Theorizing the Organization of Technology Entrepreneurship

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Theorizing the Organization of Technology Entrepreneurship

Abstract. In this paper, we explore how, why and which structures are consequential to the organization of technology entrepreneurship. Technology entrepreneurship is a relatively unexplored field of research; yet body of research in this promising area of scholarly enquiry, both theoretically and empirically is emerging. Inspired by elements of the Grounded Theory research methods for data collection and data analysis we explore (i) the process of technology entrepreneurship at different levels: university, industry, and government, including the nature of tensions, obstacles and incentives, (ii) the relationships between key stakeholders from these three levels, and (iii) the meaning/reality that is construed by these stakeholders as a result of these relationships. The research was undertaken in four universities in the UK and one in Australia. Coding of the data revealed thirteen constructs, which are presented as an integrative model of technology entrepreneurship. From the emergent model of technology entrepreneurship we move to a higher level of theorizing and develop a framework of the organization of technology entrepreneurship.

1. Setting the scene

In this paper we explore how, why and which structures are consequential to the organization of technology entrepreneurship (TE). TE is a relatively unexplored field of research (Beckman, Eisenhardt, Kotha, Meyer & Rajagopalan, 2012a) that is positioned at the intersection between entrepreneurship and technological innovation research domains (Beckman, Eisenhardt, Kotha, Meyer & Rajagopalan, 2012b; Shane & Venkataraman, 2003). There is a growing– yet scarce – body of research in this promising area of scholarly enquiry, both theoretically (see e.g., Gans & Stern, 2003; Wright, 2012; Wright, Birley & Mosey, 2004) and empirically (see e.g., special issues by Beckman, Eisenhardt, Kotha, Meyer & Rajagopalan, 2012a, b; and by Shane & Venkataraman, 2003).

Being a multifaceted concept with multiple sets of actors at different levels of analysis (Garud & Karnøe, 2003), it adds to the challenge of researching and advancing TE research domain. A number of concerns have been identified in this regard. More research is needed to understand the contexts in which TE occurs (Wright, 2012) – to understand the role and influence of technology, technical systems, industries and institutions, as well as of processes, resources and capabilities on TE (Shane & Venkataraman, 2003; Wright, Birley & Mosey, 2004).

Theorizing and theory building are imperative strategies to employ to advance theoretical understanding of young research domains such as TE. Inspired by elements of the Grounded Theory research methods for data collection and data analysis (Glaser, 1978; 2012; Glaser & Strauss, 2010) we explore (i) the process of technology transfer at different levels: university, industry, and government, including the nature of tensions, obstacles and incentives, (ii) the relationships between key stakeholders from these three levels, and (iii) the meaning/reality that is construed by these stakeholders as a result of these relationships. Grounded theory research was undertaken in four universities in the UK and one in Australia. Substantive and theoretical coding of the data revealed thirteen constructs, which are presented as an integrative model of technology transfer; the model is discussed in Section 3. From the emergent model of technology transfer we move to a higher level of theorizing and develop a framework of organization of TE that is discussed in Section 4, followed by conclusion. We continue with Section 2 introducing the research methodology.

2. Research Methodology

2.1 The research process

The research was conducted in two phases. The first phase begun in Australia in mid-2003 at the Australian National University (ANU), and lasted eight months. The second phase was carried out in the UK and started in March 2004 and was finalized in December 2004.

2.1.1 First phase

The ANU was selected for the first phase of the research being theoretically an opportunistic and convenient sample. One of the authors had the opportunity to do action research in the commercialization arm of the ANU. Access was successfully negotiated, and the researcher was employed part-time as a knowledge-transfer officer. At the very outset of the action research, all employees were made aware of the dual role of the author as an employee and as a researcher.

Data was collected through various methods, such as formal and informal respondent encounters, observations drawn on the basis of day-to-day activity as well as participation at various meetings, and perusal of organization archives and current documents. None of the respondent encounters were tape-recorded; rather, a field note journal was kept in which observations were recorded. The encounters were then re-constructed from notes and observations within 24 hours after the event took place.

Data collection and analysis began with the first respondent encounter. As new data from other respondent encounters influenced the authors' understanding of the system, the structure of subsequent encounters reflected this new information. The method of coding for emerging concepts was used to analyze the collected data. In the process, multiple follow-up encounters took place understanding that both the researcher and the respondents need time and space to reflect on what they have said and then give the opportunity to develop an understanding of these encounters. Data collection continued to the point when the concepts and dimensions identified at an early stage of the analysis had been explored in multiple encounters and that no new constructs surfaced in the analysis of new encounters. There were in total 19 respondent encounters.

Several other steps were taken to insure the quality of data analysis. Comments were sought from the respondents regarding the model as it emerged. Active participation in the day-to-day activity of the knowledge-transfer office enabled a thorough understanding of the environment. A field note journal was kept in which observations were recorded.

