2innovation* expanded its scope to address development in addition to humanitarian relief in 2011-2014, the choice of thematic areas reflected supporting the development of technologies with beneficial environmental effects – particularly renewable energy[22]. On the social aspect, the communications material in 2011-2014 asserted that *access2innovation* would deliver not just poverty *alleviation*, but poverty *reduction*, see e.g. the marketing catchphrase in the beginning of this chapter. Focus was on improving living conditions with respect to the poor. Equitable partnerships and social inclusion, on the other hand, weren't emphasized as part of the social dimension – at least only initially. The focus became what I term 'social impacts'. The focus in 2011-2014 was thus as follows:

- Commercially sustainable business models
- Environmentally sustainable technologies
- Social impacts

[22] The selection of thematic areas 2011-2014 was based on an analysis of priority areas for a number of Danish development NGO's, indirectly mirroring their sustainability mission. Some focal areas were also carried over from the 2007-2011 period – e.g. renewable energy due to a previous project dealing with sustainable energy supply for humanitarian basecamps.

Sustainability in partnership innovation wasn't presented in this way, when addressing businesses. The message (*"Save the World. Make Money. Repeat."*) was simply a matter of simultaneously fulfilling social and commercial objectives. Within the access2innovation secretariat, we sometimes referred to this as a hybrid value proposition, using the business-modeling terminology (Osterwalder and Pigneur, 2013) that heavily influenced our daily discourse and partnership facilitation methods (elaborated later in Chapter 6).

3.5. THE SECRETARIAT, OWN BACKGROUND AND ROLE

The activities of access2innovation from the 2011-2014 period onwards were carried out by an interdisciplinary secretariat of around 5 people. The exact number has always been in flux e.g. due to student interns and personnel changes. The secretariat collectively administrated the network, carrying out common tasks such as organizing business conferences and preparing for steering committee meetings, and facilitated the partnership innovation projects. It consisted of Jacob Ravn as Project Manager, a number of Program Officers (some of whom doubled as doctoral researchers, like myself), Project Officers (who had administrative duties and no research obligations) and administrative support staff.

The secretariat has included people within such diverse fields as those indicated in Table 4. Since *access2innovation* handled issues spanning the triple/quad helix, there was a need for a secretariat that was able to act as bridge-builders which meant being able to (figuratively) converse with actors using their own language, but also being able to translate and mediate in the meeting with others.

Table 5 - Disciplinary backgrounds of the access2innovation secretariat 2011-2014.

Social Science	**Natural Science & Engineering**	**Humanities**
Project Management	*Management Engineering*	User-Driven Innovation
International Politics	*Environmental Planning*	Anthropology
Business Administration		
Entrepreneurship		
Development Studies		
Agricultural Economics		

In Table 4, my own disciplinary specialty areas are highlighted in italics. My educational background spans both engineering and social sciences, and I joined *access2innovation* having previous experience from the university and NGO sectors. My personal upbringing has taken place in a number of developing countries in Southeast Asia and I am of mixed Danish-Filipino heritage myself. Sensitivity to my developing country roots has contributed to giving me a high degree of empathy with

the poor and disenfranchised[23], and having lived in both the developed and developing world has given me an international personal and professional outlook. It is therefore worthwhile highlighting that my profile hit a number of relevant notes for the secretariat. My profile presented on the *access2innovation* website is reproduced in the following.

> *David specializes in the management engineering discipline, with particular focus on technology assessments in innovation processes involving socio-technical aspects. As well, he possesses good understanding of development cooperation, and is an active member and chair of the local branch of Engineers Without Borders Denmark. David joins Access2Innovation from a Research Assistant position at Aalborg University. He holds an MSc in Engineering (Environmental Management) and a MSc in Development and International Relations from Aalborg University in Denmark.*
>
> - Website presentation for David Christensen

In the secretariat 2011-2014, I primarily handled projects within renewable energy, partly due to my environmental planning and management background. This included solid waste management, framed as 'waste-to-energy'. I was also assigned to CARE Denmark[24] as a contact person, and was attached to projects within agribusiness that they were interested in. This primarily covered chili production in Uganda and later coffee.

In the interactions with the rest of the *access2innovation* secretariat, there were others who for instance were better versed in business terminology, or more experienced in project management, or better equipped to facilitate innovation processes. However, my strength was bringing a sustainability understanding to the table. I also applied my understanding of technologies and awareness of social and cultural context to critically assess many of the project ideas that came across our desk. I found participating in *access2innovation* to be a remarkable experience that was incredibly interesting and challenging. At times, my interest in inclusivity of the poor was perhaps a minority view held up against the business logic that was an overriding priority for many in the secretariat. Although business and development interests were supposed to have been two sides of the same coin, there were ongoing discussions and reflections about balances, trade-offs and synergies. Upon reflection, handling

[23] I grew up in a privileged expat family since my father, a Danish consulting engineer, was stationed abroad on numerous development cooperation projects in e.g. Philippines, Indonesia and Thailand.

[24] The local branch of the international development/environment NGO and one of *access2innovation*'s network partners at the time.

questions related to sustainability's social dimension in *access2innovation* was difficult form the personal to the institutional level. I felt that nonetheless, it was important to keep asking the questions to better inform the process.

3.6. THE PROJECTS

The partnership innovation projects in the period 2011-2014 were organized under *access2innovation*'s thematic areas of agribusiness, renewable energy and water/sanitation. Some projects covered more than a single theme, and additionally there were humanitarian relief projects. The full overview can be seen in Table 6.

My focus was on the development-oriented projects, or BoP projects. In the following, I account for some of the partnership innovation projects that I was not personally involved in, but which are intended to illustrate the quad helix in practice and show the potential of *access2innovation* BoP 3.0 strategies.

I also provide a brief account of some failed partnership innovation initiatives under the agribusiness theme, in which I had direct insight. Stories of failed partnerships are just as important to include here because it balances out the risk of the narrative only being centered on the positive stories having emerged from the *access2innovation* framework.

Table 6 - Access2innovation partnership innovation projects 2011-2014. Asterix (*) denotes direct author involvement.

	Status	**Remarks**
Agribusiness		
Poultry Incubators (Uganda)*	Full scale demonstration project implemented.	Community based, solar-driven incubator units for poultry production with use of microfinance.
Small-scale coffee farming (Uganda)*	Exploration study carried out.	Technology, marketing and management upgrading of smallholder coffee farmers.
Chili farming (Uganda)*	Exploration study carried out.	Post-harvest technology and supply chain upgrading of smallholder chili farmers.
Dairy cooperatives (Uganda)	Exploration study carried out.	Technological upgrading of dairy production and supply chain with smallholders and farmer cooperative.
Renewable Energy		
Energy hubs (Uganda)	Full scale demonstration project Detailed in this section (as **Remergy**)	
Small scale bio-fuel (Uganda)*	Exploration study carried out.	Low-cost and scalable production of second-generation biofuel from agricultural residuals
Renewable energy and energy efficiency (Uganda, Kenya)	Detailed in this section (as **Danish Cleantech Group**)	
Waste-to-energy (Uganda)*	PhD thesis partnership innovation case, see **Chapter 9**	
Waste-to-energy (Vietnam)*	PhD thesis partnership innovation case, see **Chapter 7** and **8**	
Steam powered water pumps (Tanzania)	Exploration study carried out.	Solar thermal driven water pump technology and business model development.
Water and Sanitation		
Urban sanitation (Uganda)	Detailed in this section (as **One Stop**)	
Payment system for sanitation services (Uganda)	Detailed in this section (as **Pay E-Safe**)	
Water purification through renewables energy (Tanzania)	Exploration study carried out.	Use of solar PV for water purification in Tanzania in e.g. rural communities and the service industry.
Humanitarian relief		
The 'green generator'	Prototype developed and ready for deployment.	Multiple input energy supply for humanitarian base camps.
Emergency sanitation	Exploration study carried out.	Integrated sanitation solution for humanitarian base camps.

Figure 9 –One Stop in Kasese, Uganda (Behangaana, 2014).

One Stop (originally the *One Stop Shop)* is the name of a sustainable urban sanitation solution, important because lack of access to toilet facilities in e.g. slum areas can result in heightened disease incidence (Namuyondo, 2013). The solution is a public toilet and washhouse with a retail store for hygiene articles and sanitary products (Kabbyanga, Johansen and Ravn, 2015), and exists as a demonstration project in the city of Kasese, Uganda. The One Stop facility in Kasese has been placed in a centrally located public market place, where there is a high concentration of people especially on market days, and where up until it was established, there was a high risk of spread of disease due to food produce being handled and unhygienic public toilet facilities being the only sanitary facilities available (Danish Red Cross, 2015).

The idea originated from the Red Cross and was developed as a business case by *access2innovation* in 2012 (Kabbyanga, Johansen and Ravn, 2015). Since then, the company Enviclean has been the lead company in a partnership with Danish and local companies[25] which received Danida Business Partnership funding in 2013 (CISU – Civil Society in Development, 2014). The local authorities supported the partnership through e.g. providing public land area and carrying out awareness campaigning. The

[25] The companies include *DMS Africa* which specializes in modular and affordable housing, *Bigadan* which specializes in biogas installations and the Ugandan company *Watertech* (Kabbyanga, Johansen and Ravn, 2015).

Red Cross has provided basic health and hygiene training (CISU – Civil Society in Development, 2014).

Kasese was chosen after studies showed a need for improved sanitation: Inhabitants rely on traditional pit latrines and there are a small number of existing toilet facilities that experience challenges with operation and maintenance (Namuyondo, 2013). *Flying toilets*[26] are deposited in pits and abandoned toilet buildings, while pit latrines get destroyed during floods in the rainy season. The *One Stop* has been able to provide access to 300 users per day[27] and local authorities have reported improved local community health and attitudes towards proper sanitation, improved local environment and reduced costs for the municipality for waste collection and handling (Kabbyanga, Johansen and Ravn, 2015). *One Stop* has been seeking further financing for scaling the solution on a national scale and beyond. The partnership has claimed that the demonstration project requires 500-600 visits per day to break even, and that government subsidies will be important for scaling (Kabbyanga, Johansen and Ravn, 2015). The *One Stop* can be seen in Figure 5. In November 2015, a Red Cross health clinic has been built adjacent to it (Access2innovation (a), 2015). The partnership has been considering including sewage treatment and biogas production as a part of the business concept as well (Kabbyanga, Johansen and Ravn, 2015).

Figure 10 - Pay-E-Safe concept testing in Kasese, Uganda (Access2innovation (b), n.d.).

Pay-E-Safe is an electronic micropayment system developed for use in emerging markets in East Africa with low credit card availability and high mobile phone money

[26] Plastic bags used as a collection device when open defecation is practiced.

[27] The price per visit has been set at 300 Ugandan Schillings (approximately 0.09 US Dollars) and deemed affordable by the partnership (Kabbyanga, Johansen and Ravn, 2015).

transfer transaction costs (Prentow et al., 2015). The system provides an alternative to cash handling when buying or selling services and was developed together with Enviclean using the *One Stop Shop* as a testing platform. It addresses cash handling issues such as theft and fraud and is meant to be a safe and trustworthy solution for users and vendors (Prentow et al., 2015). The development team behind *Pay-E-Safe* consisted of students from Aalborg University. The team carried out fieldwork in Kasese, Uganda, which involved prototyping, interviewing, roleplaying and observation with locals (see Figure 6). The aim was to design a system remaining sensitive to local culture and respectful of existing payment practices. The development team found that the patriarchal family unit was the most fitting user profile as opposed to the individual. This meant that family members have to be able to share a payment device. The team also found that personal prestige was important for how the device should look like, and that security was important with regards to accessing to a user account and user information at a payment terminal (Prentow et al., 2015). The *Pay-E-Safe* ended as a system storing virtual currency balance and transaction data on a card that resembles a debit card. The card is used to pay for e.g. *One Stop Shop* visits. The other hardware components in the system are flexible, low-cost, use little power and are connectible to a motorcycle or car battery (Prentow et al., 2015). *Pay-E-Safe* has since 2013 existed as a start-up company run by former engineering students (Aalborg University, 2014), with close ties to Enviclean.

Figure 11 – The Remergy electrical micro-grid installation in Kayanja, Uganda (Vandenbroeck, 2015).

Remergy has provided mini-grid solutions for rural villages and electrification to 87 households out of 450 in the fishing village of Kayanja, Uganda in 2014 (Løcke, 2014). Kayanja is located in the Kasese District and has approximately 3000 inhabitants. Electrification increased to 120 households and businesses in 2015 (Andersen, 2016). The micro-grid in the village is based on a 5 kW solar PV system primarily for lighting (Andersen, 2016), and is partly financed by the community's

own up-front investment through a SACCO[28] consisting of local inhabitants and users of the facility (Lund, 2014). The system's solar PV panels and control facility can be seen on Figure 7. In addition to community part-ownership and the objective of full ownership after 3 years (Lund, 2014), the inhabitants pay for consumption through a prepaid metering system. The system has enabled some inhabitants to provide extra services such as offering mobile phone charging in addition to running a retail store (Løcke, 2014), or being able to sell cold drinks.

Remergy was a Danish joint venture between SystemTeknik in Northern Denmark, a company that specializes in design and production of electrical panels, and the energy utility company Trefor. The Kayanja micro-grid was supported by the WWF through its Champion District initiative in Kasese, as well as local authorities (Løcke, 2014). According to Overgaard and Nielsen (2014), the venture involved all aspects of a 'quad helix' approach and is seen as an example of a 'high level innovation'. Lund (2014) reports that the collaboration with WWF has had several beneficial outcomes for both the NGO and the company, and that *access2innovation* played an important role as an intermediary. Unfortunately, Remergy has become defunct after it filed for voluntary liquidation in 2015 (Johansen, 2015). Although Remergy was poised to prepare for implementation of a further number of village micro-grid systems (Andersen, 2016), insolvency and internal management decisions meant that these activities had to be put on hold (Johansen, 2015).

The **Danish Cleantech Group** (DCG, http://www.danishcleantechgroup.com) was established in 2014 as a partnership between four Northern Denmark energy companies with different technical specializations working together to provide services in East Africa (Lai, 2015). The partnership consists of:

- Aalborg CSP (industrial boilers using on concentrated solar power technology)
- Ea Energy (insulated piping for solar heating and cooling)
- CO2LIGHT (LED lighting)
- Danish Sun Energy (solar PV installations)

DCG has established sales offices in Uganda and Kenya and offers a range of renewable energy and energy efficiency solutions tailored for the East African market and its financial structures (Access2innovation (c), n.d.). With support from *access2innovation*, some of the DCG companies have conducted exploratory studies in Uganda, and later Kenya, with a view to B2B customers in e.g. manufacturing. DCG primarily targets industries as opposed to the BoP segment and operates mostly without close links to NGO's. In this sense DCG resembles a conventional business operation in a developing country, but it is noteworthy from an eco-systems

[28] Savings and Credit Cooperative Organization.

standpoint due to the different companies and their expertise areas working together in a new market.

One Stop, **Pay E-Safe**, **Remergy** and the **Danish Cleantech Group** comprise some of the noteworthy *access2innovation* cases 2011-2014 because of their tangible results, partnerships among businesses (e.g. DCG or *One Stop* and *Pay E-Safe* working together), partnerships with authorities and NGO's (e.g. *One Stop* and *Remergy*) and community relations (*e.g. Pay E-Safe* and *Remergy*).

On the other hand, many *acces2innovation* cases don't end up as exemplary as those highlighted above, and the cases still face challenges in their next step: *One Stop* is still seeking further investment for scaling up, *Pay E-Safe* is still a fledgling start-up, *Remergy* underwent voluntary liquidation and *DCG* is still establishing itself.

Recalling the 3-stage sustainable business innovation framework in Figure 2, firms can either take an *Operational Optimization*, *Organizational Transformation* or *Systems Building* approach, from least to most complex. Sustainable business innovation's aspects cover a firm's approach to innovation; it's innovation objective and the relationship of innovation to the firm (Network for Sustainable Business, 2013).

The presented cases align with either the 2nd or 3rd stage in the sustainable business innovation framework: *One Stop*, *Pay E-Safe, Remergy* and *DCG* all display 'doing things with others' for innovation of products, services or business models – corresponding to *Systems Building*, the 3rd stage.

The *innovation objective* is differentiated: most cases strive for 'net positive impact' in local communities in accordance with *Systems Building,* but DCG mostly looks for 'creating shared value' for its business partnership and B2B customers – an *Organizational Transformation,* 2nd stage approach.

Lastly, there are differences in the different company's relationship to innovation: While innovation is strongly embedded within *One Stop* and *Pay E-Safe* (a single-person company and a start-up, respectively), the Ugandan market activities for *Remergy* and *DCG* have been set up as a separate entity by the different companies involved in each joint venture.

Recalling also the further dimensions of sustainable business given in Figure 6, the presented cases have different positions along the three continuums; from technology towards a people focus in innovation, from insular towards system in the firm's relation to society and from stand-alone to integrated in the extent to which innovation extends across the firm (Network for Sustainable Business, 2013).

In the *Technology-People* continuum, all cases except DCG display a people-orientation for coming up with a solution. *Pay E-Safe* is strong in this respect. In the

Insular-Systemic continuum, all cases show that the companies see themselves as part of an organizational ecosystem. In the *Standalone-Integrated* continuum, *One Stop* and *Pay E-Safe* have innovation embedded in the organization's DNA while *Remergy* and DCG have their BoP innovation activities in a separate unit/department.

The presented cases are not representative but do show some encouraging signs for BoP 3.0 strategies. *Access2innovation* has amassed experience in partnership innovation processes, and are better positioned to support BoP 3.0 initiatives in its current phase.

Figure 12 - Access2innovation concept note front cover (chili farming, post-harvest handling and market information) (Access2innovation (c), n.d.).

There have been successes, but also failures. As mentioned earlier in this section and seen in Table 6, many *access2innovation* cases 2011-2014 never went beyond an exploration study. The example of **chili farming** in Uganda shows the difficulty of innovation partnerships. Based on CARE's membership in *access2innovation* (an international NGO), an effort was made to support their activities in Fort Portal, Western Uganda run by the local CARE country office. Many of CARE's target beneficiaries at the time were smallholder farmer groups adjacent to Kibaale National Park, who were introduced to self-organized savings and loans schemes[29], among other things. Since 2010 and together with the locally based Tooro Botanical Garden, CARE had also been supporting communities in cultivating chili (Sørensen, 2013).

[29] Otherwise known as Village Savings and Loans Associations (VSLA's).

Chili was intercropped as a means for problem animal management[30] and the commercial aspect of chili production was also recognized (Sørensen, 2013). To improve conditions for chili production, *access2innovation* had a number of discussions with CARE staff in both Denmark and Uganda and also held meetings with local stakeholders and with the communities near Fort Portal. Access2innovation also hired a consultant to investigate chili production conditions in CARE's area of activities (Ntale, 2012). Eventually, a concept note was prepared (see Figure 8) targeting Danish companies, which dealt with a number of possible partnership innovation activities as 'market opportunities' (Access2innovation (c), n.d.):

- Farming (emphasis on irrigation for secure production throughout the year)
- Post-harvest handling (storing crops to reduce losses and improve bargaining power in the supply chain)
- Market information (improved access to market information for optimal prices and choice of trading partner)

These 'market opportunities' were presented together with CARE at a business conference organized by *access2innovation* in 2012 with more than 120 participants. Among the companies that showed interest in chili production, **Arctiko** (http://www.arctiko.com) expressed interest in post-harvest handling (a company specializing in biomedical refrigeration systems) and **Loop-UX** (http://loop-ux.com) expressed interest in market information (specialized in user-experience design). Arctiko participated in a field visit to Uganda organized by *access2innovation*, while Loop-UX developed a mobile app mock-up it desired to test. However, complications resulted in these initiatives not being taken further:

- Neither company was based in Northern Denmark and *access2innovation* management did not have the mandate to offer financial support packages for facilitating innovation processes with the companies.
- CARE in Denmark expressed disappointment with the outcome of the business conference (the types and size of the companies involved) and found it difficult to see revenue streams benefitting CARE as part of partnership innovation activities. Parallel to this, CARE's activities in Uganda were set to undergo downsizing at the time.

[30] 'Problem animals' such as elephants can damage subsistence-based livelihoods, and the smell f burned chili can act as a deterrent for marauding animals.

- Further investigation indicated difficult prospects for the commercial potential of chili production and supply chain improvement in Western Uganda (Sørensen, 2013).

The attempt at partnership innovation activities in chili production thus failed. Commitment to joint activities on behalf of several key partners was lacking, and eventually ended up with *access2innovation* and CARE breaking formal ties. As far as BoP 3.0 strategies, an important learning aspect from the process is that mutually beneficial exchanges require resources, commitment and shared objectives among partners. Unfortunately, in this case the beneficiary chili farmers were not able to get involved directly in any partnership innovation processes.

3.7. CHAPTER SUMMARY

This chapter provided an introduction to the *access2innovation* initiative, which has been working with partnership innovation in developing countries since 2007 across sectors and under different organizations set-ups. The initiative is connected to regional development innovation ecosystems in Denmark, thus linking partnership innovation domestically and abroad.

Going deeper into the origins and development of *access2innovation*, the chapter established the initiative as the brainchild of Jacob Ravn, and has expanded the scope of its activities from humanitarian relief to include development-oriented projects in especially East Africa. Agribusiness, renewable energy and water/sanitation were the thematic headings that *access2innovation* focused on during my connection to the initiative in 2011-2014.

The chapter discussed *access2innovation*'s development through the lens of triple and quad helix innovation frameworks. The quad helix framing reflected how access2innovation included public authorities in its partnership innovation *modus operandi*. In terms of inclusion and sustainability, the chapter established that the main objectives of *access2innovation* were to seek commercially sustainable business models, environmentally sustainable technologies and social impact.

In a section dedicated to the internal workings of access2innovation, the chapter described the inter-disciplinary nature of its secretariat. The secretariat was comprised of 'bridge builders' capable of speaking with different types of actors and able to translate and mediate in partnership innovation settings. The chapter included reflections about my own role in the secretariat, emphasizing my critical, sustainability-oriented thinking and my strengths within understanding of cultural context.

Finally, the chapter described and discussed several of the projects that *access2innovation* facilitated during the 2011-2014 period, including *One Stop*, *Pay*

E-Safe, *Remergy*, the *Danish Cleantech Group* and a failed partnership innovation case study within chili farming. The case studies showed promising signs with regards to BoP 3.0 strategies. Among the notable factors for the chili farming case to have failed were the regional limitations of *access2innovation*, economic considerations from the partner NGO and difficult conditions for chili production and supply chain improvement based on a feasibility study.

CHAPTER 4. SOLID WASTE MANAGEMENT (SWM) IN DEVELOPING COUNTRIES

Access2innovation is presented as a BoP 3.0 initiative with a 'Quad Helix' actor configuration in its partnership innovation activities. Two 'waste-to-energy' projects in Uganda and Vietnam are case studies in this PhD thesis. To provide a contextual understanding for these cases, the following chapter reviews solid waste management (SWM) in relation to developing countries. In particular the chapter deals with socio-technical perspectives on improving SWM systems, including multi-stakeholder approaches and partnerships. It further details SWM in relation to BoP business modeling and technology development.

4.1. INTRODUCING SWM IN DEVELOPING COUNTRIES

History of SWM

Human activities have led to the generation of solid waste since pre-historic times[31]. Industrialization marked an increase in waste challenges, as it concentrated people in urban areas and gave rise to new types and increased quantities of waste. In the 19th century public health concerns arose as a result of improper storage, collection and disposal, and the realized link between unhygienic conditions and the spread of disease (Worrel and Vesilind, 2012). Waste services in the industrialized countries were put in operation, and this has led to a long tradition of collection and removal of waste.

SWM developed as a discipline addressing waste from generation to disposal, linking diverse fields such as engineering, urban planning, economics, sociology and communication (Tchobanoglous, Theisen and Vigil, 1995). With technological and societal developments since industrialization, the SWM field has grown more complex, not least as the understanding has improved of adverse environmental effects of improperly managed waste. According to Marshal and Farahbakhsh (2013), public health was the earliest driver for SWM, followed by environmental concerns about soil, air and water pollution from the 60's. This was followed by resource scarcity concerns and the view of waste as a resource, marked by the introduction of the 'waste hierarchy' concept in Europe in the 70's with its emphasis on waste

[31] Innovative re-use, recycling and otherwise value-generating human activities based on waste also have a corresponding history.

prevention as preferred SWM strategy[32] (Marshal and Farahbakhsh, 2013). In the 90's, climate change acted as an additional driver. Finally, public concerns and awareness has become an important driver, as public perception and behavior can enable but also cause resistance towards system changes (Marshal and Farahbakhsh, 2013).

SWM in Developing Countries

In an older World Health Organization manual on SWM in developing countries (Flintoff, 1976), it is suggested that the *West* (sic) could potentially offer a lot in terms of understanding of waste issues, technology and guidance – due to decades of experience. However, a number of factors in developing countries were identified which warned against any assumption of being able to 'transplant' Western methods. Among the factors were: Extremely high urban population densities, constrained budgetary resources, climatic conditions and seasonal variation, foreign exchange limitations, regional economy, social and religious customs, public health awareness, managerial and technical capacity and required environmental standards (Flintoff, 1976). To address these, some issues were identified: Setting health and environmental protections at a locally sustainable level, developing systems in accordance with local conditions, efficient use of local tools and equipment as well as labor, public education and vocational and professional training (Flintoff, 1976).

These decades-old SWM considerations cover economic, technical, public awareness and managerial aspects with particular attention to local conditions. In a more recent review of SWM in developing countries, many of the same challenges persist (Lerpiniere et al., 2014): Urbanization is now linked with global consumerism as the drivers behind 'unprecedented' levels of waste generation in low and middle-income countries. As previously, waste collection is limited and open dumping widespread, with the burdens particularly affecting the poor. Brunner and Fellner (2007) argue that in setting priorities for SWM in developing countries, waste hierarchy-prescribed options of prevention and recycling are not as appropriate as the improvement of basic disposal systems, i.e. complete collection and sanitary landfilling. Waste incineration and mechanical treatment as otherwise known in the West is less suitable due to expense and stakeholder acceptance (Brunner and Fellner, 2007).

Informal recycling is recognized to play an important role in the waste systems of developing countries, and is a source of occupation for many thousands who depend on recovering materials for their livelihoods (Lerpiniere et al., 2014). One of the major challenges is how to work with informal recycling. While there are health and social problems associated with these activities, there are 'significant' economic benefits that could be retained, with experience showing that it can be 'highly

[32] The waste hierarchy is sets priorities for waste management from prevention (reduction) to re-use, recycling, energy recovery, and disposal (Marshal and Farahbakhsh, 2013).

counterproductive' to disregard informal recycling when setting up formal systems (Wilson, Velis and Cheeseman, 2006). The preferred option is to integrate informal recycling practices and experiences into SWM planning, while working towards improvement of livelihoods, working conditions and recycling efficiency (Wilson, Velis and Cheeseman, 2006).

According to Lerpiniere et al. (2014), international cooperation efforts aimed at improving SWM in developing countries includes aspects as improving governance, building local capacity and infrastructure and providing access to loan and grant funding. Emphasis is on the supporting capacity and skills at community level, and on systems and infrastructures that protect human health and the environment, conserve resources and create jobs. The authors recommend raising priority on SWM in general, maintaining emphasis on capacity building and good governance, and improving access to financing through official sources blended with philanthropic and commercial and private sector sources (Lerpeniere et al., 2014). In the post-2015 landscape framed by the Sustainable Development Goals, it is further stressed that physical and governance issues should be addressed holistically, investment needs should be better understood and effective partnerships need to be built between donors, governments and other stakeholders. Finally, a systems-based *integrated* and *sustainable* approach to SWM is becoming increasingly established (further elucidated in Chapter 4.2).

Circular Economy

Recently, the concept of a 'Circular Economy' (CE) has received increased attention, including but not limited to the SWM literature. CE is a transition from current linear production and consumption patterns based on continuous growth and resource throughput (Ghisellini, Cialani and Ulgiati, 2016) also known as the *take-make-dispose* model (Ellen Macarthur Foundation, 2013; Bocken et al., 2017). CE is rooted in ecological and environmental economics as well as industrial ecology and promotes 'closing-the-loop' in an economic system in order to increase resource efficiency (Ghisellini, Cialani and Ulgiati, 2016). Closing-the-loop strategies include reuse, refurbishment and remanufacturing of products, components and materials for extending product lifetimes, as well as sharing and design for multi-functionality (Bocken et al., 2017). Particular attention is given to urban and industrial waste. CE entails cleaner production in companies, increasing producer and consumer responsibility and awareness, using technologies and materials that can be 'renewed', as well as policies and tools (Ghisellini, Cialani and Ulgiati, 2016).

Geissdorfer et al. (2017) compare similarities and differences between CE and sustainability and find that both seek cooperation and value co-creation among stakeholders and attribute importance to regulation, incentives and the role of business, business model innovation and technological solutions. There are also differences, e.g. within goals where CE is focused on closing loops, whereas

sustainability is more open-ended. Ghisellini, Cialani and Ulgiati (2016) find that successful CE experiences involve all actors in society and their capacity to link and create suitable collaboration and exchange patterns, but that further work needs to be done on investigating returns on investment in order to motivate companies and investors.

CE in Developing Countries

CE has been promoted by China on the basis of pollution challenges and rapid growth, and as a national top-down political objective (Ghisellini, Cialani and Ulgiati, 2016; Bocken et al., 2017). In Europe, Japan and the Unites States, CE emphasis is on environmental and waste policies, business opportunities and resource efficiency. Implementation of CE strategies on a worldwide level has focused on recycling rather than reuse, with SWM systems in developed countries highlighted for beginning to achieve high recycling rates (Ghisellini, Cialani and Ulgiati, 2016).

In developing countries, Diaz (2017) argues that CE is met with a lack of political will, lack of national policy, absence of rules and regulations, insufficient funds, absence of educational programs and a lack of policies for preserving or creating a CE. However, developing countries typically have been practicing CE principles in SWM through informal recycling, with approximately 10%-15% of residential and commercial waste diverted (Diaz, 2017). As argued by Diaz (2017), CE efforts should include the recyclers in informal waste management processes in a way that protects their health and decent wages. Velis (2017) goes further into the informal sector with respect to CE[33]; the sector's role is seen as an expression of wider social organization, governance and financial activity in developing countries. Velis contends that informal recycling cannot be explained simplistically by 'underdevelopment' or institutional failure – the sector is there to stay, and a lack of support leads to only a small recovered fraction of dry recyclables. CE is seen as emphasizing business models, but also offers opportunities for inclusion or formalization of informal recycling (Velis, 2017). One significant challenge in this respect is to reconcile labor intensiveness with technological innovation. There is also a tension between developing CE product stewardship systems and the informal sector's access and ownership of lucrative waste resources. Beyond recycling activities, there are also CE opportunities for recognizing and working with the informal sector in repair and remanufacturing (Velis, 2017).

Introduction to SWM in Developing Countries: Summary

Within SWM in developing countries, there are opportunities for sustainable solutions, including partnership innovation, if actors can navigate the pitfalls. The

[33] Velis (2017) identifies 20 challenges with respect to waste pickers in an emerging CE landscape in his article – all of which are not summarized in this short passage.

literature particularly highlights opportunities and pitfalls within informal recycling activities. CE has emerged as an interesting subject with propositions for business and technology innovation (e.g. closing, narrowing and slowing resource loops), while SWM developments have emphasized *integrated* and *sustainable* approaches for sustainable SWM. The following Chapter 4.2 will go into further detail with integrated SWM.

4.2. INTEGRATED SUSTAINABLE WASTE MANAGEMENT

Integrated Sustainable Waste Management (ISWM) views waste systems as comprised both of social and technical elements and connected with stakeholders and framework conditions (Guerrero, Maas and Hogland, 2013). ISWM examines both physical components (e.g. collection, disposal, recycling) and governance aspects such as inclusivity of users and service providers, financial sustainability and institutions and policies (Wilson, Velis and Rodic, 2013). ISWM comprises a socio-technical approach emphasizing identification of stakeholders that have an interest in the SWM systems in cities, and the factors that influence the performance of such systems.

ISWM as an analytical model for a waste system prescribes 1) stakeholder mapping, 2) and the stages in the flow of waste from generation to treatment and final disposal. Additionally, it recommends 3) different aspects with which to analyze the system such as the environmental, socio-cultural, legal, institutional and economic aspects, also termed the ‘enabling environment’ or ‘sustainability aspects’ (Guerrero, Maad and Hogland, 2013; Scheinberg and Anschütz, 2006). The ISWM analytical model is illustrated in Figure 13.

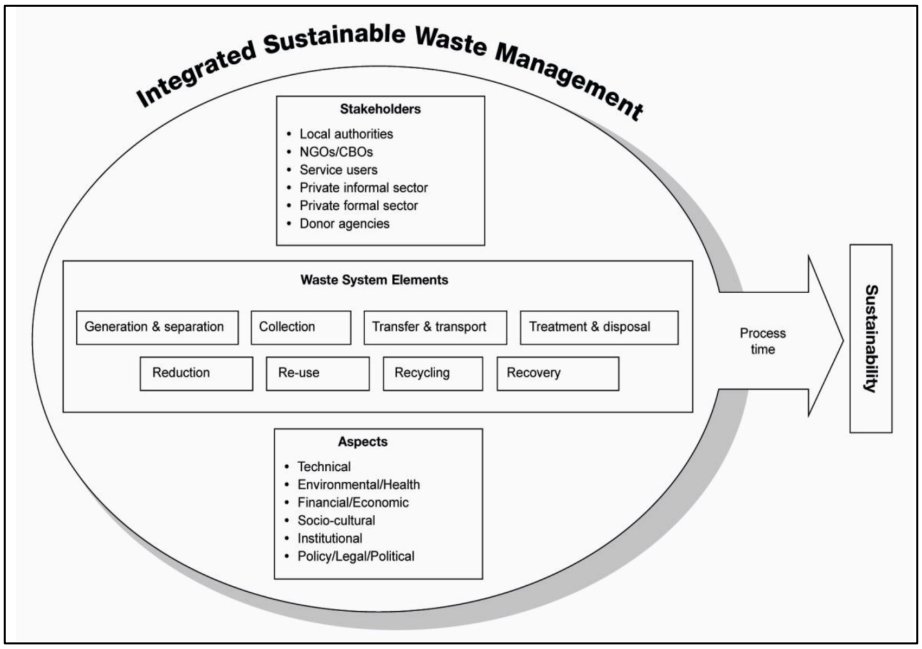


Figure 13 - The Integrated Sustainable Waste Management (ISWM) framework (IJgosse, Anschütz and Scheinberg, 2004)

Along each stage of a waste system in an ISWM analysis (generation and separation, collection, transfer and transport, etc.), the stakeholder actions or behavior are seen in connection with the different aspects of the enabling environment. The development of the model was led by a Netherlands-based consultancy, 'WASTE advisors on urban environment and development' in the 1980's and further developed in the 1990's through a so-called Collaborative Working Group (Anschütz, Ijgosse and Scheinberg, 2004; Guerrero, Maad and Hogland, 2013). ISWM has since its Dutch inception and refinement eventually become adopted in international circles (Scheinberg, Wilson and Rodic, 2010).

Guerrero, Maad and Hogland (2013) have applied an adapted ISWM model to analyzing 30 urban areas in 22 developing countries. In their findings, recognized, 'formal' stakeholders are comprised of local authorities, some central government ministries, private contractors providing services, and users such as households, civil society organizations and businesses. Unrecognized or 'informal' stakeholders carrying out recycling functions include waste pickers (door-to-door, street or disposal site), itinerant waste buyers and junk shop owners and street sweepers. The authors find that while there are a large number of different stakeholders and interests, SWM is often seen only as a responsibility of local authorities. Only in the best of cases are citizens seen as co-responsible together with the municipality. Further, technological solutions such as equipment are prioritized by municipalities, but a

good enabling environment is a prerequisite for a system to function effectively. Expenditure for provision of solid waste services is typically not recovered, and central government financial support as well as municipal leadership interest in SWM is seen as essential, together with user participation and proper administration of funds (Guerrero, Maad and Hogland, 2013). The authors find that actors such as universities, research centers and centers of excellence have a very important role to play.

These recommendations are supported by Wilson, Velis and Rodic (2013) in another ISWM study of 20 reference cities in 6 continents. In their findings, significant improvements have been made in the decade preceding the study; service coverage of waste collection services have reached 45-75% in lower income countries, and basic 50% control of waste disposal achieved in many. 20-30% is typically recycled by the informal sector in this study, and the authors recommend that for a successful SWM system to work, technical elements need to be addressed as well as 'soft' governance aspects, i.e. solutions should be locally anchored, include users, encourage diversification of service providers while affordability of services.

ISWM and Modernized Mixtures

Netherlands-based researchers and practitioners behind the ISWM model link it with (ecological) modernization processes (van Vliet et al., 2013). This strand of the literature uses 'modernized mixtures' to capture dynamics when different kinds of socio-technical systems interact. One focus area has been waste and sanitation in East African cities, and the mixing of Western/local and formal/informal systems (van Vliet et al., 2013). According to Scheinberg et al. (2011), 'modern' does not necessarily mean systems that are large, centralized, high-tech and distanced from consumers. Modernization is not held to have simplistic and negative connotations; 'modernized mixtures' instead refers to (Scheinberg et al., 2011):

"… socio-technical complexes of infrastructures, institutions, and payment systems which combine large-scale, centralized, high-technological, low citizen-consumer participation models, with small-scale, decentralized, less technologically advanced and more participative models."

In the context of improving waste systems of developing countries, the focal point for 'modernized mixtures' is neither Western nor local systems but the development and implementation of intelligent and context-dependent combinations of both Western systems and local practices and arrangements (Tukahirwa et al., 2010). The ISWM model is an analytical framework for waste systems, while the 'modernized mixtures' approach sees the model as a springboard for adaptive and reflexive waste planning and management. Scheinberg et al. (2011) state that modern systems can make use of e.g. innovative institutional arrangements, financial mechanisms, participation, resilient technologies and decentralized structures. Van Vliet et al. (2013) emphasize

that 'modernized mixtures' is built on ideas that allow for various combinations of actors and technologies, depending on local contexts; they claim that it is *not* based on what are termed 'dogmatic frames' such as *Small is Beautiful* (Schumacher, 1973), 'alternative technology' (Dickson, 1974)[34] – on the one hand – or what they term 'neo-developmental movements' on the other hand that place the state at the center stage of economic development and provisioning of urban infrastructure and services. 'Modernized mixtures' is seen as modular and takes into consideration the multiple scales of providing infrastructure and technology, and what are termed 'hybrid governance solutions' (van Vliet et al., 2013). According to Scheinberg et al. (2011), sustainability, resilience and affordability is promoted not by copying the large-scale systems that have dominated in Western societies, but by seeking 'pluralistic' structures based on parallelism and mixtures of providers and technical approaches.

Integrated Sustainable Waste Management: Summary

In summary, ISWM is an analytical model to waste systems that has gained international prominence and involves analysis at the level of 1) stakeholders, 2) waste system elements and 3) sustainability aspects. In this PhD thesis, the ISWM framework is utilized in Chapter 10 (Paper 4). The ISWM analytical model inherently carries a socio-technical understanding of waste systems and is linked with the 'modernized mixtures' approach which seeks to support adaptive and reflexive waste planning and management. In developing countries this is characterized further by solutions that are context-dependent, multi-level and inclusive of combinations of actors and technologies. The ISWM model is thereby helpful in partnership innovation settings facilitated by *access2innovation*. The following chapter 4.3 will go further into partnerships and the role of BoP approaches in respect to ISWM.

4.3. ISWM AND BASE-OF-THE-PYRAMID APPROACHES

The Private Sector in SWM

Private sector role is important in SWM, with opportunities arising from blended financing and effective partnerships with donors, philanthropic organizations and NGO's (Lerpeniere et al., 2014). As argued by Halla and Majani (1999), public authorities have historically had a monopolistic role in delivering basic services in developing countries but have failed to provide them satisfactorily, opening the way for non-state actors to get involved. Tukahirwa et al. (2010) argue that a partnership paradigm has come to the fore, including the involvement of private companies in

[34] *Small is Beautiful* was famous for its critique of Western economics and calls for human-scale, decentralized and appropriate technologies (Prasad, 2002), while 'alternative technology' conceptions by e.g. Dickson similarly called for radical, transformational technologies that were simple (craft-based), had local participatory control, were small-scale and decentralized and ecologically sound (Smith, 2005).

SWM in places as Kampala, Uganda. Some SWM operating budgets for local authorities in developing countries exceed 60% of total budgets, and there is a potential for offsetting this at least partially through private sector involvement (Ahmed and Ali, 2004).

As Lerpeniere et al. (2014) report, the World Bank sees benefits in private sector involvement in SWM in low- and middle-income countries, not only due to capital investment but also specialist expertise and increased competition which is seen as driving down deficiencies. As elaborated by Stutz (2008), multinationals can supply services that complement those provided locally, e.g. truck fleets and construction and operation of large-scale facilities. They can also provide managerial and logistical expertise required to integrate services provided by local businesses. Sensitivity toward existing informal recycling activities (highlighted in Chapter 4.1) remains important and is a potential issue of conflict (Lerpeniere et al, 2014). Experiences with failed integration of informal recyclers in Cairo in the 1990's are cited as an example. Nevertheless, the SWM has been developing modes of operation for engaging civil society that potentially improve services, provide access to investment, protect the environment and communities and generate employment (Lerpeniere et al. 2014).

Involvement of the private sector in SWM typically involves delivery of services and infrastructure through public-private-partnerships (PPP) - often supported by development banks in order to facilitate private sector investment (Lerpeniere et al. 2014). Full privatization is rare but is a possible route and a tendency seen in developing countries (Stutz, 2008). Under privatization, SWM responsibilities, typically handled by national and local governments, are replaced by corporations, but the main challenges for them at the BoP are (Stutz, 2008):

- The typically capital-intensive technologies involved
- The politics of SWM whereby multinationals are often not accepted by the public as sole service providers as they can, for instance, conflict with existing waste-based activities and businesses

In PPP's, public and private entities assume co-responsibility and co-ownership for services, combining perceived advantages of the private sector (dynamism, finance, knowledge of technologies, managerial efficiency, entrepreneurship) with public sector concerns regarding social responsibility, environmental awareness, local knowledge and job creation (Ahmed and Ali, 2004). However, an enabling environment is necessary, and PPP's should entail more than merely co-operation but a shared commitment to pursuing common goals. Additionally, Ahmed and Ali (2004) find that large-scale partnerships between conglomerates and government agencies may find more limited success compared with vertical integration between the public sector and small-scale operators. Incentives need to be in place for both

parties in a PPP to work, and barriers remain as regards structural, financial and legal frameworks. For a PPP to succeed, transparency, fairness and accountability is needed, and PPP's need to be dynamic and adaptable to new conditions. Ahmed and Ali (2004) point to the need for a 'facilitating agency', without conflicts of interests, to nurture subsidies.

Stutz (2008) proposes a similar framework to the PPP approach, but is based on a hybrid BoP model of privatization that relies on contracting with small, local entities. In his proposed framework, a sustainable alternative to full privatization involves an inclusive process which begins with the community to be served. Here is it first identified what can be provided locally in terms of e.g. local businesses and existing recycling stations, which then leads to identification of services to be provided. The dimensions that are important in this respect according to Stutz (2008) include the *social* aspect (high level of local support is necessary), the *economic* aspect (reliance on locally owned businesses strengthens the local economy), the *environmental* aspect (emphasis on intensive recycling and composting) and the *technological* aspect (emphasis on low-tech techniques that draw on local skills).

The process is envisioned as being led by a multinational company with an independent advisory committee representing the local community. Integrating existing SWM service providers into the overall plan is important because it addresses one of the major shortcomings of multinationals at the BoP (Stutz, 2008). The key challenge within BoP-thinking is how to successfully partner to tap the market, which requires a broad set of participants and new and creative approaches such as with PPP. Stutz (2008) only proposes this model, as BoP thinking in SWM has remained a concept rather than a proven approach, with the author not aware of any instances in which local government, businesses and the community, NGO's and multinationals have come together.

Base-of-the-Pyramid Approaches

The role of partnerships and the private sector prompts examination of BoP experiences within SWM. According to Seelos and Mair (2007), BoP (detailed in Chapter 2.2.) involves acquiring and building resources and capabilities and forging partnerships, and for e.g. multinationals to rethink their business models. Seelos and Mair find that preceding literature lacks depth in how these elements should be managed and assembled to create value, and investigate two case studies through a strategic BoP partnership lens. Both case studies involve partnerships, and one case study falls within SWM, involving a company called Waste Concern in Bangladesh, and another locally-based company called Map Agro.

In Dhaka where Waste Concern operates, 4,000 tons of waste is produced daily but the private sector had hitherto failed to see how waste could be used for economic gains without significant investment and sophisticated technology (Seelos and Mair,

2007). While the Dhaka City Council believed that centrally managed processes were how to best deal with the problem, less than 40% of waste was being collected. Waste Concern was founded in 1994 by two entrepreneurs, who saw an opportunity and believed that waste could be utilized as a resource profitably, in a decentralized manner, and without significant investment or sophisticated technology. The company was set up based on the idea of leveraging the high organic content in food waste and selling a fertilizer substitute based on it. Its strategic objectives were job creation and supporting a clean environment. Waste Concern began by setting up a demonstration project which included community-based house-to-house waste collection services, and then it composted the waste. For marketing the resulting product as fertilizer, Waste Concern approached Map Agro, which was the largest fertilizer company in Bangladesh. Although initially disinterested in a partnership, Map Agro eventually supported Waste Concern by investing in a purpose-built composting facility. The final product was then distributed through Map Agro's existing dealer network, creating what Waste Concern calls an 'urban/rural symbiosis' as urban waste in their business model becomes utilized in rural agriculture. Job creation at community level has been supported for rural farmers, and Waste Concern's success led to being able to access financing from international organizations. Additionally, revenue was secured through so-called Clean Development Mechanism (CDM) registration in partnership with a Dutch company, connected with the joint development of a landfill gas recovery site.