2.1.2 Second phase

Four UK universities were selected on the basis of intensity sampling strategy that is based on information-rich cases that manifest the phenomenon intensely (Miles & Huberman, 1994). For example: the most successful science park in Europe, and an extensive and well-integrated internship program (University of Surrey); an innovative entrepreneurship program that integrates theory with teaching (University of Strathclyde); an established university, with a long history of tradition, which is determined to implement new methods of KT (Oxford University); and a well-established pre-incubator with an accompanying seed-corn fund (University of Bath).

A similar methodology to Phase 1 of data collection and analysis was adopted in Phase 2. A number of differences and challenges emerged however. In this phase all encounters were tape-recorded and transcribed verbatim, and an encounter lasted approximately 1 hour on average. Data collection stopped when no new insights surfaced in the analysis of new transcripts that would contribute to the refinement of the model. A total of 14 encounters, including follow-up encounters were conducted at Surrey University, 12 at Strathclyde University, 7 at Oxford University, and 9 at the University of Bath. The list of respondents is presented in Table 1; respectively, each respondent was coded to illustrate the quotes in the Appendix.

Insert Table 1 about here

The major challenge was to evoke in-depth insights about the KT system through gaining the trust of the respondents and encouraging them to converse openly. To overcome this challenge the research was placed in a wider context during the introduction to the interview. That is, the respondents were informed that the research was of interest to policy makers and the research findings would be considered for implementation. Moreover, open questions were employed to encourage practitioners to tell stories based on their actual experience. The specific focus was on the failures of their KT system, uncovered indirectly through questions such as, "*what you would not do if you were to design a KT system*".

2.2 Data analysis

The data collected was coded and organized into 13 constructs; the constructs that emerged are defined in Table 2, and their linkages are explained in the Appendix, along with quotes from the respondents. The constructs that emerged can be broadly grouped into things facilitators do, things facilitators have, the results of facilitator action, and the impact of those the facilitators have to deal with.

Insert Table 2 about here

The constructs that emerged formed the basis of the emergent Knowledge Transfer Model (KT model) (Figure 1). The model allows themes of common difficulty across the data to be clearly highlighted, and is based on clear definitions of the emerged theoretical constructs (see also the Appendix). The data also informed cause-effect relationships between constructs. The reader may have noticed that many of the constructs appear linked, or dependent. In presenting the KT model, the priority is upon establishing understanding and credibility in the model. To this end, the model constructs are grouped and explained, and then discussed from the perspective of regions and processes within the model.

Insert Figure 1 about here

3. Emergent model of technology transfer

The process model is taken from the perspective of facilitators, and given that they constitute eighty percent of the data, this is not unexpected. The description follows the structure of the model, beginning with the horizontal center line travelling from right to left. This depicts the most linear aspects of the overall model, and moves from official sanction [1] to project operation [3]. The constructs situated off the horizontal are ancillary in their impacts; with the upper side concerned with resources, and the lower mostly political in nature, with autonomy being given its own discussion. There is then an analysis of feedbacks from the center line to the upper and lower side, and reversing back on itself.

On the center line, a logical flow of events is perceived. The institution (typically the university) decides to hire appropriately-skilled facilitators [1→6], who then coordinate information [6→11] between them to identify opportunities for knowledge transfer [11→8]. However, as mentioned previously, it is the participants that must act on this recognition via interaction [13→8], and facilitators help by controlling quality and weeding out undesirables beforehand [6→13]. Reversing the direction briefly, interaction (which also includes that between stakeholders and facilitators) allows information to be collected that assists with future coordination [13→11]. From opportunity, a project is launched [8→4], and then achieves ongoing viability [4→3]; although the discovery of an opportunity may also distract from an ongoing project [8→3].

Examining the upper side, returning to the right, here an institution makes funds available for projects [1→2], and also sufficient numbers of facilitators [1→7]. Project funds are used to both assist projects directly [2→4] (announced at launch) and also, importantly, act as a 'honey pot' that provides a reason for stakeholders to engage with the system [2→13]. Having a larger office allows more interactions to be arranged [7→13], but, on the other hand, means there are more people to coordinate between [7→11]. An office also provides facilitators (or other staff) to help with applications for grants [7→2].

As previously mentioned, the lower side is largely political, and perhaps not coincidentally, also more complicated. Starting again at the institution, enthusiasm for knowledge transfer leads to intelligent policies [1→5], while also to a propensity to micro-manage decisions on the ground [1→10]. Good policies accomplish two outcomes: they give facilitators a formal mandate [5→10], and they provide incentives for new or current (project-involved) participants by structuring general (or project-specific) rules [5→9]. If stakeholders feel comfortable with knowledge transfer, they will be more likely to accept their ongoing role in a project [9→3], and also be happier to make (and maintain) contact with a facilitator [9→12]. The more contacts known to facilitators (collectively), the more probable it will be that a fruitful opportunity will arise [12→8] as a result of facilitator-arranged interaction. However, more contacts means more

information to deal with, increasing the complexity of coordinating the overall system [12→11].