Seelos and Mair (2007) characterize the Waste Concern and Map Agro partnership as both a BoP business model and an example of 'social entrepreneurship' (similar to the social business approach in Chapter 2.3). In their analysis of the case study, the partnership leveraged existing company capabilities and was able to implement multiple strategies aimed at different income levels. The partnership was able to address a knowledge gap about what is required in managing the complexities in partnerships at the BoP, where the preceding literature had identified a substantial failure rate (Seelos and Mair, 2007). The business model of the Waste Concern and Map Agro partnership is illustrated in Figure 14.

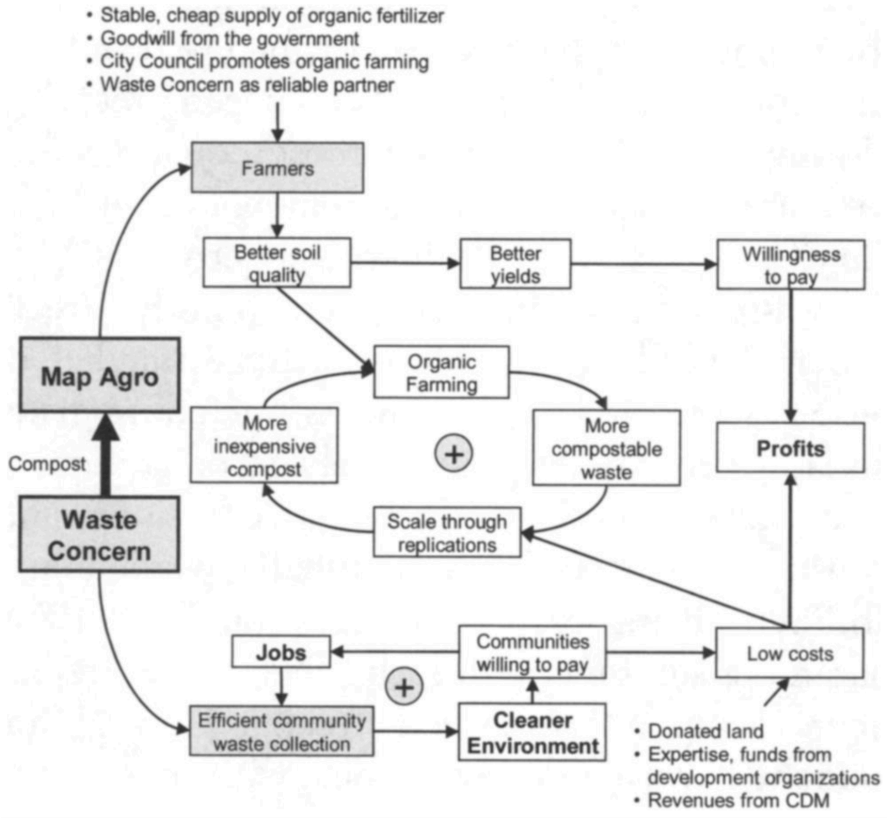


Figure 14 – The Waste Concern-Map Agro business model (Seelos and Mair, 2007).

Another approach to BoP business in SWM is detailed by Villela et al. (2008), involving cooperative self-organization and glass recycling in Brasília, Brazil. In this pilot project, the aim was to build capacity for employment and income generation based on partnerships in solidarity networks. As reported by the authors, simple and feasible ways of processing glass waste can add value to it when transformed to e.g. bathroom and kitchen tiles to be sold at 'top-of-the-pyramid' markets in the country (Villelas et al, 2008). The pilot project in this study showed that it is possible to set up decentralized, bottom-up BoP initiatives with a little institutional support toward training informal sector waste collectors, with potentials for empowering the community in the process.

Villela et al. (2008) argue that local communities possess greater creative capacity than capital-intensive solutions, despite their reliance on being labor-intensive. They are better poised to address today's 'buy-and-throw-away' society through recycling and socially inclusive technologies. Accordingly, free-market mechanisms and public policy are insufficient to reduce waste, inequalities and poverty. Coordinated interests

among communities in solidarity networks are instead an innovative strategy that promotes sustainability and is 'anti-hegemonic' toward globalized society. Instead of BoP as 'inclusive capitalism', what is proposed is an 'eco-capitalist' alternative (Villela et al., 2008). Self-organized communities are able to find solutions based on locally available resources and develop innovative products and services through participatory planning processes. The authors refer to this as a form of 'social innovation', where individuals at the BoP become entrepreneurs instead of passive consumers. The role of government is suggested to be to either financially support to such bottom-up initiatives, or otherwise support them through policy and PPP's.

In Brazil, entrepreneurial waste collection cooperatives operate as part of an informal network without institutional support yet are still able to carry out recycling and reuse activities. By incorporating the informal sector in SWM, collectors are argued to be able to improve quality, efficiency and frequency of collection services. Street dwellers have increased from 150,000 in 1999 to 600,000 in 2006 (Villela et al., 2008). However, waste collectors at the bottom tier become excluded as recycling production chains in Brazil become more technology and capital-intensive, and waste becomes privatized. Additionally, the public sector continues to prefer sanitary companies instead of cooperatives for waste collection services. These findings are more nuanced in Rebehy et al. (2017), who report that the SWM system in Brazil 'joins' informal and formal actors, but that institutional arrangements vary depending on waste characteristics, location, qualifications, cost, availability of labor resources and technological appropriateness. The legislative framework in Brazil for national SWM policy is fairly new and only put in place in 2007 and 2010 (Rebehy et al., 2017), but the authors agree that in the Brazilian context, socially driven investments can support hybrid structures within SWM such as a social business, which engages with BoP as a consumer market or as one of the links in the production chain. In the design of sustainable business models, Rebehy et al. (2017) place emphasis on identifying agents and including the BoP and meet the challenge of mediating conflicts of interest between them. For this, the authors propose an inclusive and decentralized institutional arrangement to foster cooperation between agents (actors), e.g. supported by contracts.

4.4. CHAPTER SUMMARY

SWM in developing countries was introduced in this chapter in order to provide context to the case studies in Uganda and Vietnam that are part of this PhD thesis. Covering the historical development of SWM as a field showed its complexities and multidisciplinary nature. It additionally showed the unique SWM challenges faced by developing countries and some of the fallacies about any assumptions of simply modeling solutions based on implemented technologies in developed countries.

The SWM challenges and opportunities in developing countries were covered in further detail, in particular highlighting the importance of informal recycling in waste systems and the need to remain sensitive toward the informal sector in any holistic SWM effort. This was underpinned when looking closely at the 'circular economy' concept and its implications for developing countries, where there are opportunities for reconciling technological innovation with labor-intensiveness.

A portion of the chapter was then dedicated to explaining the ISWM model for analyzing waste systems, involving the mapping of 1) stakeholders, 2) waste system elements and 3) framework conditions that can be referred to as 'sustainability aspects'. The ISWM model is an analytical framework widely accepted in international circles and is based on a socio-technical understanding of waste systems. ISWM's theoretical underpinnings are the sociological 'modernized mixtures' perspective that places emphasis on reflexive and adaptive waste planning and management as well as solutions that are context-dependent and make use of varying technologies and actors as locally appropriate.

'Modernized mixtures' encourages partnership innovation settings as facilitated by *access2innovation*, and propositions and experiences involving the private sector in SWM were covered. At a general level, the private sector and partnerships can play an important role in SWM in developing countries. Different modes of operation were shown, including full privatization (rare), PPP's (promising but possibly requiring facilitation) and a BoP approach similar to privatization but which integrates small businesses and communities into the business model (unproven).

At a specific level, the chapter ended by exemplifying two kinds of BoP (and partnership) experiences uncovered in the literature. The first was located in Bangladesh and involved the partnership and business model of Waste Concern and Map Agro, which was based on composting the organic fraction of urban waste for selling as a chemical fertilizer alternative to rural markets. This constituted a BoP example based on local companies in Bangladesh. The second example was a pilot project located in Brazil which involved a bottom-up and self-organized cooperative that recycled glass waste for bathroom/kitchen tiles. This constituted another kind of BoP approach that is 'bottom-up' and driven by the informal sector itself.

With the context for the PhD thesis established (inclusive innovation and technologies in Chapter 2, the *access2innovation* initiative in Chapter 3 and finally ISWM in developing countries in Chapter 4), the next part of the PhD thesis will focus on the Research Design.

PART II – RESEARCH DESIGN

This part consists of:

- *Chapter 5: Aims and Research Questions*
- *Chapter 6: Theories of Science and Methodology*

The purpose of Part II is to present the scientific basis for the PhD thesis, elaborating upon the aims and research questions of the thesis, the theories of science behind the research and the utilized methodologies. Finally, the theoretical considerations of the thesis are presented.

Chapter 5 makes use of the preceding Chapters 2, 3 and 4 detailing inclusive innovation and sustainable technologies, the *access2innovation* initiative and SWM in developing countries, respectively, to articulate the PhD thesis' main research question and related sub-questions.

Chapter 6 goes into the ontology and epistemology of the thesis, commonly referred to as 'theories of science'. This relates to the utilized methodologies, in particular SCOT and the Constructive Technology Assessment (CTA) conceptual frameworks that is central to the 'bridging' aspect in facilitation of *access2innovation*'s partnership innovation processes. **Paper 1** is inserted into this chapter.

CHAPTER 5. AIMS AND RESEARCH QUESTIONS

Facilitation and management of collaborative exchanges between different partners, also termed 'bridging', is the focus of this PhD thesis. Previous *access2innovation* research emphasizes bridging as a foundation for partnership innovation, i.e. joining knowledge, practices, competencies and networks across organizational domains (Ravn, 2012; Ravn, 2015). Previous research has also emphasized the processes by which commercial actors, i.e. companies, attempt to develop solutions under conditions of uncertainty (Butler, 2017). These are areas of public policy interest, seen for instance in the rationales behind the Danida Market Development Partnerships instrument (Ministry of Foreign Affairs of Denmark, 2016).

In *access2innovation* the research interest has predominantly been questions about managing a network with different subsets of actors and on successful business modelling (Ravn, 2012; Ravn, 2015), and on business-centered navigation processes under conditions of uncertainty (Butler, 2017). Actors within the network collaborate in partnerships (i.e. actors within civil society, business, academia and the public sector as illustrated via the quad helix framework in Chapter 3). These main areas of interest reflect a preoccupation with the *managerial* and *entrepreneurial* aspects of partnership innovation. In Ravn (2012), the focus was on how to build, develop and implement a commercial, cross-institutional network between NGO's, researchers and companies, whereas in Butler (2017) the focus was how companies create solutions in developing countries through network-relations building in conjunction with firm-development activities (exploring, blueprinting, validating, preparing and scaling). Several sub-questions guided Ravn's research focus, as follows (Ravn, 2012): What is the basis and what are the ground rules for innovation in networks? What are the prerequisites for connecting knowledge between different actors in innovative networks? How is a network to be organized? How can network-based collaboration be facilitated? What characterizes the innovation processes in a network collaboration? Which potentials and barriers do commercial partnerships hold between NGO's, researchers and companies? In the company-centric research focus in Butler (2017) the sub-questions included: How do actors make sense of the opportunities? How do actors enrol other actors as part of developing solutions?

Based on action research case studies during the *Access2innovation 1.0* period 2007-2011, Ravn (2012) arrives at conclusions to these sub-questions mainly through innovation management, network theory and business modelling lenses. For instance, Ravn finds that network-based business modelling is a highly iterative process in practice, that organizing a network requires e.g. goal alignment and different resources among partners in the network, and that access to various resources and knowledge are crucial to an individual partnership's main entrepreneur at various

stages of a business model innovation process (Ravn, 2012). This again reflects that the main preoccupation with *access2innovation* research has been the network itself, and the factors that support commercial sustainability in partnership innovation. In Butler (2017) the main preoccupation is how companies navigate under conditions of uncertainty and on understanding these processes. Through process theories of sense-making and enrolment, Butler (2017) finds that such processes are based on learning, adding and subtracting actors over time and interacting with certain actors as part of e.g. learning, experimentation and validation with the aid of concepts such as 'blankness'[35].

The aims of the research in this PhD thesis tie in more closely with questions of *inclusivity* and *sustainability* (elaborated in Chapter 2 with regards to market-based solutions in developing countries), and the social factors that 'shape' or influence the design and use of *technology*. As explained in Chapter 1, the concept of bridging can also relate to addressing differences of understanding between the global 'North' and 'South' in partnerships (Bietmann et al., 2007) in which inclusive and sustainable outcomes are tricky to facilitate. So far this has not been central to research or practice in *access2innovation*; Chapter 3 elaborates on why a holistic sustainability understanding and inclusivity interest was a minority view held up against the overriding business logic within the *access2innovation* secretariat. Nevertheless, as member of the secretariat and a researcher working under the premise of the *access2innovation* set-up, I have based my research approach with this sustainability and inclusivity interest. Altogether this explains the rationale for the overall aims of the research:

- To address knowledge gaps regarding sustainability in BoP business modeling, technology transfer[36] and capacity development identified by Ravn (2012), also referred to as 'bottom-up BoP'.

- To highlight considerations toward inclusivity in partnership innovation processes across cultures and geographical contexts, i.e. social equity and participation in various forms, seen from an empathetic position with regards the 'Southern' (developing country) perspective.

- To inform partnership innovation processes through a socio-technical understanding as complementary to managerial and entrepreneurial-focused research interests.

[35] As explained by Butler (2017) 'blankness' is a concept that refers to an object or actor that other actors can inscribe attributes to.

[36] As argued in **Paper 1**, 'technology transfer' can often indicate a unidirectional and thereby limited framing of partnership innovation processes.

As presented in Chapter 1 the overall research question is based upon a socio-technical standpoint originating from the STS and SCOT tradition (further developed in Chapter 6), and is reiterated below:

How is technology socially constructed in partnership innovation for developing countries? How can inclusive and sustainable innovation in developing countries be co-constructed?

The papers included in the thesis touch upon the research question in various ways. A number of sub-questions have also guided the research process and connect more specifically with the papers:

- Sub-question 1: What interests influence how technology is constructed? How do the interests come into play?
- Sub-question 2: How are inclusivity and sustainability framed and addressed?
- Sub-question 3: How do socio-technical systems in developing countries influence the way that solutions can be co-constructed?
- Sub-question 4: How can a proactive intake of knowledge be supported?
- Sub-question 5: What are possibilities and challenges in bridging across multiple organizational domains?

The sub-questions individually emphasize different aspects of partnership innovation: The first two sub-questions are interlinked and deal with the interests and shaping of technology seen from within a partnership (**Papers 2** and **3** dealing with the Vietnam case study address this directly). The third sub-question relates to external, or contextual socio-technical factors that influence possible solutions (**Paper 4** dealing with the Uganda case study best addresses this question). Finally, the last two sub-questions are also interlinked, and deal with bridging and being proactive from a partnership facilitation perspective (**Paper 1** dealing with Constructive Technology Assessment addresses this).

How the preceding chapters (Chapters 2, 3 and 4) connect to the overall research question and sub-questions is illustrated in Figure 15. The preceding chapters provide *contextual positioning* (*thematic*, *project* and *professional* positioning) for the research aims and research questions, which is elaborated in the following.

5.1. CONTEXTUAL POSITIONING

The way that the aims, overall research question and sub-questions are framed make them applicable most partnership innovation settings. Contextual positioning assists with sharpening focus in the research.

Thematic Positioning: Inclusive Innovation and Sustainable Technologies (Chapter 2)

This positioning links directly with Chapter 2. The literature review on inclusive and sustainable innovation and technology specifies these themes in relation to business in developing countries. Two contrasting but possibly complementary approaches are represented in the BoP and social business literature. Of the two, *access2innovation* has contributed to developing BoP practice in particular, which increasingly emphasizes sustainability, partnership and ecosystems frameworks. Inclusivity – the social dimension of sustainability – as *empowerment-seeking co-creation*, i.e. sharing decision-making processes with local communities, is rarely a normative objective in the BoP literature; promoting inclusivity to this extent remains a proposition, and the more widely held understanding of inclusive markets merely calls for social impact such as the improvement of welfare in poor communities, or user-involvement in innovation processes.

The *sustainable business innovation* framework, developed by the Network for Business Sustainability, provides a useful tool for discussing inclusivity, sustainability and the role of technology in business and partnership case studies. The framework helps to unpack these themes through its different dimensions (the firm's *innovation focus*, its *relation to society* and the *extent to which innovation extends across the firm*). Each dimension is seen as a continuum, and is used in the chapter as an analytical framework for a number of Danish case studies concerning BoP venturing. Altogether, these case studies show that among Danish multinationals enterprises, SME's and a single 'conventional' business there have been attempts at BoP 3.0 or systems-building strategies, but none have fully achieved them.

In summary, Chapter 2 positions the overall aims and research questions of the thesis within thematic discussions about inclusivity and sustainability in business development in developing countries. The BoP and social business literature form the main general body of literature for discussing the themes, whereas a more specific vocabulary is provided in the *sustainable business innovation* framework. Danish case studies within BoP venturing guide the research process by showing that BoP 3.0 and full inclusivity propositions have yet to be realized.

Project Positioning: Access2innovation (Chapter 3)

This positioning links directly with Chapter 3. Presenting *access2innovation*'s background, history and triple/quad helix collaboration framework anchors the research process within this initiative. *Access2innovation* has facilitated partnership innovation projects in development cooperation and humanitarian settings. It has been gradually expanding and developing the scope of its activities, geographically and thematically, to become a membership-based organization and 'commercial foundation' in a Danish legal sense. The secretariat consists of personnel from

different disciplines capable of acting as 'bridge builders' in partnership innovation settings.

Sustainability considerations have been part of *access2innovation*'s objectives for partnership innovation 2011-2014 with emphasis on commercially sustainable business models, choice of environmentally sustainable technologies and on social impact. Addressing businesses, this was framed differently by the secretariat and reduced to fulfilling both charitable and commercial objectives. With respect to social sustainability, equitable partnerships and social inclusion have not characterized activities in practice. The secretariat's daily workings and partnership innovation methods have relied on business modeling terminology, and sustainability and inclusion were minor points of interest held up against the business logic in the *access2innovation* secretariat.

Case studies of the *access2innovation* projects in the 2011-2014 period (One Stop. Pay E-Safe, Remergy and the Danish Cleantech Group) using the *sustainable business innovation* framework show that there have been promising signs with regards to BoP 3.0 strategies. Challenges within and external to a partnership innovation process have led to the failed case of chili farming, however.

In summary, Chapter 3 positions the overall aims and research questions within *access2innovation* as a promising BoP 3.0 initiative that has been successful in supporting partnership innovation activities in developing countries, though yet has to fully address and integrate sustainability and inclusivity considerations.

Professional Positioning: Solid Waste Management in Developing Countries (Chapter 4)

This positioning links directly with Chapter 4. Because the central case studies to the thesis deal with the SWM field, a 'professional' focus (relating to a profession or discipline) was needed to inform the research process. The literature review on SWM and developing countries shows the increasing complexity and interdisciplinarity nature of SWM, with concepts such as the circular economy having become topical internationally. It is further established that in developing country settings, there are particularities with respect to the interplay between formal and informal SWM system elements.

The ISWM framework was introduced both as an analytical approach to studying waste systems, covering analysis at three levels: *stakeholders*, *waste system elements* and *sustainability aspects*. The framework is tied with the 'modernized mixtures' approach, which sees ISWM analysis as a springboard to reflexive and adaptive SWM planning and management, context dependent solutions and use of varying actors and technologies – in other words, an approach that encourages partnership innovation solutions that are sustainable and inclusive.

Some examples of BoP venturing within SWM in Bangladesh and Brazil, respectively, show that there is room for partnerships and innovation with respect to the private sector operating parts of SWM systems in developing countries. Each of the case studies represent their own approach within a BoP framing – the Bangladesh case with more emphasis on scale and complexity in partnerships, and the Brazilian case with emphasis on the informal sector and bottom-up organizing of recycling activities.

In summary, Chapter 4 provides deeper understanding of SWM, including within sustainability and inclusivity issues vis-á-vis privatization and the formal/informal sector. It provides an analytical lens and theoretical perspective on solutions-building, and presents examples of BoP venturing within SWM in practice.

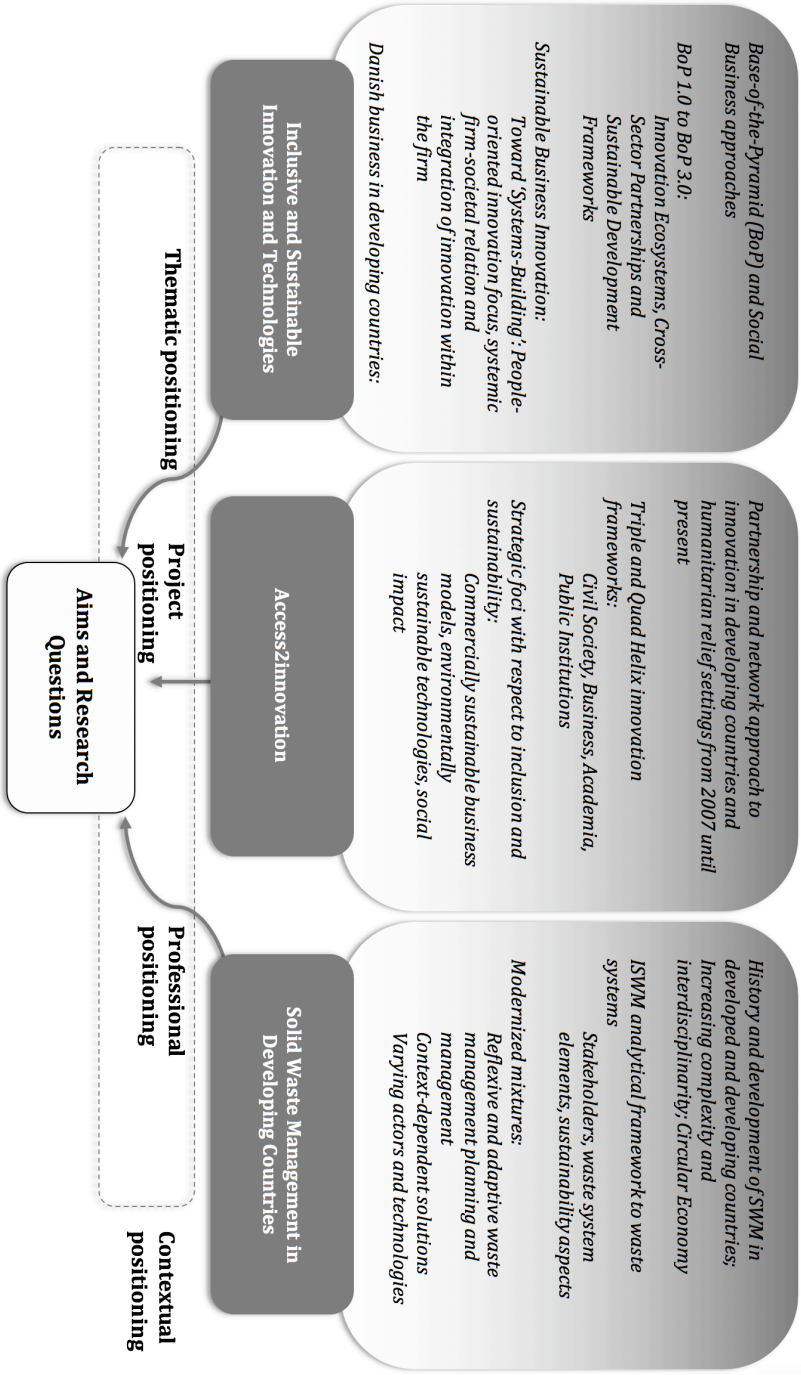


Figure 15 - Contextual positioning of the Aims and Research Questions of the thesis.

5.2. CHAPTER SUMMARY

In this chapter, the aims of the research were stated, based on considerations with respect to previous *access2innovation* research, the concept of *bridging* as explained in Chapter 1, the concepts of *inclusivity* and *sustainability* as elaborated in Chapter 2, and the framing of the two latter concepts within the *access2innovation* secretariat detailed in Chapter 3. The main research question was presented, as well as sub-questions for guiding the research, each of which are connected to the different papers included in the thesis in different ways. A contextual positioning then clarified the research focus with respect to partnership innovation, consisting of three elements: Thematic positioning with emphasis on sustainable innovation and technology (Chapter 2), project positioning with emphasis on the inner workings of the *access2innovation* secretariat (Chapter 3) and professional positioning, referring to the SWM field especially as it related to developing countries (Chapter 4). In the following chapter, the 2nd part of the Research Design is developed further, i.e. theories of science end methodology (including methods).

CHAPTER 6. THEORIES OF SCIENCE AND METHODOLOGY

The theories of science of the PhD thesis are elaborated in this chapter, based upon social constructivism. First, an explanation is provided for why social constructivism has been chosen as the philosophical foundation. This is then followed up by a presentation of how this position and the research views reality (ontology) and what can be known about reality (epistemology).

The methodology applied in the research is then elaborated i.e. Social Construction of Technology and Constructive Technology Assessment (CTA), which is the focal point of **Paper 1** that is inserted into the chapter. Afterward the use of case studies and the related empirical data gathering methods are explained.

6.1. WHY SOCIAL CONSTRUCTIVISM

Social constructivism is the theory of science[37] underlying the thesis. The relationship between social constructivism and the thesis shows how the research question is framed: *Technology* is literally understood as *socially constructed*. The research question places technology as a central outcome in developing country partnerships, and the way technology comes into being is seen as a result of some form of construction, which involves a social process. This may be stating the obvious. However, this underlines that the research question and social constructivism are intertwined. Social constructivism directly informs the research question by providing operational language with embedded ontological and epistemological claims (elaborated in the next section, Chapter 6.2).

The social constructivist basis refers back to the phrase coined by Peter L. Berger and Thomas Luckmann in *The Social Construction of Reality* in 1966. This treatise drew inspiration from a number of classic social theorists including Marx, Durkheim, Weber, Mead, Simmel and Schütz (Lynch, 2016). The Austrian philosopher and social phenomenologist Alfred Schütz's (1899-1959) conception of the *sociology of knowledge*, as well as the French sociologist Émile Durkheim's conception of *institution* were essential. In the dissertation it was investigated how subjective meaning turns into social fact, the idea being that actors (individuals or groups) interactively construct mental representations of each other's actions over time, which become part of reciprocal, habitual actions which can become institutionalized in society (Berger and Luckmann, 2011). Through interactive knowledge production, meaning and conceptions about reality becomes institutionalized, thus making reality

[37] Alternatively, a *philosophy* of science.

socially constructed. Since reality is perceived as socially constructed, Berger and Luckmann call for the sociology of knowledge to analyze such processes.

There is, however, plenty of distance between Berger and Luckmann's grand ideas about the sociology of knowledge and this thesis' inquiry into the social construction of technology in partnerships. For the purpose of this thesis' more particular inquiry, the literature about social construction of technology (SCOT) is useful. As introduced in Chapter 1.3, SCOT is a tradition based on a social constructivist standpoint (Bijker, Hughes and Pinch, 1987), but it differs by placing importance upon the *material*. Bijker and Finch (2012) offer a SCOT-founded critique of the grand notions in social constructivism by underlining the importance of investigating the *material*, and not only *representations* of actions, etc. over time:

"... approaches that deal with representation - such as social constructivism – are in some ways inadequate or limited because they do not deal with the material stuff of the world in its own right. According to this view, looking at the meanings given to technological artifacts is to focus too much on humans and how humans conceive of or interpret technology."

(Bijker and Finch, 2012)

Thus, social constructivism is underpinned through shared operational language in the main research question and the shared view that mental representations, interactively co-constructed among actors, shape what is perceived as reality. SCOT places importance on technology and the material in its own right. Similar, Ravn (2012) claims heritage to social constructivism having guided research inquiry during the *Access2innovation 1.0* period 2007-2011. Here the interest was in the business modeling perspective and how to make a cross-institutional set-up to bridge organization domains in innovation between NGO's, researchers and businesses.

6.2. ONTOLOGY AND EPISTEMOLOGY IN SOCIAL CONSTRUCTIVISM

Choosing social constructivism necessitates elaborating upon the ontological and epistemological basis and what this implies for the research. To define these central terms (Crotty, 1998; Burr, 2015):

- *Ontology* is the way that the theory of science views reality, i.e. the study of being and existence in the world, in other words the concern with *what is* with the nature of existence and the structure of reality.

- *Epistemology* is the study of the nature of knowledge and the methods of obtaining it and understanding the world of things, in other words understanding *what it means to know*.

Guba and Lincoln (1989) discuss social constructivist ontology and epistemology in their work *Fourth Generation Evaluation,* which was seminal in proposing a constructivist evaluation practice, in which evaluator and stakeholders create the product of the evaluation through mutual interaction. This is the basis of Constructive Technology Assessment (CTA) further described as a methodology in **Paper 1**.

Guba and Lincoln (1989) contrast social constructivist ontology with 'naïve' and 'critical' realist positions. According to them, the conventional paradigm asserts that an objective reality exists irrespective of the interest that an inquirer might have (Guba and Lincoln, 1989). 'Naïve' realism holds that disciplined inquiry can eventually converge on it, while critical realism holds that this is usually impossible (it can only be approximated), though both realist perspectives fundamentally rest on a belief in a substantial reality that exists 'out there' (Guba and Lincoln, 1989). In contrast, a constructivist position implies a relativist ontology, which holds that multiple, socially constructed realities exist that are ungoverned by natural laws. As they explain further:

"… constructions are devised by individuals as they attempt to make sense of their experiences, which… are always interactive *in nature. Phenomena are defined depending on the kind and amount of prior knowledge and the level of sophistication that the constructor brings to the task. Constructions can be and usually are shared, ranging all the way from constructions about subatomic particles to those about cultural mores. That does not make them any more* real*, but simply more commonly* assented *to."*

(Guba and Lincoln, 1989)

With respect to *ontology*, a social constructivist standpoint is thus skeptical about scientific claims about reality and emphasizes the plurality of views, where interactions and assent determine perceptions about *what is*. The term "truth" in is seen to have a problematic nature (Guba and Lincoln, 1989) and is defined as *"that most informed and sophisticated construction on which there is consensus among individuals most competent (not necessarily most powerful) to form such a construction."* Guba and Lincoln (1989) further state that it is dubious whether the social constructivist position requires a term like truth. Multiple constructions can co-exist which all are able to fit the criterion of having been brought about in an 'informed' and 'sophisticated' manner (Guba and Lincoln, 1989). Constructions are always open to alteration, and while constructions about "truth" can become increasingly harder to challenge, a disruptive insight may overthrow them should such a thing come to light.

With respect to *epistemology*, Guba and Lincoln (1989) explain that from a realist perspective, an 'objective' distance is appropriate when studying reality as subjectivity can distort what one can learn about reality. In contrast, a social

constructivist position views reality as a series of cognitive constructions in which subjectivity does not make sense (Guba and Lincoln, 1989). Subjectivity is embraced as a premise for learning about reality; a separation between the inquirer and what is being investigated is seen as impossible, and it is through *interaction* that data emerges from the inquiry (Guba and Lincoln, 1989). As a result, they go as far as to state that *"... the constructivist position effectively eliminates the ontology-epistemology distinction."* (Guba and Lincoln, 1989), which may seem surprising or controversial from a scientific standpoint.

As mentioned in Chapter 6.1, the SCOT tradition is based on social constructivism and is ancillary in the focus on technology co-construction. Adherents of SCOT write similarly to Guba and Lincoln (1989) about SCOT's ontological and epistemological claims, e.g. Bijker and Pincher (2012) who write, *"SCOT recommends ontological agnosticism. This does not mean that SCOT denies there is stuff in the world any more than methodological relativism denies that scientists can reach "truth" over their scientific claims."* In other words, SCOT is not concerned by the actual ontological questions about reality. Bijker and Pincher (2012) write further, *"... for the purpose of our studies we do not bracket epistemological claims… we do not assume that there is some sort of epistemological criterion that will provide the royal road to scientific truth during a scientific controversy. In our investigations we act as if both sides of the controversy had truth on their side."* Here, there is an emphasis on flexibility in the understanding of epistemology, as opposed to a more deterministic path of inquiry to arrive at a "truth". Truth claims are recognized as contested, and a scientific inquiry ought to be able to see and handle multiple perspectives to the "truth".

In summary, the theory of science underlying this thesis rests on social constructivist and SCOT-founded claims on ontology and epistemology. The most recurring themes include reality as a plurality of constructs and the skepticism toward the notion of an objective reality. It is inappropriate to disentangle the inquirer from the object of inquiry, where interactions instead form the most appropriate basis for generating empirical data.

6.3. METHODOLOGY: SOCIAL CONSTRUCTION OF TECHNOLOGY

While social constructivism underpins the PhD thesis with propositions augmented by SCOT, SCOT itself also works as a *methodology* that the thesis utilizes, interwoven with the use of Technology Assessment (TA) and CTA in particular. SCOT is elaborated in this chapter as a lead-up to **Paper 1** inserted in Chapter 6.4. In general, the question of methodology is usually the third question after the ontological and epistemological questions in a scientific inquiry (Guba and Lincoln, 1989), and has to do with the *"strategy, plan of action, process or design lying behind the choice of particular methods and linking the choice and use of methods to the desired outcomes."* (Crotty, 1998). So, while not as specific as *methods*, which Crotty (1998)

explains as *"techniques or procedures used to gather and analyse data related to some research question or hypothesis."*, *methodology* guides the research in a more prescriptive manner, while still being strategic. To elaborate on what this means for SCOT, further details about this perspective is provided below than otherwise introduced in Chapter 1.3, Chapter 6.1 and Chapter 6.2 where SCOT has been mentioned.

Kline and Pinch (1999) describe SCOT as having been developed by Trevor Pinch and Wiebe Bijker in the 1980's as a branch of Science and Technology Studies (the late 1980's to pinpoint specifically with the 1987 publication: *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* with Pinch and Bijker among the editors). In SCOT, the preoccupation is with users as agents of technological change, where the concept of 'relevant social groups' is central, i.e. users and others that play a role in the development of a technological artifact (Kline and Pinch, 1999).

SCOT emphasizes the 'interpretative flexibility' of an artifact, which involves recognizing that that social groups attribute different meanings to the same technological artifact, where 'stabilization' may occur when a technological artifact appears to have fewer problems and becomes the increasingly dominant form (Kline and Pinch, 1999). SCOT analyses are *socio-technical* analyses (Lindegaard, 2009). Through concepts such as 'relevant social groups', SCOT enables analysis of different interlinked social and technical relations that both are at play in the development of new technologies, but also of existing technologies and products (Lindegaard, 2009; Bijker, Hughes and Pinch, 1989). Being attentive to social structure and power relationships within which technological development takes place is important, and has sometimes been a weak point in SCOT[38] (Kilne and Pinch, 1999).

Kline and Pinch (1999) also see it as important to consider how identities of social groups are reconstituted in the process of technology development, attributing agency to technological artifacts. In this respect, an offshoot of SCOT that is *not* applied in this thesis is Actor-Network Theory (ANT) which expands upon this viewpoint; technological development processes in ANT are seen through a lens of 'actor networks', i.e. heterogeneous networks of entities consisting of both human and nonhuman actors under the principle of 'generalized symmetry', to explain technology development (Brey, 2003; Latour, 2005). The reason for not using ANT is because ANT involves looking at phenomena entirely through actor-networks, their interconnections and use of derived terms – such as 'boundary objects' (Star and Griesemer, 1989) and 'translation' processes (Callon, 2007). This would have been problematic to incorporate with the chosen SCOT and CTA-based research

[38] This is alleviated in this thesis as a result of the research aims and sub-question interest in *inclusivity* in partnership innovation (see Chapter 5) leaning especially on Nahi's (2016) conceptualization of co-creation processes at the BoP (see Chapter 2.2).

methodology because a combination is seen as unwieldy. The focus is bridging across organizational domains in partnership innovation[39], which has a more human-centered preoccupation than what ANT's principle of generalized symmetry embodies.

The main methodological conceptions in SCOT utilized are those of 'relevant social groups' (actors involved in partnership innovation settings), 'interpretative flexibility' (recognition of plurality of views among actors) and 'stabilization' (processes of e.g. contestation and negotiation of technologies over time), as well as SCOT's fundamental *socio-technical* underpinning. With respect to understanding of 'co-construction' of technology, Brey (2003) notes that SCOT can be seen apart from social constructivism in an extreme sense since SCOT does not go as far as seeing technologies as purely mental constructions where technological characteristics are merely the outcome of social interactions. SCOT *does* recognize inherent characteristics of technologies, where Brey makes a distinction between 'weak' and 'strong' social constructivism as elaborated in the following:

"The social-shaping thesis implies a weak constructivist claim that technological configurations are variable and strongly conditioned by social factors. Social constructivist approaches go beyond this claim to arrive at the strong constructivist claim that technological change can be entirely analyzed as the result of processes of social negotiation and interpretation, and that the properties of technologies are not objective, but are effectively read into the technologies by social groups. Social constructivism is hence a contemporary form of idealism, denying the possibility or desirability of a reference to any "real" structures or forces beyond the representations of social groups. Whether a certain technology works or is efficient or user-friendly, and the nature of its functions, powers, and effects is not a pregiven, but the outcome of social processes of negotiation and interpretation."

(Brey, 2003)

With respect to the partnership innovation processes in *access2innovation* in which technology co-construction is analyzed, Figure 16 explains how innovation was generally understood within the secretariat. The process is illustrated as a linear model, though 'spaghetti-like' and iterative in practice (Ravn, 2012). Nonetheless, it is useful in specifying how SCOT may be applied in the research; **Paper 2** (Vietnam, early-stage partnership facilitation) and **Paper 3** (Vietnam, partnership maturation and dissolution) take point of departure in the early and later stages along the timeline, respectively, where the 'relevant social groups' – the different organizations and individuals involved in the partnership – formed a plurality of views about the technology in the partnership in different ways along the timeline. 'Interpretative flexibility' meant recognizing the different ways these became expressed and why,

[39] See Chapter 1 on 'bridging' and the research question and sub-questions in Chapter 5.

while 'stabilization', seen as a process of contestation and negotiation, was fluid throughout.

Paper 4 (Uganda, pre-intervention socio-technical system analysis) is seen from a broader socio-technical angle without a partnership involved, thus outside of the timeline but where SCOT conceptions remain valid points of analysis in the utilized ISWM framework (see Chapter 4.2).

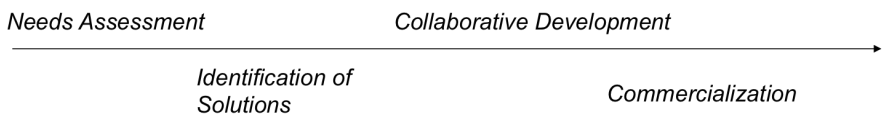


Figure 16 – Partnership innovation conceptual model utilized in the access2innovation secretariat 2011-201440.

Altogether, SCOT as a methodology helps in providing conceptions about relevant social groups, interpretative flexibility and stabilization that have informed the way the research has been planned in partnership innovation case studies as per the *access2innovation* conceptual model. SCOT forms the methodological basis CTA, which is detailed in in **Paper 1** inserted in Chapter 6.4. CTA is consistent with SCOT, and **Paper 1** takes the effort to specify the methodology with respect to developing countries with examples to illustrate.

6.4. METHODOLOGY: CONSTRUCTIVE TECHNOLOGY ASSESSMENT

As explained in Chapter 1.3, CTA is a methodology used in the thesis, which entails inserting oneself in a socio-technical context to gain an understanding of a phenomenon, with social constructivist *interactivity* as a guiding principle. CTA is used for investigating partnerships and their context and involves e.g. socio-technical mapping, experimentation and dialog. **Paper 1** elaborates upon CTA with a basis in Pearson et al. (2016), Rip and Robinson (2013) and others with respect to this perspective.

In general, technology assessment deals with the identification and handling of risks involved with technology development. As Martin and Schinzinger (2005) write with respect to technology assessment in engineering projects in their book *Ethics in Engineering*, the danger in such an assessment is that some serious risks can be overlooked while studies and reports can lull the decision-maker into over- or underestimating risks, or taking no action. Rather than a 'legalistic' exercise that can

[40] Simplified for illustrative purposes here for ease of communicating the intent behind the *access2innovation* partnership innovation process to project stakeholders.

shade issues and favor the narrow interest of corporations, Martin and Schinzinger (2005) contend that engineering should be understood as social experimentation and an ongoing process. As they write with respect to engineers, *"Engineers, it is sometimes said, are apt to find the right answers to the wrong questions"* (Martin and Schinzinger, 2005). Further, *"the questions we should be answering are not yet known. Unfortunately the process required for discovering the right questions is totally different from the process of discovering the right answers"* (Robert Theobald as quoted in Martin and Schinzinger, 2005). Though this is written with engineers in mind, Martin and Schnzinger's points raised about technology assessment can be framed as a broader discussion about handling of technology in society. The fundamental point about asking the right questions is mirrored in Table 7, which is also part of the explanation of CTA in **Paper 1**.

Table 7 - Traditional and constructive modes of technology assessment (Remmen, 1991).

Traditional Technology Assessment	Constructive Technology Assessment
Dominance and authority given to science and scientist-practitioners	Users and scientist-practitioners engage in dialog
Provides the direct consequences and effects associated with a technology	Specifies both goal and methods as well as consequences and problems
Limited problem analysis	Emphasizes a problem analysis
Focus on technical solutions	Combines a number of possible solutions
Results provided in a report	The results are provided through design
Tool for decision-making	criteria, a report as well as dissemination
Linked automatically (technocratically) with parliamentary decision-making processes	Provides a 'catalytic effect'
	Interlinks with different arenas of decision-making
Finding the right answers	***Asking the right questions***

The challenge is how to make technology assessments more applicable when 'asking the right questions' is the more pertinent thing to do. In **Paper 1**, a CTA methodology is proposed. Another challenging issue elaborated upon is how to address technology assessment and development in an international setting, i.e. what has sometimes been termed 'technology transfer'. Development of technologies from one context to another involves a variety of agents which may conduct the transfer, which is usually thought of as a complex process that requires cross-cultural social experiments (Martin and Schinzinger, 2005). The following highlights sum up **Paper 1**, which is afterward inserted directly into the thesis.

6.5. HIGHLIGHTS: PAPER 1

Constructive Technology Assessment and Partnership Innovation in Developing Countries

In this paper, CTA as a methodology is proposed for facilitating sustainable solutions and creating linkages between knowledge bases and resources in the developed and developing world. Its use is illustrated through partnership innovation activities in *access2innovation*, where the paper addresses sub-questions 4 and 5 (see Chapter 5) to the thesis' main research question which deal with supporting a proactive intake of knowledge and with possibilities and challenges in bridging actors across multiple organizational domains.

After framing international technology development and innovation as co-development and capacity-building among stakeholders, the paper presents TA as encompassing a variety of methods that have changed characteristics over time[41]. Additionally, CTA is imagined of as an 'infrastructure for actors to meet and exchange' and as an informal and flexible *insertion.* Emphasis is on being anticipatory, on interactivity with stakeholders and active negotiation and learning. However, it is found that CTA in developing countries has been lacking. Recommendations by others point to the importance of including diverse stakeholders and citizens in decision-making processes. Key points raised in the paper include:

- How CTA in *access2innovation* in partnership activities found high risks and unfavorable conditions with respect to centralized waste handling technologies[42].
- How CTA in *access2innovation* partnership activities identified favorable local conditions and company interest in the case of poultry incubation and small-scale biofuel production. However, there were limitations with respect to addressing community needs regarding coffee production. Additionally, the potential was missed for supporting integrated small-scale renewable energy solutions.

[41] CTA is based on 'intervention in innovation networks', 'demand articulation', 'socio-technical mapping', 'experimentation' and 'social experiments', 'dialog' and 'tasks, enactments and improvisational action'.

[42] Detailed further in Paper 4.

PAPER 1

Christensen, D., Remmen, A. (Forthcoming) Constructive Technology Assessment and Partnership Innovation in Developing Countries. Submitted book chapter for *Technology Assessment (TA) in Techno-Anthropological (TAN) Perspectives*, eds. L. Botin & T. Børsen, IOS Press, Lexington Books or Aalborg University Press (TBC)

Constructive Technology Assessment and Partnership Innovation in Developing Countries

David Christensen and Arne Remmen

Introduction

The development and innovation of technologies in developing countries has been discussed for many years. 'Technology transfer' has been applied to describe processes of international technological change from one social and cultural environment to another. These processes have typically been seen as unidirectional, from a developed country to 'beneficiaries' in the South (Müller 2011, Andersson 2013). However, investments and aid programs with this logic have been hit-and-miss over the decades, and cases of "white elephants" have been numerous.
Kebede & Mulder (2008) highlight local needs assessments and technology assessments as crucial steps toward improving technology transfer overall. Another emphasis has been on adaptation of technology, conceptions of 'appropriate' technology and upgrading of key factors such as local technical or managerial capabilities (Chatterji 1990, Reddy & Zhao 1990, Cohen 2004).

In lieu of the one-sidedness in technology transfer, innovation in developing countries can be framed as co-development among actors. This opens up the field by recognizing that people, organizations, etc. influence the process in various ways and directions. For navigating such complexity, we draw on Constructive Technology Assessment (CTA), an offshoot of TA. In this chapter we consider how practitioners can use CTA to add robustness to promotion of sustainable solutions in developing countries through socio-technical mapping and interaction.

Our explorations of CTA practice are based on partnership-based innovation experiences in East Africa through the initiative *access2innovation*. First, the principles and relevance of CTA in international technology (co)-construction and innovation is investigated. Next, we show through cases within solid waste management and smallholder coffee production how CTA informs practice. Finally, we reflect upon these experiences and their implications for CTA practitioners with respect to partnership innovation processes.

From TA to CTA

With the realization that developments in e.g. IT, nuclear energy and biotechnology carried associated risks and undesired and unintended side effects, TA emerged in the post 1960's (Goonatilake 1994, Grunwald 2015), and was institutionalized in the 1980's and 1990's (Russell et al. 2010). TA emerged out of an imperative to *control* technology in society (Rip, Misa & Schot, 1995). While an impetus existed to disseminate technologies, it was considered that a 'watchdog' mechanism was needed. TA sought to assess potential positive or negative impacts following in the wake of new technologies (Coates & Jarratt 1992). The institutional vehicles for this function took different forms on both sides of the Atlantic (Russel et al. 2011); Sometimes TA was carried out by independent consultative bodies and by university researchers. Sometimes it was carried out through dedicated public institutions as in the United States, which was the first to set up (but later dismantled) an Office of Technology Assessment.

Some TA communities saw that TA gave rise to a dilemma, arguing that direct control of new technologies is illusory in light of the difficulty of reversing decisions once negative effects become apparent (Remmen 1991) - also known as the Collingridge dilemma (Collingridge 1980, van Merkerk & Smits 2008). An anticipatory TA approach was called for instead, i.e. being able to manage technologies under conditions of incomplete knowledge about their effects. TA was thereby challenged on the idea that its practitioners were to be experts providing indisputable solutions to problems. Truth claims were recognized as assailable, and TA practitioners were to instead act as interactive dialogue facilitators among actors, what Grunwald (2015)

describes as part of a *shaping technology* approach which directly addresses groups involved in 'making of technology'. The objective of anticipatory TA remained the same: assessing the potential positive or negative impacts associated with a technology. However, added to this was a heuristic learning perspective which viewed technology development as a 'search process' guided by shared frames of meaning among coalitions of actors (Grin & van de Graaf 1996). There was also the idea that by anticipating potential impacts and feeding them into actor strategies and decision-making processes early as possible in an interactive manner, this would reduce the cost of learning in society's handling of new technologies (Schot & Rip 1996, Grin et al. 1997).

Different forms of TA emerged to reflect this difference from more reactive approaches. CTA was a distinct variant[1] that came out of an interpretative tradition, emphasizing socially constructed processes of innovation and the shaping of technology in early stages of development (Moens et al. 2010). As defined by Remmen (1991), CTA is characterized as an interactive process that embraces active negotiation and learning among involved parties in a technological development process in order to influence participatory change.

Lack of TA focus in developing countries

TA emerged out of a narrow "Euro America" space (Goonatilake 1994), and had a cultural bias that seldom took the needs of non-Western nations into consideration (Palm & Hansson 2006). Though e.g. Coates (1998) saw its usefulness in guiding United Nations programs in developing countries, this was a rare foray into TA applications in these settings. Within the CTA strand of TA studies, there is a preoccupation with emerging technologies in Western settings, e.g. nanotechnology and biotechnology (van Merkerk & Smits 2008, Kuhlmann 2013, Rip & Robinson 2013, Roelofsen et al. 2008).

To address the gap, the STEPS Centre[2] has published recommendations for flexible TA's in developing countries (Ely, et al. 2011): Here, decision-making ensures involvement of diverse actors including citizens and continual learning among e.g. universities, NGO's, firms and users/citizens, see Figure 1.

Figure 1 – TA within the policy-making and technological development process (Ely et al. 2011)

According to Ely et al. (2011), the few TA's carried out in developing countries have mostly been technical and for national government or aid programs by centralized

[1] The terminology is sometimes muddled: Aside from use of the TA term itself, similar approaches to CTA include e.g. awareness TA, strategic TA, interactive TA, participatory TA, tracker TA and real-time TA (Genus & Coles 2005, Kuhlmann 2012, Guston & Sarewitz 2002).

[2] The STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre is based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex in the UK.

institutions or Western consultants. These TA's have been narrow-scoped covering e.g. cost-benefit analyses of infrastructure projects like dam construction, or technical assistance to national agricultural and development strategies. Whereas TA originally developed to support democratically inspired parliamentary decision-making and policy, TA's in developing countries have been far removed from this ideal.

Some exceptions to the above rule can be found: Moens et al. (2010) report the robustness of a CTA process using a roundtable workshop methodology for information and communication technologies applied to education (Tanzania), agriculture (Mali) and health (Tanzania) using process and output criteria. However, Ely et al. (2011, 2014) note that the practicalities in developing countries make it unfeasible and unpromising to carry out TA's as in the West due to cost, infrastructure, capabilities required and weak governance structures. They instead emphasize joining citizens and decision-makers together with technical expertise in ways that combine the best of both worlds through TA's that are *virtual* (referring to the use of IT) and *flexible*, i.e. which do not make use of dedicated TA institutions but by *networks* of different kinds of actors. This is seen as a way of filling out institutional capacity gaps of resource-constrained governments. As part of this, the authors call for a so-called 'broadening out' of inputs in TA's, referring to the involvement of diverse actors including citizens to support analytical robustness and continuous learning. In many ways, this mirrors the ambitions behind CTA.

CTA principles and practice

TA is an umbrella for a variety of methods that have developed and changed in characteristics over time. A number of qualitative and quantitative methods are covered by the term[3], from the inceptive use of financial evaluation tools and Delphi methods to so-called radical and broader scoped methods as with CTA in later years (Tran 2007, Tran & Daim 2008, Daim et al. 2011). The field is still under development, and researchers and practitioners often apply combinations of tools and methods as well as develop their own to cater to their specific needs. 'Traditional' TA can include e.g. economic analysis, decision analysis, systems engineering, technological forecasting, risk assessment and impact analysis, while CTA utilizes e.g. intervention in innovation networks and demand articulation (Tran 2007, Van Den Ende et al. 1998). Further elaborated, CTA is characterized by three analytical achievements (Guston & Sarewitz 2002): socio-technical *mapping* involving analysis of actors and plotting of recent technological dynamics, controlled *experimentation* and *dialogue* between the public and innovators.

Remmen (1991, 1995) elaborates on the use of *social experiments* as a means to affect participatory technological change in CTA. Social experiments are trial-and-error search processes that involve practical sets of organized activities enabling technology developers and users to make the technology on an experimental basis, functioning as a learning platform. Social experiments bring forth concerns and negotiations among participating parties, and support pertinent external considerations being brought into innovation and implementation processes. Remmen (1991) states that this ought to be a focus in future CTA methodology development, in which dialogue-based research and development activities ensure that users constitute the basis of planning and are involved.

Moens et al. (2010) describe CTA as an *infrastructure* for multiple actors to meet and exchange. In this respect Avgerou (as cited in Moens et al. 2010) emphasizes that construction of technological artifacts and organizational arrangements arise out of a mix of *technical/rational tasks*, *institutionalized enactments* and *improvisational action*.

---

[3] The methods have a truly broad range (Ely et al. 2011): *"... from brainstorming, literature research, document analysis, expert consultation, case studies, cross impact analysis, cost/benefit analysis, trend extrapolation, decision trees, Delphi methods, computer simulations and scenario development."*

CTA practice is further described as an *insertion* methodology that is fairly informal and flexible in its initial approach to a research domain (Pearson et al. 2016, Rip & Robinson 2013), and involves inserting oneself in a socio-technical context to gain an understanding of a phenomenon through interaction: CTA practitioners in the early phases of a CTA 'move about' in a socio-technical context in order to develop a better understanding and build relationships and trust among the actors in a domain. Gradually, opportunities are built for reflexivity among different technology actors, aiming to produce inquiry and generate insights. CTA practitioners need to understand layers and relationship between 1) broad public policy activities and public debate, 2) organizations and institutions within a particular domain and 3) a bottom layer of ongoing practice and projects (Rip and Robinson 2013).

For innovation processes in developing countries, CTA principles and practice can make use of e.g. social experiments, 'moving about', tasks, enactments and action to incorporate users and broader inputs from relevant actors across sectors in line with Ely et al. (2011).

Criticism leveled at CTA is worth keeping in mind. Genus and Cole (2005) warn that co-construction of technology in CTA underplays differences in agenda or 'rules setting' among parties. This may lead to decision-making becoming influenced by those already powerful in society, which is a particularly sensitive issue in developing countries. Additionally Reuzel (2001) questions whether CTA truly leads to 'assessments' since it cannot so easily be distinguished from technology dynamics and development in general. Since CTA has reflected a change from an analytical activity to a system of constant feedback, learning, moderation and adaptation, Reuzel questions whether it can take a critical standpoint on technological change; because CTA is applied to a social context but is also shaped by it, Reuzel argues that it cannot be objective or value free. Genus (2006) notes similarly that subjective factors may constrain self-reflection and socio-technical criticism among individuals and organizations, and that there are fundamental tensions between being inclusive, reflective and reflexive in TA, and finding practical solutions. Reuzel concludes however that CTA, while cumbersome, is a more 'justified road to take' compared with rational (or 'traditional') TA.

Reuzel and Genus' questioning of CTA make it clear that subjectivity and contention of values are embedded within the method. This is a premise of CTA. We argue that not only can CTA *not* claim objectivity, but it *should* not lay such claims either. The critique can instead be taken as a challenge. The onus is on CTA practitioners to be critical towards both self and technological dynamics in a CTA process.

Towards TA in innovation networks

Policy-making decision arenas have historically been prominent for TA across the developed world, and remain a focus (Klüver et al. 2016, Grunwald 2017). An example is the Danish use of 'scenario workshops' and 'consensus conferences' with citizens, in which the focus has been to facilitate an open dialog between policy-makers, experts and ordinary citizens (Andersen & Jæger 1999).

TA can however also be carried out within the decision space of a firm with an interest in developing a product and service for a market (Braun 1998). Within corporate management and strategy as a decision space, managers pursue objectives, means and ends and allocate resources toward e.g. technological developments in order to improve upon a firm's competitive position (Grin & van de Graaf 1996). Tran and Daim (2008) note that businesses, universities and individual researchers have picked up on TA and applied it to various technological applications such as alternative assessments, strategic selection and acquisition and planning. They further note that this deviates from historical and so-called 'conventional' TA, but that value addition for TA applications for the business and non-governmental sector decision-making clearly merits further study.

We argue that network oriented modes of TA that are aligned with CTA principles are particularly suited to developing country settings. In the following presentation of the *access2innovation* initiative, we seek to show how CTA principles have guided

the initiative's partnership innovation processes in Uganda, which has been the focus for many of its activities.

Partnership innovation and the *access2innovation* initiative

Taking up the gauntlet from Ely et al. (2011) with respect to CTA principles in developing countries, *access2innovation* (www.access2innovation.com) is a Danish network-oriented organization that has been fostering partnership innovation activities since 2007 (Ravn 2012, Christensen 2014, Christensen & Bach 2015). *Access2innovation* involves the following sectors, both in Denmark and in East Africa, Uganda in particular:

- Civil society (international development and relief NGO's)
- Business (business membership organizations and individual firms)
- Academia (universities and individual researchers)
- Public sector (national bodies and local municipalities)

Figure 2 illustrates the sectors involved in *access2innovation* as well as their respective knowledge bases, with the organization itself positioned in the center. *Access2innovation* originally formed in 2007 as an action research project to address calls for cross-sectorial collaboration between NGO's, businesses and authorities at the EU policy-level, and innovation shortcomings within NGO's (Ravn 2012). Originally the focus was on humanitarian relief applications, i.e. partnership innovation directed at post-disaster settings. Based on the successful facilitation of 4 partnerships[4], regional development and national research grants were awarded in 2011 which allowed *access2innovation* expanded its scope to development issues with the poor as clients, customers, partners and beneficiaries. Today, it is a stand-alone, membership-based organization and a 'commercial foundation': a form of Danish legal entity with a number of requirements to its governance structure.

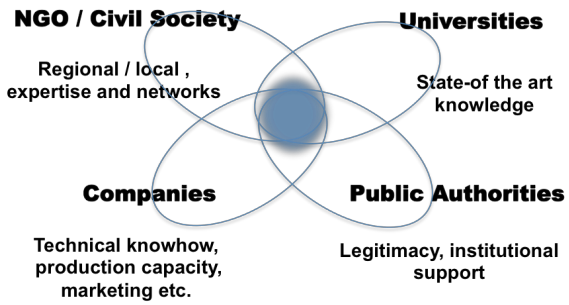


Figure 2 – The access2innovation 'quad helix' configuration.

Access2innovation seeks to meet challenges and needs in developing countries through sustainable solutions, inspired by 'Base-of-the-Pyramid' (Prahalad 2004, Kandachar & Halme 2008, Hart & Cañeque 2015) and business model development (Osterwalder & Pigneur 2013). Triple and quad-helix innovation frameworks (Leydesdorff & Etzkowitz 1998, Kimatu 2016) also loosely inspire its set-up. The premise of the initiative is that synergies may be found in combining inputs, interests and capabilities of the different knowledge bases involved, with *access2innovation* functioning as an inter-organizational 'infrastructure' or 'partnership incubator' (Ravn 2015).

The initiative's partnership innovation processes are cross-sectorial and involve co-development within three thematic areas: renewable energy, water and sanitation

[4] Successfully launched commercial ventures included SkyWatch, which produces unmanned aerial drones for various terrain surveying applications and ViewWorld, a mobile phone application for assisting aid and development workers with data collection and reporting.

and agriculture. Technology development is part of the processes, where *access2innovation* supports firms in matching up to local needs and cultural preferences. The initiative's activities are carried out by an interdisciplinary secretariat that includes staff with varied backgrounds in e.g. environmental engineering, business management, project management and international development studies.

As per Stember (1991), an *interdisciplinary* way of operating means integrating knowledge and methods from different disciplines, and thereby using a synthesis of approaches. This is a mid-stage between being *multidisciplinary* (people from different disciplines simply working together) and *transdisciplinary* (a unity of intellectual frameworks transcending disciplinary boundaries). In *access2innovation* the interdisciplinary mode of operation is shown in the roles and assignments placed on the people in charge of facilitating individual partnership innovation projects: Regardless of disciplinary background 'specialization', each is tasked with facilitating a project as a whole, using input and methods discussed in the secretariat team setting. Such a role requires the facilitator to cover all aspects of a partnership innovation process, often bringing a facilitator outside of familiar disciplinary territory. This requires them to integrate own training, background and experiences with approaches and methods more familiar to other, fellow *access2innovation* members.

Access2innovation specializes in early-stage partnership innovation activities until a concept is tested. Once a concept has reached this stage, bringing an initiative to commercial scale is the main responsibility of the entrepreneur or firm taking the lead position in the partnership. Beginning as a set of activities funded by research project grants, *access2innovation* currently functions as a membership-based commercial foundation.

Access2innovation makes use of a palette of process management methods to drive partnership innovation processes. They include:

- At the operational or project management level: Structured interactive workshops with representatives from participant organizations across and within sectors, as well as with target communities in Uganda and local authorities, as well as bilateral/multilateral negotiations (meetings) in more sensitive situations as needed.
- At the strategic level: Organized field visits to a developing country for a number of interested Danish businesses as well as strategic co-funding packages to carry out activities such as market and user studies, needs assessments, feasibility studies, prototyping, business model testing and meetings/dialog with potential customers and partners. Organized field visits for local authorities and other partners to visit Denmark for mutual learning sessions.
- Continuously and in support of the above: Networking activity in support of partnership and business model innovation processes. This includes such activities as partnership search, liaising with public authorities, finding further funding opportunities for up-scaling and finding knowledge resources for technology validation, among others.

These are in line with CTA principles. *Access2innovation* itself functions as an *infrastructure* for actors to meet and exchange (Moens et al. 2010), and to support networked innovation processes (Van de Ven 1986). Its operational, strategic and continuous activities amount to *technical/rational tasks*, *institutional enactments* and *improvisational action* (Moens et al. 2010).

In accordance with CTA insertion principles (Pearson et al. 2016, Rip & Davidson 2013), its secretariat members 'move about' for gaining understanding of socio-technical contexts (socio-technical mapping). Socio-technical mappings focus on the thematic areas of renewable energy, water and sanitation and agriculture in both Denmark and East Africa.

When a firm's innovation process develops to a point that prototyping and testing occurs in partnership with e.g. an NGO, researchers, local companies and

communities, this amounts to *social experimentation* of sustainable solutions (Remmen 1991, 1995).

Finally, *access2innovation* insertion activities do rely on the secretariat's members being able to navigate different 'layers' (Pearson et al. 2016, Rip & Davidson 2013), i.e. taking part in public debate and policy-making activities, engaging with organizations and institutions within a domain and carrying out specific project activities. Figure 2 provides the full overview of *access2innovation*'s partnership innovation projects in the period 2011-2014[5].

	Stage reached	Details
Agribusiness		
Chicken Incubators (Uganda)	Full scale demonstration project implemented	Community based, solar-driven incubator units for chicken and egg production with use of microfinance.
Small-scale coffee farming* (Uganda)	Exploration study carried out	Technology, marketing and management upgrading of smallholder coffee farmers.
Chili farming* (Uganda)	Exploration study carried out	Post-harvest technology and supply chain upgrading of smallholder chili farmers.
Dairy cooperatives (Uganda)	Exploration study carried out	Technological upgrading of dairy production and supply chain with smallholders and farmer cooperative.
Renewable Energy		
Energy hubs (Uganda)	Full scale demonstration project ongoing	Solar photovoltaic mini-grids in rural off-grid communities.
Small scale bio-fuel* (Uganda)	Exploration study carried out	Low-cost and scalable production of second-generation biofuel from agricultural residuals.
Renewable energy and energy efficiency (Uganda, Kenya)	Exploration study carried out	Business-to-business energy efficiency and renewable energy solutions.
Waste-to-energy* (Uganda)	Exploration study carried out	Waste treatment technology for municipal waste with a view to biogas-based energy and soil fertilizer production
Waste-to-energy* (Vietnam)	Exploration study carried out	Waste treatment technology for municipal waste with a view to biogas-based energy and soil fertilizer production
Steam powered water pumps (Tanzania)	Exploration study carried out	Solar thermal driven water pump technology and business model development.
Water and Sanitation		
Urban sanitation (Uganda)	Full scale demonstration project ongoing	Combined retail shop and toilet and shower facilities for urban areas
Payment system for sanitation services (Uganda)	Full scale demonstration project ongoing	Electronic micropayment system as alternative to cash handling
Water purification through renewables energy (Tanzania)	Exploration study carried out	Use of solar PV for water purification in Tanzania in e.g. rural communities and the service industry.
Humanitarian relief		
The 'green generator'	Prototype developed and ready for deployment	Multiple input energy supply for humanitarian base camps.
Emergency sanitation	Exploration study carried out	Integrated sanitation solution for humanitarian base camps.

CTA process further detailed in this chapter

Figure 3 - Access2innovation partnership innovation projects 2011-2014. Asterix (*) denotes direct author involvement.

The following presents a few examples of how *access2innovation*'s facilitation processes have played out in two different geographies in Uganda and in two different thematic areas: renewable energy (waste management) and food security (coffee production).

[5] 2011-2014 covers the scope of this chapter and the main author's involvement in the access2innovation initiative.

Waste Management in Kasese, Western Uganda

Access2innovation worked in this case with the World Wildlife Fund (WWF) towards mobilizing municipalities[6] and businesses in Denmark to support the development of a showcase district in Kasese, Western Uganda, with renewable energy technologies meeting commercial and domestic energy needs. This 'champion district' initiative began in 2012 with WWF's Uganda Country Office as implementing party with support from WWF Denmark and WWF Norway. The district was to demonstrate replicable and scalable solutions through identifying, piloting and demonstrating innovative ways for increasing access to clean energy. With a target of reaching 100% energy access by 2020, it had a broad partnership scope that included partners both locally and from abroad – including *access2innovation*.

Identifying waste management in Kasese as an intervention area came up during an *access2innovation* field visit in early 2012. The delegation observed waste practices, and after discussions with WWF Uganda proposed it as a business case for Danish investors particularly with regards to biogas or incineration technology with energy recovery for electricity generation.

The CTA process consisted of a socio-technical mapping study of the solid waste management system in Kasese, the district's main city of around 100,000 inhabitants. Christensen et al. (2014) provides a detailed elaboration of the mapping, providing a system characterization seen through socio-technical theories of path dependencies and innovation, and using the ISWM[7] analytical framework (Anschütz et al. 2004) for analysis of social and technical system elements. Methods in the mapping study included qualitative and quantitative data-gathering methods including document reviews, semi-structured interviews, direct observations and surveys covering 15 households and 5 services and industries. Additionally, a workshop with local stakeholders was carried out, facilitated by the WWF Uganda Country Office. A research team consisting of an *access2innovation* staff member and master students carried out the socio-technical mapping.

The mapping study included dialog with key local decision-makers and waste generators in Kasese, and it was found that the introduction of the initially envisioned waste treatment technologies would be difficult to open a pathway for in the existing waste system, e.g. due to an existing composting plant in operation and lock-in of solid waste amounts to this treatment facility, and would not be commercially viable (Christensen et al. 2014). It was decided to abandon the idea of introducing the waste treatment technologies. Decentralized solutions based on the informal waste sector had more immediate potential instead (but would be less attractive for Danish investors), and opportunities for 'waste-to-energy' were identified in relation to urban sanitation in a separate but related *access2innovation* project in Kasese with the WWF Uganda Country Office.

Coffee production, small-scale biofuel and chicken Incubators in Mbale, Eastern Uganda

In this example, *access2innovation* partnered with a Danish coffee importer that had existing supplier relationships with a local Ugandan processing company that sourced from smallholder farmer groups dispersed throughout the slopes of Mt. Elgon to the east of the country. The coffee importer marketed high-quality coffee to the Danish market, based in part on a CSR strategy: it had also been partnering with smaller NGO's to supplement their business with philanthropic development

---

[6] The municipalities of Frederikshavn and Aalborg in Northern Denmark, near where *access2innovation* is based, were in particular invited to take part in the 'Champion District' initiative.

[7] Integrated Sustainable Waste Management.

programs, e.g. dissemination of improved cook stoves and solar PV units for schools. The beneficiaries of these programs were included in the coffee packaging for Danish supermarkets with personal pictures of individuals from the communities and supplementary text.

Access2innovation assessed that the well-established and longstanding relationships with businesses, NGO's and communities in the area provided a solid foundation for additional partnership innovation activities. The secretariat sought out Danish firms that had an interest in working on innovative solutions to improve the livelihood basis for the smallholder farmers through e.g. agricultural post-harvest technologies.

The CTA process involved *access2innovation* first carrying out a series of research interviews with actors (international agencies, aid agencies, NGO's and producers and exporters) within Ugandan agriculture and post-harvest technology in general as well and coffee production specifically. This initial mapping was carried out in the 1st quarter of 2012 in order to gain an initial understanding of the socio-technical context as well as potentials and challenges in the sector.

Later in the 2nd quarter of 2013, a field study was organized in which the Danish firms that *access2innovation* sought out were invited. In the field study the firms, together with some university researchers who also showed interest in participating, interacted with the local communities at Mt. Elgon through informal interviews with farmers in their homes as well as workshops. The field visit also included visits to existing firms with post-harvest processing technology and with sellers/exporters. The composition of the participants in the field visit is shown on Figure 3.

Field study participant	Description
Firm A	Single-person agribusiness consultancy and agricultural economics specialist with longstanding work experience in Uganda
Firm B	Farm owner and manager with longstanding work experience in Uganda
Firm C	Private company developing and selling solar-boosted bioethanol production facilities based on agricultural residues
Researcher/Firm	Engineering researcher in vertical axis wind turbines for productive applications in developing countries. Also an entrepreneur within the field with Indian ties.
Researcher A	Geography specialist in cultural economics with emphasis on international networks within quality coffee and specialty coffee
Researcher B	Geography and environmental social science specialist in sustainability, innovation and networks

Figure 4 – Participants in "Go and See" field study to Eastern Uganda, May 2013.

After the field visit, *access2innovation* invited the Danish businesses to carry out detailed feasibility studies based on their impressions and needs assessments, which the secretariat offered to co-finance. The feasibility studies were to encourage the individual firms (or partnerships, not necessarily with each other) to develop their business models. Afterward, *access2innovation* was ready to offer co-financing for concept testing as the final step before commercial scaling.

Access2innovation granted feasibility study co-financing packages to 2 firms: Firm A, which was interested in community based, solar-driven incubator units for egg hatching and poultry production in communities near Mt. Elgon, and Firm B, which was interested in small-scale bioethanol production units for coffee residuals as well as larger scale units for cane sugar production elsewhere in Uganda. The researcher/firm also applied based on an idea of vertical-axis wind turbine technology for irrigation of coffee crops and energy production, but was found lacking by the *access2innovation* secretariat due to technical feasibility and due to questions that the secretariat raised about the firm's capacity to financially scale the venture. In assessing the applications, the *access2innovation* secretariat considered the proposed business models, the partnerships involved and the individual capabilities and resources of the applicants.

For the final concept testing stage, Firm A received *access2innovation* co-funding for setting up a solar-driven incubator, while Firm B was refused but did receive funding from alternative sources (the Nordic Climate Facility) instead. Firm A has

managed to test its concept successfully in terms of proving the technical viability and significantly improving poultry production efficiency[8]. Currently the concept is looking be scaled. Firm B meanwhile received its funding to deliver a preliminary bioethanol production facility together with a sugar producer, disseminate cook stoves using the fuel, develop a background analysis for a business plan and national expansion plan, interact with stakeholders and finally establish an office in Uganda (Nordic Development Fund 2015).

The initial mapping and the following *access2innovation*-supported CTA activities, which included individual firms and researchers, has thus led to validation of business model ideas and opened up further technology development within poultry production and bioethanol in Uganda. The specific community needs with regards to coffee post-harvest technologies were not addressed directly. The single firm/researcher that did address the needs ended up not being supported by *access2innovation* for a feasibility study and concept testing. This is argued to have been a missed opportunity, and shows that *access2innovation*'s CTA approach and allocation of resources can remain entangled in economic interests (resource-capable firms) and shies from niche technology development and entrepreneurial support.

CTA and the Practitioner

Reflecting upon the CTA approach within *access2innovation*, there have been valuable lessons navigating the complexities in partnership innovation in developing countries with firms and other actors involved in 'making of technology' (Grunwald 2015). One important challenge is directly addressing articulated user needs under conditions where there are different interests at play, e.g. Danish business communities, individual firms and local communities. Articulated needs were not addressed in the case of coffee post-harvest technology, for instance. Therefore, the critical perspectives leveled at CTA by e.g. Genus and Cole (2005) remain relevant for the practitioner, i.e. the danger of favoring those already powerful in society, and the questions about being able to disentangle from a technological development process and keeping a critical standpoint (Reuzel 2001, Genus 2006). We argue that these are matters of expertise and training but also matters of personal qualifications and competencies on behalf of the practitioner. It is also a matter of how a secretariat like *access2innovation* operates. What needs to be further developed are ways of articulation and balancing of views appropriately with respect to power relations, and more substantial critical reflection in technology co-construction.

Here we recognize the conflicts involved in partnership innovation in places like Uganda, and that CTA practitioners have an important role to play in fostering inclusion and sustainable technology development. Feenberg (2017) offers support to this, having developed the 'critical theory of technology' approach since the early 90's which calls for more democratic control of technology[9]. In the critical theory of technology approach, citizen action is vital and usually occurs downstream after technologies are released into public domain as controversies arise over e.g. pollution or medical treatment, but can also occur 'a priori' with public participation via citizenship juries, or through *"... "hybrid forums" to evaluate proposed innovations, and collaboration in the design process"* (Feenberg 2017). This is consistent with CTA and *access2innovation* can more systematically work with this aspect in the partnership innovation processes it facilitates, i.e. through 'hybrid forums' understood as systematic local community participation in collaboration and evaluation.

In *access2innovation*, the interdisciplinary way of working with partnership innovation processes could also developed as a strategy for dealing with the need for fostering inclusion and sustainable technology development, i.e. synthesizing

[8] A hatching efficiency has been claimed to have improved from 10% to 96%, see video 'Chicken incubators in Budaka – access2innovation': https://www.youtube.com/watch?v=pzCpX0RpI_c

[9] A full elaboration on critical theory of technology is not provided here but its essential position is to critique technocratic systems in modern society and open the way toward social critique in Science and Technology Studies (STS), from which TA and CTA have sprung out (Feenberg 2017).

knowledge and methods from different disciplines represented within the secretariat – but in a more elaborated manner than has hitherto been seen in Uganda. Competencies in the developing *techno-anthropology* tradition can help inspire the kind of further interdisciplinary fostering that the CTA experiences call for*,* i.e. what Børsen (2013) explains as 'interactional expertise', 'social responsibility' and 'anthropology-driven design' respectively[10].

Conclusions

CTA is a particular aspect of TA that remains relevant today for innovation processes in developing countries. A*ccess2innovation* experiences have involved partnerships across different sectors within renewable energy, water and sanitation and agriculture in East Africa and Uganda in particular. CTA is not prescriptive but is flexible and relies on an insertion methodology involving socio-technical mapping, experimentation and dialog between the public and innovators. CTA has been operationalized in *access2innovation* in a firm-centric, partnership and network setting, as opposed to public policy and debate as with traditional TA.

Through practical experiences with CTA in agriculture (coffee production, small-scale biofuel, vertical-axis wind turbines and chicken incubators), it is demonstrated that the *access2innovation* initiative has pushed ahead when local conditions have been favourable towards the introduction of innovative technology, and when there is specific interest in a venture from a firm. This has been the case with regards to chicken incubators and small-scale biofuel production. However, this has *not* been the case with regards to coffee production and post-harvest technologies involving vertical-axis wind turbines.

Through practical experiences with CTA in renewable energy (waste management), *access2innovation* discovered high risks and unfavourable conditions with regard to centralized biogas or waste incineration technologies in a socio-technical mapping of the analysed waste system. Further partnership activities along this idea were halted hereafter.

For the practitioner, the *access2innovation* experience base provides a foundation for further development of CTA. In particular the opportunity presents itself for further fostering of inclusion and sustainable technology development through 'hybrid forums' which have the goal of democratizing technology development and ensuring public participation. Further, improved interdisciplinarity can be a strategy for building the needed competencies for inclusive and sustainable technology development. These proposals address some key criticisms of CTA regarding power relations among participants, and being able critically to stand apart from a technological development process despite being embedded in it.

[10] Techno-anthropology is explicitly oriented toward translations of technology across cultural settings (Børsen 2013): 'Interactional expertise' is a quality that supports constructive cooperation among various interest, 'social responsibility informs ethical scientific and technological production and 'anthropology-driven design' positions practitioners as bridgers between opposing views in design and innovation projects.

References

Andersen, I. E. & Jæger, B. 1999, "Danish participatory models: Scenario workshops and consensus conferences: towards a more democratic decision-making", Science and Public Policy, October 1999, pp. 331-340

Andersson, V. 2013, "Technology Transfer in Developing Countries; A Case Study from Bolivia" in What is Techno-Anthropology? eds. T. Børsen & L. Botin, Aalborg University Press, Aalborg

Anschütz, J., IJgosse, J. & Scheinberg, A. 2004, "Putting Integrated Sustainable Waste Management into Practice: Using the ISWM Assessment Methodology", WASTE, Gouda

Braun, E. 1998, "Technology in Context: Technology Assessment for Managers", Routledge, London & New York

Børsen, T. 2013, "Identifying Interdisciplinary Core Competencies in Techno-Anthropology: Interactional expertise, social responsibility competence, and skills in anthropology-driven design" in What is Techno-Anthropology? eds. T. Børsen & L. Botin, Aalborg University Press, Aalborg

Cañeque, F.C. & Hart, S.L. (Eds.). 2015, "Base of the Pyramid 3.0: Sustainable Development through Innovation and Entrepreneurship" Greenleaf Publishing

Chatterji, M. (Ed.). 1990. "Technology Transfer in the Developing Countries" Palgrave Macmillan, New York

Christensen, D. 2014, "Innovation in Multi-Actor Partnerships: A Waste Management Initiative in Vietnam" in Technologies for Sustainable Development: A Way to Reduce Poverty? Eds. J. Bolay, S. Hostettler & E. Hazboun. Springer-VS

Christensen, D., Drysdale, D., Hansen, K., Vanhille, J. & Wolf, A. 2014, "Partnerships for development: Municipal solid waste management in Kasese, Uganda" Waste Management & Research, vol. 32, no. 11, pp. 1063-1072

Christensen, D. & Bach. L.T. 2015, "A Danish-Vietnamese partnership for business and technology development in solid waste management", Resources, Conservation and Recycling, vol. 105, part A, pp. 123-133

Coates & Jarratt, Inc. 1992, "Technology assessment: Anticipating the consequences of technological choices" Course workbook presented in conjunction with the international association for impact assessment's 12th annual meeting in Washington, D.C.

Coates, J.P. 1998, "Technology Assessment as Guidance to Governmental Management of New Technologies in Developing Countries", Technological Forecasting and Social Change, vol. 58, no. 1-2, 35-46

Cohen, G. 2004. "Technology Transfer: Strategic Management in Developing Countries" SAGE Publications India Pvt. Ltd., New Delhi

Collingridge, D. 1980, "The Social Control of Technology" Pinter, London

Daim, T., Gerdsri, N., Basoglu, N. (Eds.). 2011, "Technology Assessment: Forecasting Future Adoption of Emerging Technologies", Erich Schmidt Verlag, Berlin

Ely, A. Van Zwanenberg, P. & Stirling, A. 2011, "New Models of Technology Assessment for Development", STEPS Workning Paper 45, STEPS Centre, Brighton

Ely, A. Van Zwanenberg, P. & Stirling, A. 2014, "Broadening out and opening up technology assessment: Approaches to enhance international development, co-ordination and democratization", Research Policy, vol. 42, no. 3, pp. 505-518

Feenberg, A. 2017. "A Critical Theory of Technology" in Handbook of Science and Technology Studies, eds. U. Felt, R. Fouché, C.A. Miller & L. Smith-Doerr, MIT Press

Genus, A. & Coles, A. 2005, "On Constructive Technology Assessment and Limitations on Public Participation in Technology Assessment", Technology Analysis & Strategic Management, vol. 17, no. 4, pp. 433-443

Genus, A. 2006, "Rethinking constructive technology assessment as democratic, reflective, discourse", Technological Forecasting & Social Change, vol. 74, issue 1, pp. 13-26

Goonatilake, S. 1994, "Technology Assessment: Some Questions from a Developing Country Perspective", Technological Forecasting and Social Change, vol. 45, pp. 63-77

Grin, J. & ven de Graaf, H. 1996, "Technology Assessment as Learning", Science, Technology & Human Values, vol. 21, no. 1, pp. 72-99

Grunwald, A. 2014, "Technology Assessment for Responsible Innovation" in Responsible Innovation 1: Innovative Solutions to Global Issues, eds. J. van den Hoven, N. Doorn, T. Swierstra, B.J. Koops & H. Romijn, Springer, Dordrecht

Grunwald, A. 2015, "Technology Assessment" in Encyclopedia of Information Science and Technology, ed. M. Khosrow-Pour, IGI Global

Grunwald, A. 2017, "Technology Assessment and Policy Advice in the Field of Sustainable Development" in Technology, Society and Sustainability: Selected Concepts, Issued and Cases, ed. L.W. Zacher, Springer International Publishing, Cham, Switzerland

Guston, D.H. & Sarewitz, D. 2002, "Real-time technology assessment", Technology & Society, vol. 24, issues 1-2, pp. 93-109

Kandachar, P. & Halme, M. (Eds.). 2008, "Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor" Greenleaf Publishing

Kebede, K. Y. & Mulder, K. 2008, "Needs Assessment and Technology Assessment: Crucial Steps in Technology Transfer to Developing Countries", Revista Internacional de Sostenibilidad, Tecnología y Humanismo, no. 3, pp. 85-104.

Kimatu, J.N. 2016, "Evolution of strategic interactions from the triple to quad helix innovation models for sustainable development in the era of globalization", Journal of Innovation and Entrepreneurship, vol. 5, no. 16, pp. 1-7

Klüver, L., Nielsen, R.Ø. & Jørgensen, M.L. (Eds.). 2016, "Policy-Oriented Technology Assessments Across Europe: Expanding Capacities" Palgrave Macmillan

Kuhlmann, S. 2013, "Constructive Technology Assessment" in The Power of Design: Product Innovation in Sustainable Energy Technologies, eds. A. Reinders, J.C. Diehl & H. Brezet, John Wiley & Sons

Leydesdorff, L., Etzkowitz, H. 1998, "The triple helix as a model for innovation studies", Science and public policy vol. 25, no. 3, pp. 195-203

Moens, N.P., Broerse, J.E.W., Gast, L. & Bunders, J.F.G. 2010, "A Constructive Technology Assessment Approach to ICT Planning in Developing Countries: Evaluating the First Phase, the Roundtable Workshop", Information Technology for Development, vol. 16, no. 1, pp. 34-61

Nordic Development Fund. 2015, "NCF: Sustainable consumption and production of biofuel in Uganda [NDF C62 B 11]", http://www.ndf.fi/project/ncf-sustainable-consumption-and-production-biofuel-uganda-ndf-c62-b-11 (last retrieved April 5, 2017)

Osterwalder, A., Pigneur, Y. 2013, "Business model generation: a handbook for visionaries, game changers, and challengers" John Wiley & Sons

Palm, E. & Hansson, S.O. 2006, "The case for ethical technology assessment (eTA)", Technological Forecasting and Social Change, vol. 73, pp. 543-558

Pearson, J., Gianni, R., Ikonen, V. & Haick, H. 2016, "From Technology Assessment to Responsible Research and Innovation (RRI)" Future Technologies Conference, San Francisco, United States, 6-7 December 2016. IEEE

Prahalad, C.K. 2004, "The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits" Upper Saddle River, New Jersey: Wharton School Publishing

Ravn, J., 2012, "Access2innovation: Network-Based Business Model Innovation for Disaster Relief and Development Assistance" (Translated from Danish). PhD Dissertation, Department of Development and Planning, Aalborg University

Reddy, N. M. & Zhao, L. 1990, "International technology transfer: A review", Research Policy vol. 19, no. 4, pp. 285-307

Ravn, J. 2015, "Access2innovation: An innovative BoP network partnership model" in Base of the Pyramid 3.0: Sustainable Development through Innovation and Entrepreneurship, eds. F.C. Cañeque & S.L. Hart, Greenleaf Publishing

Reuzel, R.P.B. 2001, "To assess rationality before anything else. A remark on the legitimacy of Rational Technology Assessment" in Interdisciplinarity in Technology Assessment: Implementation and It's Chances and Limits, eds. M. Decker & F. Wütscher, Wissenschaftsethik und Technikfolgenbeurteilung, vol. 11, Springer-Verlag, Berlin, Heidelberg & New York

Remmen, A. 1991, "Constructive Technology Assessment" in Danish Experiments – Social Constructions of Technology, eds. T. Cronberg, P. Duelund, O. M. Jensen & L. Qvortrup, New Social Science Monographs, Copenhagen

Remmen, A. 1995, "Greening of the fishprocessing industry in Denmark: Constructive technology assessment" Proceedings of the First International Symposium on Sustainable Fishfarming, Oslo, Norway 28-31 Agust 1994.

Rip, A., Misa, T. J. & Schot, J. 1995, "Constructive Technology Assessment: A New Paradigm for Managing Technology in Society" in Managing Technology in Society: The Approach of Constructive Technology Assessment, eds. A. Rip, T. J. Misa & J. Schot, Pinter Publishers, London & New York

Rip, A. & Robinson, D.K.R. 2013, "Constructive Technology Assessment and the Methodology of Insertion" In Early Engagement and New Technologies: Opening Up the Laboratory, eds. N. Doorn, D. Schuurbiers, I. van de Poel & M.E. Gorman, Philosophy of Engineering and Technology, vol. 16, Springer, Dordrecht

Roelofsen, A., Borerse J.E.W., de Cock Buning, Tj. & Bunders J.F.G. 2008, "Exploring the future of ecological genomics: Integrating CTA with vision assessment", Technological Forecasting and Social Change, vol. 75, issue 3, pp. 334-355

Russell, A.W., Vanclay, F.M. & Aslin, H.J. 2010, "Technology Assessment in Social Context: The case for a new framework for assessing and shaping technological developments", Impact Assessment and Project Appraisal, vol. 28, no. 2, pp. 109-116

Russell, A. W., Vanclay, F. M., Salisbury, J. G. & Aslin, H. J. 2011, "Technology assessment in Australia: the case for a formal agency to improve advice to policy makers", Policy Science, vol. 44, issue 2, pp. 157-177

Schot, J. & Rip, A. 1996, "The Past and Future of Constructive Technology Assessment", Technological Forecasting and Social Change, vol. 4, no. 2-3, pp. 251-268

Stember, M., 1991. "Advancing the social sciences through the interdisciplinary enterprise", The Social Science Journal, vol. 28 *no.* 1, pp.1-14

Tran, T. A. 2007, "Review of Methods and Tools Applied in Technology Assessment Literature", PICMET 2007 Proceedings, 5-9 August, Portland, Oregon, USA

Tran, T. A. & Daim, T. 2008, “A taxonomic review of methods and tools applied in technology assessment”, Technological Forecasting and Social Change, vol. 75, no. 9, pp. 1396-1405

van Merkerk, R. O., Smits, R.E.H.M. 2008, “Tailoring CTA for emerging technologies”, Technological Forecasting and Social Change, vol. 75, pp. 312-333

Van de Ven, A. 1986, “Central problems in the management of innovation”, Management Science, vol. 32, no. 5, pp. 590-607

Van Den Ende, J., Mulder, K., Knot, M., Moors, E. & Vergragt, P. “Traditional and Modern Technology Assessment: Toward a Toolkit”, Technological Forecasting and Social Change, vol. 58, issues 1-2, pp. 5-21

6.6. METHODS APPLIED IN THE DIFFERENT STUDIES

Under the framework of social constructivism as the theory of science, and SCOT and CTA respectively as research methodologies, a number of empirical data-gathering methods have been used. These are shown in Table 8 detailing which methods are connected with the different papers in the thesis.

In general, case studies have been applied throughout the papers. From within a partnership in the case of Vietnam, action research was applied in the early stage of the partnership (**Paper 2**) while participant observation was applied in the maturation stage and its dissolution (**Paper 3**). Derived from these were the use of literature studies, interactive workshops, formal and informal meetings and discussions with partnership participants as well as site visits and direct observation. In the case of Uganda (**Paper 4**) [43], the socio-technical system with respect to the studied waste system was analyzed using ISWM as previously described in Chapter 4.2. Derived methods from this included literature studies and a field visit with semi-structured interviews, direct observation of practice, and a survey including households and services/industries.

The Vietnam partnership was followed from its inception to its eventual dissolution, which spanned a period of from February 2011 to sometime in the summer of 2013. The early phase of the partnership February 2011-January 2012 I shown on Figure 15, illustrating workshop dates and activities surrounding the approval and carrying-out of a pre-feasibility report by an external consultant, all detailed in **Paper 2**. Field study activities in Vietnam and Uganda were carried out in the following periods:

- Visit to Vietnam March 30-April 5, 2013 (basis for **Paper 3**)
- Visit to Uganda December 2-10, 2012 (basis for **Paper 4**)

Uganda has been a hub for the majority of *access2innovation*'s activities. It is worthwhile to mention that several other visits took place to Uganda before and after the field visit specified above. These visits were in support of *access2innovation* activities and not always focused on the SWM system in Kasese but included e.g. knowledge-gathering about different aspects of cash crop value chains in support of the failed chili farming initiative detailed in Chapter 3.6, or participation in business delegation "Go and See" trips for Danish companies under different thematic headings. While not always related to SWM, the visits helped in deepening an understanding of the country. The visits took place as follows: May 28-June 2, 2011; March 10-16, 2012; June 18-24, 2012 and April 30-May 6, 2013.

[43] And for illustrative purposes with respect to CTA methodology, **Paper 1.**

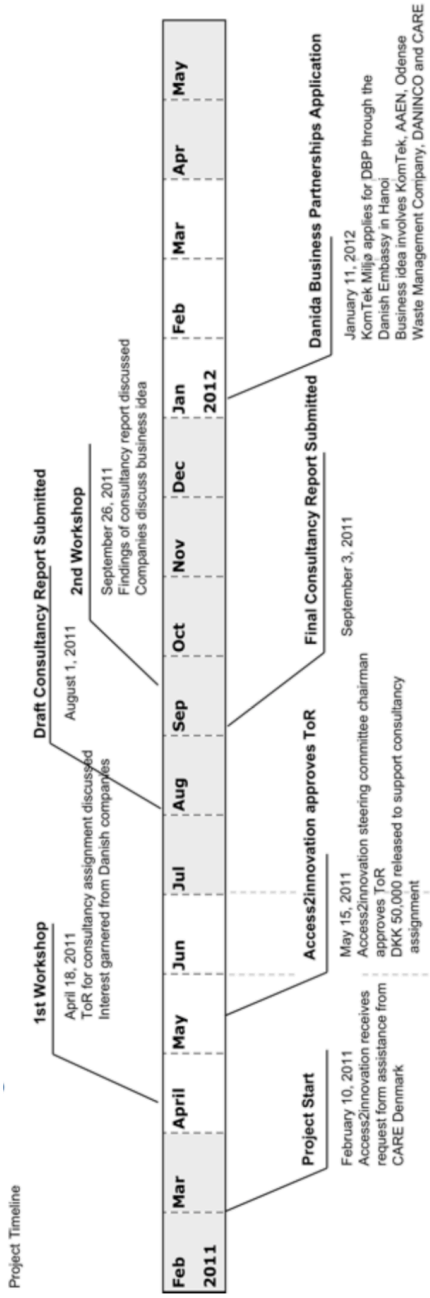


Figure 17 - Vietnam partnership timeline in the early phase

Table 8 - Methods used in papers 1-4.