Moving to autonomy [10], which has four positive and three negative effects founded upon it, and examining the negative first, facilitator autonomy may lead stakeholders to feel pressured as a result of being imposed upon – colloquially known as 'power tripping' [10→9]. In a similar fashion, facilitators may push opportunities on to stakeholders, rather than allowing them to decide upon the transfer itself, and thus 'false' opportunities displace the real ones [10→8]. Autonomy for facilitators may also translate as individualization, meaning they become less open to sharing information between each other, or promoting opportunities objectively [10→11]. Regarding the positive effects of autonomy, it encourages facilitators to seek new contacts [10→12], and to foster greater interaction [10→13] (this arising perhaps in imaginative ways?). In the context of active projects, giving facilitators the power to intervene if a problem arises [6→10] allows remedial oversight to avoid irretrievable failure [10→3].

Looking now at the feedbacks from the center-line constructs to the upper and lower side, or those occurring further to the right along the center-line. Starting with active projects, which has the greatest number (namely four) of feedbacks, we see that active projects are a fertile environment for fresh ideas [3→8]. They provide validation for the support originally given by the institution, and lead to more of the same [3→1]. In a similar fashion, project participants will express gratitude to their facilitator for the project's success [3→12]. Ongoing projects serve to teach facilitators by providing feedback on what actually works, and thus improve their personal abilities [3→6].

Newly-launched projects increase stakeholder support due to the interest aroused among colleagues involved in a (potentially-lucrative) new project [4→9]. Discovered opportunities provide validation to facilitators who might otherwise become frustrated from a lack of results [8→7]. Interactions arranged by facilitators have a positive effect on stakeholders generally, but a negative one on contacts specifically. The difference is subtle but based upon the psychology of attributing beneficence to a collective, but detriment to an individual, allowing one to avoid feeling beholden to an actual person while at the same time feeling part of a tribe. So the enjoyable aspects of interaction such as learning and socializing are ascribed to the network [13→9], while the blame for wasting time attending events (among other frustrations) is attached to the facilitator who invited you [13→12]. Next is the positive feedback befalling a well-coordinated system, in which it is seen as a 'tight ship' by those who sponsor and fund it, creating a positive impression [3→1] (even without actual projects being delivered; this feedback therefore being important in the initial stages).

Facilitator quality has two impacts as a result of confidence and social ability, respectively. Confidence is necessary to correct institutional 'bosses' who make policy [6→5]. Social ability makes facilitators more able to 'sell' the idea of knowledge transfer to their contacts, and then be able to maintain the relationship afterwards [6→12]. This concludes the model definition section.

4. Organization of technology entrepreneurship

In the following discussion we compare the emergent model of technology transfer with extant body of knowledge in an attempt to generate grounded theory of organization of TE. It is interplay, back and forth between data and theory to maximize the generation of theory (Glaser & Strauss, 2010). We ground inductively the emergent model of technology transfer in institutional theory Scott (1995) and sociology of markets theory (Fligstein, 2001; Fligstein & Dauter, 2007). Technology transfer could be seen as a market or as a field that "…depends not just on the power of incumbents, but on more general rules in society in order to stabilize the power of incumbents" (Fligstein, 2001, p. 28). Through the lenses of sociology of markets theory, key concern is social exchange,

that of a market, and structuring of that social exchange (Fligstein, 2001; Fligstein & Dauter, 2007). We conjecture that the organization of TE refers to the following attributes: set of principles that organize thought and are used by actors to make sense of their situations; routines or practices that actors perform in their day-to-day social relations, and the social relations that constitute fields that may or may not be consciously understood by actors (Fligstein, 2001, p. 29).

Further comparison of the emergent model of technology transfer with institutional theory yields a framework of organization of TE (Figure 2). From institutional theory perspective, Scott (1995) defines three institutional pillars: regulatory, normative, and cognitive. The regulatory pillar refers to rules, regulations, standards, and expectations created by the governments, and other regulative or professional bodies. It also includes sanctions in the form of rewards and punishments aimed at influencing stakeholders' behavior. Through institutional support and knowledge entrepreneurship project funding, we capture two generic elements of the regulatory pillar. One may further distinguish between legislative and executive support, as this differentiation, in our view, plays an important role in screening for differences in knowledge entrepreneurship market at the inter-state level.