Publication	Partnership Innovation Emphasis	Summary	Methods
Paper 1 *Constructive Technology Assessment and Partnership Innovation in Developing Countries*	CTA as methodology	Discussion of international technology development and innovation and the history of TA and CTA. CTA proposed as a way to support bridging and sustainable solutions-building in developing country innovation networks, illustrated through *access2innovation* cases. ➔ See *6.5 Highlights: Paper 1*	Case studies
Paper 2 *Innovation in multi-actor partnerships: A waste management initiative in Vietnam*	Early-stage partnership facilitation	Introduction of *access2innovation* as an initiative supporting sustainable solutions in developing countries through partnerships between NGO's, business and academia. A partnership idea is introduced about waste handling in Vietnam with CARE in Denmark and Vietnam and 6 Danish companies. The partnership idea, as facilitated through 5 steps, is explained. In conclusion, CTA-based interactive workshops have supported reaching common objectives among partners. ➔ See *7.1 Highlights: Paper 2*	Case study; Action research (author as facilitator of partnership idea); Interactive workshops with partnership participants; Literature study of internal CARE documents and other documents pertaining to the partnership idea; Formal and informal meetings and discussion with partnership participants over the course of one year.
Paper 3 *A Danish-Vietnamese partnership for business and technology development in solid waste management*	Maturation-stage facilitation and dissolution	Discussion of partnerships within waste management in developing countries and introduction to *access2innovation*. Review is carried out of current SWM practice and issues in Vietnam, including closing material cycles, circular economy and support of technology development and North-South partnerships. A Danish-Vietnamese *access2innovation* partnership is introduced, and its maturation explained through 4 steps, ending with the business concept being challenged. Recommendations include seeking a more comprehensive problem understanding in partnerships, and challenges in the Vietnamese SWM framework conditions are identified. ➔ *See 8.1 Highlights: Paper 3*	Case study; Participant observation; authors as participants in the partnership in different capacities); Literature study of Vietnamese SWM conditions; Interactive 2-week field visit to Vietnam with partnership participants including meetings, formal and informal discussions and site visits with direct observation.
Paper 4 *Partnerships for development: Municipal solid waste management in Kasese, Uganda*	Pre-intervention socio-technical system analysis	MSW conditions in Uganda and similar Sub-Saharan country settings are introduced together with discussions about technology transfer and (innovative) partnerships. *Access2innovation* is introduced. A socio-technical perspective is proposed for analyzing the waste system of Kasese, and an ISWM-based research design is explained. Results show Kasese's waste system elements interacting with the formal and informal sector and only offering basic MSW services. Recommendations include mobilizing the community and engaging stakeholders in the long term, while informal sector based and decentralized solutions are seen as a pragmatic option. ➔ *See 9.1 Highlights: Paper 4*	Case study; Literature study of Ugandan SWM conditions; Semi-structured interviews with stakeholders in Kasese's waste system; Direct field observation of waste practice in Kasese; A total of 20 surveys (15 households and 5 services/industries) in Kasese; Workshops and informal meetings with SWM stakeholders in Kasese.

Case Studies

Case-based research can be designed and classified in many ways. Clarifying the Ugandan and Vietnamese case studies I therefore pertinent. Each represent different time- and analytical scales, and the intention has not been to make direct cross-comparison.

In general. Flyvbjerg (2006) argues that case studies offer value in terms of generating knowledge, even though the knowledge is usually context-dependent: Characteristics of case studies are usually contingent upon their framework conditions, and it is problematic to assume it is possible to generalize widely from them. Flyvbjerg argues, however, that context-independent knowledge shouldn't be seen as more valuable than context-dependent knowledge, because when it comes to explaining or predicting human affairs, universal theories are rarely applicable (Flyvbjerg, 2006). Flyvbjerg argues for experts to move beyond such notions of universal theories and utilize the practical experience from case studies to gain more nuance. The aim is not to generalize per se, but to gain an in-depth understanding of a phenomenon that is interesting in and of itself, the knowledge here being supplementary to more traditional scientific approaches. As he contends, *"... formal generalization is overvalued as a source of scientific development, whereas the "force of example" is underestimated."* (Flyvbjerg, 2006)

Case studies according to Yin (2003) allow *"... investigators to retain the holistic and meaningful characteristics of real-life events."*, and further, that they can be seen as *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."* (Yin, 2003). Thus, case studies are argued to be a meaningful method guided by SCOT and CTA when investigating co-construction of technology within a partnership as in the case of Vietnam, or investigating socio-technical system considerations for this kind of co-construction in Uganda. Extracting holistic and meaningful characteristics was the aim for both cases considering their contexts, guided by the research question and sub-questions detailed in Chapter 5.

Considerations about choice and classification of case studies are important. According to Flyvbjerg (2006), a strategic selection of cases is important, since an average representative case might not provide the richest information on a topic – a study on an atypical or extreme case will often reveal more, it is argued. In this respect, Vietnam and Uganda represent such partnership innovation cases within SWM insofar as having been organized under the uncommon *access2innovation* cross-sectorial framework. Selection of the cases has been 'constrained' as a result of myself being directed to be responsible for them by the head of *access2innovation* and because they were among the opportunities that arose that fit my perceived competencies. They were therefore not strategic in the sense of being a free and open choice. Nonetheless, the thematic sharing of SWM as a professional area of expertise

(as detailed in Chapter 4) provides for cohesion in case selection. For instance, the chili farming case in Uganda detailed in Chapter 3.6 was an option elaborate on, but was discarded as a poor thematic supplement to the Vietnam case.

Yin (2003) elaborates on case selection with respect to single or multiple case study designs. Because the intention has not been to use the Vietnamese and Ugandan cases for direct cross-comparison, it is better to view them as complementary single cases under a shared SWM theme, answering different sub-questions as given Chapter 5. In this respect, Yin (2003) details three different rationales for choosing single case studies:

- If the case is a *critical* case, it exhibits the conditions for confirming, challenging or extending the propositions of a theory.
- If the case is an *extreme* or *unique* case, it represents a rare set of conditions that fall outside of a theoretically understood pattern.
- If the case is a *representative* or *typical* case, it reflects common everyday conditions.

Classifying the chosen cases is then a matter of ruling out the possibilities. First, it is argued that the cases are not representative of partnership innovation settings (again because *access2innovation* represents an uncommon cross-sectorial framework). On the other hand, the cases do not represent phenomenon for which there are no theories to help explain them at all – for instance, BoP as detailed in Chapter 2.2 and the role of the private sector and BoP in ISWM as detailed in Chapter 4.3 show that there are phenomena and propositions within the topic of the Vietnam and Ugandan cases. Therefore, the cases can best be understood as *critical* cases.

Action Research and Participant Observation

Action research is a method in the Vietnam case, especially in the early-stage partnership facilitation detailed in **Paper 2** which lasted for approximately 1 year. Reason and Bradbury (2010) explain that action research combines action and reflection, and as per Goduscheit et al. (2008), the researcher acts as both observer and problem solver, taking action as well as generating knowledge or theories about that action. Action research further combines theory and practice and emphasizes inclusivity[44] in practical knowledge production and solutions-building for pressing issues among people and communities (Reason and Bradbury, 2010). In this thesis' understanding, action research characterizes the entirety of activities throughout the timeline shown in Figure 17, and is closely tied with the CTA methodology as mentioned in **Paper 2** in which CTA principles shown in Table 7 are used to illustrate. Action research covers the 'milestone events' throughout the time period in Figure 17, and the activities and reflection that took place between and after these events. As

[44] Understood as participatory, democratic processes (Reason and Bradbury, 2010).

a method, action research thus denotes the lengthy process of partnership facilitation over a period of time, as well as the set of observations and problem-solving activities (and their reflection) that take place during this process.

Participant observation was used once the partnership in the Vietnam case eventually entered its maturation stage detailed in **Paper 3**. According to Taylor and Bogdan (1984), participant observation refers to *"research that involves social interaction between the researcher and informants in the milieu of the latter, during which data are systematically and unobtrusively collected."* As explained in **Paper 3**, the method is similar to action research but what was different in the case of the maturation stage was that the lead company, in this case KomTek, had a leading role. In comparison to action research and the early stage facilitation, the researcher's role was less as a problem-solver and more as a team participant under the leadership of the company contributing in meetings and discussions and participating in the field study to Vietnam. In **Paper 3** it is further explained how the researchers[45] were distanced from the process. As argued in the paper, neither researcher may have been truly impartial to the process – although the notion of impartiality is critiqued under social constructivism, see Chapter 6.2 – but we were well positioned to extract meaning from the events from a Danish and Vietnamese perspective.

Interactive Methods

All papers in the thesis describe the use of different interactive methods, which cover workshops, stakeholder meetings and informal meetings and discussions as understood here. Grin, van de Graaf and Hoppe (1997) advocate for structured and interactive discussions to be embedded methods in a TA process, while in Rasmussen (2011) a number of specific interactive methods are described in relation to change management in organizations, communities and networks. It is argued here that interactive methods are integral in SCOT and CTA methodology and well-suited for action research and participant observation in partnership innovation.

In **Paper 2** and **Paper 3** especially, extensive use of workshops and meetings are described. Figure 18 shows snapshots taken of workshops and meetings during the early stage of the Vietnam partnership with emphasis on e.g. goal alignment, understanding the context and framing different ideas for solutions, and the maturation stage with emphasis e.g. on co-constructing a business model for the partnership's joint venture.

[45] Myself and Vietnamese co-author, Professor Leu Tho Bach from Hanoi's National University of Civil Engineering.

Figure 18 – Workshops and meetings in the Vietnam partnership (early-stage at top, maturation stage at bottom). Own pictures.

Paper 4, although it had a socio-technical SWM system focus, also included meetings with stakeholders as a form of interactive method as part of its ISWM-based analysis. Figure 19 shows 2 snapshots of this, taken during visits with local kingdom and local government representatives in Kasese, respectively. These meetings were seen as crucial in understanding roles and capabilities in the existing system, as well as in a future system which might include technological changes.

Figure 19 - Meetings with stakeholders in the SWM system in Kasese, Uganda. Pictures by Josefine Vanhille

Literature Studies

Literature studies are seen as integral to a thorough research process (Andersen, 1997) and have been used to cover concepts and theories such as inclusive and sustainable technology and innovation including e.g. the BoP and social business literature covered in Chapter 2, SWM management in developing countries (covered in Chapter 4) and the theory of science and methodologies (covered in the preceding sub-chapters in Chapter 6). As well, literature studies have supplemented the action research and participant observation methods in **Paper 2** and **Paper 3** and the ISWM analysis in **Paper 4** by being applied to study country context of SWM issues in Vietnam and Uganda. As a result, the papers include data on SWM governance in these countries, their challenges are described and quantitative data is included where pertinent to characterize e.g. volumes of waste flows and percentages of waste fractions.

Field Work

Field work has been used as part of both the Vietnamese and Ugandan cases in order to understand complexities involved with SWM and innovation in the Vietnam and Uganda – in which interactive methods and direct observation have played an important part. Mikkelsen (2005) details the use of such social research methods in international development research and practice, though emphasis here is a more 'traditional' development cooperation program and project cycle, e.g. in a context where they are used in conjunction with Logical Frameworks, and with participative appraisal with 'target groups' as part of program and project design. Nonetheless the definition of field work is applicable (Mikkelsen, 2005): Field work is the actual process of data collection (in the field), intertwined with data analysis and possible revision of initial questions. It is thus seen as iterative enough to be embedded in action research and participant observation, and inform the co-construction of technology in the Vietnamese partnership and when assessing technological pathways for the SWM system in Kasese, Uganda.

Figure 20 shows snapshots of field work in Uganda, while Figure 21 shows snapshots of direct observation of SWM system elements in both Uganda and Vietnam.

Figure 20 - Waste survey and composting plant visit in Kasese, Uganda. Pictures by Josefine Vanhille

Figure 21 - Waste system element observations of collection and transfer sites (Kasese, Uganda to the left, Hanoi, Vietnam to the right). Picture by Josefine Vanhille (left) and own picture (right).

6.7. CHAPTER SUMMARY

In this chapter, which constitutes the 2nd part of the Research Design, the theories of science and the methodologies have been elaborated that form the research basis. The theory of science was based on social constructivism, in which ontological and epistemological claims were elaborated and nuanced with respect to SCOT, which has sprung out of social constructivism. SCOT and CTA were then elaborated as methodologies, the former with contributing with insights concerning *relevant social groups*, *interpretative flexibility* and *stabilization* in technology co-construction processes. CTA was developed in **Paper 1** with respect to developing countries, in which its suitability as a form of socio-technical *insertion* was argued with respect to partnership innovation processes in networks.

Finally, utilized methods in the research were described, covering case studies, action research and participant observation, interactive methods, literature studies and field work. With the Research Design thus explained, the next part of the thesis will focus on the Results and Analysis.

PART III – RESULTS AND ANALYSIS

This part consists of:

- *Chapter 7: Vietnam: Early-Stage Partnership Facilitation*
- *Chapter 8: Vietnam: Maturation-Stage Facilitation and Dissolution*
- *Chapter 9: Uganda: Socio-Technical System Analysis*

The purpose of Part III is to present the results and analysis in the PhD thesis based on the preceding chapters in Part I and Part II, in which the papers relating to the Vietnamese and Ugandan case studies are inserted. **Paper 2**, **Paper 3** and **Paper 4** each make up Chapters 7, 8 and 9 respectively, and are each preceded by an introductory text denoted as 'highlights'.

CHAPTER 7. VIETNAM: EARLY-STAGE PARTNERSHIP FACILITATION

7.1. HIGHLIGHTS: PAPER 2

Innovation in Multi-Actor Partnerships: A Waste Management Initiative in Vietnam

In this paper, the earliest stage of the Vietnam case study is presented and considered from a CTA perspective, and the potentials and limitations of *access2innovation* are reflected upon. The paper addresses sub-questions 1 and 2 (see Chapter 5) to the thesis' main research question. These sub-questions deal with what interests influence the construction of technology and how they come into play, and how inclusivity and sustainability are framed and addressed.

After presenting *access2innovation* as an innovative way of supporting sustainable ventures in developing countries through partnerships, the background for the development of an idea for waste handling in Vietnam is introduced. CARE in Denmark and Vietnam approached *access2innovation* with the idea of treatment and sales of derived products from organic waste due to the problems they saw with indiscriminate coastal household waste disposal. After this, the business development process took place was based on action research. This involved CARE in Denmark and Vietnam as well as six different companies including an organic waste treatment company, engineering consultancies, a carbon project developer and a municipal waste management company. Key points raised in the paper include:

- CTA facilitated partners from different sectors in reaching a common set of objectives through e.g. interactive workshops.
- The partnership innovation process following five steps[46] leading to one company taking the lead in the business concept of small-scale composting and biogas technology, inclusive of poor and vulnerable groups.
- *Access2innovation* can act as an 'institutional infrastructure' capable of supporting the path from an NGO-driven needs assessment towards garnering commercial interest in a business concept in partnership innovation. Companies can still (and fairly easily) opt out of the process, however.

[46] Initial Needs Assessment, First Interactive Workshop, Providing a Decision Base, Second Interactive Workshop and Business Development.

PAPER 2

Christensen, D. (2014) Innovation in multi-actor partnerships: A waste management initiative in Vietnam. In: Bolay J., Hostettler, S., Hazboun, E. (Eds.) *Technologies for Development: A Way to Reduce Poverty?* Springer International Publishing, Cham, pp. 147-158

Chapter 13
Innovation in Multi-Actor Partnerships: A Waste Management Initiative in Vietnam

David Christensen

Abstract *Access2innovation* is an initiative based in Denmark that develops and tests innovative new ways to build and implement strategic partnerships between civil society, business and academia. The objective is to meet perceived market opportunities and challenges in developing countries by developing innovative sustainable technological solutions and business models through partnerships. In this paper, an action research study is presented involving the early stage development of a commercial venture addressing waste problems in Vietnam involving CARE International and Danish companies in the waste management sector and carbon market. As facilitator and mediator, the author has sought to align objectives and bring about a business idea involving waste handling technologies. In the study, it is shown that going from an initial needs assessment towards a business idea is challenging, although some keys to success lie in providing actors with a sound base for decision-making as well as active bi- and multilateral negotiations. As a novel experiment, the study shows that *access2innovation* can provide a platform conducive for partnership-based innovation for development.

13.1 Introduction

This paper presents some preliminary findings from an initiative that distinguishes itself through its innovative approach to supporting sustainable, commercial ventures in difficult developing and emerging markets. The initiative, termed *access2innovation*, develops and tests new ways to build and implement strategic partnerships between development NGO's, businesses and academia.

D. Christensen (✉)
Department of Development and Planning, Aalborg University, Copenhagen, Denmark
e-mail: damc@plan.aau.dk

J.-C. Bolay et al. (eds.), *Technologies for Sustainable Development*,
DOI: 10.1007/978-3-319-00639-0_13,

The objective of the initiative is to meet market opportunities and challenges in developing countries by developing innovative sustainable technological solutions and business models through such partnerships. Specific thematic areas for *access2innovation* are renewable energy, water and sanitation and food security. The initiative is driven forward by an interdisciplinary, network–administrating secretariat which the author has been part of since 2011 as an action researcher and member specializing in management engineering, with a further specialization area in technology assessment.

Access2innovation is an initiative based in Denmark running for a total project period 2011–2014, and is what may be seen as an experiment in building and implementing partnerships between disparate sets of actors. Working to turn needs and challenges into market opportunities, its secretariat counts specialists within project management, management engineering, business modeling and development studies and has in the past drawn on competencies within user-driven innovation and anthropology.

External parties involved as partners in the *access2innovation* initiative include several Danish universities, business interest organization as well as Danish branches of international NGO's—among them CARE, ActionAid, the Red Cross, and the World Wildlife Fund. The full list of participating project partners is shown in Table 13.1.

The rationale for bringing disparate partners together lies in the initiative's premise that synergies may be found in combining the competencies found in multi-actor partnerships involving all parties. The specific propositions are listed below (Ravn 2012), while the overarching model followed by *access2innovation* is illustrated in Fig. 13.1.

- For NGO's, the proposition is that these types of organizations gain access to better tools for operational activities in their relief and development work. NGO's provide their partners with local expertise and networks in developing countries.
- For businesses, the proposition is that they gain access to new knowledge, networks, improved positioning and new markets. Companies enter into partnerships with vital technical know-how as well as production and marketing capabilities.

Table 13.1 *Access2innovation* participant organizations

Development NGO's	Business interest organizations	Universities
CARE Denmark	Confederation of Danish Industry	Aalborg University
MS Actionaid Denmark	Northern Jutland Food Network	Copenhagen Business School
Danish Red Cross	Danish Water Forum	Copenhagen University
World Wildlife Fund	Renewable Energy Innovation Network, Danish Technological Institute	

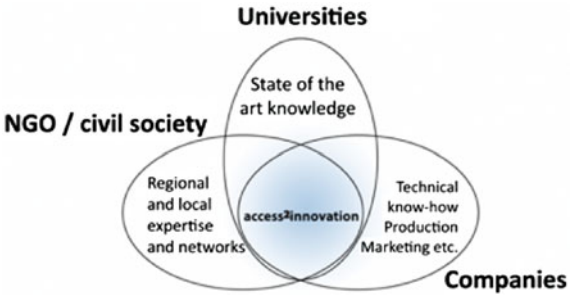


Fig. 13.1 *Access2innovation* illustrated

- For universities, the proposition is that these knowledge institutions get an expanded base on which to pursue their core activities within research, higher education and societal engagement. They gain access to new knowledge and research areas, and enter into partnerships with state-of-the-art knowledge.

These propositions have been tried out in a previous incarnation of the *access2innovation* initiative in 2007–2011 running on a smaller scale than the current set-up. This pilot initiative achieved remarkable results in generating entrepreneurial spin-off companies addressing needs and challenges in humanitarian mine–clearing activities, which was the departure point for the pilot (Ravn 2012). Among others, the pilot initiative launched SkyWatch, a company producing a remotely controlled multi-rotor aerial vehicle for digital mapping of a mine–clearing area. It also produced ViewWorld, a company that developed a mobile phone application specifically designed to assist aid workers in field reporting. Though these examples will not be dealt with in detail, they serve to illustrate that *access2innovation* can serve as an institutional infrastructure that in the innovation management literature is seen as crucial for addressing networked innovation processes (Van de Ven 1986).

As part of the *access2innovation* initiative in its current incarnation and as member of the secretariat, this author has facilitated a multi-actor partnership centered on developing a business idea for handling of waste in Vietnam. The background for becoming engaged with waste management in Vietnam to begin with was because of the prompting of a development NGO (CARE International, in Denmark and Vietnam) that identified a specific need for private sector involvement and presented it to the *access2innovation* secretariat. CARE Vietnam sought private sector assistance after identifying the problem of a lack of formalized waste handling in the coastal communes of the country where the NGO operates, south of Hanoi. In these communes, CARE Vietnam observed that waste was indiscriminately disposed of directly to the surrounding environment. This negatively affects their activities, because domestic household waste (specifically plastic bags) stunt the growth of mangrove saplings that have been planted as part of a CARE Vietnam coastal disaster risk reduction and climate adaptation project.

The case study presented in this paper is based on action research, with the author assuming the role of facilitator and mediator in a multi-actor partnership.

Table 13.2 Partnership participants

Partnership participant	Description
CARE Denmark	NGO; Danish subsidiary of CARE International
CARE Vietnam	NGO; Vietnamese subsidiary of CARE International
Company A	Contracting business; Organic waste and residual waste management, especially composting
Company B	Engineering consultancy; Management of energy projects including carbon projects in transition countries, with an express wish to expand into developing countries
Company C	Municipally owned limited company; Not-for-profit, municipal public waste management service delivery
Company D	Engineering consultancy; Specializes in bioenergy systems, quality management and training
Company E	Engineering consultancy; Specializes in environmental and geotechnical construction with an already established presence in Vietnam
Company F	Engineering consultancy; Specializes in waste management consultancy services

The case study exemplifies how the *access2innovation* principles work in practice, and centers on the early stage development of developing a commercial idea based on CARE Vietnam's needs assessment and wish to collaborate with businesses. Specifically, it includes the involvement of a number of Danish companies operating in the waste management sector and carbon market. The full list of actors involved in the process is given in Table 13.2.

13.2 Design and Methods

13.2.1 Action Research

Because the author in the case study is inextricably part of the phenomenon, the scientific approach may be best aligned with *action research*. Action research brings together action and reflection. It links theory and practice and puts emphasis on participatory, democratic processes in practical knowledge production and the creation of solutions to issues of pressing concern to people and communities (Reason and Bradbury 2010).

The role of the researcher under this set of scientific principles is dualistic. Goduscheit et al. (2008) frame this quite simply, based on a Danish inter-organizational network study similar to *access2innovation*: when conducting action research, the researcher works as both an *observer* and *problem-solver*. In this sense, action research aims at taking action as well as generating knowledge or theories about that action, giving rise to a delicate balancing act between the roles. In the context provided by *access2innovation*, this author therefore facilitates and

constructs as much as observes and evaluates. Coughlan and Coghlan (2002) point to the same kind of dualism, stating that action research projects typically consist of two distinct elements: the actual change project involving some kind of action, and the research project based on that change. These elements in the case study designed are seen as follows:

- The change project is the process of getting the Danish companies in the waste management sector and carbon market to collaborate with CARE Denmark and CARE Vietnam in the formation of a business idea.
- The research project seeks to understand how business and development concerns are negotiated against each other in the social setting provided by the partnership. Due to the novel constellation of participants, one could reasonably expect that there will be issues of contention between these concerns.

13.2.2 Data Collection Methods

The empirical data-collecting methods used by the author have been those of an interactive field practitioner and process facilitator. This consisted of workshops, bilateral and trilateral meetings, phone conversations, email exchanges, field observations and field notes.

In addition, documents have been key for the partnership process in the sense that they have formed the reference point for discussion, dissent, negotiations etc. between the participants in the partnership. These have included:

- Internal CARE Denmark documents;
- Workshop summaries;
- A Terms of Reference for a consultant field study in Vietnam;
- A consultant report conducted on the basis of the Terms of Reference;
- A Danish company memo on the carbon credit potential of the project;
- An application document to a governmental, Danish private sector support mechanism for developing countries.

While the data-collection methods may have lack the robustness of more 'traditional' methods, e.g., questionnaires among the partnership's participants, or conducting formal semi-structured interviews, some arguments go some way towards addressing this. Firstly, there is the richness of data, which comes from multiple sources: from personal interaction at different levels of communication with the people and organizations involved, as well as textual artifact documents. Secondly, there is the timeframe. Because the partnership has been running for the duration of a year, any observations have had a chance to play out throughout this period. Any issues raised during the case study have had a chance to become robustly embedded in discussions throughout the duration of the process. The study is not a simple snapshot picture of a partnership collaboration process taken at an arbitrary point in time, but a study of the process in its entirety so far.

13.2.3 Constructive Technology Assessment

A special note should be made concerning the use of participatory action research methods in the above process; this author has employed the use of *Constructive Technology Assessment* as a guiding methodological framework. Technology assessment is a discipline usually thought of and embedded within policy studies and sometimes mistakenly equated with solely an engineering approach. In general terms, technology assessment is a set of methodologies that are utilized to help assess the potential positive or negative impacts that may follow in the wake of introducing a new technology of any conceivable type (Coates and Jarratt 1992). Though not focused exclusively on technology development *per se,* the activities in *access2innovation* imply that careful foresight is necessary concerning the technological elements on which any business model is developed. This is especially due to the low-income and/or marginalized groups that are likely to be affected by a commercial intervention in a developing country.

Historically, technology assessment has mostly been applied in setting whereby experts and scientists undertook retrospective assessments of known technologies and providing incontestable answers (Remmen 1991; Schot and Rip 1996). More recently, a shift has been made from being *diagnostic* and *reactive* in such occasions to becoming *predicting* and *constructive* in conditions requiring more agility, and in more fluid situations when the context of a technological development and its impacts is highly uncertain. Such conditions are argued to be embodied in the partnerships settings provided by *access2innovation*. To address the increasing uncertainty of many technological developments, constructive technology assessment relies on the practitioner-researcher to be interactive and promote more democratic, participatory decision-making. A characterization of constructive technology assessment, contrasted with traditional technology assessment, is illustrated in Table 13.3. The important point to be made is that the practitioner–researcher no longer is tasked with finding the right answers to a

Table 13.3 Traditional technology assessment versus constructive modes of TA (Remmen 1991)

Traditional Technology Assessment	Constructive Technology Assessment
Dominance and authority given to science and scientist-practitioners	Users and scientist-practitioners engage in dialog
Provides the direct consequences and effects associated with a technology	Specifies both goal and methods as well as consequences and problems
Limited problem analysis	Emphasizes a problem analysis
Focus on technical solutions	Combines a number of possible solutions
Results provided in a report	The results are provided through design
Tool for decision-making	criteria, a report as well as dissemination
Linked automatically (technocratically) with parliamentary decision-making processes	Provides a 'catalytic effect'
	Interlinks with different arenas of decision-making
Finding the right answers	***Asking the right questions***

given problem complex, but is instead tasked with making sure that the right questions are asked.

Most recently, the technology assessment literature suggests that concerning developing countries, constructive types of applied technology assessments have their greatest applicability (Ely et al. 2011). This is seen to be because they are flexible enough to make use of networks of actors to fill in institutional capacity gaps often seen in resource-constrained governments. In this light, it can be argued that *access2innovation* appears to follow the general call for including diverse stakeholder groupings to participate in technology assessment processes in developing countries.

13.3 Results

A narrative of the case study explaining the process is given in the following.

Step 1—Initial Needs Assessment: First, CARE Denmark made an approach to *access2innovation* requesting assistance for a business partnership idea centering on waste management in Vietnam. At this point CARE Denmark was already established as a participating partner in *access2innovation*. Upon receiving the request for assistance, *access2innovation* responded by asking CARE Denmark to reformulate their problem identification into a Terms of Reference for a further in-depth study of the problem area. The background for CARE Denmark's request for assistance was explained as follows:

- CARE Vietnam had for four years been involved in a community–based climate change adaptation and disaster risk reduction project involving mangrove tree planting in coastal areas of Thanh Hoa province, south of the nation's capital Hanoi. This was a coastal disaster risk reduction and climate change mitigation project. The project had major problems with untreated domestic household waste, in particular plastic bags washed in from inland and further up the coast that become entangled with the tree saplings and stunting their growth. Attempts to secure funding for a root-cause waste management project have failed.
- CARE Denmark has become interested in establishing relations with Danish companies and adopted a formal policy to this end in 2010. Additionally, Danish companies are perceived by CARE to be at the 'cutting edge' in terms of waste management know-how and technology.
- Perceived positive developmental effects in addressing the waste situation in Vietnam are apparent. Untreated amounts of waste are only increasing due to the country's largely unchecked economic growth, and the negative environmental and health problems are unfairly distributed towards poverty-affected groups. There is also a potential for job creation if a waste management intervention is made.
- Traditionally a purely private sector-oriented support program, the so-called Danida Business Partnerships program under the development cooperation arm

of the Danish Ministry of Foreign Affairs is a funding source that had recently opened up to enabling NGO participation in the commercial ventures it co-finances. This, coupled with the fact that CARE Denmark's traditional funding sources at the Ministry of Foreign Affairs were being phased out, increased CARE Denmark's interest in the Danida Business Partnerships (DBP) program and in collaborating with Danish companies in general. Additionally, the guidelines from the Danish Embassy in Vietnam were quite clear in stating that they strongly favor commercial business ventures under the DBP program featuring the use of 'green' technology.

- CARE Denmark was an active member of the *access2innovation* project and seeks to make use of their support in early stage commercial venture development be-tween NGO's and Danish companies.

As for the Terms of Reference submitted by CARE Denmark, these established:

- Waste management problems were real, pervasive and affected CARE Vietnam's mangrove project in the coastal communes in Thanh Hoa province.
- There were at present unclear roles and responsibilities on behalf of the Vietnamese authorities throughout different levels of government to address rural waste issues.
- There was a lack of any formal, proper disposal facilities for solid waste present in the target communes, located in two specific districts of Hau Loc and Hoang Hoa in particular.
- There had been aborted previous attempts at commune level for household waste collection schemes because of a lack of proper disposal facilities, and aborted attempts at district level to attract bidding for establishing such facilities.

As its objectives, the Terms of Reference established the following goals:

- To analyze the waste management situation and waste-to-energy potentials in five target communes and at least one town in Hau Loc and Hoang Hoa districts in Thanh Hoa province.
- To make recommendations for a project to address the waste management situation in the area.

Step 2—First Interactive Workshop: The Terms of Reference formed the basis of a first interactive workshop, in which a number of companies were identified and invited to discuss the draft contents of the study in accordance with what they saw as important from their own business perspective. During this workshop, the companies also voiced how they saw themselves as being involved in the partnership. The companies were identified through private networks at both the *access2innovation* secretariat and CARE Denmark.

The main output of the workshop was a consensus that there was no reason to delay the in-depth study. Upon explaining the conditions for *access2innovation* to support paying for the in-depth study by man-hours in kind supplied by the companies and CARE Denmark, the workshop participants agreed that this could

be done by holding a follow-up workshop after the consultancy assignment was conducted. The second workshop would have the function of having the companies come together to discuss the findings and decide upon the next steps in the partnership.

In effect, this was a workshop output that alleviated many of the uncertainties involved in the initiative: by adopting a stance that insisted upon data from the consultancy assignment first before committing fully to becoming a commercial partner in the initiative, the collective sentiment was 'wait-and-see'. In this manner, the Vietnam initiative held the companies' attention until further light could be shed on the waste management situation in the target communes.

The Terms of Reference was accepted by the *access2innovation* secretariat to be supported financially. As a research initiative supported with external funding, *access2innovation* has the discretionary mandate to disperse of such support funding on condition of in-kind contributions from the organization or organizations applying for such funding.

A support package of 50,000 Danish Krone (approximately 6,700 €) was released from the secretariat to support a consultant to carry out the in-depth study of the problem area. As agreed with the participating companies and CARE Denmark, this amount was to be released on the condition that the same corresponding amount was to be provided in-kind by the partners in terms of man-hours.

Step 3—Providing a Decision Base: Once the Terms of Reference were accepted, an external consultant was identified to carry out the field study in collaboration with local consultants. The external consultant submitted a draft, then a final report on his findings.

The main conclusions in the study by and large confirmed the overall picture assumed to begin with, but provided greater detail of the waste situation. The study was able to provide more specific information about the volumes and composition of the waste, where it came from and also showed that the informal recycling sector was active to a certain degree in the surveyed areas. In the most populated commune in the surveyed areas, a rudimentary solid waste collection system existed with a number of waste collectors using pushcarts and a small fee for service. However, the system only served to collect urban waste for direct disposal to coastal waters. In no place among the surveyed areas was there any final handing of organic waste other than direct dumping to the surrounding environment.

Step 4—Second Interactive Workshop: After the external consultant submitted the findings, the *access2innovation* secretariat organized another workshop to discuss the report. This second workshop was crucial because it provided the venue and forum for the participating companies to coalesce a more tangible business idea together. While the innovation process as a whole may have begun the moment *access2innovation* reacted to CARE Denmark's request for assistance in Vietnam, there was no real business development process to speak of until the consultancy report was handed in. The report provided a decision-base from which the participating companies would be in an improved position to assess their continued commitment, leading to the formation of an actual business idea.

During the workshop, the partners discussed their differing interests in the waste management initiative. Two companies dropped out of the entire process prior to this workshop after having seen the consultancy report. Company E was too occupied with existing commercial activities to consider continuing with the Vietnam initiative, while Company F was a smaller consultancy company that did not see a business case in the submitted material.

For those companies that did come around the table to participate in the second workshop, they did eventually move to coalesce around a specific business idea centered on the utilization of composting and biogas technology on a minor scale and specifically including poor and vulnerable groups in the business model as paid waste collectors. The revenue streams in the business idea focused on sales from biogas and digestate/fertilizer production as well as carbon credit sales. In this manner, the idea made use of the different core competencies that existed in the partnership. There was some back and forth discussion among the companies concerning how the initiative was to consider commercial scalability to begin with, or whether the initiative should first start out with a small-scale pilot phase. Both considerations had implications for the technologies to be implemented, as well as how it would address development objectives in line with CARE Vietnam's priorities. A large-scale and centralized waste handling plant would have implied a greater catchment area than what CARE Vietnam was initially prepared for, and would have had fewer opportunities for involving poor and vulnerable groups as waste collectors in the business model. Electricity production and carbon crediting would however be at a commercial scale more in line with the mainstream for such technologies. In contrast, it was reasoned that a biogas facility dimensioned to fit with the small local solid waste production amounts might not be commercially feasible to begin with and might imply problems relating to continuous biomass supply, but would have a greater potential for social inclusion and development impact.

Two lead company contenders emerged from the workshop: companies A and B. The *access2innovation* secretariat had to subsequently hold bilateral meetings with each of the companies and with CARE Denmark in order to come to an agreement about which one was to ultimately take the lead role. Company A ended with taking the role, mostly on merit of being a contracting business and technology provider rather than being a consultancy. As such, it was reasoned that it would be easier and more in line with Company A's core business to direct investments towards building up the waste handling facilities locally.

Step 4—Business Development: Based on the input from the second workshop and through the bi- and trilateral meeting between the *access2innovation* secretariat, the companies and CARE Denmark, the basis began to be laid for a concrete business idea to be submitted to the Danida Business Partnerships program, a Danish governmental support scheme for private sector development in developing countries. The business idea outlined in the support scheme application ended up being granted support funding from the Danish government. Initially, the government support facilitated only a field visit to Vietnam by representatives of the participating Danish companies in the partnership. The field visit, as well as

subsequent visits to Vietnam by Danish company representatives, identified a number of potential local partner companies in the business idea. Currently, an in-depth feasibility study (a further and more detailed decision base) is being worked out as the business idea continues to undergo further maturation with the support of the *access2innovation* secretariat.

13.4 Conclusions

In the attempt to facilitate multi-actor partnerships, the Vietnam case study shows that the *access2innovation* approach has shown some real effects in ensuring the stability of disparate actor constellations, spanning the NGO and business sectors, in the process of developing a business idea. Through interactive workshop methods in the spirit of a constructive technology assessment ('asking the right questions'), this author has facilitated reaching a common set of objectives for a waste management business idea in Vietnam with positive development effects. Seen in this light, the *access2innovation* case study shows that an interdisciplinary network-administrating secretariat can provide the institutional infrastructure to manage the complex task of going from an initial NGO-driven needs assessment towards garnering commercial interest and crystallizing a business idea, making use of a multi-actor partnership. As a novel experiment in its initial stages, the case study shows that *access2innovation* can provide a platform that is conducive to network-based technological innovation for development.

There is a caveat, however. The task given to *access2innovation* is not easy, and many factors remain beyond its control. Even the presence of a dedicated network administrating secretariat does not guarantee 'buy-in' to a business idea from companies in a difficult market environment, and even financial support to spur momentum in a partnership process does not guarantee results by the same token. For example, this was carried out in the case study when the *access2innovation* secretariat released funds for a consultant to provide an in-depth analysis of the waste management problem in Vietnam. The initiative saw the opt-out of two companies that were initially involved in the partnership. Yet despite this, the partnership lives on, and it is with this note that this author highlights the innovative value of the *access2innovation* approach, as the partnership enters into a more decisive phase of maturing and testing out the business idea.

References

Coates & Jarrat, Inc. (1992). *Technology assessment: Anticipating the consequences of technological choices*. Course workbook presented in conjunction with the international association for impact assessment's 12th annual meeting in Washington, D.C.

Coughlan, P., & Coghlan, D. (2002). Action research for operation management. *International Journal of Operations and Production Management, 22*(2), 220–240.

Ely, A., Van Zwanenberg, P., & Sterling, A. (2011). *New models of technology assessment for development*. STEPS working paper 45. Brighton: STEPS center.

Goduscheit, R. C., Bergenholtz, C., Jørgensen, J. H., & Rasmussen, E. S. (2008). Action research in inter-organizational networks: Impartial studies or the trojan horse? *Systemic Practice and Action Research, 21*(4), 267–281.

Ravn, J. (2012). *Access2Innovation: Netværksbaseret forretningsmodel innovation målrettet nødhjælps- og udviklingsbistanden (translated from Danish: Access2Innovation: Network-Based Business Model Innovation for Disaster Relief and Development Assistance)*. Ph.D Dissertation, Department of Development and Planning, Aalborg University.

Reason, P., & Bradbury, H. (2010). Introduction: Inquiry and participation in search of a world worthy of human aspiration. In P. Reason & H. Bradbury (Eds.), *The handbook of action research*. London: Sage Publications Ltd.

Remmen, A. (1991). Constructive technology assessment. In T. Cronberg, P. Duelund, O. M. Jensen, & L. Qvortrup (Eds.), *Danish experiments—social constructions of technology*. Copenhagen: New Social Science Monographs, Institute of Organisation and Industrial Sociology, Copenhagen Business School.

Schot, J., & Rip, A. (1996). The past and future of constructive technology assessment. *Technological Forecasting and Social Change, 54*(2–3), 251–268.

Van de Ven, A. (1986). Central problems in the management of innovation. *Management Science, 32*(5), 590–607.

CHAPTER 8. VIETNAM: MATURATION-STAGE FACILITATION AND DISSOLUTION

8.1. HIGHLIGHTS: PAPER 3

A Danish-Vietnamese partnership for business and technology development in solid waste management

In this paper, the Vietnam case study is examined until its conclusion, which was the dissolution of the partnership and abandoning of the business concept. As with Chapter 7, sub-questions 1 and 2 to the thesis' main research question are addressed in this paper (see Chapter 5), dealing with the interests influencing the construction of technology and the framing of inclusivity and sustainability.

After presenting partnerships as a means addressing sustainability in SWM in developing countries, it is shown that Vietnamese framework conditions provide important roles to certain actors[47]. In the Vietnam case study, this was considered when a re-ordering was made in the partnership: CARE withdrew and Vietnamese partners entered the picture. Key points raised in the paper include:

- The business concept was based on a large-scale, complete waste treatment facility and sales of derived organic products. Barriers to the concept included: a misjudged level of public subsidies for fertilizer production, the adaptability of the technology to local conditions with respect to fertilizer quality level, and internal conflicts among the actors in the partnership with respect to objectives, ownership, transparency and participation in decision-making processes as well as lack of communication – resulting in a lack of trust.
- *Access2innovation* can support a partnership innovation process, but remains sensitive to external unfavorable conditions and internal disagreements and conflicts.
- A comprehensive problem understanding should be sought beforehand to avoid the selection of a technical solution prior to a problem analysis.

[47] *People's Committees* and *Urban Environment Companies* (URENCO's) play important roles, amongst others. However, the contribution of the informal sector is not recognized and opportunities neglected for closing material cycles in line with CE thinking.

PAPER 3

Christensen, D., Bach, L.T. (2015) A Danish-Vietnamese partnership for business and technology development in solid waste management, *Resources, Conservation and Recycling* 105 (2015): 123-133

Resources, Conservation and Recycling 105 (2015) 123–133

Contents lists available at ScienceDirect

Resources, Conservation and Recycling

journal homepage: www.elsevier.com/locate/resconrec

Full length article

A Danish–Vietnamese partnership for business and technology development in solid waste management

David Christensen [a,*], Leu Tho Bach [b]

[a] Department of Development and Planning, Aalborg University, Vestre Havnepromenade 9, 9000 Aalborg, Denmark
[b] Institute of Environmental Science and Engineering, National University of Civil Engineering, 55 Giải Phóng Road, Hanoi, Vietnam

ARTICLE INFO

Article history:
Received 14 June 2015
Received in revised form 18 October 2015
Accepted 20 October 2015
Available online 14 November 2015

Keywords:
Partnerships
Vietnam
Waste management
Business development
Innovation

ABSTRACT

In business and socio-technical literature, partnerships are highlighted as an important tool for developing sustainable solutions to environmental challenges, such as the waste management systems of developing countries. In order to investigate the formation of North–South partnerships in this respect, the business development process of a Danish–Vietnamese partnership in the waste sector is analyzed in this paper.

From a participant's perspective, a business development process is narrated, showing how innovation management in partnerships evolves: through socially and culturally influenced negotiations that shape the technology in question. This study investigates both the external and internal challenges in adapting Danish technology to Vietnam though a North–South partnership, in a physical, legislative and market context, and contributes to understanding the issues that arise the early stages of these partnerships.

The partnership's business concept deals with the proposed introduction of improved, Danish solid waste separation and treatment technology at a plant in a suburb of Hanoi. The technology enables the production of derived products, such as organic fertilizer, and is suitable for biogas-based electricity production. This case study highlights issues for partnership facilitation: careful partner selection, managing different interests, cultural differences, and securing joint ownership in constructing a solution, while also showing the need for a comprehensive understanding of these issues. Additionally, the study shows that the technology is capital-intensive and requires financially viable supportive policies and subsidies, as well as a robust organic fertilizer market.

1. Introduction

Innovating more sustainable solutions for resource use is an ongoing challenge in developing countries. One strategy for exploring opportunities is through partnerships that involve the exchange of competencies and resources among actors (LaFrance and Lehmann, 2005). These partnerships are a means of promoting sustainability and eco-innovation (Lehmann, 2008; Rivas-Hermann et al., in press), and may involve exchanges across sectors and between countries in the global North and South. In international development, a more critical perspective is that partnerships represent areas of interaction that encourage competition for resources in favor of powerful stakeholders, diverting them away from the poor and reinforcing aid dependency (Müller, 2011).

With contrasting standpoints, there is a basis for investigating how partnerships can be central to promoting solutions to environmental challenges in developing countries. In this article, we chose a focus on waste management, and investigated the issues through a case study that took place in Vietnam. We were particularly interested in the issues that arose among actors in the early stages of their partnerships. What should be taken into account in the introduction of new technologies? Our case study focuses on partners that jointly developed a waste management business idea in 2011–2013. The partnership was initially facilitated and seed-funded by a network and support organization in Denmark called *access2innovation.* The partnership was later supported by Danida, the Danish development cooperation agency. The case study involved businesses with public and private ownership from Denmark and Vietnam as well as non-governmental organizations (NGOs). Additionally, the partnership was supported by consultants from both countries.

The roles played by *access2innovation* and the consultants occasionally amounted to those of an intermediary in a technological

* Corresponding author. Tel.: +45 99408186.
E-mail address: damc@plan.aau.dk (D. Christensen).

http://dx.doi.org/10.1016/j.resconrec.2015.10.019
0921-3449/

innovation process (Stewart and Hyysalo, 2008). The process involved the occasional facilitation, configuration and brokering of exchanges between partners and stakeholders, in addition to more standard consultancy-type services. The Vietnamese consultants, in particular, also functioned as language translators, with a deeper role as 'cultural or business interpreters' for both Danish and Vietnamese partners (Napier and Hoang, 2011).

We present the case from the perspective of such intermediaries and consultants, using participant observation. One author participated in the partnership, without receiving a salary from the partners, as a Danish *access2innovation* representative. The other was a paid Vietnamese consultant, normally affiliated as a researcher with a technical university in Hanoi. This disclosure is important since neither author may have been truly impartial to the process, but together we were in a unique combined position to extract meaning from the events. Participant observation enabled us to bring action and reflection together, in a manner consistent with our roles in the partnership. In a similar fashion to action research studies, the role of the researcher is both that of observer and of problem-solver (Christensen, 2014; Goduscheit et al., 2008); research becomes a matter of taking action, as well as generating knowledge or theories about that action. Methodologically, the case study is consistent with innovation studies, such as previous *access2innovation* action research (Ravn, 2012), based on analysis of inter-organizational business development processes. This implies the organization of important events and factors, as distinct stages in the process emerged and were identified.

1.1. Waste management partnerships in developing countries

The case study is of topical importance because partnerships within waste management are an emerging issue, including in relation to developing countries. The dangers of unmanaged waste to human health and the environment have been recognized for decades (Flintoff, 1976), but the call for their management through partnerships is more recent (Kironde and Yhdego, 1997; Halla and Manjani, 1999). Traditionally, waste management has been viewed as the responsibility of public authorities, but increasingly, the effectiveness and legitimacy of purely government-led strategies has been challenged. The alternative suggestion is a collaboration of various actors in the provisioning of collective goods, e.g. environmental services (Tukahirwa et al., 2010). Similar calls have been made in the business and socio-technical literature.

In business studies, 'Base-of-the-Pyramid' (BoP) thinking refers to a commercial mindset toward poverty alleviation and development (Kandachar and Halme, 2008). Multinational enterprises were initially seen as the most important actors for BoP innovation (Prahalad and Hammond, 2002). However, Kolk et al. (2014) have noted that the capability of multinational enterprises to develop profitable businesses and positive development outcomes has become de-emphasized in recent years. Kolk et al. (2014) further argue that BoP initiatives cover varied approaches, and that there is a need to consider insights from *cross-sectorial partnerships* focusing on relationships between e.g. firms (including smaller firms and social enterprises), NGOs and government.

Hart (2005, 2011) emphasizes 'green leap' BoP strategies, focusing on the incubation and commercialization of 'disruptive' green technologies to address environmental challenges in developing economies. Green technology development is broad-ranging, but solid waste management has emerged as one field holding attention and promise for BoP initiatives (Stutz, 2008; Lecomte et al., 2012). Due to the important role played by the informal sector in waste systems in developing countries, the emphasis is on partnerships, as well as appropriately scaled technologies, waste valorization and the integration of communities and scavengers.

In socio-technical studies, a similar proposition has been suggested for including both formal and informal stakeholders into integrated and sustainable waste management systems under the term 'modernized mixtures' (Scheinberg and Anschütz, 2006; Scheinberg et al., 2011; van Vliet et al., 2013). These studies trace the roots of their proposition to the 'ecological modernization' paradigm. Rooted in a Northern discourse, ecological modernization stresses that institutions and actors can internalize care for the environment (Hajer, 1995; Mol and Sonnenfeld, 2000).

This article contributes to existing literature on partnerships in Southeast Asia, which have been studied from a business and innovation perspective grounded in the ecological modernization paradigm (Welford et al., 2006). Emphasis has typically been on implementing cleaner production measures and environmentally friendly management practices, as well as on the changing nature of relationships between firms and stakeholders (Lehmann and Jeppesen, 2006). From a different perspective, this article offers an insider view to partnership-building and explores the early-stage processes of business and technology development 'co-construction' in a chosen environmental sector–waste management.

First, the present conditions for solid waste generation and management in Vietnam are assessed to provide context for the business partnership. The conditions indicate some challenges, though they may conversely be seen as opportunities if impetus is provided for supporting innovation within the waste sector. The article then follows with the background and content of the business partnership, which is presented as a process-narrative. The paper concludes with a summary of the challenges and propositions collected from the Danish–Vietnamese waste management partnership, and offers a discussion on forming such partnerships in a manner that supports learning and adapting to challenges, as well as setting up and reaching collectively formed objectives.

2. Waste management in Vietnam

While the situation for each country is specific to its own development, the Vietnamese waste situation shares similarities with other Southeast Asian nations it is frequently compared with in regional studies (AIT/UNEP RRC.AP, 2010; Wittmaier et al., 2009; Pariatamby and Tanaka, 2014).

The 3rd highest-ranking country in population density in Southeast Asia, Vietnam has achieved high growth; an average GDP growth rate of 7% in the period 2006–2010 during the 2008 global financial crisis, increasing to 8.5% in 2012 (Ministry of Natural Resources and the Environment, 2012; Thai, 2014). National development strategies promote a continued expansion of the industrial and service sectors, and the country is developing rapidly in production, including services in urban areas and industrial zones. This results in increasing volumes of solid waste of all types. Illegal waste dumping and ineffective waste management remains widespread, and there is considerable room for improving waste management to address environmental pollution, health hazards and quality of life (Thanh and Matsui, 2011; Nguyen and Le, 2011; Omran and Gavrilescu, 2008).

The development of solid waste generation in rapidly urbanizing Vietnam is illustrated in Table 1. Rising prosperity levels and urbanization have been followed with an increase in waste generation (Ministry of Natural Resources and the Environment, 2012) and increasing volume percentages of inorganic waste fractions. The organic fraction percentage is significant, and in excess of 50% on a national level, although it is lower in Hanoi at 43.8%, of which 41.9% is food waste (AIT/UNEP RRC.AP, 2010).

Solid waste management systems and practices in Vietnam during the 1970s and 1980s centered on collecting municipal waste for

Table 1
Urban Solid Waste 2007–2010 and Projected 2015–2025 (Ministry of Natural Resources and the Environment, 2012).

	2007	2008	2009	2010	2015	2020	2025
Urban population (million people)	23.8	27.7	25.5	26.22	35	44	52
% of the urban population in the total population	28.20	28.99	29.74	30.2	38	45	52
Urban solid waste generation indicator (kg/person/day)	~0.75	~0.85	0.95	1.0	1.2	1.4	1.6
Total volume of urban SW generated (MT/day)	17,682	20,849	24,225	26,224	42,000	61,600	83,200

dumping in uncontrolled landfills (Ministry of Natural Resources and the Environment, 2012). Initially, municipal Urban Management Departments, as well as provincial People's Committees, were primarily in charge of collecting and landfilling domestic household waste. This system eventually changed with the introduction of separate, function-specific Urban Environment Companies (URENCOs) as waste streams began growing more complex and increased in both quantity and toxicity. A legislative policy framework began taking shape that delegated and distributed areas of responsibilities among different ministries. However, despite increasing awareness, the system remains characterized by the involvement of many different actors, overlapping responsibilities, and at times unclear lines of authority (Jensen, 2011).

The National Strategy for Integrated Management of Solid Waste to 2025 is one particular waste governance strategy that designates targets affecting actors and partnerships in the waste sector. By 2015, 40% of urban waste is to be landfilled—set to be reduced to 15% by 2025. The remaining collected urban waste is to be recycled, reused, recovered for energy, or used for organic fertilizer production.

At the operational level, provincial and municipal governments carry out waste management service provision. The most important actors include the *People's Committees*, which are responsible for state administration at a local level, and the *Urban Environment Companies* (URENCOs), which are companies of differing ownership structure and are almost exclusively awarded annual waste management service contracts (Thanh and Matsui, 2011).

2.1. Current solid waste management practice

In the current municipal solid waste management system, URENCOs are mainly contracted with the responsibility to collect, transport and treat the solid waste generated by residential areas, streets, commercial areas, offices, markets, industrial parks, hospitals, etc. (Thanh and Matsui, 2011). Aside from URENCOs, in some cities private companies also contribute to waste management within recycling and treatment. URENCOs and private companies thus carry out the majority of the contracted work: from waste collection and operating transfer stations, to transporting waste for final disposal or treatment.

At the collection stage, street cleaners usually collect urban solid waste with small rubbish carts to transfer/rally sites, where waste is transported by garbage trucks to waste treatment facilities. However, the informal sector also plays an important role: while URENCOs, and approximately 30 other entities throughout the country, take part in collecting and transporting solid waste in urban areas, the informal sector remains active in reclaiming waste fractions from the waste stream for reuse and recycling purposes. These even extend out to specialized craft villages in peri-urban and rural areas (Mitchell, 2008). By some estimates, the informal sector activities significantly reduce the waste amounts that were ultimately being sent to landfills by approximately 15–20% (Thai, 2014). This contribution is not recognized in any formal policy, and actors such as the URENCOs have no relationship with the informal sector, or any representative body, due to this non-recognition (Jensen, 2011).

Japanese development cooperation activities are playing an important role in Vietnam (AIT/UNEP RRC.AP, 2010), in recognizing the need to improve practice and awareness at the waste generation stage (Phuong et al., 2012). Under a technical support program dealing with the development of a 'Sound Material-Cycle Society', the Japanese development agency, JICA implemented a pilot project 2006–2009 on source segregation of household waste in four selected districts in Hanoi (Taniguchi and Yoshida, 2011; Kawai and Osako, 2013). Similar projects have also been implemented in other major cities such as Da Nang and Ho Chi Minh City (Thai, 2014).

Evaluations of the JICA pilot project point to mixed results. Taniguchi and Yoshida (2011) report that the project has successfully involved a variety of stakeholders, and ultimately led to an improved composting rate. However, Thai (2014) reports that the source separation projects in Vietnam's major cities have not been successful due to a lack of community awareness, lack of informal sector recognition, and the lack of treatment facilities to process the separated solid waste, which subsequently ends up being landfilled. Finally, Chi and Long (2011) highlight a number of challenges with source separation of waste, including limited manpower, facilities, technologies and financial resources. They also stress the need to improve education, due to the lack of experience on the part of the waste generators.

In the treatment phase, Vietnam through the MOC, has licensed the introduction of alternative treatment technologies to landfilling to companies willing to try new waste treatment technologies. This has included waste incineration, organic waste treatment resulting in the production of organic fertilizer, and waste compression technology that produces material blocks. Crucially, simple waste incineration is winning in comparison to the attempts at organic fertilizer production. At least one company has given up the production of organic fertilizer in favor of installing waste incineration facilities instead, and nationwide less than 10 organic fertilizer plants are operating, with a throughput capacity of 200 MT/day (Ministry of Natural Resources and the Environment, 2012). One plant in Hanoi (the Cau Dien composting plant) has a 600 MT/day capacity for transforming organic waste into compost, but the actual throughput is much lower, estimated at 100 MT/day (Chi and Long, 2011). This has been due to difficulties in providing compost of a sufficient quality for the market.

The considerably more common practice of landfilling accounts for 76–82% of collected solid waste in Vietnam. Only 50% of this is disposed of in sanitary landfills, with only 16 of 96 total landfilling sites in the country meeting sanitation requirements. Regarding waste incineration: approximately 40–50% is burned in the open air under unsanitary conditions. Modernized waste incineration technologies are the exception rather than the norm. MoNRE considers that future cogeneration heat/power plants may be envisioned for Hanoi and Ho Chi Minh City (Ministry of Natural Resources and the Environment, 2012).

2.2. Closing material cycles in Asian settings

The current policy focus in Vietnam is to reduce the quantities of waste destined for landfilling. Less attention has been paid to

Table 2
Proposed criteria for selection of urban solid waste treatment technology developed by the Institute for Urban Environment and Industry of Vietnam (Ministry of Natural Resources and the Environment, 2012).

Proposed Criteria	Maximum points (100 total)
Technical	30
Technical principle, function of each group of equipment in the treatment chain, treatment efficiency, solutions to secondary waste treatment, level of mechanization, automation, level of convenience in operation, maintenance, endogenous technology	
Economic	30
Investment in equipment purchase and installation, fees of operation, maintenance, secondary waste treatment, benefit from products (if any), consumption markets and outlets	
Compatibility with Vietnamese Urban Areas	20
Suitability with waste components, types of materials and equipment, adaptability to weather conditions, abrasiveness, economic and technical conditions, scale of urban area	
Safety and environmental friendliness	20
Technical safety indexes of equipment, indexes on environmental friendliness, indexes on measures to minimize negative impacts on the economy, culture, landscape and eco-system	
Scoring for all criteria	
Type A (scoring > 70 points); Encourage for application	
Type B (50–70 points); eligible for application	
Type C (scoring < 50 points); not eligible for application	

the waste hierarchy: Pariatamby and Fauziah (2014) assess that landfilling is the preferred practice in most developing nations, particularly in Asia due to its simplicity and low cost, while other strategies in the waste hierarchy are implemented to a far lesser degree.

Waste prevention strategies, the 1st priority in the waste hierarchy, have advantages, including the business sense in designing products, manufacturing and service systems that minimize waste generation and increase efficiency in raw material use. Recently, the 'circular economy' paradigm has become popular in Europe (Ellen Mac Arthur Foundation, 2013; European Commission et al., 2014). The basic premise is to foster a shift away from linear, 'take-make-dispose' production and consumption systems.

Circular economy systems work on the principle of utilizing waste as a resource, principally rejecting the notion of waste. Making this operational involves viewing all kinds of waste as nutrients, which either feed into the biosphere or a technical system. For 'technical nutrients' like metals and plastics, this system implies designing a series of loops to ensure their re-entry. This covers, in order of preference: maintenance, reuse/redistribution, refurbishment/remanufacturing and recycling. 'Closing loops' involves avoiding incineration and landfilling, and seeking the highest preferred order of nutrient handling.

Waste prevention and circular economy strategies are being promoted in the North, but may also be promoted among developing nations in Asia. Large portions of the informal economy in countries like Vietnam are devoted to functions that correspond to circular economy loops for handling technical nutrients. An example is tinkerers/repairmen, corresponding to the maintenance loop, whose services are arguably more easily accessible and affordable than in the North. These maintenance functions support the longevity of products and constitute a significant employment basis. Also significant are the functions of craft villages specializing in solid waste reuse/redistribution, refurbishment/remanufacturing and (most commonly) recycling activities in rural areas near urban centers (DiGregorio, 1994; Dang et al., 2013). Governmental recognition of these craft villages has focused on the negative environmental effects stemming from polluting soil and water discharges, without the same regard to any beneficial effects in terms of the waste stream or the economic activity they generate.

3. Prospects for North–South partnerships in technology development

Vietnam is actively searching for new solid waste treatment technologies, but is wary of imported technologies due to the high likelihood of them failing to adapt to local conditions. The 2011 *National State of the Environment: Solid Waste* report states (Ministry of Natural Resources and the Environment, 2012): "Many individual investors have recently come to Vietnam bringing with them many diverse technologies, but some of these have failed to adapt to the conditions in the country." The Ministry of Construction has therefore licensed a number of domestic technologies to encourage more individuals and organizations in the country to become involved. Four domestic treatment technologies have been licensed and have undergone testing: two within organic fertilizer production, one within waste compression into material blocks, and one within waste incineration. Out of these, one technology within organic fertilizer has been trialed but abandoned in its testing plant, in favor of the simpler method of waste incineration.

3.1. Priority setting in waste treatment technology development

Ministry of Natural Resources and the Environment (2012) refers to a proposed set of criteria for solid waste treatment technology selection in the licensing process, developed by Vietnam's Institute for Urban Environment and Industry. Though not implemented to date, the criteria do indicate current Vietnamese preferences. These are detailed in Table 2 and specify the priority setting on domestic technology development by including 'endogenous' technology as a technical parameter. The parameters imply a preference toward technologies with: a certain level of safety, environmental performance and technical efficiency; that are easy to operate, not too costly in terms of installation and operations; and that produce beneficial, derived products with a market demand. Additionally, technologies should match waste amounts and composition in a given urban catchment area and there is an implied preference toward the use of materials and equipment that are readily available. There is no explicit consideration given to the waste hierarchy.

These selection criteria and preference for technological solutions form framework conditions for North–South partnerships in the Vietnamese waste sector. They highlight the necessity of a local entity as an anchoring point in a partnership, with the possible role of a foreign entity in financing, sharing, and upgrading knowledge and capabilities with respect to technology development.

In contrast to the Vietnamese criteria, Visvanathan and Kashyap (2012) have studied Asian waste sector settings, and attach a greater importance to partnerships, and the transfer of North–South technology, in promoting appropriate technologies. The authors find a necessity, and a significant business potential, in introducing advanced technologies capable of turning waste into

resources. Technology transfer processes through North–South partnerships are well positioned to take advantage of such green business opportunities, so long as local needs and capabilities are taken into consideration, and communities and stakeholders are included throughout the chain. Seeing it as desirable to move beyond the 'primitive' composting and plastic pelletizing that is commonplace in Asia, the authors suggest promoting technologies that involve energy recovery and anaerobic digestion.

3.2. Danish–Vietnamese partnerships

The scepticism in Vietnam toward foreign investment is well founded. Schaumburg-Müller (2006) has studied the investment activities of Danish firms, and their interaction with Vietnamese firms, under business partnership support mechanisms through the Danish state. The study is useful for characterizing Danish–Vietnamese partnerships, though it should be noted that the partnerships involve direct business-to-business interactions. Partnerships involving non-firm entities have *not* been studied.

Schaumburg-Müller finds that there have been Danish contributions in terms of management upgrading, machinery acquisition and setting of production quality standards. However, the Danish partners have rarely shared their core competencies that are needed for any strategic up-scaling of business activities. This has withheld the Vietnamese partners from getting beyond incremental processes and product upgrading.

Schaumburg-Müller (2010) carried out a later study on the internationalization strategies of firms in Vietnam including their dynamics with foreign-owned enterprises. The findings indicate only a limited use of linkages in developing new capabilities. Joint venture partnerships were often unsuccessful; partner strategies have often diverged, and there were cumbersome differences in managerial practices that were often risky or counter-productive. Statistical studies on international joint ventures in Vietnam (Anh and Baughn, 2011) indicate that learning can be supported in such partnerships but requires investments, joint participation and frequent interaction between partners. There has been a high rate of dissolution of international joint ventures, and a high rate of unsatisfactory performance explained to a great degree by cultural differences (Anh and Hang, 2010; Anh and Thoan, 2010).

Considering the above, there are significant challenges for North–South partnerships in the waste sector. In light of Vietnamese local preferences and foreign investment wariness, a partnership must be attentive toward local anchoring and securing mutually reinforcing relationships. Furthermore, conditions for partnerships in technology development appear myopic toward treatment technologies for wastes that enter the waste stream; with reference to circular economy thinking, the conditions do not take waste prevention, repair and maintenance, reuse and retrofitting strategies into account.

3.3. Access2innovation: *Action research in partnership facilitation*

Access2innovation is a network that has supported a partnership building initiative in Vietnam under the existing conditions for technology development in the waste sector. It is an action research initiative run by a secretariat based in Denmark that sets out to develop and test innovative ways of building strategic partnerships among actors in civil society, business and academia. In line with the ideas behind BoP, the initiative has a philosophy of approaching societal challenges and the requirements of developing countries in a commercial manner, aiming to foster partnerships that lead to disseminating sustainable technological solutions and business models. The premise of the initiative is that synergies may be found in combining the interests and capabilities of different actors, with *access2innovation* itself functioning as an inter-organizational infrastructure for facilitating innovation processes (Ravn, 2012).

Access2innovation works within the thematic areas of renewable energy, food security, and water and sanitation. Aside from the Vietnam case, the network has also attempted to set up a waste management initiative with Danish businesses in Uganda, with the intention of generating renewable energy recovered from the organic fractions of solid waste (Christensen et al., 2014). As the nature of partnership building within such technological systems has environmental and social dimensions, socio-technical theories on innovation and social shaping of technology are applicable. Socio-technical theory allows the inclusion of technical, organizational, societal and institutional aspects (Bijker, 2001). Such a perspective additionally supports the concept that innovation management in partnerships evolves through socially and culturally embedded negotiations among its actors, shaping the technology in question (Remmen, 1991). This shaping may also be termed a co-construction of technology, which occurs in fluid situations when the participating actors frame the technology based on their respective dominant intentions, objectives, values and logical thought patterns.

4. A Danish–Vietnamese business partnership

The Vietnamese waste situation is challenged by increasing prosperity levels and urbanization, and this challenges the institutions and actors involved in waste management to come up with a viable means to tackle the projected waste amounts. Additionally, strategies based on waste prevention through household sorting are met with barriers in their implementation, while informal sector activities in line with circular economy thinking lack government recognition.

Partnerships for technology development in the Vietnamese waste sector are subject to constraints emphasizing local anchoring and fitting with local conditions, but have little incentive to adopt waste prevention as a guiding principle.

The current widespread practice of unsanitary landfilling is untenable and there is indeed an important push-factor in Vietnam's National Strategy for Integrated Management of Solid Waste up to 2025 to reduce landfilling to 40% in the near future and 15% in the mid-term, whilst collection rates are to increase to 100% of all urban waste generated. Under conditions of overcapacity and personnel shortages, this appears to be a difficult proposition and prompts higher public investment into developing landfilling alternatives in order to reach this policy objective (Omran and Gavrilescu, 2008). Most efforts to introduce alternative waste treatment technologies have largely floundered; waste incineration is taking off slowly, but treatment of organic waste into organic fertilizer has decidedly not been a widespread success so far. Despite the framework conditions, a Danish–Vietnamese business partnership has followed the following distinct stages as part of an overall early-stage business development process, identified by the authors:

- Partner Identification (Denmark).
- Local Partner Identification (Vietnam).
- Business Concept Development (Joint).
- Challenging the Business Concept (Joint).

4.1. Danish partner identification

In early 2011, *access2innovation* helped identify a number of potential Danish businesses within the waste sector that were willing to collaborate with an international development NGO (CARE International) with regards to setting up waste treatment facilities on a commercial basis in rural areas of Vietnam. Additional

support was given by another NGO, SustainableEnergy, which was also active in the country. At this stage, CARE International was carrying out a development program to the far southeast of Hanoi and requested *access2innovation* to assist setting up and facilitating a business partnership in this area that it was thought to be an interesting expansion of their Vietnam activities. Through workshop methods, bilateral and multilateral negotiation among partners and an explorative consultancy study, goal alignment was obtained among most participants in the partnership in this early-stage innovation process, which then set the stage for developing the business idea (Christensen, 2014).

A lead company in the partnership was identified, KomTek, which had the primary interest and responsibility of implementing the partnership idea on a commercial basis. Odense Waste Management was involved on a much lesser scale, being a municipally owned waste services company merely interested in knowledge and experience sharing. The idea at this stage was building small-scale biogas plants utilizing domestic household waste in rural areas of Vietnam, initially as a pilot in the areas where CARE International was active. The company took interest in an NGO partnership from a social responsibility perspective at first, seeing the partnership as a means to gain a foothold in Vietnam within waste management broadly, and as a long-term learning objective for the organization when dealing with new markets.

KomTek is a business based in Denmark with previous experience along these lines, having participated in an explorative study into the market for domestic waste for biogas production in Bangladesh. However KomTek's main area of operations by far is Denmark and other Scandinavian markets; the company offers broad waste management services within organic waste handling as contractor for e.g. Danish municipalities, and is also the proprietary holder of a technology that enables high-grade separation of the organic waste fraction from domestic household waste using water. This organic fraction that is separated, also termed bio-pulp, only has a 0.01% content of plastic, metals and glass and is then able to be used in e.g. biogas plants for anaerobic energy production. It is also a precursor product for high-grade organic fertilizer. By entering into a partnership with an international NGO like CARE International in Vietnam, the company had been eager to look to rapidly expanding markets in Southeast Asia with a view to adapting its technology to the local context.

KomTek's technology is illustrated in Box 1 and Fig. 1. Through a process by which *access2innovation* facilitated goal alignment with CARE and the other partners, KomTek applied the Danish government (the Danish Ministry of Foreign Affairs) for co-financing support under a private sector support facility called Danida Business Partnerships. This private sector support facility is available to Danish businesses seeking to open operations in any of the bilateral priority countries for Danish development cooperation, including Vietnam. The first step, and a condition for entering the program formally, was to identify a local partner in the priority country. For this, Danida is and was able to reimburse field trip expenses for KomTek.

4.2. Local partner identification

Through it's successful application to the Danida Business Partnerships program, KomTek was granted reimbursements for a field trip to Vietnam, which was carried out with the objectives of gaining an initial understanding of the country context as well as identifying a local business partner. Afterwards, CARE International soon retracted from the partnership with KomTek due to internal management disagreements within their own organization about how to handle a partnership with a for-profit business. By this time KomTek had decided to continue pursuing Vietnam interest with or without an NGO partner. KomTek still had an NGO partner, however (the smaller Danish NGO, SustainableEnergy), which importantly had development programs in Vietnam, including waste collection and organic waste composting projects, and which continued to put in manpower resources to support the project on a consultancy basis.

From KomTek's perspective, the first field trip to Vietnam gave them an awareness of a vast market potential due to the increasing amounts of domestic household waste generation in urban and peri-urban areas. The company also saw the technological capability level of organic waste treatment in Vietnam, and confirmed that their proprietary technology was something that the Vietnamese waste sector hadn't yet seen. KomTek saw themselves as first-movers in a potentially lucrative business area, and therefore shifted focus from rural areas to looking at peri-urban areas, utilizing their adapted proprietary waste separation technology, initially thought of as smaller and cheaper units, and looking to scale up a business fast as possible for a large urban waste collection catchment area instead of small-scale piloting for smaller waste amounts. This meant that KomTek's business idea ended up fitting closer with their core technological competencies than with the connection originally to CARE International.

Box 1: KomTek Waste Separation Technology.

KomTek's waste separation technology is also known as the ECOGI process and involves the mechanical pre-treatment and separation of organic waste in order to obtain bio-pulp for biogasification (DANETV, 2013). Water and waste from households and/or industry is fed into a pulper/separator, which extracts organic waste as bio-pulp using a centrifuge. The bio-pulp consists of particles less than 6 mm. Materials that cannot be gasified such as metal cans, plastic packaging, textiles, larger pieces of glass and ceramics constitute a reject product that goes through a washing and dewatering process. The extracted bio-pulp is concentrated using a screw press, and the excess water ends up in a collection tank together with the water from the reject product dewatering. This water is then recirculated into the system together with a new input of waste.

The Danish Centre for the Verification of Climate and Environmental Technologies has tested and approved the technology for producing bio-pulp for gasification. It reports that the recovery rate of organic waste is 94.8% (claimed target 90%) while the purity is 99.8% (claimed target 95%), with impurities consisting of non-degradable particles of plastic, glass and metals of 2–6 mm in a pulp with 15% dry matter content (DANETV, 2013).

KomTek's technology exists as a single large-scale pilot plant in Denmark with a capacity of 5–6 t/h and an energy usage of 20–30 kW h/MT. Currently, the bio-pulp is added to a nearby large-scale biogas plant in an agricultural area where it constitutes a minor biomass input compared with the livestock manure it normally receives. ECOGI can be classified as a capital intensive niche technology with high operational costs, but the idea was to adapt the technology in a small-scale manner for Vietnamese conditions this initial stage of the partnership.

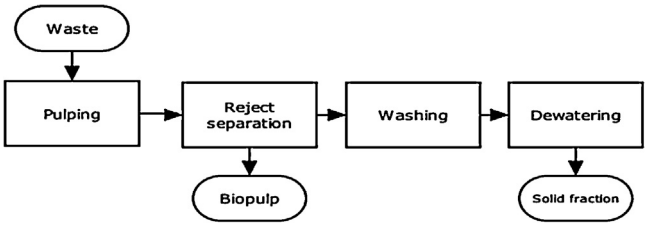


Fig. 1. ECOGI process for mechanical treatment of waste for bio-pulp production (DANETV, 2013).

For the business idea, a local partner was seen as necessary for navigating the local market and political system, not only due to formal eligibility requirements in the Danida Business Partnerships program.

Through the initial field trip, KomTek thus sought to find an appropriate business partner in Vietnam with their particular business idea and technological competencies in mind. The screening process, facilitated by the Danish Embassy in Vietnam and supported by *access2innovation*, identified a number of different potential partners in or near Hanoi. In the end, KomTek decided upon two partners:

- *URENCO Son Tay* was selected because it is an URENCO situated in a high-growth peri-urban area outside Hanoi to the northwest. As a private municipal waste contractor, URENCO Son Tay operates a number of landfills and includes parts of Hanoi in its collection area for urban waste.
- *Vitec* was selected because it was a holding company in possession of knowledge and technical resources in relation to waste separation technology in Vietnam. It had already developed its own mechanical waste sorting technology at the prototype stage, which made use of dry mechanical sorting techniques, and was interested in Danish expertise to improve upon its design.

Consultants working on behalf of both URENCO Son Tay and Vitec were included in the partnership at this stage. One consultant came from a private environmental consultancy and had an extensive background working with business development activities with Danish firms, and the other consultant was a senior staff member from a technical university in Hanoi specializing in waste and wastewater technology (and co-author in this article). Both consultants, in addition to providing expert advice, also functioned as translators and mediators, and as played the important role of 'cultural or business interpreters' (Napier and Hoang, 2011), assisting the Danish partners in 'deconstructing reality'. The Vietnamese partners' interest, as interpreted by the consultants, was to carry out a viable business and not enter into a partnership primarily because of the development assistance co-funding opportunity from Danida. In addition to this premise, the Vietnamese partners sought to be actively involved as equally contributing partners in developing the business idea.

4.3. Business concept development

After identifying the Vietnamese partners, including consultants and confirming their initial interest, KomTek was then in a position to focus discussions on a business model that would be viable in a Vietnamese context. This began after a series of short visits to (and correspondence with) the Vietnamese leading to a larger workshop for a Vietnamese delegation in Denmark that brought the parties together for an extended period of time. The resulting agreement among the partners was the identification of the following business concept, with the main objective being the construction of a complete treatment facility for municipal solid waste with an annual capacity of minimum 30,000 MT throughput annually. The partnership business concept covered a set of short and medium-to-long term objectives, but was not a business plan detailing specific timeframes and deadlines. The 'short term' implied what was thought feasible while the partnership received co-financing from the Danida Business Partnerships program. The 'long term' implied what was feasible when the short-term objectives were met and the partnership was self-sustaining without outside financing. The objectives were as follows:

In the short term:

- The further development and refinement of a separation technology based on both Vietnamese and Danish technical expertise as a foundation for waste treatment whereby dumping is significantly reduced in favor of recycling.
- The production and sale of organic fertilizer.

In the medium to long term:

- The production of biogas which would also impact positively on the quality of organic fertilizer.
- Sales of energy produced from biogas combustion and energy recovery.

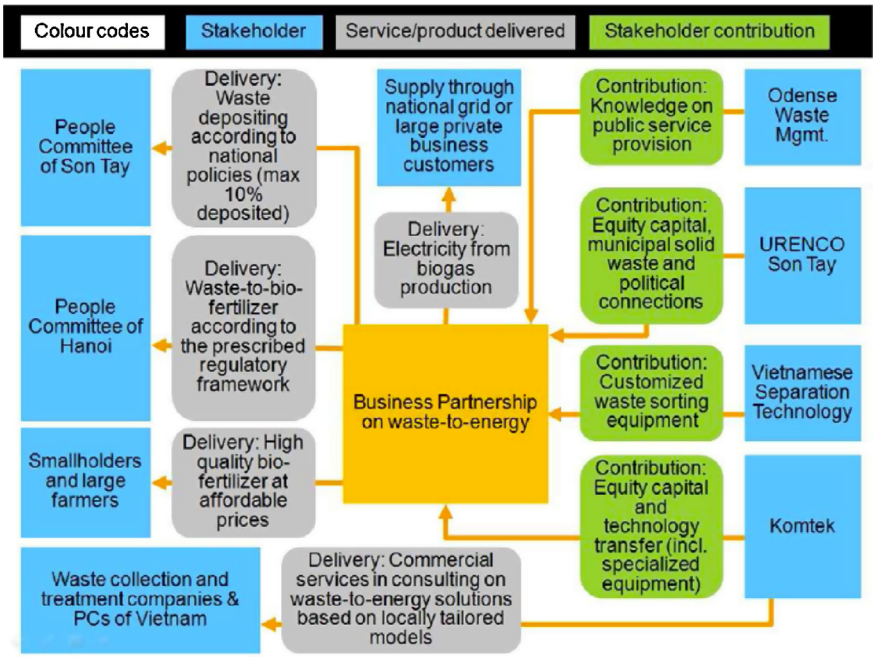


Fig. 2. Workshop output: alignment of a business strategy for the partnership.

- Provision of consultancy services on waste separation and treatment.
- Sale of technology concept.

These common business concept discussions are summarized in Fig. 2, and resulted in some degree of goal alignment with regards to envisioning a commercially viable business with a number of proposed revenue streams, which however would need further validation through a feasibility study in a further stage in the partnership. In addition, the business strategy utilized the core business areas and technological competencies of the Danish partner and the two Vietnamese partners involved.

Stakeholders: The stakeholders involved in the business concept comprised the actors directly involved in the partnership, shown in the right-hand column in Fig. 2. Shown on the left-hand column are the key stakeholders external to the partnership with a direct role to play in the business concept: The People's Committee of Son Tay, the People's Committee of Hanoi, smallholders and large farmers and finally a diffuse group of stakeholders referred to as 'waste collection/treatment companies and People's Committees elsewhere in Vietnam' (potential customers for consultancy services or turnkey solutions resulting from the partnership). There is also a diffuse group of stakeholders referred in the top part of Fig. 2 as the 'national grid' (customers indirectly supplied with energy through electricity grid infrastructure) or large private businesses.

Stakeholder contribution: The business concept was based upon equal equity capital contributions from KomTek and URENCO Son Tay, respectively. While KomTek was set to contribute with its technological competencies and specialized equipment, URENCO Son Tay had political influence with e.g. the People's Committees and national and provincial authorities. Vitec is designated in Fig. 2 as 'Vietnamese Separation Technology', which was seen as its primary contribution to the concept. Finally, Odense Waste Management was prepared to contribute with its knowledge on public provision of waste services, being a publicly run company with no interest in profit generation in Vietnam.

Service and product delivered: The proposed revenue streams in the business concept were derived from the envisioned services/products delivered as a result of the partnership, designated centrally in Fig. 2 as 'Business Partnership on waste-to-energy'.

The most immediate product/service delivered by the partnership was seen as avoidance of waste for landfilling, and which in Vietnam is normally a subsidized activity by the People's Committees: Landfill avoidance is designated as a Delivery to the People's Committee of Son Tay in the figure.

The next most important product/service involved supply of organic fertilizer, which according to available documents at the time was a subsidized activity under the purview of the People's Committee of Hanoi. URENCO Son Tay also manages some waste from Hanoi, enabling reference to subsidy frameworks from both People's Committee's from Son Tay and Hanoi in the partnership. Organic fertilizer production is designated as a Delivery to the People's Committee of Hanoi in the figure.

After the landfill avoidance and organic fertilizer production as delivered services, the organic fertilizer itself was a product that was assumed to have a customer base. This is designated as a Delivery to smallholders and large farmers in the figure.

Biogas combustion and energy recovery were seen as a potential medium to long term revenue stream, and is designated as a Delivery either to the national grid or direct to large private businesses in the figure.

Finally, establishing a proof of concept and a viable business on the basis of the hitherto mentioned revenue streams was seen as enabling the partnership to sell consultancy services and turnkey solutions to other actors similar to URENCO Son Tay elsewhere in the country. In the figure, this is designated as a Delivery to waste collection and treatment companies and People's Committees in Vietnam.

The business concept thus involved Danish waste separation technology in combination with local technology, and the utilization of existing local facilities, land area and contractual agreements that URENCO Son Tay possessed for waste treatment of domestic household waste from Son Tay and Hanoi. Revenue streams were to stem from Vietnamese waste treatment subsidies from authorities and sales of high-quality organic fertilizer to farmers. As a long-term objective, electricity generation from biogas production was included in the strategy as a revenue stream but not initially seen as feasible due to the lack of policy support and subsidies for this at government level. Including the informal sector and addressing household waste generation were considered, but ultimately discarded by KomTek due to it being perceived as outside its core business area and resources to manage these aspects of a waste stream. This indicated that the company was not interested in conducting business activities beyond its comfort zone and its self-perceived, limited contributions in terms of equity capital and technology transfer.

With the above business concept in hand, KomTek again applied for co-financing from the Danida Business Partnerships program in order to carry out a fully-fledged feasibility study in order to explore the proposed revenue streams. This would test the assumptions in the business concept and, it was hoped, strengthen goal alignment among the partners.

4.4. Challenging the business concept: Tensions and disagreement

With support from Danida, the proposed feasibility study was carried out and was based upon the findings of a two-week long field trip to Vietnam which we as authors participated in. KomTek representatives and hired consultants, together with representatives from SustainableEnergy and *access2innovation*, carried out observations, in-depth explorative discussions with authorities and other stakeholders, market studies and partner workshops. The feasibility study, including its preparation and the reflection period afterwards, represented a stage in the innovation process in itself.

Table 3 shows the budget for the initial phase of the partnership, which was drafted during the feasibility study trip. It covers the construction, development and refinement of a waste sorting test facility combining the Danish and Vietnamese technologies. It further covered the initial production of organic fertilizer. Table 4 additionally shows the initially assumed revenue streams for products and services.

During this stage, KomTek faced the realization that the partnership idea was a great deal more difficult to implement in practice than previously thought. Based on the two-week field study, the major barriers to realizing the partnership's business strategy were as follows:

- *Public subsidies*: First, one of the main revenue streams for the partnership idea was the *assumed* level of public subsidies per ton urban waste that was treated in accordance with modern waste treatment technologies resulting in organic fertilizer production. The subsidy level for the business to function in Vietnam was found not to be as high as anticipated, eroding this revenue stream. It turned out that validating the subsidy levels was more than a matter of researching what was stated in a public document about standard waste treatment fees. It required sustained consultations with many public authorities in different parts of Vietnam to realize that the subsidies given by public authorities toward modern waste treatment is entirely conditional upon the locality in question and the political willingness to provide a high subsidy level. In other words, nothing was certain and there was a considerable variability across different local contexts.

Table 3
Draft budget for the initial phase of the partnership (development and refinement of Danish and Vietnamese separation technology and production/sale of organic fertilizer).

Investment	Total (USD)
Construction of small-scale Danish (wet) separation facility	410,000
Materials	55%
Salaries, transportation and insurance	45%
Construction of Vietnamese (dry) separation facility	230,000
Materials	40%
Salaries	25%
Patent application and approval	35%
Compost equipment	60,000
Rent and preparation of land (5000 m^2)	21,500
Including salaries	
Collection of waste (1 truck, 9 months)	27,500
Including salaries	
Installation of the 2 facilities, testing of methods (3 months)	84,000
Salaries, travel and Per Diem	
Production, demonstration and testing of products (6 months)	92,000
Salaries, laboratory work, travel and Per Diem	
Training, workshops	7500
Project management (12 months)	145,000
Salaries, administration costs, consultant costs and travel	
Supervision, reporting, etc.	21,500
Salaries, travel and Per Diem	
Dissemination and publication of results	20,500
Salaries, seminar, material costs, travel and Per Diem	
Ministerial approval	7500
Salaries and environmental assessment	
Budget reserve	75,000
Auditing	15,500
Total	1217,500

- *Adaptability to local conditions*: Second, while market studies gave positive indications about the possibility of sales of *high-quality* organic fertilizer through discussions with both farmers and fertilizer distributors and retailers, there continued to be serious misgivings about the capability of KomTek's proprietary technology to in fact provide the type of high-quality product that was required by the market. In other words, KomTek's technology was completely unproven in local settings and there was a steep barrier to overcome in terms of raising awareness or demonstrating the possibility of adapting the technology to local conditions.
- *North–South conflicts*: Third, internal conflicts arose during the course of the field trip between the Danish and Vietnamese partners, which had eroded away at the common objectives otherwise agreed upon at the prior workshop in Denmark. As the partnership idea edged closer toward realization, the Vietnamese partners had to reconsider their initial promises about providing equity capital and land area (on the part of URENCO Son Tay, which needed to seek government approval for the latter) and about contributing openly with their technology and technical know-how (Vitec) in a proposed joint venture. Vitec in particular was concerned about who was to retain ownership of the combined waste treatment solution, which made use of both KomTek's wet separation and Vitec's dry separation technologies. Vitec felt that the dry separation prototype that Vitec was developing on its own stood a risk of being taken over by the Danish business in hostile fashion if it meant that Vitec would have to surrender proprietary ownership of both the machinery and designs to a newly constructed joint venture entity. The conflicts surfaced in direct interactions between KomTek-URENCO Son Tay and KomTek-Vitec, and lingered after the feasibility study trip. As conveyors of dissatisfaction with one another's positions, the Vietnamese consultants grew frustrated in their efforts to mediate. According to the consultants, the Vietnamese partners' concerns came from a belief that the Danish partners were not managing the partnership process in a transparent manner. In particular, KomTek was perceived as taking full credit for the partnership project and showed this by being primarily interested in obtaining signatures and deliverables from the Vietnamese partners and otherwise not including them fully in decision-making processes. The Vietnamese consultants reported that at times, the Vietnamese partners experienced a distinct lack of communication. For their part, the Danish partners might not have been fully aware of this deeper-lying issue of trust, and only found it obvious to be leading the process due to having initiated the partnership.
- *South–South priority divergence*: Among the Vietnamese partners, an issue of lesser importance compared with the North–South conflicts was differing interests between URENCO Son Tay and Vitec in the partnership. Whereas Vitec was primarily interested in developing a technical solution appropriate for local conditions as well as guarding its proprietary equipment and designs, URENCO Son Tay was interested in expanding upon its waste market business areas. The latter interest from URENCO Son Tay meant greater desire from their part to expedite the feasibility study and business development process going forward to an implementation stage, whereas Vitec held a critical approach to crucial assumptions taken prior to and during feasibility study, such as the assumed quality of the organic fertilizer product and the available market and willingness-to-pay. In addition to North–South mediating, the Vietnamese consultants thereby became involved in South-South mediating too.

These findings and observations by us authors and based on the feasibility study demonstrate that although a partnership facilitation and support organization like access2innovation can go a significant way toward developing an innovative business idea in a developing country, the business and technology itself remains sensitive to external unfavorable conditions such as those present in the Vietnamese waste sector, e.g. unproved (in Vietnamese conditions) niche technology leading to critical questions about the possibility of supplying to the organic fertilizer market, and lower-than-expected subsidy levels for waste treatment.

Additionally, the partnership constellation was sensitive to internal disagreements and conflicts among participants, in this

Table 4
Estimated revenue from different products/services in the initial phase of the partnership.

Products/services	Estimated revenue (USD/ MT)	Notes
Depositing fee	7, 2	Based on contractual agreements between URENCO Son Tay and the People's Committee of Son tay
Recyclable steel, plastic, etc.	30	Production of high quality recyclable materials assumed
Composting fee at extra subsidized rate	75	Extraordinary high subsidy deemed critical to partnership for temporary and initial (4-year) period for providing cash-flow until plant is fully operational; Requires agreement with People's Committee of Hanoi
Composting fee at regular rate	12, 53	Assumed regular subsidy in accordance with an existing public documents (Decree 322/QD-BXD)
Organic fertilizer	100	Based on market study and price checking with existing Vietnamese suppliers of organic fertilizer

case both in relation to North–South and South–South interactions. This becomes confounded when different culturally embedded practices are brought together in a North–South partnership. For instance, discussions on matters such as (joint) ownership of proprietary technology ought to be handled carefully. However this becomes difficult when aside from a language barrier, there are different styles of negotiation and in making dissatisfaction known in Danish and Vietnamese business culture. Different fundamental perceptions of partnerships also have influence. As observed by Napier and Hoang (2011) when mapping common misunderstandings between foreigners and Vietnamese in early business collaboration:

> Understanding what 'strategic partnerships' mean for Vietnamese is one of the most challenging issues that foreigners face. Sometimes, a strategic partner is viewed as a person who shares a long-term business development plan and core values for building the organisation. Sometimes, a strategic partner is someone or an organisation that a Vietnamese corporation needs in the short-term for branding or to generate higher equity prices.

Long-term strategic planning is somewhat new in the Vietnamese business context according to Napier and Hoang (2011), who highlight that there is likely to be a lack of 'natural' teamwork and sense of working toward a common goal unless this skill is explicitly developed within the firm (or partnership).

5. Conclusions and discussion

In order to address the environmental and social challenges of increasing waste amounts in Vietnamese urban areas, a Danish–Vietnamese partnership has tried to tackle the proposition of a potential market by working together on the idea of introducing innovative waste treatment technology. While capital-intensive, it was thought possible to generate revenue through organic fertilizer sales and public waste treatment subsidies; in the long run, this was also to include electricity from biogas production, the sales of consultancy services and of an entire technology package.

During the partnership building process, there was a flaw in identifying an intervention point for technology development in the waste sector from the outset. The partnership's solution required a significant capital investment and revenue flows from untested revenue streams to be commercially viable, and the partners underestimated the time horizon needed for viability to be achieved. Additionally, the partnership's solution did not take waste prevention strategies into account. This calls into question whether intermediary organizations were positioned to shape technology co-construction away from the dominating logic of the main business partner involved. In selecting and working together with different actors, the recommendation is therefore to seek a more comprehensive problem understanding of a given context upfront, and let partner selection come in secondarily. This avoids the selection of a technical solution prior to a problem analysis, and opens up for co-construction of innovative approaches.