Insert Figure 2 about here

Within this pillar, the role of institutional pressures on TE is reflected in the loop 2: policy intelligence that, as explained earlier, has the function of stimulating an efficient and effective TE market both at national and supranational levels. As Schneiberg and Clemens (2006) maintain, higher institutional pressures may amplify heterogeneity across various stakeholders rather than increasing their homogeneity. One may argue here that such institutional pressures to produce may constrain activity and creativity, and could be amplified through misuse or abuse of sanctions and rewards, all leading to a sequence of supranational, field-wide conflicts and resistance to change. Furthermore, the setting of regulatory boundaries, including sanctions and rewards, is influenced by the perceived likelihood of success (loop 1). Here we insist on 'perceived likelihood of' rather than 'perceived' success to emphasize the importance of a vision for the TE market, as opposed to building institutional support based on past experience that most of the time is linked to specific opportunities.

The normative pillar is derived from societal values (that which is preferable and desirable) and norms (how things should be done); it is about shared norms and values, and binding expectations. Here we emphasize the extant values and norms related to businesses engaging with universities in R&D activities (industry support), as well as extant values and norms in universities that encourage academic entrepreneurship (academic support). As part of normative pillar, we view the autonomy of knowledge-transfer facilitators, whose autonomy is institutionalized not only through policy decisions, but also through the actual power of those who decide what is appropriate and what constitutes valuable knowledge. In relation to this, we posit that norms (unwritten or unenforceable) will always tend to become more accommodating to those already in power, as expressed in terms of the creation of roles and accepted types of behavior (loop 3, power transition). The perceived likelihood of success (loop 1), as in the case of the regulatory pillar, we argue, may effect changes in extant norms and values, mitigating, for example, the risk as when a knowledge-transfer facilitator might take the lead on creating projects, or stopping projects that otherwise have had support.

The cognitive pillar derives from a 'taken for granted' or 'that's the way we do business here' type of behavior. The prime instigator of the cognitive pillar is interaction causing information to be absorbed and knowledge built – knowledge that creates the means by which cognition makes decisions (loop 4, cultural-cognitive frames). As D'Andrade (1984, p. 88) argues: 'in the cognition paradigm, what a creature does is, in large part, a function of the creature's internal representation of its environment'. We emphasize as

sources of the cognitive pillar cross-industry, academic-industry, and cross-discipline interactions, as well as the strengths (of strong and weak ties) of academic and industry networks. At the same time, we argue that of the three institutional pillars, the cognitive one is the most difficult one to change or de-institutionalize. In this we view the perceived likelihood of success (loop 1) as having a positive effect on effecting change or initiating de-institutionalization of 'taken for granted' type behavior.

As institutional theory is not concerned with entrepreneurship or opportunity emergence, we bring opportunity emergence into the picture. Here we emphasize not only opportunity discovery, but also opportunity pursuit (Davidsson, 2004). The latter is pivotal to the knowledge entrepreneurship market as it is triggered by what we call institutional munificence (loop 5). By institutional munificence we understand, for example, that established norms and values are conducive to academic entrepreneurship, or are encouraging businesses to engage with universities in R&D activities. By institutional munificence we also understand, for example, an academic's belief that s/he has the ability to overcome the constraints posed by the 'that-is-the-way-we-do-business-here' type of behavior in order to pursue an identified opportunity. The nature of the opportunities identified and pursued will have an impact on resource configuration and their use in being targeted at successful knowledge transfer (loop 6, reality gap). We introduce the 'reality gap loop' as well to control for (i) the differences that exist between an opportunity as an objective concept, available for everyone to grasp, and the 'business venture idea' being a mental, subjective concept developed in response to an identified opportunity, and (ii) the effects of the pursuit of an opportunity, in that one may only know whether an opportunity has been a real opportunity after some time when the first outcomes and outputs are realized. By acknowledging and understanding these differences, stakeholders can change the institutional environment so that promising opportunities are not discarded but rather capitalized upon, yet unsuccessful pursuits are stopped to minimize potential losses, and resources are instead directed to other areas in the field.

5. Conclusion

The above theorizing suggested a number of categories and propositions that would allow researchers explore for example the emergence, stability, or transformation of technology entrepreneurship as a market, as well as focusing on understanding how social structures in technology entrepreneurship market at times promote efficiencies, while at other times are used to protect incumbents. Such propositions would also allow studying the dynamism of these social structures in the process of developing efficient technology transfer polices at micro (university), meso (industry) and macro (government) levels, as well as studying the role and influence of technology, technical systems, industries and institutions, as well as of processes, resources and capabilities on technology entrepreneurship.

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References

Beckman, C., Eisenhardt, K., Kotha, S., Meyer, A., & Rajagopalan, N. (2012a). Technology entrepreneurship. *Strategic Entrepreneurship Journal*, *6*(2), 89-93.