In the specific context of the Vietnamese waste situation and with circular economy thinking kept in mind, a more sustainable solution would have focused on partnership-building much earlier in the waste stream prior to waste treatment, and on stronger informal sector interactions in the business development process.

In the institutional set-up, the legislative incentive in the Vietnamese National Strategy for Integrated Management of Solid Waste up to 2025 creates opportunities for innovative treatment technologies such as that envisioned in the partnership as the country seeks to overhaul and upgrade its waste management systems at national level. However it is unclear by which implementing mechanisms and under what subsidy levels technology innovation is being incentivized.

Currently, efforts to transform something productive out of the urban organic waste fraction have stalled and waste incineration (with little to no energy recovery) is being favored under existing conditions. Additionally, waste prevention strategies in line with circular economy thinking are faced with structural and cognitive barriers when piloting e.g. household source separation schemes in major urban areas.

In lieu of mechanisms and institutional arrangements for technology innovation in transforming waste to value, the idea of a North–South partnership effort supported by Danish development cooperation has been attempted. For such a partnership to stand a better chance of success, some prerequisite conditions should be in place. These include: clear transparency and negotiating willingness on subsidization practices for advanced solid waste treatment for organic fertilizer production (external), and the ability for the partnership to be able to negotiate culturally reinforced disagreements and conflicts among its participants (internal).

A note on waste and energy recovery: The waste sector in Vietnam and associated policies appear to be disjointed from energy policy, which makes it difficult to provide coherent support to a business idea involving the potential benefits of both improved solid waste treatment *and* renewable energy production. This falls in the proverbial space between two chairs. Vietnamese energy policy has not been assessed in depth in the present paper, but it has been found through the partnership's feasibility study that it is difficult to feed electricity to the grid under existing institutional conditions, which lack a common feed-in tariff for electricity produced using biogas. The Danish–Vietnamese partnership idea might be able to demonstrate this technically, but without the framework conditions in place, the actors in the partnership will not be able to rely on any revenue base and cannot expect to scale the solution up on any meaningful basis.

Funding

This work was supported by grants to the *access2innovation* secretariat through the Danish Ministry of Science, Technology and Innovation disbursed to Aalborg University, and by both the European Social Fund and the European Regional Development Fund disbursed via Væksthus Northern Jutland to the North Denmark EU-Office. Additionally, a field trip was partially reimbursed by the Danish Ministry of Foreign Affairs' *Danida Business Partnerships* facility disbursed via KomTek Miljø A/S to Aalborg University.

References

Anh, N.H., Thoan, N.V., 2010. The impact of culture on business relationships. In: Schaumburg-Müller, H., Chuong, P.H. (Eds.), New Asian Dragon: Internationalization of Firms in Vietnam. Copenhagen Business School Press, Frederiksberg, Copenhagen, Denmark, pp. 135–155.

Anh, P.T.T., Baughn, C., 2011. Antecedents and consequences of international joint venture learning: the case of Vietnam. J. Econ. Dev. 13 (3), 58–71.

Anh, P.T.T., Hang, N.T.M., 2010. Culture and performance of international joint ventures in Vietnam. In: Schaumburg-Müller, H., Chuong, P.H. (Eds.), New Asian Dragon: Internationalization of Firms in Vietnam. Copenhagen Business School Press, Frederiksberg, Copenhagen, Denmark, pp. 115–133.

Asian Institute of Technology/United Nations Environment Programme Regional Resource Center for Asia and the Pacific (AIT/UNEP RRC.AP), 2010. Municipal Waste Management Report: Status–quo and Issues in Southeast and East Asian Countries, Available at ⟨http://www.environment-health.asia/userfiles/file/Municipal%20Waste%20Report.pdf⟩ (accessed August 24, 2014).

Bijker, W.E., 2001. Understanding technological culture through a constructivist view of science, technology and society. In: Cutcliffe, S.H., Mitcham, C. (Eds.), Visions of STS: Counterpoints in Science, Technology and Society. State University of New York Press, Albany, NY, pp. 19–34.

Chi, N.K., Long, P.Q., 2011. Solid waste management associated with the development of 3R initiatives: case study in major urban areas of Vietnam. J. Mater. Cycles Waste Manage. 13, 25–33.

Christensen, D., 2014. Innovation in multi-actor partnerships: a waste management initiative in Vietnam. In: Bolay, J., Hostettler, S., Hazboun, E. (Eds.), Technologies for Sustainable Development: A Way to Reduce Poverty? Springer International Publishing, Cham, pp. 147–158.
Christensen, D., Drysdale, D., Hansen, K., Vanhille, J., Wolf, A., 2014. Partnerships for development: municipal solid waste management in Kasese, Uganda. Waste Manage. Res. 32 (11), 1063–1072.
Dang, T.D., Mahanty, S., MacKay, S., 2013. Living with pollution: juggling environmental and social risk in Vietnam's craft villages. Crit. Asian Stud. 45 (4), 643–669.
The Danish Centre for the Verification of Climate and Environmental Technologies (DANETV), 2013. ECOGI Pre-treatment of biomass for anaerobic digestion: Mechanical pretreatment and separation of organic waste from households and industry to obtain a pulp for biogasification, Verification Report J.no. 1004, Available at: http://www.etv-danmark.dk/filer/energi/ECOGI_verification_report.pdf (accessed October 25, 2015).
DiGregorio, M.R., 1994. Urban Harvest: Recycling as a Peasant Industry in Northern Vietnam. East-West Center Occasional Papers; Environmental Series No. 17.
Ellen Mac Arthur Foundation, 2013. Towards the Circular Economy: Opportunities for the Consumer Goods Sector.
European Commission, Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions, 2014. Towards a circular economy: a zero waste programme for Europe. In: EUR-Lex, Available at ⟨http://eur-lex.europa.eu/resource.html?uri=cellar:50edd1fd-01ec-11e4-831f-01aa75ed71a1.0001.01/DOC_1&format=PDF⟩ (accessed August 13, 2014).
Flintoff, F., 1976. Management of Solid Wastes in Developing Countries. World Health Organization, New Delhi.
Goduscheit, R.C., Bergenholtz, C., Jørgensen, J.H., Rasmussen, E.S., 2008. Action research in inter-organizational networks: impartial studies or the Trojan horse? Syst. Pract. Act. Res. 21, 267–281.
Hajer, M., 1995. The Politics of Environmental Discourse: Ecological Modernization and the Policy Process. Clarendon Press, Oxford.
Halla, F., Manjani, B., 1999. Innovative ways for solid waste management in Dar-Es-Salaam: toward stakeholder partnerships. Habitat Int. 23 (3), 351–361.
Hart, S.L., 2005. Capitalism at the Crossroads: The Unlimited Business Opportunities in Solving the World's Most Difficult Problems. Prentice Hall, New Jersey.
Hart, S.L., 2011. Taking the green leap to the base of the pyramid. In: London, T., Hart, S.L. (Eds.), Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Pearson Education, New Jersey.
Kandachar, P., Halme, M., 2008. Farewell to pyramids: how can business and technology help to eradicate poverty? In: Kandachar, P., Halme, M. (Eds.), Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor. Greenleaf Publishing, Sheffield.
Kironde, J.M.L., Yhdego, M., 1997. The governance of waste management in urban Tanzania: towards a community based approach. Resour. Conserv. Recycl. 21, 213–226.
Ministry of Natural Resources and the Environment, 2012. National State of Environment 2011: Solid Waste.
Jensen, B., 2011. Solid Waste Management in Hanoi. Ninth Semester Report. Aalborg University (M. Sc. Environmental Management & Sustainability Science).
Kawai, K., Osako, M., 2013. Advantages and disadvantages of a municipal solid waste collection service for citizens of Hanoi City, Vietnam. Waste Manage. Res. 31 (3), 327–332.
Kolk, A., Rivera-Santos, M., Rufín, C., 2014. Reviewing a decade of research on the "Base/Bottom of the Pyramid" (BOP) concept. Bus. Soc. 53 (3), 338–377.
LaFrance, J., Lehmann, M., 2005. Corporate awakening—why (some) corporations embrace public–private partnerships. Bus. Strat. Environ. 14 (4), 216–229.
Lecomte, C., Naquin, P., Yelkouni, M., Blanco, E., Boissin, O., 2012. From participatory design to local appropriation: a case study of waste management in Ouagadougou (Burkina Faso). In: Proceedings from the 2012 Tech4Dev International Conference, 29–31 May, Lausanne, Switzerland.
Lehmann, M., Jeppesen, S., 2006. Public–private partnerships: facilitators of environmental improvement? In: Welford, R., Hills, P., Young, P. (Eds.), Partnerships for Sustainable Development: Perspectives from the Asia-Pacific Region. The Center for Urban Planning and Environmental Management, The University of Hong Kong, Hong Kong.
Lehmann, M., 2008. Conceptual Developments and Capacity Building in Environmental Networks: Towards Public–Private–Academic Partnerships for Sustainable Development. Department of Business Studies, Aalborg University (PhD dissertation).
Mitchell, C.L., Altered landscapes, altered livelihoods: the shifting experience of informal waste collecting during Hanoi's urban transition, 2008. Geoforum 39 (6), 2019–2029.
Mol, A.P.J., Sonnenfeld, D., 2000. Ecological modernisaiton around the world: an introduction. Environ. Polit. 9 (1), 1–14.
Müller, J., 2011. Part III. Social conditions of production. In: Müller, J. (Ed.), Making Ends Meet: Local Socio-technological Transformations in the South. Department of Development and Planning, Aalborg University, Aalborg.
Napier, N.K., Hoang, V.H., 2011. Getting to the real story: what Vietnamese business people wish foreigners understood about doing business in emerging and transition countries like Vietnam—before they start. Int. J. Hum. Resour. Dev. Manage. 11, 208–220 (2/3/4).
Nguyen, X.H., Le, H.V., 2011. Solid waste management in Mekong Delta. J. Vietnamese Environ. 1 (1), 27–33.
Omran, A., Gavrilescu, M., 2008. Municipal solid waste management in developing countries: a perspective on Vietnam. Environ. Eng. Manage. J. 7 (4), 469–478.
Pariatamby, A., Fauziah, S.H., 2014. Sustainable 3R practice in the Asia and Pacific Regions: the challenges and issues. In: Pariatamby, A., Tanaka, M. (Eds.), Municipal Solid Waste Management in Asia and the Pacific Islands. Springer-Verlag, Singapore, pp. 15–40.
Pariatamby, A., Tanaka, M., 2014. Municipal Solid Waste Management in Asia and the Pacific Islands. Springer-Verlag, Singapore.
Phuong, N.T.L., Higano, Y., Yabar, H., 2012. A New approach for municipal solid waste governance aiming to become green city bases for sound material-cycle society initiative in Hanoi, Vietnam. In: Matsumoto, M., Umeda, Y., Masui, K., Fukushige, S. (Eds.), Design for Innovative Value Towards a Sustainable Society. Springer Science+Business Media, Dordrecht.
Prahalad, C.K., Hammond, A.L., 2002. Serving the world's poor, profitably. Harvard Bus. Rev. 80 (9), 48–57.
Ravn, J., 2012. Access2innovation: Network-Based Business Model Innovation for Disaster Relief and Development Assistance (Translated from Danish). Department of Development and Planning, Aalborg University (PhD dissertation).
Remmen, A., 1991. Constructive technology assessment. In: Cronberg, T., Duelund, P., Jensen, O.M., Qvortrup, L. (Eds.), Danish Experiments—Social Constructions of Technology. New Social Science Monographs. Institute of Organisational and Industrial Sociology, Copenhagen Business School, Copenhagen.
Rivas-Hermann, R., Smink, C.K., Kerndrup, S., (in press). Partnerships for environmental technology development in the shipping industry: two Danish case studies. Int. J. Innov. Sustainable Dev. http://www.inderscience.com/info/ingeneral/forthcoming.php?jcode=ijisd.
Scheinberg, A., Anschütz, J., 2006. Slim pickin's: Supporting waste pickers in the ecological modernization of urban waste management systems. Int. J. Technol. Manage. Sustainable Dev. 5 (3), 257–270.
Scheinberg, A., Spies, S., Simpson, M.H., Mol, A.P.J., 2011. Assesing urban recycling in low- and middle-income countries: building on modernised mixtures. Habitat Int. 35 (2), 188–198.
Schaumburg-Müller, H., 2006. Upgrading and aid dependency: Danish firms in Vietnam. In: Hansen, M.W., Schaumburg-Müller, H. (Eds.), Transnational Corporations and Local Firms in Developing Countries—Linkages and Upgrading. Copenhagen Business School Press, pp. 199–229.
Schaumburg-Müller, H., 2010. The dynamics of firm internationalization in Vietnam. In: Schaumburg-Müller, H., Chuong, P.H. (Eds.), New Asian Dragon: Internationalization of Firms in Vietnam. Copenhagen Business School Press, Frederiksberg, Copenhagen, Denmark, pp. 13–38.
Stewart, J., Hyysalo, S., 2008. Intermediaries, users and social learning in technological innovation. Int. J. Innov. Manage. 12 (3), 295–325.
Stutz, J., 2008. Sustainable solid waste management using a base-of-the-pyramid approach. In: Kandachar, P., Halme, M. (Eds.), Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor. Greenleaf Publishing, Sheffield.
Taniguchi, Y., Yoshida, M., 2011. Public involvement and mobilization for promoting 3R initiative in Hanoi City–lessons from 3R initiative project in Hanoi City 2006–2009. In: Proceedings of the 8th Expert Meeting on Solid Waste Management in Asia and Pacific Islands (SWAPI), 21–23 February, Tokyo, Japan.
Thai, N.T.K., 2014. Municipal solid waste management i Vietnam challenges and solutions. In: Pariatamby, A., Tanaka, M. (Eds.), Municipal Solid Waste Management in Asia and the Pacific Islands. Springer-Verlag, Singapore, pp. 355–377.
Thanh, N.P., Matsui, Y., 2011. Municipal solid waste management in Vietnam: status and the strategic actions. Int. J. Environ. Res. 5 (2), 285–296.
Tukahirwa, J., Mol, A.P.J., Oosterveer, P., 2010. Civil society participation and solid waste management in Uganda. Local Environ. 15 (1), 1–14.
van Vliet, B., van Buuren, J., Oosterveer, P., Spaargaren, G., 2013. Network governance for waste and sanitation service provision: an introduction to the modernised mixtures approach. In: Urban Waste and Sanitation Services for Sustainable Development: Harnessing Social and Technical Diversity in East Africa. Routledge, London and New York.
Visvanathan, C., Kashyap, P., 2012. Effective policy framework for the promotion of 3R technology transfer. Int. J. Environ. Technol. Manage. 15, 501–515 (3/4/5/6).
Welford, R., Hills, P., Young, W., 2006. Partnerships for Development: Perspectives from the Asia-Pacific Region. The Center for Urban Planning and Environmental Management, The University of Hong Kong, Hong Kong.
Wittmaier, M., Langer, S., Wolff, S., Bilitewski, B., Werner, P., Stefan, C., Schingnitz, D., Wiesmeth, H., Parthasarathy, R., Woolridge, C.F., Green, J., Quyh, D.N., Viet, L.H., Ngan, N.V.C., Hoang, N.X., Trang, N.T.D., Minh, P.H., Touch, V., Samell, K., Khouangvichit, S., Daladone, P., Tia, S., Songkasiri, W., Commins, T., 2009. INVENT Handbook: Innovative Education Modules and Tools for the Environmental Sector, Particularly in Integrated Waste Management, Available at ⟨http://www.invent.hs-bremen.de/Teaching%20Modules.htm⟩ (accessed August 22, 2014).

CHAPTER 9. UGANDA: SOCIO-TECHNICAL SYSTEM ANALYSIS

9.1. HIGHLIGHTS: PAPER 4

Partnerships for development: Municipal solid waste management in Kasese, Uganda

In this paper, a district-level solid waste management (SWM) system in Uganda is analyzed with the aim of identifying sustainable pathways for partnership innovation. The paper addresses sub-question 3 (see Chapter 5) about how socio-technical systems in developing countries influence the way that solutions can be co-constructed.

After a framing of SWM challenges in Uganda[48] and an elaboration of partnerships as innovative governance toward solid waste, the paper contains the results of an ISWM-based analysis (see Chapter 4.2) applied to Kasese district. Key points raised are as follows:

- Kasese offers basic SWM service delivery but suffers shortfalls, and only 60 tons/day of 230 tons/day generated waste ends up being formally treated at Kasese's composting plant. The stakeholder analysis shows the limited scope of action by the municipality due to budgetary earmarks and dependency on World Bank assistance, and shows that high-volume waste generators in the urban core are connected to transport and treatment options, but low-volume generators in the outskirts are not.
- The church and the King were found to wield influence in the community with respect to mobilization potential.
- Opportunities exist related to mobilization of stakeholders and being more pragmatic with SWM technological and business model innovation and instead emphasizing decentralized solutions and the informal sector. Possible opportunities are also identified linking the solid waste stream with the sanitation (liquid) waste stream.
- Socio-technical theories in SWM can help identify lock-ins that create or reinforce unsustainable pathways, and can clarify possibilities for immediate and long-term action among stakeholders.

[48] Unavailability of capital-intensive technologies, low levels of service provision, effectiveness and legitimacy among public authorities and a challenging process of distribution of tasks to municipalities and districts.

PAPER 4

Christensen, D., Drysdale, D., Hansen, K., Vanhille, J., Wolf, A. (2014) Partnerships for development: Municipal solid waste management in Kasese, Uganda, *Waste Management & Research* 32 (11): 1063-1072

Original Article

WM&R

Waste Management & Research
2014, Vol. 32(11) 1063–1072

DOI: 10.1177/0734242X14539029
wmr.sagepub.com
SAGE

Partnerships for development: Municipal solid waste management in Kasese, Uganda

David Christensen, David Drysdale, Kenneth Hansen, Josefine Vanhille and Andreas Wolf

Abstract

Municipal solid waste management systems of many developing countries are commonly constrained by factors such as limited financial resources and poor governance, making it a difficult proposition to break with complex, entrenched and unsustainable technologies and systems. This article highlights strategic partnerships as a way to affect a distributed agency among several sets of stakeholders to break so-called path dependencies, which occur when such unsustainable pathways arise, stabilize and become self-reinforcing over time. Experiences from a North–South collaborative effort provide some lessons in such partnership building: In Uganda and Denmark, respectively, the World Wildlife Fund and the network organization *access2innovation* have mobilized stakeholders around improving the municipal solid waste management system in Kasese District. Through a municipal solid waste management system characterization and mapping exercise, some emergent lessons and guiding principles in partnership building point to both pitfalls and opportunities for designing sustainable pathways. First, socio-technical lock-in effects in the municipal solid waste management system can stand in the way of partnerships based on introducing biogas or incineration technologies. However, opportunities in the municipal solid waste management system can exist within other areas, and synergies can be sought with interlinking systems, such as those represented with sanitation.

Keywords

Developing countries, innovation, path dependencies, partnerships, Uganda

Introduction

In Uganda, much in line with a wider picture seen throughout cities in Sub-Saharan Africa and similar developing country settings, municipal solid waste (MSW) management systems are being placed under increasing strain as a result of rapid urbanization and population growth (Okot-Okumu and Nyenje, 2011; United Nations Human Settlements Programme, 2010). Public authorities are often unable to effectively manage the associated build-up of urban solid waste amounts that are generated and insufficiently collected at household and street level, where 30%–60% commonly remains uncollected and where service provision often reaches out to less than 50% of the population (Omran and Gavrilescu, 2008). It is symptomatic of this ineffective management that collection and transportation equipment is not routinely repaired or maintained, while waste disposal techniques otherwise widespread in the North are often perceived as out of reach for being technology and capital-intensive. The resulting impacts prove detrimental to the environment and to human health. Against this backdrop, the challenge has been laid out for public authorities to improve upon their management of solid wastes by considering alternative governance structures in the interest of both improved effectiveness and legitimacy from affected and disenfranchised urban communities (Kironde and Yhdego, 1997). Further, the challenge is on them to carry this out despite the financial constraints that these authorities may operate under. Conceptual frameworks on technology transfer in developing country settings provide some helpful insights on how different material/non-material aspects of technology may be shaped to secure best appropriate fit in situations as illustrated with constrained MSW management systems (Müller, 2003; Müller, 2011; Saad, 2000). However, emphasis in this body of literature is on direct North–South sender–recipient interactions between singular actors or nations/economies, with lesser attention paid to networked governance systems and the role of multisectorial partnerships.

Department of Development and Planning, Aalborg University, Aalborg and Copenhagen, Denmark

Corresponding author:
David Christensen, Department of Development and Planning, Aalborg University, Vestre Havnepromenade 9, 9000 Aalborg, Denmark.
Email: damc@plan.aau.dk

Partnerships and innovative solid waste governance

The sought-after capability to think alternatively and innovatively in constrained settings is what has prompted varied explorations into more sustainable and integrated solid waste management systems that are environmentally, socially and financially favourable (Omran and Gavrilescu, 2008) and explicitly give due attention to stakeholder engagement and horizontal interactions at the local level in a manner that moves away from more traditional, engineering-based assessment and planning (Anschütz et al., 2004; Okot-Okumu and Nyenje, 2011; United Nations Human Settlements Programme, 2010). The clarion call for innovative approaches to solid waste governance has furthermore brought a *partnership* paradigm to the fore in the context of African and Ugandan urban settings (Tukahirwa et al., 2010). Here, the strong involvement of non-state actors as stakeholders is important as we move away from the conception of solid waste as the monopoly domain of public authorities and their historical failure at delivering basic services to the poor through conventional approaches (Halla and Majani, 1999). The argument puts forward that no single actor can successfully carry out solid waste management alone, regardless of belonging to the public or private sector. In the partnerships alternative, various actors may collaborate in the provisioning of collective goods, and it follows that these arrangements tend to form and deal more successfully with emergent social issues as they arise – of which solid waste management is an example.

It has yet to be demonstrated that innovative partnerships within solid waste governance can arise, be promoted or made to function effectively in Uganda. In this country's institutional framework for waste management, a decentralization strategy has been pursued that has delegated key roles and responsibilities to urban councils at the local level (Okot-Okumu and Nyenje, 2011), but ineffectually. Under decentralization, local level public authorities have been afforded a wide-reaching mandate that is seemingly conducive for partnerships, grounded in the Local Government Act (LGA) of 1997; they are given provision to enact specific ordinances and by-laws and contractually engage with private companies in collection and disposal activities. This potentially gives them the opportunity to act with both the authority and means to tailor locally adapted solutions together with partners, and in line with national environmental policy objectives. However, overstretched fiscal and human resources has meant that solid waste governance at the local level is primarily compartmentalized, non-inclusive towards other stakeholders and reactive (Okot-Okumu and Nyenje, 2011), leading to the argument that decentralization policies have been in name only, unsupported and imposed unilaterally from above.

Despite the outlook on MSW management in Uganda in light of ineffectual decentralization policies, this article asserts the potential of the partnership perspective, placing emphasis on how heterogeneous social actors may collaborate to break so-called path dependencies through strategic partnerships in the solid waste management domain (Christensen, 2014). Experiences from a North–South collaborative effort provide some lessons in such partnership-building. In Uganda and Denmark, respectively, the World Wildlife Fund (WWF) and the network organization *access2innovation* have attempted to mobilize actors around improving the MSW management system in Kasese District in the Western Region of the country. *Access2innovation* has had a simultaneous history in partnership-building in relation to the town's sanitation system with possible MSW linkages in terms of treatment technologies for organic waste, but this is outside the main empirical focus of this study.

The lessons learned in the formative process of MSW partnership building in the Kasese example are reported in this present article and seen in the perspective of socio-technical theories on path dependencies and innovation. Its basis is the result of a system characterization study on the waste management system in Kasese, involving qualitative and quantitative field methods and stakeholder participation. The specific rationale for this study has been to provide some guidance on forming strategic partnerships in the complex and constrained settings commonly seen in developing countries' MSW management systems. The study is embedded within a North–South partnership and a set of overall project objectives as presented in the following.

Partnerships through North–South collaboration

Access2innovation is an initiative run by an interdisciplinary secretariat based in Denmark that sets out to develop and test innovative ways of building strategic partnerships among actors in civil society, business and academia (Christensen, 2014). The initiative has a philosophy of approaching societal challenges and needs in developing countries in a commercial manner, aiming to foster partnerships that lead to disseminating sustainable technological solutions and business models within three thematic areas: renewable energy, water and sanitation and food security. The premise of the initiative is that synergies may be found in combining the interests and capabilities of heterogeneous actors, with *access2innovation* itself functioning as an inter-organizational infrastructure for facilitating innovation processes (Ravn, 2012). In Uganda, *access2innovation* has linked with a number of recognized international NGO's (non-governmental organizations) as well as socially responsible businesses already established in the country. By utilizing these organizations as local anchoring points for its lines of action among its three thematic areas, *access2innovation* is able to mobilize and funnel Danish resources towards a number of business development activities in Uganda with high sustainability impact potential. It is a requirement that these activities be partnership-based and preferably link across the business-NGO-academia sectors. Business development as facilitated by *access2innovation* covers, among others, early-stage needs assessment, market research, feasibility studies, prototyping, partnership search and user-centred design studies. Concerning MSW management in Uganda,

access2innovation has sought to attract business interest as part of its renewable energy track and its collaboration with the WWF Uganda Country Office, with support from WWF Denmark. Although WWF Uganda here is designated as a local and 'Southern' entity in the framing of the relationship with *access2innovation* as a North–South partnership, it is important to keep the reservation in mind that WWF Uganda is connected to WWF internationally and in the Nordic countries through a broader network relationship, and may be correspondingly beholden to another set of interests and discourses than a purely Ugandan one. To what degree this has influenced the outcome of the partnership building process in terms of the MWS management system in Uganda, however, has been beyond the scope of this study.

WWF in Uganda has sought to address energy poverty through an inherently partnership-based programming approach, leveraging efforts around a single district in the country to act as a locality for demonstrating replicable and scalable solutions (World Wildlife Fund Uganda Country Office, 2012). Termed the Champion District project and initiated in 2012, the project's purpose is to identify, pilot and demonstrate innovative ways to increase access to clean energy for the rural poor. The project has an ambitious target of reaching 100% access by the year 2020 within the intervention area. Of key importance is the project's broad partnership scope, by which WWF has taken the initiative to mobilize and include civil society organizations, businesses, communities, local and central government and academia locally and abroad – including *access2innovation*. WWF Uganda acts as the implementing party in the project with technical and financial support provided by WWF in Norway, Denmark and Sweden. Owing to the pooling of such resources and the selection of a district as an intervention area, WWF Uganda is supported in its assertion that the project distinguishes itself from many other energy projects that have remained small-scale with limited impact. The choice of Kasese District has not come about arbitrarily, but has been selected as the focal district through a multi-stakeholder consultative process that narrowed down a broad candidate field to three districts based on a combination of own criteria and stakeholder criteria, and finally selected Kasese District based on this multi-criteria assessment together with additional data gathered from secondary literature. The stakeholder criteria cited during a WWF Uganda-led questionnaire process with ministerial, development agency, research institution and NGO representatives covered the following: population data (growth rate, density, poverty levels), environmental management status (deforestation rates, proximity to important conservation areas), energy data (productive demand, grid connection and extension plans, renewable energy sources), current availability of improved cooking stove and solar energy technology, district-level goodwill and leadership and finally gender and HIV issues. WWF's own criteria covered: current basic energy access, renewable energy potential, current WWF Uganda involvement and partnerships, potential as district role model, linkages to conservation priority areas, potential for collaboration with partners across sectors at district and national level, logistical challenges in implementation (road network, distance to Kampala, security and financial systems) and socio-economic scope (land area, population size, poverty levels).

Kasese District's population is approximately 700,000 inhabitants, and the focal point of the effort to address MSW management from both *access2innovation* and the WWF Uganda's Champion District project's side is the district capital of Kasese town itself. Kasese town is estimated to count just over 100,000 inhabitants, up almost 100% since the last 2002 national census making it one of the fastest growing towns in Uganda and recently entitling it to the status of a municipality (Uganda Bureau of Statistics, 2002). The district as a whole is predominantly agricultural based (e.g. coffee), while Kasese town itself is situated near some industrial activity (e.g. cobalt and copper mining and cement production) (Uganda Communication Commission, 2012). The background for identifying solid waste management in Kasese town as a common priority area for *access2innovation* and WWF Uganda was an exploratory field visit by a Danish delegation in early 2012. Direct observations of insufficiently managed solid waste in Kasese town among the delegation participants led to the issue being listed as one of potential for joint intervention during joint workshop sessions and bilateral communication with WWF. While *access2innovation* saw the opportunity to mobilize Danish investors to look upon the waste amounts in Kasese as a bio-energy business case, WWF too saw it within its Champion District mandate to mobilize business interest around the issue in alignment of its rural energy access goals. An exploration of technological options led to the propositions of introducing centralized biogas or incineration technology at Kasese with energy recovery (primarily for electricity generation), supposing that an enabling environment could be fostered to support a sustainable energy business.

Path dependencies, lock-ins and distributed agency

As small cities under 500,000 inhabitants go, Kasese town represents a crucially important setting for interventions and innovations within many areas, including solid waste management in developing countries, owing to previously highlighted concerns about rapid urbanization and population growth. While large cities beyond the 500,000-population threshold are commonly framed as needing urgent attention, it has largely escaped notice that small cities in developing countries account for the bulk of population growth in the foreseeable future (Cohen, 2006). In addition to accounting for the fastest growth rates, small cities are also the poorest served in terms of basic services and are generally also in possession of relatively higher poverty rates compared with large cities. Compounding the problem is the common lack of institutional capacity to manage these issues, coupled with a tendency towards decentralization in many developing countries, and more responsibilities on service delivery being placed on lower levels of government. As noted earlier, such decentralization policies have not necessarily led to improved

solid waste management in Uganda. What further underscores the challenge is that the Ugandan local government structure is regarded as one of Africa's most decentralized institutional systems (Kritaka et al., 2010).

In light of North–South collaboration and partnership building, the framework conditions present in Uganda and Kasese render it a challenging prospect to further sustainability objectives. Analysis of, and interventions in, solid waste management under such conditions is argued to be most appropriately conducted by adopting a socio-technical perspective, which looks beyond a narrow definition of a solid waste management system as being made up solely of tangible and technical constituent elements. A socio-technical perspective allows for the inclusion of technical, organizational, societal and institutional aspects, following the Science, Technology and Society (STS) tradition (Bijker, 2001). It also allows for the introduction of concepts and theories pertaining to so-called path dependencies. Such a framing refers to how processes and technologies arise, stabilize and become self-reinforcing over time as a result of, for instance, socio-cultural and political factors (Pierson, 2000). Here, particular courses of action are understood to be attributable to patterns of sequence and timing. These are then crucial for later developments. An unsustainable pathway might emerge out of a series of seemingly small or contingent events, but these may in fact have significant ramifications for later outcomes and trajectories. In such cases, a path dependency framing recognizes that alternative courses of action may eventually become nearly impossible to reverse, and that the costs of switching paths may increase over time. In such a situation, it is important for an analysis of a given situation to identify what mechanisms are working to reinforce an undesirable or unsustainable system or technology; these mechanisms are referred to as lock-ins (Unruh, 2002). Lock-ins can stem from a variety of sources, such as from dominant technological regimes or institutional frameworks, or even the cognitive behaviour of individuals. It is a proposition following from this that a mapping of sources of lock-in for a particular situation of path dependency may help inform decisions to move along on a more desirable trajectory. Here we return to *partnerships* as a way of potentially breaking path dependencies, in spite of entrenchment. From a path dependency perspective, challenging a locked-in system is situational and not prescriptive; it may require innovation or changes at technology, sub-system or entire system level, and can encompass interventions from outside the system or within. The *agency* of actors becomes a noteworthy object of study in this respect. While the outlook for a single actor being able to challenge a locked-in system may be dubious, it may appear more feasible for technological breakthroughs to take place through a distributed entrepreneurial agency shared among several actors, as in the case with wind turbine development in Denmark (Garud and Karnøe, 2003).

Design and methods

In the context of the *access2innovation* and WWF Uganda partnership building effort, and prior to any attempted involvement of Danish investors into the intervention area, the early stage identification of potential biogas and incineration pathways for Kasese municipality prompted first carrying out a MSW characterization study. In this study, an *access2innovation* field research team utilized qualitative and quantitative empirical data-gathering methods covering document reviews, semi-structured interviews, direct observations and a total of 20 surveys covering 15 households and five services/industries (two small shops, one petrol station and two hotels).

The surveyed household size ranged between one and nine, with a mean of 5.13 members/household. The assistance tool for carrying out the surveys was the 'ViewWorld' smartphone application (© ViewWorld ApS), which was used for logging of respondent's answers and further allowed for geo-tagging and linking of pictures to the cloud storage-based survey database. The surveys were executed during the course of a day in two divisions within Kasese municipality with the translation aid of a field officer appointed by WWF Uganda, and involved asking the respondents about waste generation patterns, disposal practices and satisfaction levels. Some indicative, qualitative questions were added when the opportunity presented itself concerning the views and perceptions of local residents towards the MSW management in their area. The response rate was 100%, with all approached households and services/industries agreeing to take part. The households and services/industries were accessed by foot with the aim not being to have a representative sample, but rather one in which different geographical areas and socio-economic groups in the town centre were included. It is worthy to mention that the Integrated Sustainable Waste Management (ISWM) framework, described in the next section and used as guidance for the research, recommends that between 15–100 household/services surveys be carried out.

The semi-structured interviews comprised a critical part of the qualitative data collection, which was used to analyse Kasese municipality's waste system elements and stakeholders in alignment with a socio-technical standpoint and the ISWM framework. The interviews allowed the research team to understand specific viewpoints, contexts, perspectives, intents, relations, etc. In some instances, the interviews led to identifying additional stakeholders who were later interviewed. The interviews on average lasted between 30–60 minutes each, and counted: the mayor of Kasese town, the deputy town clerk, the principal health inspector (responsible for MSW management), the manager of the municipal compost plant, a parish priest (and community organization chairperson representing the local king), an energy manager at WWF Uganda, a Danish businessman and a professor at Uganda's Makerere University (and MSW management expert). Following the method prescribed by Bickman and Rog (2009), the interviews were carried out with pre-assigned objectives, which are presented below together with the following question categories.

- Who are the main stakeholders involved in the current waste management system? Objective: To understand how much

the stakeholder knows about the waste management system network and to learn about new stakeholders.
- How are you as a stakeholder involved in the current waste management system? Objective: To understand the role the stakeholder plays in the waste management stakeholder network.
- What are the main challenges of the current waste management system? Objective: To understand the main challenges of the waste management system and to understand how much the stakeholder knows about the waste management system and its issues.
- How could the current waste management system be improved? Objective: To understand what the stakeholder thinks is a good idea on how to improve the waste management system and to identify potential path dependencies.

As an additional method for characterizing the current MSW management system, as well as to verify interview data, site observations were carried out. The technique used for observational data collection was direct observation, which aided the research team in observing phenomenon going on in real-time (Olsen and Pedersen, 2008). While carrying out observations, the research team attempted to remain discreet and unobtrusive so as not to cause interference. Observations along the waste stream were primarily visual and not based on physical inspections and analysis owing to time and resource constraints, while the boundaries were mainly restricted to what the research team could cover by foot in the Kasese town centre. However, in some cases vehicles were made available for observations on the outskirts of the town and certain spots of interest including a prison, hospital, abattoir and two hotels. Prior to venturing into the field, a rough observational guide was developed to serve as the structure, though as pointed out by Bryman (2012) structured observations may risk imposing an inappropriate or irrelevant framework. Once adapted to the field setting, the observations were able to prove a snapshot in time of the following, visible waste system characteristics.

- Generation, collection, transport and treatment/disposal.
- Evidence of re-use, recycling, recovery, burying and burning of waste.
- Presence of unlawful waste dumping at roadsides, pits and hillsides.
- Identifying different waste fractions present in the waste stream at dumpsites, skips and waste sent for composting.
- Sorting at the generation level, such as in households and services/industries.

Additionally, the team utilized interactive methods through attendance of multi-stakeholder workshops organized and facilitated by WWF Uganda, which included municipal officials as well as local NGO partners involved all aspects of the Champion District project. In terms of public participation, this type of activity was more supportive of collaboration and partnerships with local stakeholders, while the applied interview and survey techniques were more consultative in nature (Kørnøv, 2007). Taken together, the employed quantitative and qualitative data gathering methods determined what data was available for analysis and interpretation. Prior studies on the waste system in Kasese have not been plentiful, so there have undoubtedly been some uncertainties in parts of the analysis. Increasing the validity of the findings through triangulation was aimed for where possible by searching for converging findings from different sources.

ISWM Framework

In conducting the study, some of the most important principles of the ISWM framework (Anschütz et al., 2004) were followed and adapted to the Kasese context and the research team's use of the quantitative and qualitative empirical data-gathering methods (Vanhille et al., 2013). This applies particularly to the fitting for developing country settings, as the framework was originally developed in the Netherlands and has eventually been adopted in international circles (United Nations Human Settlements Programme, 2010). The ISWM framework is a versatile way of describing, theorizing, assessing and ultimately improving upon existing systems in low- and middle-income countries in particular. It is in alignment with STS studies and shares an understanding of solid waste management systems as comprising of both technical and socio-cultural elements. Stakeholders, waste system elements and sustainability aspects are seen as three main elements to waste management in the ISWM framework (Scheinberg and Anschütz, 2006). Emphasis is placed on local conditions, actors and users, and the use of participatory processes in the design and choice of waste elements (van Vliet et al., 2013). In this manner, it is a practitioner-oriented framework that is normatively influenced by an objective to empower poor and disenfranchised (informal) stakeholders at the grassroots level. These characteristics make the ISWM framework distinct from the path dependency and lock-in effect perspective; although there is common ground in terms of viewing waste systems as socio-technical systems, the ISWM framework embraces bottom-up driven processes without necessarily implicitly carrying the system understanding of lock-in factors and path dependencies possibly occurring along the way. Such a perspective is argued here to be complementary to the ISWM framework.

The ISWM framework directed the research along two lines of study. First, the study included an analysis of the waste system elements in Kasese town, covering the generic four phases (generation, collection, transport, treatment/disposal) applicable to such systems, and an overall characterization according to four waste hierarchy elements (prevention/reduction, re-use, recycling, recovery). Second, the study included a stakeholder analysis, recalling that the principles of the ISWM framework placed emphasis on utilizing participatory approaches and on normative principles such as fairness and equity. The adopted ISWM approach to the study of Kasese town was taken with a theoretical point of departure recognizing the complementary lock-in

and path dependency perspective, remaining aware that potential lock-in effects might affect the potential future trajectories for either a biogas or incineration treatment in the towns' MSW management system, jointly identified by *access2innovation* and WWF.

Interpretation of the results from the ISWM-guided study was carried out after piecing together and analysing the various forms of collected data from surveys, interviews, field observations and workshops. The ISWM framework provided sensitivity about stakeholder roles and relations, guiding and placing some emphasis on the executed semi-structured interviews. Here, the research team partially transcribed the interviews in order to gather the main points, which were then classified into issues such as environmental, political, financial, structural, etc. The framework further provided assistance with distilling the key issues and prioritizing them through a prescribed ranking matrix and scoring system carried out by the research team. Beyond this practical method however, the ISWM framework did not have an approach to interpret the results gathered in the field. The path dependency and lock-in theories were utilized and took over from here in the interpretation process, guiding the research team in identifying sources of lock-in from a system-level viewpoint. Thus, the ISWM framework provided a useful stakeholder understanding of waste systems in developing countries as well as a data analysis protocol, while the path dependencies and lock-in theoretical perspectives provided guidance (though not deductively) on diagnosis of the Kasese MSW management system, and how lock-in situations might be challenged through, for instance, North–South partnerships.

Results

The MSW management system of Kasese was perceived as comprising both waste system elements and stakeholder interactions from both the formal and informal sectors. The system is institutionally embedded in the overarching Ugandan decentralization context, wherein policy objectives delegate responsibilities for environmental safeguarding to different bodies and even to individual citizens themselves, some of the most central pieces of legislation being the National Environment Act of 1995 and the National Environment (Waste Management) Regulations of 1999 (Okot-Okumu and Nyenje, 2011). At the municipal level, Kasese Municipality has put into place a legislative enforcement and punitive mechanism by which illegal waste dumping may be fined by 20,000 Ugandan Schillings (approximately 7.40 US Dollars), to be effectuated through the employment of so-called waste scouts. However, cursory inspections by the research team quickly found that visible waste dumping, burning and burying activities were taking place, and gathered through interviews with municipal officials that lack of enforcement was a problematic issue and a possible source of lock-in.

Aside from attempting to carry out responsibilities under national environmental legislation and decentralization, Kasese Municipality has adopted normative objective of achieving a *'clean, green and well-planned city'* as part of the elected mayor's running platform, which has been sought integrated as a guiding principle in physical planning objectives. This was also an important influence on the selection of Kasese as the focal intervention area in the Champion District project. The waste management system as observed, however, found that there were challenges in achieving this within the solid waste management system aside from aforementioned lack of legislative enforcement: One significant hindrance to addressing waste management adequately at a systemic level had to do with budgeting mechanisms. Local governments in Uganda as a whole are reliant on national government transfers, as these make up some 66% of revenues while own taxes similarly make up only 15% of generated revenue, with the rest being made up of 5% user fees/charges, 11% donor contributions and 3% other non-tax revenues (Kritaka et al., 2010). In Kasese, no direct fee-for-service is levied towards citizens for solid waste management, meaning there exists no direct method of improving revenue for service delivery. Counter-intuitive to decentralization policies, a markedly high percentage of 88% of the national government transfers are made up of earmarked grants, leaving only some 11% as discretionary revenue for Kasese municipality to utilize according to its own priorities. Factors such as these place limits on the municipal latitude for action on solid waste management, such that, on average, less than 10% of total revenue is directed towards this issue. The waste characterization study of Kasese is summarized below in Table 1.

Characterization of waste system elements

Seen from an overall perspective, the Kasese MSW management system, while suffering shortfalls in basic service delivery, at minimum offers rudimentary collection, transport and treatment of the waste that is generated at the densest-populated urban core and at marketplaces that together account for some of the most significant waste volumes. Out of approximately 230 tonnes day^{-1} waste generated, approximately 180 tonnes day^{-1} ends up being informally treated (burned or buried), while approximately 60 tonnes day^{-1} ends up treated at the municipal composting plant. Here, inorganic waste fractions are simply deposited in piles without further treatment, while approximately 3 tonnes day^{-1} of compost is produced but not being sold (Vanhille et al., 2013). In terms of finer-aggregate data on MSW composition in Kasese municipality, a 2006 study showed the following percentages for different kinds of fractions (Kyambadde et al., 2006): Food 49.8%, garden 24.2%, paper 5.4%, plastic 5.1%, glass 0.4%, metals 0.1%, textile 0.5%, wood, charcoal, leather and rubber 1.3% and other (soil, ash, stones and debris) 13.4%.

Stakeholder analysis

As emphasized in the ISWM framework, gaining an understanding of stakeholders and interrelations is paramount when looking upon a waste system. The findings of this line of study

Table 1. Description of Kasese's waste system elements (Vanhille et al., 2013).

Waste system element	Findings
Generation	• Literature and field study yielded rough estimations of 230 tonnes day-1 generated MSW • MSW generated across all urban areas but with highest generation at town centre and marketplaces (where organic content is highest)
Collection	• 25 collection points equipped with skip placed across Kasese town, mostly situated near high waste generating locales • No waste separation at source • Skips and immediate surroundings overflowing with waste • Households bury/burn own waste or transport to collection points at frequencies ranging from several times a day to every couple of days • Children often tasked with transfer of waste from residence to collection points; • Pilot initiative has attempted house-to-house collection (relais system) in densest urban core • Pilot scheme of installing 50 dustbins failed owing to theft of dustbins • Informal dumping widespread
Transport	• Kasese Municipal Council oversees operations of 3 waste trucks (1 compressor truck, 1 open bed waste truck, 1 skip truck) • Waste handled and loaded manually by municipal waste management employees • Rough estimation of waste density at 590 kg m^{-3} • Collected waste volumes vary from 0 m^3 day^{-1} (weekends, vehicle breakdowns or other unspecified reasons) to approximately 60–100 m^3 day^{-1}, meaning a collected average of approximately 20 tonnes day^{-1} in weight when checked against estimated waste density • Waste is transported to municipal central compost plant (construction funded by the World Bank and part of a Clean Development Mechanism registration) • Field observations showed many skips overflowing and uncollected • Frequency of skip collection severely affected by lack of funding for fuel • Informal transport to burning/burying sites takes place, and is a source of income for some individuals
Treatment and disposal	• Compost plant constructed with support from the World Bank and included in a larger Clean Development Mechanism registration running for 21 years • Approximately 1500 tonnes $month^{-1}$ MSW received, and producing approximately 90 tonnes $month^{-1}$ of compost, which is not socially accepted/being sold • Compost plant dimensioned to handle an inflow of 70 tonnes day^{-1} but is seldom operating at full capacity • Inorganic fractions of the incoming waste (plastic, glass, polyethylene bags and rubber tyres) are deposited in separated heaps on the composting site grounds without further treatment • Informal treatment takes the form of waste burning or burial

are presented in Table 2. In the ISWM framework, the stakeholder identification process is not inductive, but guided through prior knowledge about MSW systems in developing countries, i.e. concerning what roles and power relations typically are present but not the least also outlining a participatory process for stakeholders to become engaged in (Anschütz et al., 2004). Owing to being an initial mapping exercise, the utilized stakeholder approach is distinct from a fully ISWM-structured one, which continues further into implementation of MSW system interventions.