Beckman, C. M., Eisenhardt, K., Kotha, S., Meyer, A., & Rajagopalan, N. (2012b). The role of the entrepreneur in technology entrepreneurship. *Strategic Entrepreneurship Journal*, *6*(3), 203-206.

D'Andrade, R. (1984). Cultural meaning systems. In R. Shweder,& R. LeVine (Eds.), *Culture theory: Essays on mind, self, and emotion* (88-119). Cambridge: Cambridge University Press.

Davidsson, P. (2004). *Researching entrepreneurship.* New York: Springer.

Fligstein, N. (2001). *The architecture of markets: An economic sociology of twenty-first-century capitalist societies*. Princeton, NJ: Princeton University Press.

Fligstein, N. & Dauter, L. (2007). The sociology of markets. *Annual Review of Sociology*, 33, 105-128.

Gans, J. & Stern, S. (2003). The product market and the market for "ideas": commercialization strategies for technology entrepreneurs. *Research Policy*, 32(2), 333-350.

Garud, R., & Karnøe, P. (2003). Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship. *Research policy*, 32(2), 277-300.

Glaser, B. (1978). *Theoretical sensitivity.* California: Sociology Press.

Glaser, B. (1992). *Basics of Grounded Theory Analysis.* California: Sociology Press.

Glaser, B. (2012). No preconception: The dictum. *Grounded Theory Review. An International Journal*, 11(2).

Glaser, B. & Strauss, A. (1967). *The discovery of grounded theory: strategies for qualitative research.* London: Wiedenfeld and Nicholson.

Miles, M. & Huberman, A. (1994). *Qualitative Data Analysis.* Beverley Hills, CA: Sage.

Schneiberg M. & Clemens, E. (2006). The typical tools for the job: Research strategies in institutional analysis. *Sociological Theory*, 24(3), 195-227.

Scott, W. (1995). *Institutions and Organizations.* Thousand Oaks, CA: Sage Publications.

Shane, S. & Venkataraman, S. (2003). Guest editors' introduction to the special issue on technology entrepreneurship. *Research Policy*, 32, 181-184.

Wright, M. (2014). Academic entrepreneurship, technology transfer and society: where next?. *The Journal of Technology Transfer*, *39*(3), 322-334.

Wright, M., Birley, S. and Mosey, S. (2004). Entrepreneurship and University Technology Transfer. *Journal of Technology Transfer*, 29(3-4), 235-246.

Wright, M., Piva, E., Mosey, S., & Lockett, A. (2009). Academic entrepreneurship and business schools. *Journal of Technology Transfer,* 34(6), 560-587.

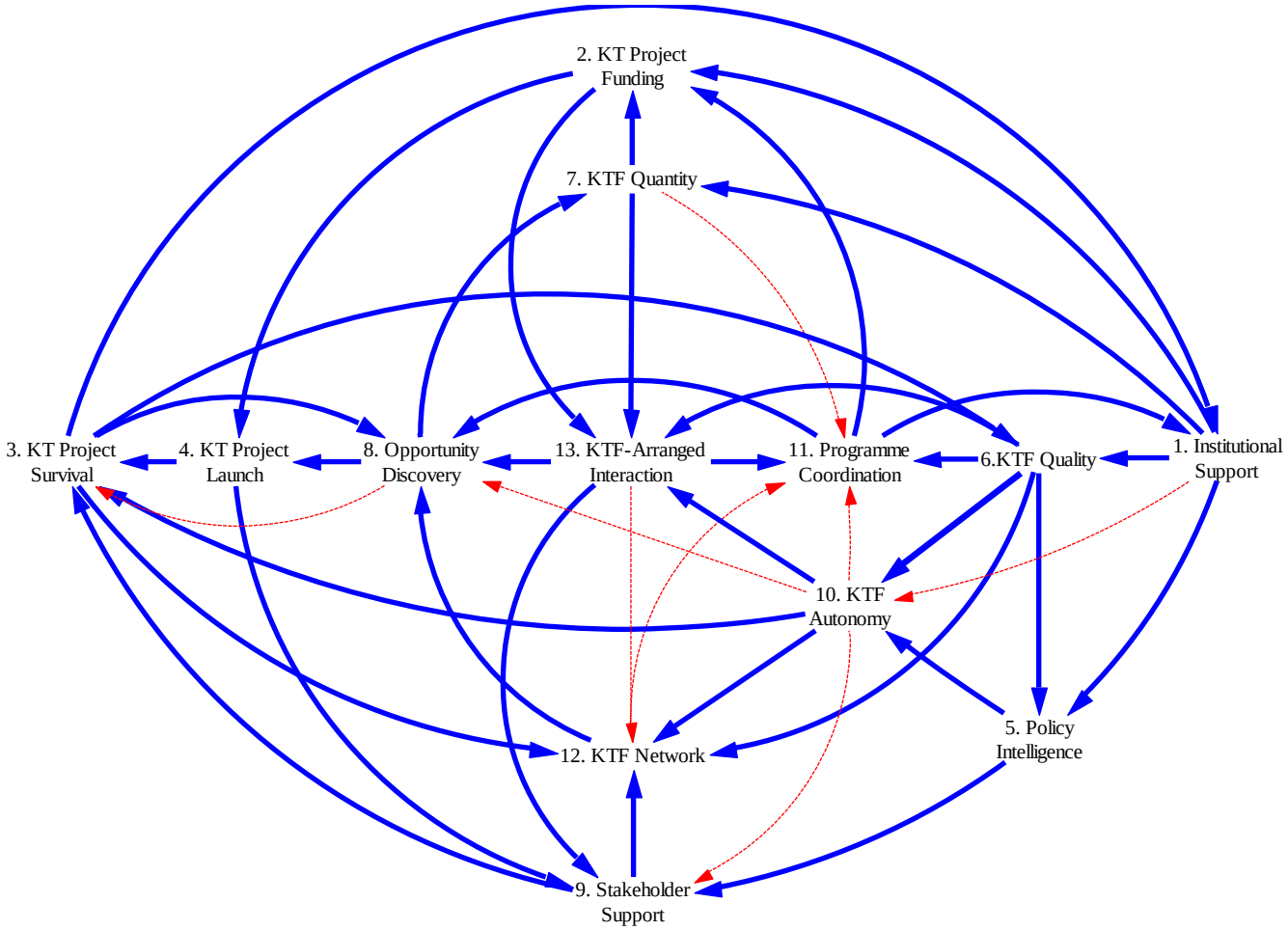
Table 1: List of respondents and their coding