The stakeholder analysis indicated attitudes and perceptions of challenges related to the MSW management in Kasese. Additionally, the findings provided a basis for distinguishing between three types of relationships among the stakeholders in the system: (i) with the institutional framework underpinning the waste system; (ii) with the waste generators; and (iii) with regard to how the community functions. The first set of relationships indicated how budgetary earmarks had a significant impact upon the municipality's scope of action in dealing with solid waste management. Additionally, it showed that the crucial treatment stage of the waste system (the composting plant) depended upon support from outside parties, such as the World Bank. In the second set of relationships concerning waste generators, it was found that where these were located in the densest sections of the urban core, they were then most likely to be included in the formalized MSW management system, whereas those located in the outskirts were generally not connected. Waste generators that were important owing to high volumes and types of waste, such as the abattoir and hospital, respectively, had direct arrangements with other stakeholders. An informal waste collection and treatment scheme for plastic waste had at one time existed, but this ecosystem of sorts collapsed when market demand from Kampala fell. For the third sets of relationships dealing with community cohesion and mobilization potential, it was identified that the church and the local King wielded key influence as regards awareness of any sustainability-related issues.

Identifying and characterizing all three sets of relationships as mentioned helps to inform a future-oriented study of potential pathways and supports an identification of lock-in sources. Some of the identified lock-ins include: (i) the perception that legal requirements or duties are not being enforced, thus weakening the power of regulative instruments; (ii) the earmarked budgetary

Table 2. Findings from stakeholder analysis (Vanhille et al., 2013).

Stakeholder	Findings
Kasese Municipality	• Interviews carried out with Mayor, Deputy Town Clerk, Principal Health Inspector and Compost Plant Operator • Municipality oversees physical infrastructure of the waste management system but is constrained by earmarking of national government funds • Liquidity of funds to pay for fuel for waste collection perceived as challenge • Improvements cited to have occurred within the past 2 years concerning objective of a 'clean, green and well-planned' town • Waste management perceived to be a challenge owing to the town population exclusively seeing it as the responsibility of municipality to handle ('poor methods', 'little awareness', 'lack of education') • Inappropriate protection equipment for waste management workers cited as issue • Increasing population cited as issue • Lack of economic valuation of by-products resulting from waste treatment cited as issue • Future introduced technologies cited as needing to be cost-saving
Households	• Small-scale survey carried out in different parts of Kasese town and interview carried out with parish priest • Majority, but not all of respondents considered waste management as municipal responsibility exclusively (5 of 15 respondents reported joint communal responsibility) • Innovative methods of self-organization identified, e.g. fixed day of week for cleaning • Marked dissatisfaction concerning number of collection sites (skips) and trucks • Overflowing waste spreading owing to rains cited as issue • Smell cited as issue • Clear interest in a clean town
Services, industries and institutions	• Small-scale survey carried out (shops, petrol station, hotels) as well as site visits to significant waste generators (abattoir, hospital, prison) • Mixed levels of satisfaction with waste system, and varying practice • Limited source-separation in existence, where cardboard is given to informal collectors • Existence discovered of previously operating recycling plant for processing of plastic for further resale to Kampala (now defunct owing to decrease in market demand)

funding that places limits of discretionary municipal spending according to own priorities; (iii) the organic fraction of MSW destined for the composting plant means that this fraction is difficult to switch to other productive uses, such as biogas production, without negatively affecting the composting plant operations; and finally (iv) the cognitive behaviour of individuals largely indicates that waste is principally considered a burden instead of a resource.

Discussion

A basic premise in this article has been that a careful mapping of a MSW management system, if conducted in accordance with the ISWM framework and in recognition of path dependencies and lock-ins, helps to inform how to mobilize actors in partnerships to affect a path breaking, distributed agency. For a North–South collaborative effort as in the *access2innovation* and WWF Uganda example, being aware of socio-technical considerations in this manner provides a grounded reality check to preconceived ideas of sustainable business opportunities within biogas and incineration. It shows the complexity of MSW management, as well as what kind of scale needed to affect a direction change towards a more sustainable pathway.

Concerning pitfalls, the most pertinent issue to be brought to the fore in this respect is that any North–South transferral or shaping of a sustainable technological solution has to take into account the embedded nature of such solutions within local institutional settings. Although almost banal-sounding, it nonetheless bears repeating. To exemplify in the Kasese MSW management system, it is difficult to envision the introduction of biogas technology if the existing technical waste treatment element in the system (the compost plant) has the incoming organic waste amounts locked-in under a larger and binding Clean Development Mechanism project registration. Introducing such a solution would have to imply improving the overall ability of the system to collect the total generated waste in Kasese, so that the solution was adding onto, instead of competing with, the composting plant for the organic fraction. There is certainly scope for this, as far from 100% of generated waste is currently being collected. But then the solution would have to consider the financial challenges of the existing system to ensure even basic provision of fuel for waste collection vehicles. Adding more trucks to the fleet would not necessarily improve upon the situation. An innovative, perhaps decentralized solution, within collection and transport would likely need to go hand-in-hand with a new treatment solution like biogas, making the resulting business model all the more complex.

Despite the constrained and multi-faceted conditions on the ground, it is argued that there are still opportunities for partnerships through North–South collaboration. In the Kasese example, the stakeholder analysis in particular pointed to individual cognitive behaviour as a source of lock-in, but also identified other

stakeholders with the potential to be utilized as leverage points in community mobilization, namely the church and the King, who wields comparatively more legitimacy than public authorities in this specific setting. Any introduced centralized system would necessitate community mobilization of this kind, but is by no means unrealistic to envision. In other words, one feasible approach to dealing with lock-in effects to the Kasese MSW management system entails community mobilization and multi-stakeholder engagement, supported by North–South collaboration, provided that engagement can be secured for the long term.

If being more pragmatic in the short term is an overriding concern with regard to technological and business model innovation, the Kasese setting appears conducive to solutions that can thrive despite the major issues affecting the existing system: the orientation of waste collection towards the dense urban core only, and the reliance on revenue flows from the national government to handle waste collection and transport effectively. It would entail decentralized solutions that have their own revenue generation streams. They could additionally build upon the fragile informal sector practices that exist in the outlying areas of Kasese, such as intermittent door-to-door waste collection and the now-defunct plastics processing business that catered to the Kampala market. Such solutions would not necessarily be waste-to-energy related, thus falling outside the mandate of both *access2innovation* and WWF Uganda, and could conceivably have more focus on, for instance, small-scale waste collection/transportation solutions and value-adding entrepreneurial activities for recovered inorganic waste. Being more locally tailored and scaled, these solutions could be argued to be more inclusive of the urban and peri-urban poor in Kasese and similar settings, and more appropriate to consider in a short time horizon. A broader waste-to-value oriented outset would additionally support a series of partnership-building efforts along this line of thinking.

As a final remark, what this study has not fully taken into account is the possibility of looking not only into MSW systems in developing countries as isolated socio-technical systems, but as a component of up to several interlinking systems that can potentially share the same technical elements. In Kasese and outside the main scope of this article, *access2innovation* has also been exploring partnership-building options for business models in the town's sanitation system. The system characteristics in this case are different from the MSW system as revealed through a similar mapping exercise. As an example, a fee-for-service collection mechanism exists for septic tank collection at household level. In the sanitation system, a business case has been made possible by bundling a revenue-generating water, toilet and wastewater treatment service in one place, leading to the joint involvement of Danish and Ugandan partners on a formalized joint venture. The relevance for the MSW system lies in the proposition that a biogas pathway for wastewater treatment is possible and actively being sought, which could also include introducing some proportion of the organic MSW fraction. This partnership opportunity has not necessarily been identified from the outset, illustrating that explorative search and selection processes for innovative solutions can be unpredictable. Additionally, it illustrates that there is scope for further applied research into partnerships in developing countries' MSW systems if viewed through a multiple socio-technical system perspective.

Conclusion

Socio-technical theories of path dependencies and innovation can contribute to understanding and characterizing MSW management systems in developing countries, specifically with regards to identifying lock-in factors that present the risk of creating or reinforcing unsustainable pathways. As guidance for North–South partnerships, MSW management system characterization can clarify latitudes for both immediate and long-term action across diverse stakeholder groups effectuating a distributed agency, potentially moving across multiple interlinking socio-technical systems in order to promote sustainable pathways.

The Kasese MSW management system characterization showed the presence of a dominant organic waste fraction, which is mainly informally managed, while several sources of lock-in stabilize the system. A few key recommendations arising from the study are as follows: (i) It is important to identify and challenge sources of lock-in in MSW management systems (these can cover technological, organizational, societal and institutional sources); and (ii) a broad range of alternative pathways should be taken into consideration and assessed comprehensively as options for improving a MSW management system, though it is important to keep in mind that the fluidity of stakeholder dynamics and waste system complexities may mean that opportunities arise contingently.

Declaration of conflicting interests

The authors do not have any potential conflicts of interest to declare.

Funding

This work was supported by grants to the *access2innovation* secretariat through the Danish Ministry of Science, Technology and Innovation disbursed to Aalborg University, and by both the European Social Fund and the European Regional Development Fund disbursed via Væksthus Northern Jutland to the North Denmark EU-Office.

References

Anschütz J, Ijgosse J and Scheinberg A (2004) *Putting Integrated Sustainable Waste Management into Practice: Using the ISWM Assessment Methodology*. Gouda: WASTE.

Bickman L and Rog DJ (2009) *The SAGE Handbook of Applied Social Research Methods*. 2nd ed. Thousand Oaks, CA: SAGE Publications, Inc.

Bijker WE (2001) Understanding technological culture through a constructivist view of science, technology and society. In: Cutcliffe SH and Mitcham C (eds) *Visions of STS: Counterpoints in Science, Technology and Society Studies*. Albany: State University of New York Press, pp. 19–34.

Bryman A (2012) *Social Research Methods*. 4th ed. Oxford University Press.

Christensen D (2014) Innovation in multi-actor partnerships: a waste management initiative in Vietnam. In: Bolay JC, Hostettler S and Hazboun E (eds) *Technologies for Sustainable Development: A Way to Reduce Poverty?* Lausanne: Springer International Publishing.

Cohen B (2006) Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in Society* 28: 63–80.

Garud R and Karnøe P (2003) Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship. *Research Policy* 32: 277–300.

Halla F and Majani B (1999) Innovative ways for solid waste management in Dar-Es-Salaam: Toward stakeholder partnerships. *Habitat International* 23(3): 351–361.

Kironde JML and Yhdego M (1997) The governance of waste management in urban Tanzania: towards a community based approach. *Resources, Conservation and Recycling* 21: 213–226.

Kritaka S, Sohini P and Pooja RG (2010) *Decentralisation in Uganda*. India: National Council of Applied Economic Research.

Kyambadde J, Hawumba J and Nyanzi SA. (2006) *Municipal Solid Waste Composition and Decay Rate Constants: A Study of Discards in Ten Municipalities of Uganda*. Final report submitted to the National Environmental Management Authority (NEMA). Uganda: Department of Biochemistry, Makerere University.

Kørnøv L (2007) Public participation. In: *Tools for Sustainable Development*. Aalborg: Aalborg Universitetsforlag.

Müller J (2003) Part I: Perspectives on technological transformation. In: Kuada J (ed.) *Culture and Technological Transformation in the South: Transfer or Local Innovation?* Gylling: Samfundslitteratur.

Müller J (2011) Holistic conception of technology. In: Müller J (ed.) *Making Ends Meet: Local Socio-technological Transformations in the South*. Aalborg: Department of Development and Planning, Aalborg University.

Okot-Okumu J and Nyenje R (2011) Municipal solid waste management under decentralisation in Uganda. *Habitat International* 35: 537–543.

Olsen PB and Pedersen K (2008) *Problem-Oriented Project Work – a Workbook*. 2nd ed. Roskilde: Roskilde University Press.

Omran A and Gavrilescu M (2008) Municipal solid waste management in developing countries: A perspective on Vietnam. *Environmental Engineering and Management Journal* 7(4): 469–478.

Pierson P (2000) Increasing returns, path dependence, and the study of politics. *American Political Science Review* 94(2): 251–267.

Ravn J (2012) *Access2innovation: Network-based business model innovation for disaster relief and development assistance*. PhD Thesis, Department of Development and Planning, Aalborg University (In Danish).

Saad M (2000) *Development through Technology Transfer: Creating new Organisational and Cultural Understanding*. Bristol and Portland: Intellect Ltd.

Scheinberg A and Anschütz J (2006) Slim pickin's: Supporting waste pickers in the ecological modernization of urban waste management systems. *International Journal of Technology Management and Sustainable Development* 5(3): 257–270.

Tukahirwa JT, Mol APJ and Oosterveer P (2010) Civil society participation and solid waste management in Uganda. *Local Environment* 15(1): 1–14.

Uganda Bureau of Statistics (UBOS) (ed.) (2002) *Uganda Population and Housing Census – Population Size and Distribution: Analytical Report*. Kampala: UBOS.

Uganda Communication Commission (ed.) (2012) Background information on the Kasese District, Kasese District Information Portal. Available at: http://www.kasese.co.ug/ (accessed December 2012).

United Nations Human Settlements Programme (UN-HABITAT) (ed.) (2010) *Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities*. London and Washington, DC: Earthscan.

Unruh GC (2002) Escaping carbon lock-in. *Energy Policy* 30(4): 317–325.

van Vliet B, van Buuren J, Oosterveer P, et al. (2013) Network governance and waste and sanitation service provision: An introduction to the modernised mixtures approach. In: *Urban Waste and Sanitation Services for Sustainable Development: Harnessing Social and Technical Diversity in East Africa*. London and New York: Routledge.

Vanhille J, Wolf A, Hansen K, et al. (2013) *At the junction: potential pathways for the waste management system of Kasese*. Project Report, MSc Sustainable Cities, Aalborg: Aalborg University.

World Wildlife Fund Uganda Country Office (ed.) (2012) *Clean energy champion District – Uganda: Access to modern energy services for all powered by 100% clean and renewable energy sources*. Project document. Uganda.

PART IV – CONCLUSION

This part consists of *Chapter 10: Conclusion*.

The purpose of Part IV is to bind together the findings from the different papers contained in the thesis and answer the main research question presented in Chapter 5. Perspectives to addressing the main research question are added to identify further directions for research.

Chapter 10 is the thesis' conclusion. It is structured by the sub-questions (1-5) subordinate to the research question, which are in turn addressed through **Paper 1** in Chapter 6, and the papers comprising the chapters in Part III (**Papers 2**, **3** and **4**). After addressing and reflecting upon each research question, the overall conclusion is reached. In the perspectives, an agenda is offered for future research based on emergent and topical issues in relation the thesis' subject areas, and based on my reflections as author on the thesis' research endeavor as a whole.

CHAPTER 10. CONCLUSION

Before answering the research question, each of the each of the five sub-questions will be addressed in this chapter, which are linked to the thesis' papers in different ways as explained in Chapter 5. The topics addressed in the individual sub-questions are elucidated in Table 9, which also explains linkages to the papers as well as previous chapters in the thesis.

Table 9 – Linkages between sub-research questions to papers and previous chapters.

Sub-Question	**Topic**	**Theoretical and Empirical Basis**
Sub-Question 1 W*hat interests influence how technology is constructed? How do the interests come into play?*	Social Construction of Technology	*Primary:* Paper 2 and 3 (Vietnam Case Study) Chapter 6.3 (SCOT) Chapter 6.4 *Secondary:* Paper 1 (CTA)
Sub-Question 2 *How are inclusivity and sustainability framed and addressed?*	Inclusivity and Sustainability	Paper 2 and 3 (Vietnam Case Study) Chapter 2.2 (Inclusivity) Chapter 2.4, 2.5 (Sustainable Business Innovation, Sustainable Value Framework) Chapter 3.4 (Inclusion and Sustainability in *access2innovation*)
Sub-Question 3 *How do socio-technical systems in developing countries influence the way that solutions can be co-constructed?*	Socio-Technical Systems	*Primary:* Paper 4 (Uganda Case Study) Chapter 4.2 (ISWM) *Secondary:* Paper 3 (Vietnam Case Study)
Sub-Question 4 *How can a proactive intake of knowledge be supported?*	Proactiveness in knowledge intake	*Primary:* Paper 1 (CTA) *Secondary:* Paper 2, 3 and 4 (Vietnam and Uganda Case Study)
Sub-Question 5 *What are possibilities and challenges in bridging across multiple organizational domains?*	Bridging across organizational domains	*Primary:* Paper 1 (CTA) *Secondary:* Paper 2, 3 and 4 (Vietnam and Uganda Case Study)

10.1. SUB-QUESTION 1: SOCIAL CONSTRUCTION OF TECHNOLOGY

What interests influence how technology is constructed? How do the interests come into play?

The basis for addressing this sub-question is **Paper 2** and **Paper 3** (Vietnam Case Study). Additionally, conclusions are drawn from the perspective of SCOT and CTA (see Chapter 6), so **Paper 1** is also drawn into the discussion.

Observations about interests in partnership innovation

Initially, small-scale and decentralized biogas technology in Thanh Hoa in Vietnam was envisioned by CARE Denmark and CARE Vietnam to address SWM challenges along the coastline in which CARE had an existing climate change mitigation program. NGO interest was thus the driving force initially, where the partnership activity and technology was seen to be complementary to programming activities, and seen as matched to scale with the type and extent of the SWM challenges in the target area.

This needs articulation by the NGO garnered enough interest among a group of companies of different types and size within SWM in Denmark to further investigate the business idea, but additional information was needed through a consultancy feasibility study in order to establish the business idea, which was facilitated through a series of interactive workshops. KomTek emerged as lead company based on a social responsibility interests and learning about a new market (not profit interests).

Danida funding was secured to identify a local joint venture partner in Vietnam, but internal disagreements within CARE about how to handle a business-NGO partnership led to them leaving and KomTek becoming the main driver. Through a study visit to Vietnam, KomTek confirmed that their technology was needed and additional to existing SWM technological capabilities in the country. Focus moved from small-scale technologies in peri-urban areas to placing priority on scaling a business as fast as possible for a large urban waste collection catchment area. The result was less adaptation and downscaling needed for KomTek's technology and more commercial interests being immediately apparent.

Technology co-construction also made use of local partner capabilities - Vitec with a "dry" waste sorting technology and URENCO Son Tay as a SWM service provider near Hanoi. The KomTek business concept was tailored to attempt to incorporate both partners' capabilities and interests.

Internal disagreement and external factors came into play during the final stage in the partnership before it dissolved where investment decisions and joint venture set-up

were to be decided. This showed the fragility of the business concept, perhaps reinforced by culturally embedded differences among the Danish and Vietnamese partners.

Conclusions from a SCOT perspective

'Relevant social groups', 'interpretative flexibility' and 'stabilization' are key terms in SCOT. In the Vietnam case study, the different partnership constellations (i.e. which 'relevant social groups' are involved with co-construction) determine to a large extent what kind of technology is envisioned and in this case how NGO interests differ from commercial interests of a company like KomTek. 'Interpretative flexibility' involves recognition of the plurality of views on a given co-construction process, and this was clearly at play during the maturation stage of the partnership. However, this ultimately dissolved because of different interests between partners that could not be bridged. 'Stabilization' involves co-construction as a process of contestation and negotiation, and this was at play as partnership constellations changed throughout the process and in the end, there was no successful negotiation of the technology that gained consensus among the partners.

Conclusions from a CTA perspective

Emphasis in CTA is on being anticipatory and on interactive facilitation with stakeholders and active negotiation and learning. In the Vietnam case, the early stage was especially characterized by a high degree of action research and facilitation on my part (*access2innovation*), and a high degree of consensus about the business concept and the technology behind it – however the primary interest was that of social responsibility. Once the company gained the lead in the partnership, there was a significantly smaller degree of facilitation from *access2innovation*'s side – I became a participant-observer – and Vietnamese partners entered into the partnership, adding complexity. Due to the inertia of KomTek pursuing its commercial objectives and own technology, and as the partnership developed, there were more risks involved with the partners in setting up the joint venture and making investment decision, and there was thus more occasion for declaring disagreement.

Therefore, a problem-oriented approach is recommended, which involves more careful selection of technology and partners in order to achieve a more robust, co-constructed business model and technology concept. One possibility would have been to continue developing the original concept in Thanh Hoa, though the business case would have been more challenging to work with.

10.2. SUB-QUESTION 2: INCLUSIVITY AND SUSTAINABILITY

How are inclusivity and sustainability framed and addressed?

The empirical basis for addressing sub-question 2 is **Paper 2** and **Paper 3** (Vietnam Case Study). More theoretically-founded conclusions on inclusivity and sustainability draw on the preceding chapters in the thesis, i.e. Chapter 2.2, 2.4, 2.5 (sustainable business innovation frameworks) and Chapter 3.5 (inclusion and sustainability with respect to *access2innovation*).

Observations about inclusivity in partnership innovation

In the early stage, the Vietnam case study involved a business concept based in Thanh Hoa that had an emphasis on community level involvement that could have been developed further and jointly between CARE and KomTek. The proximity to CARE Vietnam's activities in Thanh Hoa with their climate change mitigation program involved community mobilization via environmental education among schoolchildren in conjunction with mangrove planting. CARE Vietnam's network, experience and expertise with social inclusion thus presented itself as a potential for the early stage business concept.

In the maturation stage, inclusivity at community level (household waste generators or the informal sector) was addressed partly through Vietnamese partners and the NGO partner, SustainableEnergy[49], which remained after CARE decided to opt out of the partnership. Some meetings were organized with People's Committee representatives and farmers during the study trip to Vietnam. KomTek articulated that they did not wish to address informal waste pickers in the joint venture business concept, as this was seen as the domain of URENCO Son Tay – the waste service provider – and seen as too complicated for the concept to incorporate explicitly. People's Committees, smallholder farmers and large farmers were identified as stakeholders in the business model primarily as channels and recipients for sales of the organic fertilizer product. There was an information and mobilization component in the project with respect to local municipalities and communities, which was assigned to the NGO SustainableEnergy.

SustainableEnergy was also part of the group of actors developing the business concept since the early stage. SustainableEnergy shared their experiences with community engagement in Vietnam with e.g. organic waste composting projects in rural Vietnam as well as environmental education with respect to waste in urban settings. In this vein, their capabilities and potential for the concept were similar to CARE. KomTek continued to include SustainableEnergy as an NGO partner during

[49] *VedvarendeEnergi* in Danish.

the maturation stage, where particularly their knowledge about local conditions was valued.

SustainableEnergy's role was to be responsible for implementing the project's information component aimed at increasing recycling and collection rates in the project's catchment area consisting of five municipalities, as well as 'mobilizing' local communities (VedvarendeEnergi, 2013). SustainableEnergy, together with local partners, had built up credibility and legitimacy among the local population through many years of experience with waste projects in Vietnam, and they were also provided a role in terms of advocacy for renewable energy market development based on biogas production from the business concept (VedvarendeEnergi, 2013).

In the maturation phase, KomTek decided upon local business joint venture partners in Vitec and URENCO Son Tay. These partners were vital as locally based businesses that could provide legitimacy to the project and invaluable resources, knowledge and skills related to SWM in Vietnam. The fact the partnership dissolved due to a perceived lack of transparency and shared decision-making with these Vietnamese business partners makes it clear, however, that inclusion in this respect failed.

Conclusions from an inclusivity perspective

The utmost extent of inclusivity in BoP co-creation is, using the conceptualization by Nahi (2016) in Chapter 2.2., *empowerment-seeking co-creation* meaning the sharing of decision-making processes with local communities – as opposed to simply hearing varied groups of people or a sole focus on business model development. Inclusivity in this case could be characterized as 'hearing varied groups of people'. A more inclusive course of action would have been to build stronger informal sector interactions in the business development process.

If 'sharing decision-making processes with local communities' could be re-framed as 'sharing decision-making processes with local *partners*' in a partnership innovation setting, then this was not fulfilled in the Vietnam case. The disagreements in the partnership leading to its dissolution was, among other factors, due to Vietnamese partners not having felt that the Danish partners were entirely transparent in their decision-making processes and did not include them fully. A culturally embedded reason was offered for this, i.e. that teamwork is a skill in joint venture partnerships that needs to be explicitly developed.

Observations about sustainability in partnership innovation

From the outset of the Vietnam case study, the various NGO's and companies involved were specialized within different aspects of SWM from the public and private spheres, across sectors and with experiences in both Denmark and Vietnam. Accordingly, the partners possessed relevant knowledge and capabilities within environmental sustainability mostly specific to SWM, and addressing environmental problems related to the SWM system in Vietnam was indeed the departure point for developing the concept. Afterward, the idea of environmentally sustainable technologies to address SWM problems became central to the business development process, especially in the maturation stage. The focus was on KomTek's organic waste technology treatment technology for bio-pulp, biogas and organic fertilizer production as well as Vitec's locally adapted 'dry' waste sorting technology which enabled mechanical screening of e.g. plastic bags. Various partnership arrangements, notably with SustainableEnergy and URENCO Son Tay, fit into the envisioned joint venture with respect to a municipal and community information and 'mobilization' component, and waste collection services. Altogether the different dimensions of sustainability (environment, social and economic) were at least touched upon.

Naturally the partnership dissolved, preventing any kind of actual establishment of business operations and impact along sustainability's three dimensions. One positive environmental aspect was that it addressed SWM problems in Son Tay by moving up the waste hierarchy through developing markets for by-products related to treatment of organic waste, and avoiding landfilling.

The economic sustainability of the partnership was called into question when it came to sales projections of organic fertilizer product, was a main reason for contributing to the dissolution of the partnership. The scale of operations envisioned by KomTek meant high capital costs which would have required substantial revenue flows to make the investment worthwhile. Revenue streams were considered for organic fertilizer but also for electricity production to the grid, provision of consultancy services on waste treatment and separation, and turnkey sales of the technology concept. As the organic fertilizer subsidy levels were misjudged, and since there was no feed-in tariff system in place for sales of electricity to the grid, some critical preconditions were found not be in place in order for the joint venture to be established.

Conclusions from a sustainability perspective

From a 'sustainable value proposition' standpoint as defined and understood by *access2innovation* (see Chapter 3.4), the partnership's business *concept* fulfilled what was sought in partnership innovation, i.e. development of commercially sustainable business models, developing or rolling out environmentally sustainable technologies, and ensuring social impacts. The challenges that the partnership encountered in the *process* dealt with the commercial aspects, but also with the lack of inclusion with respect to local partners.

Sustainability of the partnership can also be discussed in terms of the 3-stage framework for sustainable business innovation (see Figure 4, Chapter 2.4) and the 3 dimensions of sustainable business (see Figure 6, Chapter 2.5). These frameworks are best used for describing already established business operations (as applied in Chapter 2 and 3), and not fully transferable to analysis of partnership innovation *processes*. However, some elements can be applied to the Vietnam case.

With the above caveat in mind, the innovation process in the Vietnam partnership displays characteristics of what is termed *organizational transformation* – the 2nd stage in the 3-stage framework. This recognizes that the business and technology idea was one step further than simple incremental improvements to business-as-usual for KomTek and "doing the same things better", and was an earnest attempt by the company to target "new market opportunities" in a dynamic Vietnamese SWM landscape where KomTek's proprietary technology was novel, potentially profitable and could perform higher-order aspects of the waste hierarchy than landfilling. However, the concept as developed by the partnership falls short of the 3rd stage, *systems building*, because this stage puts a heavy emphasis on "doing good by doing new things with others".

With respect to the three dimensions of sustainable business, the parameters utilized in Figure 6 relate to the innovation focus, the *firm's view in relation to society* and *the extent to which innovation extends across the firm*. Assessing the Vietnam case along these parameters, the study displays elements of being *technology-focused* (the first parameter) due to waste separation for derived products being so central to the concept at the expense of partnership relationships, and because the informal sector and local communities were kept at distance in the business model. The case study falls somewhere in between the *insular-systemic* continuum (the second parameter) because it never became embedded in the Son Tay SWM setting – although an *attempt* was made with URENCO Son Tay to embed the concept in existing waste collection, transport, treatment and disposal practices. Finally, I assess the case to be positioned firmly as *stand-alone* with respect the extent to which innovation extends across the firm (the third parameter): For many of the involved partners and for KomTek as a central actor, the partnership innovation process was not wholly characteristic of the

organizations themselves and in many cases only a single person or unit/department of the organization was involved.

Finally, the 'Sustainable Value Framework' (Figure 7, Chapter 2.5) links BoP and Clean Technology development as complementary future-oriented strategies for disruptive innovation addressing poverty, and also may be used to assess the sustainability in the partnership. In this respect, meeting unmet needs as the BoP was not the explicit focus of the partnership (referring again to the technology focus) but there was certainly both a pollution prevention and clean technology aspect to the business *concept* because of landfilling avoidance and production of derived organic waste products, and an attempt at 'integrating stakeholder views in into the business process' which the framework calls a 'product stewardship' strategy.

In sum, the business concept was strong in environmental sustainability especially as regards technology development for moving up the waste hierarchy in a relative sense in Vietnam's SWM (avoiding landfilling and the productive use of organic waste fractions). However the concept was weak in social inclusion and social sustainability with respect to the BoP in general, and became challenged with respect to its' economic sustainability.

10.3. SUB-QUESTION 3: SOCIO-TECHNICAL SYSTEMS

How do socio-technical systems in developing countries influence the way that solutions can be co-constructed?

Sub-question 3 differs from the previous sub-questions by asking about contextual factors influencing partnership innovation in developing countries – not the processes. Addressing this question relies mainly on **Paper 4** (Uganda case study) which applies a socio-technical systems perspective to SWM in Uganda with a theoretical basis in Chapter 4.2 (the ISWM framework). However, contextual factors are also concluded to form part of the barriers in the Vietnam case study, which means that **Paper 3** is drawn into the discussion as well.

Observations concerning socio-technical systems in developing countries

In the Uganda case study, analysis of the technical waste system elements (generation, collection, transport and treatment and disposal) in Kasese District showed that there were multiple issues faced by the SWM system. This included widespread dumping, overflowing containers, breakdown of collection frequencies due to fuel shortages and shortage of channels for productive use of compost and inorganics post-treatment. Only 26% of solid waste was being collected (60 out of 230 tons generated daily), but the 'backbone' of a SWM system was in place with waste collection services prioritizing the urban core and the highest waste-generating locales, and a World Bank-financed composting plant established. There was no source separation of solid waste.

The stakeholder analysis showed complex relationships among various stakeholders in the system. With respect to institutional conditions, budgetary earmarks left Kasese Municipal Council with little freedom to prioritize SWM and thus a dependency relationship arose with outside funders like the World Bank. With respect to waste generators, low-volume generators outside of the urban core were poorly serviced, if at all, and there was no informal sector engaged. Leverage points within the community were identified in the local King and the church, which functioned as the community's anchors.

Within the *access2innovation* secretariat, there were assumptions about launching partnership innovation activities based on Danish expertise within centralized waste treatment technologies. The analysis of Kasese's SWM system did not give backing to these assumptions. *Access2innovation*'s Concept Note for waste management in Kasese was directed toward recruiting interest among Danish companies (See Annex B) and published prior to the socio-technical system analysis of Kasese. The Concept Note (front cover shown in Figure 22) states that intervention areas have been identified by the secretariat around developing solutions based on biogas, gasification,

incineration[50] and composting technologies, as well as on waste transportation and spreading awareness about waste. The mentioned technologies can in principle be scaled up or down, yet despite this flexibility no Danish companies showed interest in the idea. The companies that existed on the Danish market traditionally dealt with economies and solutions of scale. In the socio-technical analysis of Kasese, on the other hand, the major point in the research was that more decentralized and smaller-scale solutions would have been a better fit to the local context. For instance, path dependencies and lock-ins made it difficult to envision e.g. a biogas solution when the generators of the highest-volume waste generators already were locked into sending their waste to the Municipal Council's composting plant which depended on the waste for registering carbon credits.

Figure 22 – Access2innovation concept note front cover (Waste management in Kasese)

In the Vietnam case study, there were a number of external factors to the partnership that posed barriers to the business concept at the socio-technical system level. These included subsidy levels for production of organic fertilizer product from waste which were misjudged to be higher than they actually were, and a lack of a feed-tariff as an incentive for the medium-to-long term aim of selling electricity based on biogas. Especially the first of these factors contributed to abandoning the partnership's business idea, and it is likely that it influenced the manner in which internal disagreements among the partners surfaced.

[50] The Concept Note considers the unsustainability of incinerating resources by mentioning, that *"incineration technology is not purported to hold the solution for Uganda in the future"*, however, see Annex B.

Conclusions from an ISWM and modernized mixtures perspective

Set against the ISWM literature (see Chapter 4.2), the SWM systems of Uganda and Vietnam in the case studies display characteristics shared by many developing countries including overburdened and financially strained local authorities and the need for an enabling environment for sustainable solutions. In the Uganda case, Kasese District has some distinctive features due to the lower-than-average collection rates, 26% falling well short of the 45-75% figure reported by Wilson, Velis and Rodic (2013), and because the role of the informal sector was found to be negligible. In both case studies however, the constituent socio-technical elements in the waste system did not provide support to implementing centralized waste treatment technologies. Extrapolating from this, socio-technical systems in developing countries have significant importance to the way that solutions can be co-constructed by constraining large-scale investments. A higher-order question, however, is how to *work with existing systems* to promote inclusive and sustainable innovation. In both case studies, the socio-technical systems were more favorable toward decentralized solutions, which unfortunately were not pursued by *access2innovation*[51]. In this respect, the propositions in the 'modernized mixtures' approach, which is linked with ISWM (see 'ISWM and Modernized Mixtures', Chapter 4.2) remain insufficiently explored in *access2innovation*'s partnership innovation activities. As per Scheinberg et al. (2011) and Tukahirwa et al. (2010), what is needed is the development and implementation of intelligent and context-dependent combinations of both Western systems and local practices and arrangements.

[51] The One Stop solution facilitated and promoted by *access2innovation*, however, holds promise, see Chapter 9.1 and Paper 4.

10.4. SUB-QUESTION 4: PROACTIVENESS IN KNOWLEDGE INTAKE

How can a proactive intake of knowledge be supported?

Sub-question 4 deals with a particular aspect of CTA that is fundamental to the methodology: the premise of being anticipatory in a technological innovation process. The primary basis for addressing the sub-question is conceptual and articulated in **Paper 1** (CTA as methodology). The remaining papers (**Paper 2**, **3** and **4**) illustrate empirically "what could have gone right" or "what went somewhat right" in the Vietnam and Ugandan case studies with respect to the question, so will be referred to as well.

Observations about proactive intake of knowledge

It is argued that proactivity and foresight have been illustrated as part of how CTA is practiced in *access2innovation* in the waste management case and the integrated case of coffee production, renewable energy, small-scale biofuel production and poultry incubators – both in Uganda. In the case of waste management, CTA helped identify high risks involved with preconceived ideas about centralized waste treatment technologies, which led to abandoning further attempts at facilitating partnership innovation (previous Chapter 10.3 expands on this with an outset in *access2innovation* assumptions). In the integrated case, it is argued that CTA facilitated the identification of leverage points or favorable conditions. That is, CTA helped align interests between some Danish companies and local communities and other partners through interaction, including a field visit to Uganda. However, the integrated case also showed that *access2innovation*'s CTA approach and allocation of resources favored resource-capable firms and didn't address community needs directly, which mostly related to coffee post-harvest. CTA had its limitations here.

The next logical step in the waste management case would ideally have been for *access2innovation* to pursue a different track of action than abandoning partnership innovation activities – perhaps more in line with solutions as per the 'modernized mixtures' approach (see previous Chapter 10.3). However, this did not occur so there have been limitations with respect to CTA in this case as well.

In the Vietnam case study, CTA was applied especially in the early stage of the partnership, in which knowledge was supplied to partners through a consultancy study and through interactive workshops. As also previously mentioned, CTA disappeared from the forefront as the lead company, KomTek, eventually took the lead in the partnership and steered the way until the partnership's eventual dissolution. It is argued in this case that a more problem-oriented approach in the business maturation stage would have been recommendable for a more careful technology and partner selection. KomTek's propensity toward solutions of scale made the partnership idea

more sensitive toward economic risks, and is likely to have exacerbated the disagreements between the Danish and Vietnamese partners.

Conclusions from a CTA perspective

It is apparent throughout the conceptual paper and the empirical papers that a proactive intake of knowledge has met limitations in *access2innovation*'s partnership activities. While early feeding of insights into partner strategies was supported through various actions such as workshops, a consultancy study, field visits and socio-technical analysis, the interests of resource-capable firms and the *disinterest* in e.g. small-scale solutions overrode the lessons that were being learned along the way.

Genus and Cole (2005) as well as Reuzel (2001) adopt critical perspectives toward CTA that could be valid if applied to *access2innovation* considering the above: there is a danger of favoring those already in power in society, and questions can be asked about being able to keep a critical standpoint while entangled in a technological development process. Rather than concluding this sub-question on this critical note, however, it is argued that the skill of articulation and balancing of views appropriately has scope for development. In the Critical Theory of Technology approach (Feenberg 2017), the concept of 'hybrid forums' could be useful in this respect, as it entails systematic local community participation in collaboration and evaluation – in other words, institutionalized democratization (and inclusivity) of communities in partnership innovation. This might be controversial from a standpoint of a company, but in the interest of robust and sustainable solutions, it represents a potential step up from how *access2innovation* operates.

10.5. SUB-QUESTION 5: BRIDGING

What are possibilities and challenges in bridging across multiple organizational domains?

This final sub-question focuses on the aspect of CTA in partnership innovation that in Chapter 1 was referred to as 'bridging', i.e. promoting collaborative exchanges among different kinds of actors. The basis is again **Paper 1** which is a conceptual paper on CTA methodology, but the remaining papers (**Paper 2**, **3** and **4**) also have a lot to say with respect to the potentials and challenges in the Vietnam and Uganda case studies.

Observations about bridging in partnership innovation

A*ccess2innovation* activities met a number of challenges with respect to bridging, as reported in the various papers. Conceptually, CTA in developing countries is recommended by Ely et al. (2011) to be a 'flexible' approach wherein decision-making should include diverse actors, including citizens, and continual learning among e.g. universities, NGO's, firms, firms and users/citizens (Ely et al., 2011). In this respect, *access2innovation*'s participation in WWF's *Champion District* initiative in Kasese, Uganda held promise as a bridging platform. The various workshops and meetings, etc. that took place in the Vietnam case study also constituted various means of facilitated interaction in a CTA process whereby bridging could and did occur amongst the partnership's participants. However, there are opportunities for improvement in the *access2innovation* set-up as the process could have been more inclusive, and the secretariat itself could develop its interdisciplinary competencies further accordingly.

With respect to bridging in the Vietnam case study, this was facilitated especially in the early stage where CTA was applied– although 'buy-in' to the business idea among companies was not guaranteed. This is perhaps to be expected, as it is difficult to 'coerce' potential business partners to take part in a partnership if the objectives cannot be aligned with their interests. What is more concerning is that bridging in the maturation stage of the Vietnam case study proved sensitive to external unfavorable conditions and to internal disagreements and conflicts among participants when involving Danish and Vietnamese partners. Culturally embedded practices played a role here**.**

There was no bridging to speak of in the Uganda case study as a partnership within SWM never materialized. The insight this case study was that an in-depth understanding of the socio-technical system in Kasese provided a better foundation for tailoring context-appropriate solutions through partnership innovation activities, in line with e.g. the 'modernized mixtures' approach. The specific recommendations

about smaller-scale and decentralized solutions and mobilizing community anchor points, however, were not pursued in *access2innovation*.

Conclusions about bridging

In this research, the best indication that *access2innovation* could facilitate 'bridging' was during the Vietnam case study's early stage, where CARE was involved, considerations toward poor and disenfranchised groups was included in the business concept, where decentralized, small-scale solutions were envisioned, and where *access2innovation* played an active CTA role. In the maturation stage, the partnership ran into external and internal challenges after KomTek took the lead. In the Ugandan case study, there was no partnership involved, ergo no bridging. The most important critical reflection for *access2innovation* in the research as regards bridging is that there are potentials in further developing structured democratization of technology development, and potentials in developing interdisciplinary competences in the secretariat.

10.6. OVERALL CONCLUSION

How is technology socially constructed in partnership innovation for developing countries? How can inclusive and sustainable innovation in developing countries be co-constructed?

The different sub-questions in this chapter are brought together in order to conclude on the main research question.

The first part of the main research question is investigated by linking construction of technology to the partnership innovation activities investigated in the thesis. Here the Social Construction of Technology (SCOT) concepts of 'relevant social groups', 'interpretative flexibility' and 'stabilization' were useful for understanding the activities by showing the how different partnership participants took part in socially constructing technologies, how the plurality of views aligned with or differed from each other, and how differing views were contested and negotiated. The Constructive Technology Assessment (CTA) methodology supported the development of a business concept and technology based on some variation of solid waste treatment and production of derived organic products. However, there was no guarantee of 'buy-in' to such a concept among potentially interested businesses. Additionally, the complexity of involving local partners as well as commercial interests have led to internal and external challenges.

The second part of the main research question aims to giving recommendations for co-construction of inclusiveness and sustainability in innovation in developing countries. The research first determined *how* inclusivity and sustainability were framed and addressed in partnership innovation activities, which was investigated

especially with respect to the Vietnam case study when these activities took place. Here it was found that inclusivity was addressed at the level of 'hearing varied groups of people' but not the utmost extent of 'sharing decision-making processes with local communities' and partners. From a sustainability perspective, the Vietnam case study has promoted environmental sustainability through its focus on technology development for landfill avoidance and productive use of organic waste fractions, which might have enabled moving up the waste hierarchy (in a relative sense) with respect to SWM in Vietnam. However, the case study has been weak in social sustainability due to the perceived lack of transparency in decision-making processes felt by the Vietnamese partners, and with respect to economic sustainability, this was called into question when it came to sales projections of organic fertilizer product coupled with the high capital costs for investments, and because critical conditions (misjudged levels of public subsidies and a feed-in tariff for electricity sales to the grid from biogas-based electricity production) were not in place to support the proposed revenue streams in the partnership's joint venture.

Recommendations for inclusive and sustainable innovation in developing countries is linked with investigating the importance of *socio-technical systems*, how to support a *proactive intake of knowledge* and how to *bridge* partnership participants. Implicit in this rationale is that external as well as internal factors are influential in partnership innovation and its facilitation.

Socio-technical systems in developing countries are found to influence how solutions can be co-constructed by constraining viability of large-scale investments due to lock-ins and path dependencies. This was seen in the Uganda case study, where conditions such as overburdened and financially strained local authorities have led to waste collection rates as low as 26% in Kasese District. Low-volume waste generators outside of the urban core experience little to no collection services, while high-volume waste generators have their waste locked into being treated at the Municipal Council's composting plant which depends on the waste for registering carbon credits. With respect to stakeholders in the system, there has been no informal sector engaged in Kasese's SWM system, but a few leverage points (the local King and the church) function as the community's anchors with respect to potential SWM system improvements. It is found that decentralized solutions could be a basis for such solutions in the Uganda case given the technical system elements and the stakeholders. Working with existing systems is a challenge, however, and 'modernized mixtures' is an approach that can inspire the objectives of partnership innovation activities, i.e. development and implementation of intelligent and context-dependent solutions of both Western systems and local practices and arrangements.

A proactive intake of knowledge in accordance with CTA has met limitations in the Vietnam and Uganda case studies. Interests of resource-capable firms heavily influenced partnership innovation activities, which was seen in the Vietnam case study with KomTek's interest in economies and solutions of scale especially when

CARE withdrew from the partnership. This was also seen in the Uganda case study of SWM since Danish business interests were mostly within large-scale and centralized solutions that to them, there were no convincing business cases for in Kasese. In the integrated case in Uganda of coffee production, renewable energy, small-scale biofuel production and poultry incubators, an alignment was found between business interests and local conditions for specific resource-capable firms but the direct needs of the community within coffee production were not addressed. It is porposed that a more critical disentangling from imbalanced power relations can be supported through the use of structured 'hybrid forums' for systematic local community participation and evaluation.

Bridging among partnership participants is seen most positively in the Vietnam case study's early stage, where CARE was involved and where considerations toward poor and disenfranchised groups were included in the business concept of decentralized, small-scale solutions for SWM. It is proposed that bridging can take place through facilitation and CTA so long as there is balanced representation among different kinds of actors, and if the partnership's business idea takes consideration toward local socio-technical systems, inclusion and sustainability. Improvements can be found with respect to democratization of partnership innovation processes and developing interdisciplinary competences when facilitating them.

In summary, SCOT concepts can help provide an understanding of how technology is socially constructed in partnership innovation for developing countries. Knowledge and understanding of socio-technical systems, structuring for proactive intake of knowledge through CTA and bridging through balancing of representation among actors can help facilitate that co-construction of inclusive and sustainable partnership innovation processes.

10.7. PERSPECTIVES

Danish development cooperation initially framed the research in Chapter 1, which traced its historical development with respect to business and partnerships in particular. Reconfiguration of various private sector and partnership instruments have eventually led to Danida Market Development Partnerships (DMDP) as the instrument currently utilized by the Danish Ministry of Foreign Affairs (see Chapter 1). Meanwhile, *access2innovation* has evolved from an action research initiative to an independent membership-based organization (see Chapter 3). Partnership innovation activities in the Danish context thus continue in the NGO, public and private sectors, making the research relevant in the current policy context in spite of the case studies taking place during the period 2011-2014. There is further scope for research into partnership innovation studies on this basis.