Bath University	Oxford University	University of Strathclyde	University of Surrey
University employee who facilitates commercial outcomes for research (KTF x 3)	Manager of innovation or science park, a district in which mature spin-outs reside (MPA x 1)	Manager of innovation or science park, a district in which mature spin-outs reside (MPA x 1)	Manager of innovation or science park, a district in which mature spin-outs reside (MPA x 1)
University student actively involved in a company start-up or spin-out (SET x1)	Policy maker employed by government to oversee commercialization policy (RKT x 1)	Policy maker employed by government to oversee commercialization policy (RKT x 1)	University employee who facilitates commercial outcomes for research (KTF x 2)
Manager of the KT Office where a number of KTF's are employed (MKT x 1)	University employee who facilitates commercial outcomes for research (KTF x 1)	University employee who facilitates commercial outcomes for research (KTF x 3)	
Manager of seedcorn fund that invests in university commercialization projects (MSC x 1)	Manager of seedcorn fund that invests in university commercialization projects (MSC x 1)	Manager of incubator, a building where initial start-ups are grown (MIB x 1)	
	Manager of the KT Office where a number of KTF's are employed (MKT x 1)	University student employed to run entrepreneurship network for other students (SKT x 1)	
		Academic researcher actively involved in commercialization (ACA x 1)	

Table 2: Technology transfer model constructs defined and coded

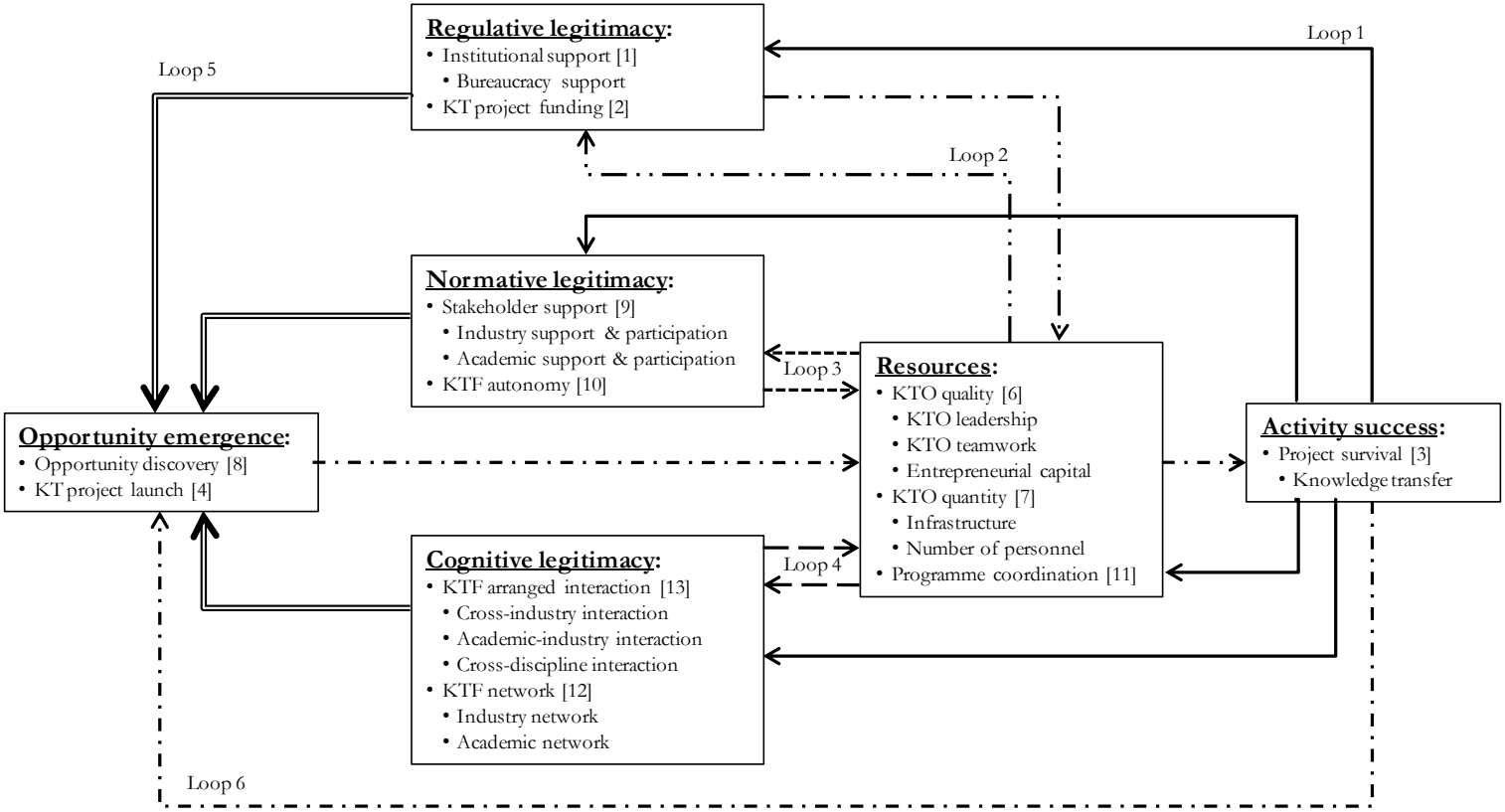
	Constructs	Coding	Definition
Things facilitators do	Program Coordination	11	The ability to correlate contact information across a number of facilitators to allow the most useful interactions to occur soonest, leading to the highest generation of KT opportunities for the least take-up of facilitators' and participants' time.
	KTF Network	12	A pool of contacts that allows entrepreneurs and academics to be introduced to each other to become part of a team, as well as a number of knowledge holders who know a facilitator well enough to divulge information regarding their knowledge.
	KTF-Arranged Interaction	13	Interaction between knowledge-holders either directly or indirectly arranged by a facilitator. A directly-arranged interaction is an introduction, while an indirectly-arranged interaction occurs during an event whereby the facilitators have specifically invited attendees. Sub-contracting invitations to others or target-marketing does not count as it should be coordinated.
Things facilitators have	KT Project Funding	2	Long-term and systemic investment in projects, and in the environment that projects are placed within (e.g., state or regional funding, project funding, or private funding).
	KTF Quality	6	The inherent effectiveness of facilitators employed within the system. Experience in industry and/or academia is valuable, as are personal attributes such as intelligence, ethics and interpersonal skills.
	KT Quantity	7	The number of facilitators and other support staff employed within the KT office/s by the institution/university, as well as appropriate infrastructure available for stakeholders
	KTF Autonomy	10	The degree to which facilitators are free agents, and thus can take meaningful and substantive responsibility for their decisions.
Results of facilitator action	Opportunity Discovery	8	Discovery of an opportunity for commercial profit and/or academic research arising as a result of interaction arranged by facilitators, or within a project overseen by facilitators.
	KT Project Launch	4	The decision of participants to form a new (or grow/re-launch an existing) project, and the potential announcement ('newsworthiness') of such to their respective colleagues.
	KT Project Survival	3	The probability of a KT project reaching its goals ('succeeding'), and/or providing an ongoing connection between the participants such that knowledge can continue to be transferred when necessary.
External impacts	Institutional Support	1	The willingness of those holding power (power-brokers) in the respective institutions from which knowledge-holders are drawn (e.g. company executive, university department or chancellor) to promote knowledge transfer.
	Policy intelligence	5	The extent to which policies provide incentives for (potential or existing) participants to engage in KT.
	Stakeholder Support	9	Support for the idea of KT – as demonstrated by the relevant people and policies – by knowledge-holders within the respective institutions. Knowledge-holders are distinct from power-brokers – who are represented by institutional support.