Partnerships are also an arena of engagement at the global level, and guidance is provided e.g. through the Sustainable Development Goals (SDG's) which are meant

to be achieved by 2030 as an integrated set of goals compared with the Millenium Development Goals (Le Blanc, 2015). Of the SDG's, Goal 17 in particular stands out as directly addressing partnerships, formulated as: *"Strengthen the means of implementation and revitalize the global partnership for sustainable development"* (Sustainable Development Knowledge Platform, 2018b) thus identifying partnerships as a way to integrate the SDG's further through action by different groups of actors. As part of the SDG agenda, Goal 17 reinforces the need for 'inclusive' partnerships between governments, the private sector and civil society at all levels (United Nations, n.d.). Areas for further research can address the specific targets and indicators for Goal 17, i.e. aspects of partnerships dealing with its headings of 'finance', 'technology', 'capacity-building', 'trade' and 'systemic issues'.

Gupta and Vegelin (2016) investigate how the concept of 'inclusive development' has been considered in the framing of the SDG's. Their concept of inclusion is presented as having *social*, *ecological* and *relational* inclusiveness dimensions, and the relationship with sustainability with this understanding is illustrated in Figure 23.

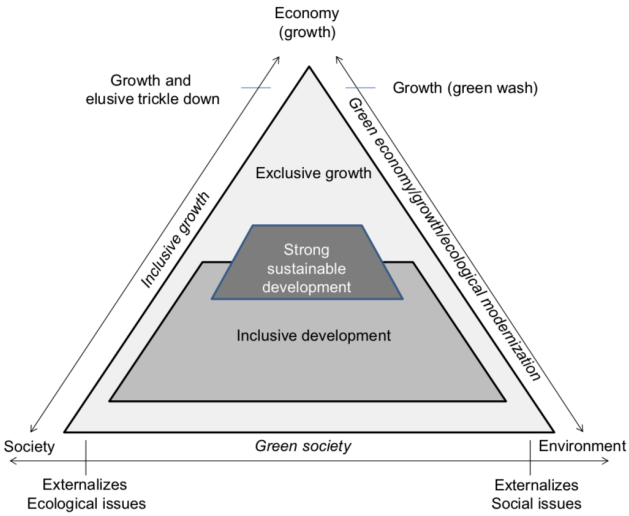


Figure 23 – The relationship between inclusive development and sustainable development (Gupta and Vegelin, 2016)

Gupta and Vegelin (2016) find that that while social inclusiveness (e.g. empowerment of the poor and investing in human capital) is addressed well in the SDG's, this is not the case with respect to the other two dimensions. Ecological inclusiveness refers to the relationship between the environment and the marginalized dealing with issues as rights and access to land and protection of ecosystems, while relational inclusiveness refers to recognizing and addressing systemic drivers of inequality, exclusion and vulnerability at multiple levels. In their research of how the SDG's have considered inclusive development as they frame it, Gupta and Vegelin (2016) point out a risk

involved in the SDG implementation processes with respect to a lack of emphasis on ecological and relational inclusiveness. Although the framing of sustainability and inclusive development is arguably idiosyncratic in Gupta and Vegelins research, it does indicate that further research can develop an improved understanding of SDG implementation with respect to inclusivity, including Goal 17 and partnership innovation.

In Denmark, Goal 8[52] of the SDG's has fed directly to the objectives and monitoring and evaluation framework for DMDP (see Chapter 1) with an emphasis on employment creation, beneficiaries reached and sustainable income opportunities created, viability of a project's business case, awareness of responsible business conduct including within partnerships, and additional capital raised. In this framework, the connection between sustained, inclusive and sustainable economic growth and partnerships is apparent. For *access2innovation*, the SDG's also provide important markers, e.g. as a workshop topic during a 'PEOPLE PROFIT PLANET' conference organized by its secretariat in September 2018 with over 250 participants from different sectors (Access2innovation, 2018). Based on the conference discussions and outputs, the *access2innovation* secretariat highlighted challenges with respect to setting up a financial ecosystem to bring solutions to scale and with respect to awareness of partnership innovation activities in the 'political system' (Access2innovation, 2018). Promoting inclusivity and sustainability remain challenges, and research can use the exemplary principle to highlight cases where these objectives have been reached satisfactorily.

With respect to circular economy (CE) and the SWM field in particular, Schroeder, Anggraeni and Weber (2018) find that CE has strong relationships with several of the SDG goals[53] and highlight that further empirical research is needed to determine which types of partnerships and means of implementation are required to apply CE practices in the SDG context. They conclude that partnerships, together with skills training, capacity building and technology development (i.e. partnership innovation) are especially well-suited to support advanced CE concepts and business models such as industrial symbiosis, remanufacturing, closed-loop supply chains and product-service-systems. On this basis, a line of research could be opened specifically

[52] SDG Goal 8 promotes *"sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all."* (Sustainable Development Knowledge Platform, 2018a)

[53] Namely SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land) (Schroeder, Anggraeni and Weber, 2018).

exploring the synergies between CE and partnership innovation in developing country contexts.

The SDG's and Goal 17 highlight the importance of addressing inclusive and sustainable development through partnerships, and provide a long-term timeframe until 2030 for addressing them. In light of this, the critical conclusions in this research about facilitation of partnership innovation in *access2innovation* can be seen in another light. The sets of cases reported on in this thesis constituted processes that took place in relatively short-term timeframes. In a longer perspective, it is possible that future research can show how partnership innovation activities have led to institutional learning among sets of actors and facilitators towards more inclusivity and sustainability in partnerships.

LITERATURE LIST

Aalborg University. 2014. *Betalingssystem til verdens fattigste.* Retrieved from: http://www.aau.dk/nyheder/alle-nyheder/vis/betalingssystem-til-verdens-fattigste.cid119160 (Last accessed July 25, 2016)

Access2innovation (a). *One Stop Shops.* Retrieved from: http://www.access2innovation.com/accordion-b-5/level-23 (Last accessed July 25, 2016)

Access2innovation (b). *Pay E-Safe.* Retrieved from: http://www.access2innovation.com/accordion-b-5/level-25 (Last accessed July 25, 2016)

Access2innovation (c). *Chili farming in Uganda*. Retrieved from: http://www.access2innovation.com/accordion-a/level-2 (Last accessed July 29, 2016)

Access2innovation. 2018. *SDG conference pinpoints new challenges.* Retrieved from https://www.access2innovation.com/news-from-2018/348-sdg-conference-pinpoints-new-challenges (Last accessed October 15, 2018)

Adams, R., Bessant, J., Jeanrenaud, S., Overy, P., & Denyer, D. 2012. *Innovating for sustainability: a systematic review of the body of knowledge*. Network for Business Sustainability

Ahmed, S.A., Ali, M. 2004. Partnerships for solid waste management in developing countries: Linking theories to realities. *Habitat International* 28: pp. 467-479

Als, B. 2010. *CSR-Driven Innovation – Combining design and business in a pro table and sustainable way*. Nordic Innovation Centre, Oslo

Andersen, I. 1997. *Den skinbarlige virkelighed – om valg af samfundsvidenskabelige metoder*. Samfundslitteratur

Andersen, P. H. 2011. Imagining and realizing Network-based business models for BOP markets: The case of Grundfos LIFELINK. Paper presented at the 27th Industrial Marketing and Purchasing Group conference in Glasgow, Scotland. Retrieved from http://www.impgroup.org/paper_view.php?viewPaper=7623 (Last accessed April 22, 2016)

Andersen, P.H. 2013. Grundfos LIFELINK: solving the base of the pyramid tangle? *Emerging Markets Case Studies* 3 (1): pp. 1-26

Anschütz, J., Ijgosse, J., Scheinberg, A. 2004. *Putting ISWM to Practice*. Gouda, The Netherlands: WASTE

Behangaana, J. 2014. Energy and Sustainable Urban Development CPD Course – Day 5. Retrieved from: https://samsetproject.wordpress.com/2014/12/22/energy-and-sustainable-urban-development-cpd-course-day-5/ (Last accessed July 25, 2016)

Berger, P.L., Luckmann, T. 2011. *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. Open Road Media

Biermann, F., Chan, M., Mert, A., Pattberg, P. 2007. Multi-stakeholder partnerships for sustainable development: does the promise hold? In *Partnerships, Governance and Sustainable Development: Reflections on Theory and Practice*. Eds. Pieter Glasbergen, Frank Biermann and Arthur P.J. Mol. Edward Elgar Publishing

Bijker, W.E. 2015. Technology, Social Construction of. *International Encyclopedia of Social and Behavioral Sciences* 24 (2nd Edition): pp. 135-140

Bijker, W.E., Hughes, T.P., Pinch, T.J. (Eds). 1987. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press

Bijker. W., Pinch, T. 2012. Preface to the Anniversary Edition. In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Anniversary Edition). Eds. Wiebe E. Bijker, Thomas P. Hughes and Trevor Pinch. Cambridge, Massachusetts and London, England: The MIT Press

Bocken, N.M.P., Olivetti, E.A., Cullen, J.M., Potting, J., Lifset, R. Taking Circularity to the Next Level: A Special Issue on the Circular Economy. *Journal of Industrial Ecology* (2017)

Bogdanski, A. 2012. Integrated food–energy systems for climate-smart agriculture. *Agriculture & Food Security* 1 (9)

Brey, P. 2003. Theorizing Modernity and Technology. In *Modernity & Technology,* Eds. Thomas J. Misa, Philip Brey and Andrew Feenberg. Cambridge, Massachusetts and London, England: The MIT Press

Brunner, P.H., Fellner, J. 2007. Setting priorities for waste management strategies for developing countries. *Waste Management & Research* 25: 234-240

Burr, V. 2015. *Social Constructionism*. London and New York: Routledge

Butler, I. 2017. The processes of creating solutions in the context of uncertainty: Case studies of companies creating solutions in relation to Sub-Saharan Africa. PhD dissertation, Aalborg University

Callon, M. 2007. Some elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. In *Technoscience: The Politics of Interventions,* Eds. Kristin Asdal, Brita Brenna and Ingunn Moser. Oslo Academic Press, Unipub Norway

Cannatelli, B., Masi, A.G., Molteni, M. 2012. Green Technology Implementation in Developing Countries: Opportunity Identification and Business Model Design. In *Social Innovation: Blurring Boundaries to Reconfigure Markets.* Eds. Alex Nicholls and Alex Murdock. Palgrave MacMillan

Crotty, M. 1998. *The Foundations of Social Research: Meaning and Perspective in the Research Process*. SAGE Publications Ltd.

CISU – Civil Society in Development. *Innovative Partnerships, Uganda: Thematic Visit, 29th November-5th December 2014*. Retrieved from http://www.cisu.dk/Admin/Public/Download.aspx?file=Files%2FFiler%2FCISU%2FLandeprofiler%2FUganda%2FInnovative+Partnerskaber_+Uganda_+2014.pdf (Last accessed July 23, 2016)

Danish Red Cross. 2015. *One Stop – Health Clinics and Toilets Innovatively Combined*. Retrieved from: http://vendelbokommunikation.dk/wp-content/uploads/pdf/onestoptoiletfinal.pdf (Last accessed May 21, 2018)

Dasgupta, P., Hart, S.L. 2015. Creating an innovation ecosystem for inclusive and sustainable business. In *Base of the Pyramid 3.0: Sustainable Development through Innovation and Entrepreneurship.* Eds. Stuart Hart and Fernando Casado Cañeque. Greenleaf Publishing

Degnbol-Martinussen, J., Engberg-Pedersen, P. 2003. *Aid: Understanding International Development Cooperation*. Zed Books

Diaz, L.F. 2017. Waste management in developing countries and the circular economy. *Waste Management & Research* 35 (1): pp.1-2

Dickson, D. 1974. *Alternative Technology and the Politics of Technical Change*. Great Britain: William Collins Sons & Co Ltd Glasgow and Fontana

Duke, D. 2013. *Base of the Pyramid (BoP) Market Entry: Finding BoP Opportunities that Match your Customer Relationship Strategy.* Inter-American Development Bank, June 2013.

Ellen MacArthur Foundation. 2013. *Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition.* Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf (Last accessed July 7, 2017)

Eriksen, F. 2016. Svendborgenser opgiver at redde Afrika. *Fyns Stiftstidende,* December 16

Etzkowitz, H. 2008. *The Triple Helix: University-Industry-Government Innovation in Action*. Routledge, New York and London

Etzkowitz, H., Leydesdorff, L. 2000. The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research policy* 29 (2): pp.109-123

Fagerberg, J., Mowery, D.C., Nelson, R.R. 2006. *The Oxford Handbook of Innovation*. Oxford University Press, Inc., New York

Fawcett, S.E., Waller, M.A. 2015. Designing the Supply Chain for Success at the Bottom of the Pyramid. *Journal of Business Logistics* 36 (3): pp. 233-239

Flintoff, F. 1976. *Management of Solid Wastes in Developing Countries*. World Health Organization Regional Publications, South-East Asia Series No. 1. New Delhi: World Health Organization

Flybjerg, B. 2006. Five Misunderstandings About Case Study Research. *Qualitative Inquiry* 12 (2): pp. 219-245

FødevareWatch. 2016. *Danone dedikerer sig til dansk iværksætters Afrika-eventyr*. Retrieved from http://fodevarewatch.dk/secure/Drikkevarer/article8468686.ece (Last accessed April 25, 2016)

Gasparatos, A., von Maltitz, G.P., Johnson, F.X., Lee, L., Mathai, M., Puppim de Oliveira, J.A., Willis, K.J. 2015. Biofuels in sub-Sahara Africa: Drivers, impacts and priority policy areas. *Renewable and Sustainable Energy Reviews* 45: pp. 879–901

Geissdoerfer, M., Savaget, P., Bocken, N.M.P., Hultink, E.J. 2017. The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production* 143: pp. 757-768

George, G., McGahan, A. M. Prabhu, J. 2012. Innovation for Inclusive Growth: Towards a Theoretical Framework and a Research Agenda. *Journal of Management Studies* 49 (4): pp. 661-683

Ghisellini, P., Cialani, C., Ulgiati, S. 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production* 114: pp. 11-32

Goduscheit, R. C., Bergenholtz, C., Jørgensen, J. H., Rasmussen, E. S. 2008. Action research in inter-organizational networks: Impartial studies or the trojan horse? *Systemic Practice and Action Research* 21(4): pp. 267–281

Gray, B., Stites, J.P. 2013. *Sustainability Through Partnerships: Capitalizing on Collaboration*. Network for Business Sustainability

Grin, J. van de Graaf, H., Hoppe, H. 1997. *Technology Assessment through Interaction: A Guide*. The Hague: Rathenau Institute

Große-Puppendahl, S., Byiers, B., & Bilal, S. 2016. *Beyond aid in private sector engagement: A mapping of the opportunities and challenges of development and commercially-oriented public support to private sector engagement*. ECDPM Discussion Paper 187. Maastricht: ECDPM.

Grundfos. 2015. *Lifelink expands into India*. Retrieved from: http://www.grundfos.com/about-us/news-and-press/news/lifelink-expands-into-india.html (Last accessed April 23, 2016)

Guba, E.G., Lincoln, Y. S. 1989. *Fourth Generation Evaluation*. Sage Publications, Inc.

Gupta, J., Vegelin, C. 2016. Sustainable development goals and inclusive development. *International environmental agreements: Politics, law and economics* 16 (3): pp. 433-448

Hammond, A.L., Prahalad, C.K. 2004. Selling to the Poor. *Foreign Policy* No. 142 (May-June): pp. 30-37

Halla, F., Majani, B. Innovative Ways for Solid Waste Management in Dar-Es-Salaam: Toward Stakeholder Partnerships. *Habitat International* 23 (3): pp. 351-361

Hargadon, A.B. 2002. Brokering knowledge: Linking learning and innovation. *Research in Organizational behavior* (24): pp. 41-85

Hart, S.L. 2011. *Sustainable Value*. Retrieved from: http://www.stuartlhart.com/sustainablevalue.html (Last accessed May 20, 2018)

Hart, S.L., Cañeque , F.C. 2015a. *Base of the Pyramid 3.0: Sustainable Development through Innovation and Entrepreneurship.* Eds. Fernando Casado Cañeque and Stuart L. Hart, Greenleaf Publishing

Hart, S.L., Cañeque, F.C. 2015b. *Why we need to push harder for inclusive business.* Retrieved from: http://www.greenbiz.com/article/weekend-read-why-we-need-push-harder-inclusive-business (Last accessed January 20, 2016)

Hart, S.L. 2015c. *CEO Breakfast: Creating Sustainable Value*. Presentation retrieved from: https://www.slideshare.net/amitkapoor/the-sustainable-value-framework (Last accessed May 20, 2018)

Heeks, R. 1995. *Technology and Developing Countries: Practical Applications, Theoretical Issues*. Eds. Richard Heeks, Prabhakara Bhatt, Mozammel Huq, Chris Lewis and Ahmed Shibli. Frank Cass & Co. Ltd

Hockerts, K. 2015. How Hybrid Organizations Turn Antagonistic Assets into Complementarities. *California Management Review* 57 (3): pp. 83-106

Johansen, M.Ø. 2015. "Intet særligt" skyld i Remergy-konkurs. *EnergiWatch*, 23 April

Kabbyanga, G., Johansen, N.H., Ravn, J. Uganda / Water and Sanitation: Uganda – DI - One Stop Shop. Paper presented at the Public-Private Dialogue 2015 Workshop in Copenhagen, Denmark, March 10-13, 2015

Kandachar, P., Halme, M. 2008. Introduction. Farewell to pyramids: How can business and technology help to eradicate poverty? In *Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor*. Eds. Prabhu Kandachar and Minna Halme. Greenleaf Publishing

Karnani, A. 2005. Misfortune at the Bottom of the Pyramid. *Greener Management International* 51: pp. 99-111

Kimatu, J.N. 2016. Evolution of strategic interactions from the triple to quad helix innovation models for sustainable development in the era of globalization. *Journal of Innovation and Entrepreneurship* 5 (16): pp. 1-7

Kimenyi, M. S., Moyo, N. 2011. Leapfrogging Development through Technology Adoption. In *Foresight Africa: The Continent's Greatest Challenges and Opportunities for 2011*. Africa Growth Initiative

Kline, R., Pinch, T. 1999. The social construction of technology. In *The Social Shaping of Technology* (2nd Edition). Eds. Donald Mackenzie and Judy Majcman. Open University Press

Koch, J.L., Caradonna, T.M. 2006. Technologies and Business Models that Work in Developing Countries. In *Information and Communications Technologies and Development, 2006. ICTD'06*: 193-202. IEEE

Kolk, A., Rivera-Santos, M., Rufín, C. 2014. Reviewing a Decade of Research on the "Base/Bottom of the Pyramid" (BOP) Concept. *Business & Society* 53 (3): pp. 338-377

Kuada, J. *Culture and Technological Transformation in the South: Transfer or Local Innovation?* Ed. John Kuada. Samfundslitteratur

Lai, J.K. 2009. Nordjysk partnerskab på spring i hele Østafrika. *Børsen*, 30 July

Latour, B. 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford University Press

Lazonick, W. 2006. The innovative firm. In *The Oxford Handbook of Innovation*, Eds. Jan Fagerberg, David C. Mowery and Richard R. Nelson. Oxford University Press, Inc., New York

Le Blanc, D. 2015. Towards Integration at Last? The Sustainable Development Goals as a Network of Targets. *Sustainable Development* 23: pp. 176-187

Lerpiniere, D., Wilson, D.C., Velis, C., Evans, B., Voss, H., Moodley, K. 2014. *A Review of International Development Co-operation in Solid Waste Management.* Report prepared by University of Leeds and formatted by D-Waste on behalf of ISWA Globalisation and Waste Management Task Force. Vienna: International Solid Waste Association

Leydesdorff, L., Etzkowitz, H. 1998. The triple helix as a model for innovation studies. *Science and public policy* 25 (3): pp. 195-203

Lindegaard, H. 2009. Teknologiers egenskaber og betydning. In *I teknologiens laboratorium – ingeniørfagets videnskabsteori*. Ed. Ulrik Jørgensen. Lyngby: Polyteknisk Forlag

London, T. 2016. *The Base of the Pyramid Promise: Building Businesses with Impact and Scale*. Stanford Business Books

Long, J.C., Cunningham, F.C., Braithwaite, J. 2013. Bridges, brokers and boundary spanners in collaborative networks: a systemic review. *BMC health services research* 13 (1): 158

Lund, J.H. 2014. Formation, implementation and outcomes of cross-sectorial partnerships between non-governmental organizations and business. Master Thesis (M.Sc. International Business), Copenhagen Business School

Lynch, M. 2016. Social Constructivism in Science and Technology Studies. *Human Studies* 39 (1): pp. 101-112

Løcke, L. 2014. Remergy har bragt el til ugandisk landsby. *Nordjyske Stiftstidende*, 26 August

Løcke, L. 2017. Nordjylland tæller fire milliardær-familie. *Nordjyske Stiftstidende,* March 28

Mahama, A. 2016. Growth versus Green Transition: Energy in Sub-Saharan Africa. In *Energy and Transport in Green Transition: Perspectives on ecomodernity.* Eds. Atle Midttun and Nina Witoszek. Routledge

Marshall, R.E., Farahbakhsh, K. 2013. Systems approaches to integrated solid waste management in developing countries. *Waste Management* 33 (4): pp. 988-1003

Martin, M.W., Schinzinger, R. 2005. *Ethics in Engineering* (International Edition). The Philippines: McGraw-Hill

Mendoza, R.U., Thelen, N. 2008. Innovations to Make Markets More Inclusive for the Poor. *Development Policy Review* 26 (4): pp. 427-458

Mikkelsen, B. 2005. *Methods for Development Work and Research: A New Guide for Practitioners* (2nd Edition). New Delhi, Thousand Oaks and London: SAGE Publications

Ministry of Foreign Affairs of Denmark. 2011. *Strategic Framework for Priority Area: Growth and Employment 2011-2015*. The Ministry of Foreign Affairs of Denmark.

Ministry of Foreign Affairs of Denmark. 2012. *Danida 50 years: A story of Dairy projects, dirt roads and developers, values and water pumps, solidarity, successes and shortcomings – and a few white elephants.* Ministry of Foreign Affairs of Denmark. Retrieved from: http://um.dk/da/danida/om-danida/danida-50-aar/ (Last accessed January 23, 2016)

Ministry of Foreign Affairs of Denmark. 2014. *Evaluation of Danida Business-to-Business Programme 2006-2011: Synthesis Report*. Evaluation Department, Ministry of Foreign Affairs of Denmark

Ministry of Foreign Affairs of Denmark. 2016. *Programme Document: Danida Market Development Partnerships 2016-2020*. Retrieved from: http://um.dk/en/danida-en/business/danida-market-development-partnerships (Last accessed April 11, 2017)

Mård, S. (Senior Sustainability Adviser, Novozymes). 2011. Personal and confidential interview carried out at Novozymes August 18, 2011.

Nahi, T. 2016. Cocreation at the Base of the Pyramid: Reviewing and Organizing the Diverse Conceptualizations. *Organization & Environment* 29 (4): 416-437

Namuyondo, E. 2013. One Stop Shop: A solution to sustainable sanitation for slum dwellers in developing countries: The case of Kasese municipality, Uganda. 3rd semester report (M.Sc. Environmental Management & Sustainability Science), Aalborg University

Network for Business Sustainability. 2013. *Sustainability through Partnerships: A Guide for Executives.* Network for Business Sustainability.

Novozymes. 2014. *NewFire Africa files for voluntary liquidation* (Press Release). Retrieved from: http://www.novozymes.com/en/news/news-archive/pages/newfire-africa-files-for-voluntary-liquidation.aspx (Last accessed April 22, 2016)

Ntale, C. 2012. *Chilli Value Chain Pre-Feasibility Study: Kabarole, Kamwenge and Kyenjojo Districts.* Report commissioned by *access2innovation* by Charles Ntale, Shoreline Services

The Organisation for Economic Co-operation and Development (OECD). 2013. *An International Benchmarking Analysis of Public Programmes for High-Growth Firms.* The OECD Local Economic and Employment Development Programme in collaboration with the Danish Business Authority

Osterwalder, A., Pigneur, Y. 2013. *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.

Overgaard, J., Nielsen, R.L. 2014. Networks for Sustainable Innovations in Kasese, Uganda. Master Thesis (M.Sc. Environmental Management & Sustainability Science), Aalborg University

Pearson, J., Gianni, R., Ikonen, V. & Haick, H. 2016. From Technology Assessment to Responsible Research and Innovation (RRI). Paper presented at the Future Technologies Conference, San Francisco, United States, 6-7 December 2016. IEEE

Pedersen, M.B. 2016. Deconstructing the concept of renewable energy-based mini-grids for rural electrification in East Africa. *Wiley Interdisciplinary Reviews: Energy and Environment*

Prahalad, C.K., Hammond, A. 2002. Serving the World's Poor, Profitably. *Harvard Business Review*, 80 (9): pp. 48-59

Prahalad, C.K. Hart, S. 2002. The Fortune at the Bottom of the Pyramid. *Strategy+Business* 26 (First Quarter)

Prahalad, C.K. 2004. *The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits.* Upper Saddle River, New Jersey: Wharton School Publishing

Prasad, A. 2002. *A Dictionary of Strategic Management*. New Delhi: Excel Books

Prentow, R., Steiniche, R., Johansen, S.D., Paay, J., Aaen, I., Kjeldskov, J. 2015. When Value is Greater than Money: a Micropayment System in Uganda. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (pp. 765-772). ACM.

pv magazine. 2013. *Bangladesh: Grameen Shakti celebrates one-millionth installation*. Retrieved from: https://www.pv-magazine.com/2013/01/14/bangladesh-grameen-shakti-celebrates-one-millionth-installation_10009840/ (Last accessed March 4, 2018)

Rasmussen, L.B. 2011. *Facilitating Change: Using INTERACTIVE METHODS in organizations, communities and networks.* Polyteknisk Forlag

Ravn, J. 2012. Access2innovation: Netværksbaseret forretningsmodel innovation målrettet nødhjælps- og udviklingsbistanden. PhD dissertation, Aalborg University

Ravn, J. 2015. Access2innovation: an Innovative BoP network partnership model. In *Base of the Pyramid 3.0: Sustainable Development through Innovation and Entrepreneurship.* Eds. Fernando Casado Cañeque and Stuart L. Hart. Greenleaf Publishing

Reason, P., Bradbury, H. 2010. Introduction: Inquiry and participation in search of a world worthy of human aspiration. In *The handbook of action research*, Eds. Peter Reason and Hilary Bradbury. London: Sage Publications Ltd.

Rebehy, P.C.P.W., Costa, A.L., Campello, C.A.G.B., de Freitas Espinoza, D., Neto, M.J. 2017. Innovative social business of selective waste collection in Brazil: Cleaner production and poverty reduction. *Journal of Cleaner Production* 154: pp. 462-473

Remmen, A. 1991. Constructive technology assessment. In *Danish experiments—social constructions of technology,* eds. Tarja Cronberg, Peter Duelund, Ole Michael Jensen, and Lars Qvortrup. Copenhagen: New Social Science Monographs, Institute of Organisation and Industrial Sociology, Copenhagen Business School.

Remmen, A., Ravn, J. 2009. access2innovation – a strategy to fight climate change? *IOP Conference Series: Earth and Environmental Science* Volume 6, Session 41

Rip, A., Robinson, D.K.R. 2013. Constructive Technology Assessment and the Methodology of Insertion. In *Early Engagement and New Technologies: Opening Up the Laboratory*, eds. Neelke Doorn, Daan Schuurbiers, Ibo van de Poel and Michael E. Gorman, Philosophy of Engineering and Technology series, vol. 16. Dordrecht: Springer

Saad, M., Zawdie, G. 2011. *Theory and Practice of the Triple Helix System in Developing Countries: Issues and Challenges.* Eds. Mohamed Saad and Girma Zawdie. Abingdon and New York: Routledge

Scheinberg, A., Anschütz, J. 2006. Slim pickin's: Supporting waste pickers in the ecological modernization of urban waste management systems. *International Journal of Technology Management and Sustainable Development* 5 (3): pp. 257-270

Scheinberg, A., Wilson, D.C., Rodic, L. 2010. *Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities.* London and Washington, DC: Earthscan

Scheinberg, A., Spies, S., Simpson, M.H., Mol, A.P.J. 2011. Assessing urban recycling in low- and middle-income countries: Building on modernised mixtures. *Habitat International* 35 (2): pp. 188-198

Schumacher, E.F. 1973. *Small is Beautiful: Economics as if People Mattered*. New York, Hagerstown, San Francisco and London: Harper & Row Publishers, Inc.

Schumpeter, J.A. 1942. Creative destruction. *Capitalism, socialism and democracy* 825: pp. 82-85

Seelos, C., Mair, J. 2007. Profitable Business Models and Market Creation in the Context of Deep Poverty: A Strategic View. *The academy of management perspectives* 21 (4): pp. 49-63

Simanis, E., Hart, S. 2008. *The Base of the Pyramid Protocol: Toward Next Generation BoP Strategy* (2nd Edition). Retrieved from: http://www.stuartlhart.com/sites/stuartlhart.com/files/BoPProtocol2ndEdition2008_0.pdf (Last accessed January 20, 2016)

Smith, A. 2005. The Alternative Technology Movement: An Analysis of its Framing and Negotiation of Technology Development. *Human Ecology Review* 12 (2): pp. 106-119

Srinivasa, S., Sutz, J. 2008. Developing Countries and Innovation: Searching for a New Analytical Approach. *Technology in Society* 30: pp. 129-140

Star, S.L., Griesemer, J.R.. 1989. Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social studies of science* 19 (3): pp.387-420

Stringer, L.C., Dougilll, A.J., Dyer, J.C., Vincent, K., Fritzsche, F., Leventon, J., Falcão, M.P., Manyakaidze, P., Syampungani, S., Powell, P., Kalaba, G. 2014. Advancing climate compatible development: lessons from southern Africa. *Regional Environmental Change* 14: pp. 713-725

Stutz, J. 2008. Sustainable solid waste management using a base-of-the-pyramid approach. In *Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor*. Eds. Prabhu Kandachar and Minna Halme. Greenleaf Publishing

Sustainable Development Knowledge Platform. 2018. *Sustainable Development Goal 8*. Retrieved from https://sustainabledevelopment.un.org/sdg8 (Last accessed October 15, 2018)

Sørensen, C.K. 2013. Chili Production in Western Uganda – Past Experiences and Future Prospects. Internship report (M.Sc. Global Studies), Roskilde University

Taylor, S.J., Bogdan, R. 1984. *Introduction to Qualitative Research Methods: The Search for Meanings*. John Wiley & Sons, Inc.

Tchobanoglous, G., Theisen, H., Vigil, S. 1993. *Integrated Solid Waste Management: Engineering Principles and Management Issues*. McGraw-Hill, Inc.

TriplePundit. 2014. *Killing 6 Birds with 1 Stone: Harder Than It Sounds*. Retrieved from http://www.triplepundit.com/2014/07/killing-6-birds-1-stone-harder-sounds/# (Last accessed April 22, 2016)

Tukahirwa, J.T., Mol, A.P.J., Oosterveer, P. 2010. Civil society participation in urban sanitation and solid waste management in Uganda. *Local Environment* 15 (1): pp. 1-14

United Nations, n.d. *Goal 17: Revitalize the global partnership for sustainable development*. Retrieved from https://www.un.org/sustainabledevelopment/globalpartnerships/ (Last accessed October 15, 2018)

United Nations Economic and Social Council. 2017. *Progress towards the sustainable development goals: Report of the Secretary-General*. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=E/2017/66&Lang=E (Last accessed September 5, 2018)

van der Boor, P., Oliveira, P., Veloso, F. 2014. Users as innovators in developing countries: The global sources of innovation and diffusion in mobile banking services. *Research Policy* 43: 1594-1607

van Vliet, B., van Buuren, J., Oosterveer, P., Spaargaren, G. 2013. Network governance and waste and sanitation service provision: An introduction to the modernised mixtures approach. In *Urban Waste and Sanitation Services for Sustainable Development: Harnessing Social and Technical Diversity in East Africa*. Eds. Bas van Vliet, Joost van Buuren and Shaaban Mgana. London and New York: Routledge

Vandenbroeck, J. 2015. *IDEAS For Energy Access: From California to Uganda*. Retrieved from: http://www.ideasforus.org/blog/ideas-for-energy-access-from-california-to-uganda/ (Last accessed July 25, 2016)

VedvarendeEnergi. 2013. *Strategisk samarbejde i Vietnam*. Retrieved from: https://ve.dk/strategisk-samarbejde-i-vietnam/ (Last accessed September 20, 2018)

Velis, C. 2017. Waste pickers in Global South: Informal recycling sector in a circular economy era. *Waste Management & Research* 35 (4): pp. 329-331

Villela, A., Martins, L.C., de Fátima, M., Sawyer. D. 2008. Reutilisation of waste glass leads to social and environmental sustainability in Brasília. In *Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor*. Eds. Prabhu Kandachar and Minna Halme. Greenleaf Publishing

Worrell, W.A., Vesilind, P.A. 2012. *Solid Waste Engineering* (2nd Edition). Cengage Learning Asia Pte Ltd

Wilson, D.C., Velis, C., Cheeseman, C. 2006. Role of informal sector recycling in developing countries. *Habitat International* 30 (4): pp. 797-808

Wilson, D.C., Velis, C.A., Rodic, L. 2013. Integrated sustainable waste management in developing countries. *Proceedings of the Institution of Civil Engineers: Waste and Resource Management* 166 (2): pp. 52-68

Wimmer, N. 2012. *Green Energy for a Billion Poor: How Grameen Shakti Created a Winning Model for Social Business.* MCRE-Verlag

Yang, Y., Holgaard, J.E. 2012. The important role of civil society groups in eco-innovation: A triple helix perspective. *Journal of Knowledge-based Innovation in China* 4 (2): pp. 132-148.

Yin, R. K. 2003. *Case Study Research: Design and Methods*. Applied Social Research Methods Series Volume 5. SAGE Publications

Yunus, M. 2008. *A World Without Poverty: Social Business and the Future of Capitalism.* Public Affairs

Yunus, M. 2010. *Building Social Business: The New Kind of Capitalism that Serves Humanity's Most Pressing Needs*. Public Affairs

Yunus, M., Moingeon, B., Lehmann-Ortega, L. 2010. Building Social Business Models: Lessons from the Grameen Experience. *Long Range Planning* 43 (2-3): pp. 308-325

APPENDICES

Appendix A. The Cleanstar Mozambique Business Model

ENERGIZING AFRICAN AGRICULTURE

POVERTY, POOR HEALTH, ENVIRONMENTAL DEGRADATION

A BLEAK REALITY → THE CHANGE WE BRING → A BRIGHTER FUTURE

MORE FOOD, BETTER HEALTH, STRONGER LOCAL ECONOMY

Farmers have limited market access for their crops, which leads them to cut down trees to make charcoal for urban consumers for which demand and prices are growing strongly.

By 2013, 3,000 families practice conservation agroforestry to produce their own food and sell surpluses for cash.

Farmers have a poor understanding of family health, which leads them to grow low-maintenance staple crops with limited nutritional value. 44% of Mozambican children under five are stunted due to poor diet and chronic illness.

2.4 million indigenous trees will be planted in communities.

Greater crop diversity improves family nutrition levels, while the sale of crop surpluses delivers 500% improvement on incomes compared to charcoal production.

Farmers lack technical skills and inputs, which leads to poor farming practices such as slash-and-burn methods that deplete soils and result in further forest destruction.

By 2014, 20% of Maputo households are using clean, safe, convenient, and affordable ethanol-based cooking solutions, preventing 4,000 hectares of forest destruction annually.

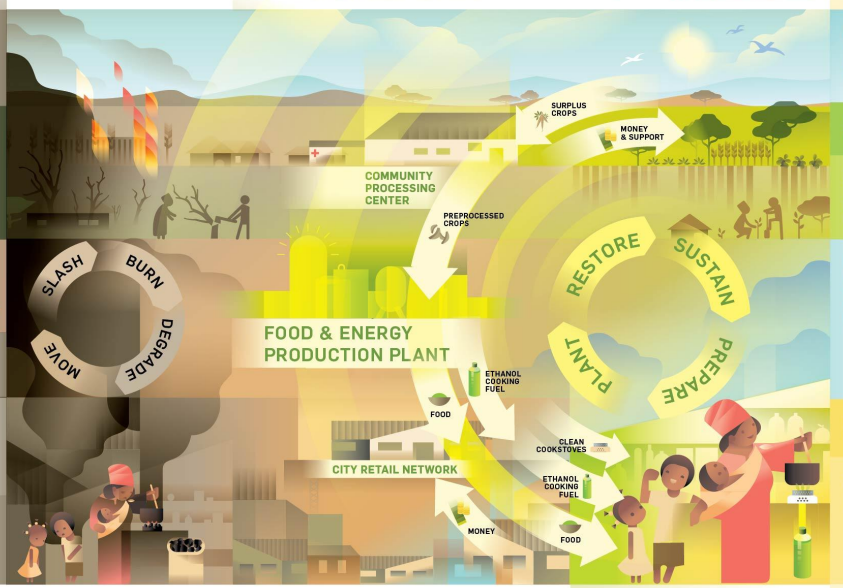
Families are increasingly buying imported food due to limited domestic supplies.

Urban families recognize charcoal as dirty, inefficient, and unhealthy, but have no real alternatives. Cooking indoors with charcoal is equivalent to two packs of cigarettes per child per day.

Reduced indoor air pollution improves family health.

Charcoal prices have doubled in the last 3 years due to receding forests and growing urbanization. Charcoal sales in Maputo now average $30 per month per family.

Spending on cooking fuel and food drives rural development and environmental restoration.



CleanStar Mozambique

novozymes® Rethink Tomorrow

Appendix B. Access2innovation Concept Note (Waste Management in Kasese)

access²innovation

Concept note

Waste management in Kasese

Danish Agency for Science Technology and Innovation
Ministry of Science, Innovation and Higher Education

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
INVESTING IN YOUR FUTURE

The search for better ideas

Access2Innovation offers your company the opportunity to enter an African growth market: Uganda.
The Ugandan economy is among the fastest growing these years, with annual growth rates of more than 6 percent, a stark contrast to Denmark, which is dangerously close to having no growth at all.
If you think this is interesting then you probably want to keep reading this concept note.
You might be asking yourself: *Why is this called a concept note*? The answer is quite simple: Access2Innovation has already been to Uganda and identified multiple interesting business opportunities in coordination with NGOs and university communities. The business opportunity is summarized in this concept note. The reason that we are involved with NGOs and universities is that it enables us to create new markets, based on innovative commercial ideas that have the benefit of creating a social impact as well.
We are looking for companies that are searching for better ways to do things, that want to embrace new ideas from people that they do not typically work with in countries and markets where they are not already represented.
In the access2innovation network we offer access to a range of talented partners; experts within their fields, that are ready to assist in developing and maturing business ideas. We also offer a very strong local network in Uganda; a network that spreads across sectors, from civil society organizations and high level political institutions to the different business communities.

All we need to get going is you.

Dealing with waste is a substantial problem for many townships and rural areas of East Africa. The environmental and health related consequences of waste problems are very much a cause for concern.

Technologies dealing with such issues are well-known to businesses and people in general in the European Economy, but in Uganda knowledge and awareness is slim.

Part of the challenge is also to secure a financial base and subsequent profits, which is why waste management solutions are closely related to how the waste is used for energy production etc.

Access2innovation and its partners are looking for Danish businesses to capture this Ugandan customer segment profitably. By succeeding in building a business case for waste management in the Kasese District in Uganda, opportunities await in nearby, as well as distant markets.

Market opportunities

The responsibility for waste management in Uganda lies with Urban Councils. However, in many cases services are poor or non-existent. Only a small fraction of Municipal Solid Waste (MSW) is collected.

93 percent of the waste is organic and 7 percent non-organic.

Municipality	Total MSW Generated (Gg/Yr)	Fraction of MSW collected
Fort Portal	32.49	0.416
Jinja	87.24	0.418
Kabale	33.58	0.254
Kasese	83.99	0.180
Lira	72.77	0.347
Mbale	26.29	0.631
Kampala		
Mbarara	79.57	0.300
Mukono	42.71	0.598
Soroti	35.08	0.300

The notion of turning waste into energy, which in turn could have tangible monetary value, is fully understood by the local authorities, but in general Uganda lacks the knowledge and know-how to utilize the potential resources at hand. This despite evident need for access to sustainable energy.

If a successful waste management solution and business model is devised, the potential for replication across Africa is very high, why WWF among others has set the focus on waste management with the *Kasese Green Energy Champion District.* This to demonstrate that it is possible to create a win-win scenario based on including human development and environmental protection.

In the partnership with access2innovation, the ambition is to demonstrate that business driven solutions can be the driving force for ensuring access to clean technologies to end-users by providing companies with an innovation platform that allows testing of products and business strategies that can be replicated throughout Uganda.

A developed platform that can provide Danish companies with the possibility to partner with WWF and Kasese Municipality to test and commercialise Danish experience with waste to energy solutions in a new emerging market .

Waste management as a potential business case

An estimated 14.000 households exist in the Kasese Municipality with an average household of 5-6 people. Households alone generate 9 kg of solid waste per day, leading to a total of 126 tons per day - of which less than half is collected, and even less is utilised for beneficial value adding activities.

65 percent of the households have access to simple pit toilets that are either filled up and left or emptied into the nearby surroundings or emptied by a local sanitation company at differing intervals.
Some wastage areas are collected several times a week, where others experience little or no collection. Garbage and organic waste is currently dumped at provided container sites, dumped in local pits or burned.

There are more than 1.000 businesses, shops, organisations, institutions, market places etc. leading to an even greater tonnage of waste, comprising both organic, mineral, non-renewables and others. However, the municipality of Kasese is only able to collect to around 40-50 metric tons per day.

Based on the preliminary research undertaken, the following intervention areas have been identified around developing:

- Bio gas
- Gasification
- Incineration
- Composting
- Waste transportation
- Spreading awareness about waste

These technologies require different resources as well as they serve different purposes. Danish businesses are asked to evaluate, which of these - or possibly other possibilities - would be relevant in case of Kasese.

Incineration technologies exist and are not purported to hold the solution for Uganda in the future, and will as such be valued lower than other greener technologies.

Prospects for companies:

- Private sectors businesses are invited to analyse, design and deliver waste management solutions in Kasese Town.
- Local councils of Uganda and elsewhere suffer from the same problems, of which they are completely aware. They will become potential customers when Kasese becomes a positive case on waste management.
- By partnering with different organisations (NGOs, Financial institutions, Researchers and others) to deliver a complete setup of waste management, including waste collection, sorting and handling, and doing so innovatively, will open up new market opportunities for the participating companies.

Framework

Kasese Municipality is aware of their waste challenges and are very receptive to learn of innovative ideas - especially those solutions that could generate value in other places (energy etc.). However in order for any viable solutions to become clear, further analysis is required, which is why businesses are invited to take a look by visiting the area.

The conditions are especially interesting in that there is a large amount of waste ready to be utilised, and that the district is ready to do something about it. Furthermore, a solution here would be replicable across many other districts and countries, and afford attending businesses great market opportunities.

During a visit to Kasese District it is recommended that the following be investigated:

- Amount, fluctuations, types of waste to establish the best treatment solution.
- Informal markets.
- Electricity grid expansion/improvement solutions.
- Collection and Transportation solutions

As a business there are many opportunities to exploit, and to learn which are potentially a match to current business activities, attend the workshop mentioned in a separate document.

Customer segments

Local municipalities in Uganda would benefit greatly from solving waste issues, and at the same time gain access to energy, compost or other. Danish companies that are able to provide both the technical and financial aspects of the solutions will have vast market opportunities. Municipalities and districts across Uganda are all interested in the Kasese efforts, and a lot of attention will be held on what takes place there.

In Kasese, a lot of waste is not utilised, and is principally discarded. The same can be said, with some confidence, about many other municipalities across Uganda, East Africa and the developing world at large.

As such, the potential customer base is very large.

Potential partners

In access2innovation there are partners with skills, knowledge and network to help companies conduct business in Uganda.

In Uganda there are already suppliers of various technologies. Finding the right set of partners is going to require a further analysis of how Kasese's waste problems are to be solved.

The increase in power increases the potential for job creation and an expanding tax-base, infrastructure development, health improvement, social development, education and tourism.
Thus, the further stakeholders include councils, inhabitants, policy makers, companies, health activists, donors and many more.
Mobilising these stakeholders will hold the key to success.

As the waste management and energy demands are evident, it is deemed a high probability for success if companies are to engage in partnerships to solve the challenges.

Essentially there are many actors already trying to change things, but in most cases they are doing so alone. If we combine the efforts of these many different initiatives, the industrial development is possible and new markets are formed for foreign businesses.

Next step

For further information of how to proceed from here, contact head of secretariat Jacob Ravn: jr@access2innovation.com

Access2innovation will be hosting seminars in October 2012 to open the dialogue with interested companies and researchers to further outline the upcoming business opportunities.

Sign up for the coming field visit to Uganda on December 4th -12th 2012

To apply for access2innovation funding, please visit the website
www.access2innovation.com

access²innovation

the commercial approach to poverty reduction

www.access2innovation.com

for video documentation, please visit our YouTube channel: www.youtube.com/access2innovation

ISSN (online): 2446-1628
ISBN (online): 978-87-7210-352-5

AALBORG UNIVERSITY PRESS