Figure 1: Emergent model of technology transfer



Note: dashed lines denote negative relationships

Figure 2: Organization of technology entrepreneurship



Loop 1. Perceived likelihood of success
Loop 2. Policy intelligence [5]
Loop 3. Power transition (shared values and norms; binding expectations)
Loop 4. Cognitive frames (taking for granted; wider beliefs; cultural frames; attribution)
Loop 5. Institutional munificence
Loop 6. Reality gap

Note: numbers in square brackets correspond to the technology entrepreneurship model constructs

Appendix: Relationships in the model explained and illustrated

Effect	Explanation	Illustration of quotes
1→2	Institutional support means that money is made systematically available to spend directly (and indirectly) on KT projects	*"…we're always getting overtures from funders who would like to get access to what is happening at the university. Because of growing awareness, track record and some successes we've been having." MSC* *"Much more common is for research associates employed at university for a period of [industry-cooperative] research funding to leave the university. We have got a lot of interim stages of funding these days - provided by Scottish Enterprise. The assumption is often that the research associate who has been employed within the university will be transferred to the company if and when it is formed." KTF*
1→5	Support is being willing to see KT in a realistic light (with regard to time frames and conflicting priorities) and to make policies that allow people to still actively participate in knowledge transfer with those outside of their institution (at its various levels).	*"In my job, if people (university bureaucrats) just kept out of it; no, we aren't making money, [but] we're creating opportunity, and that could be worth a lot of money later on." KTF* *"The returns [from licensing] will come back to their institution and that ultimately it will be a good thing, rather than worrying about the RAE status through staff loss." MSC* *"...there may have to be compensation back to the department for the loss of the academics' time - payment to the department, lecturing time lost for example." MSC* *"Until recently the IP of each of the professors was owned by the professors. The guys would not do anything with it, because they were too busy or they flog it off. They are trying to get it so that the university has an interest in the IP." KTF*
1→6	Power-brokers within institutions are effectively responsible for hiring facilitators. Either directly by selecting a candidate (or at least making their preference known), or indirectly by choosing a certain type of person to lead the KT office – who will thence employ (and be able to retain) similar people.	*"Finding those individuals who have an empathy with the university culture and with the business world and be able to straddle the two isn't easy." MKT* *"... [previous KTF team's] experience was not to do with entrepreneurship - their experience was not to do with entrepreneurship or high growth or anything. [They] weren't really meant to be in that role; they were just kind of put in that role." SET* *"[KT Office Director] is a good mentor and someone you can go and talk to. He has really good knowledge with what he's talking about. It's the quality of people working in the KT office that's important." SKT*
1→7	Institutional support means providing the KT office with sufficient human resources, including staff responsible for administrative, legal and project management tasks.	*"...that [entrepreneurship] program is costly to run because we (or my colleague and me) have to spend a lot of time going out and about recruiting companies. If I had, for example, 2 people working full time with me that are our external face out talking to business on a regular basis. If I could afford that then we would get more projects and be able to deal with more students and we might be able to do more of [involving private citizens in the entrepreneurship program]." KTF* *"[A poorly-performing KT office] may be just under-resourced so it simply can't process things." MKT* *"[Seed Corn Fund] does pay for the service of two roving 'mentors' - one on the ICT side and one on healthcare. Primarily they have got facilitative personalities, they'll get people round the table to talk, they understand the dynamics, the problems [and] the barrier[s]." MSC*

Effect	Explanation	Illustration of quotes
1→10	Support by the institution for KT may manifest as a desire to 'get involved' or micromanage. While understandable, especially in terms of risk reduction, sometimes this is not helpful. Note: The institution may be represented by 'influential academics' or small-scale angel investors backed up by large VCs, who act as 'knowledge-holders' rather than 'power-brokers'.	*"...at the time the dean of science was quite business-minded, so he was quite keen to develop that side of things." KTF* *"Some of the Challenge Funds spent all the money by giving it to the influential academics straight away without real conditions or selectivity. I don't think it worked very well particularly because after they had spent out their $250k, they were sitting on an array of opportunities." MPA* *"The investors involved with [(a business angel] can bring their own problems, such as the desire to be involved on a day-to-day basis. [It was] difficult for science park manager to intervene in the face of multi-million dollar support of VCs." KTF* *"The university would never approve a company unless it has the funding to trade for 12-18 months." KTF*
2→4	Investment is necessary for a project to be launched, be it in the form of money or facilities.	*"[It is important to] have enough start-up funding - a lot of start-up businesses would have had a better chance of succeeding if they had had a lot of funding from the outset. You get some spin-outs that almost from day 1 have to manage a potential cash crisis." KTF* *"...we'll use a small development fund (up to 15k) to build a prototype or engage a consultant - once only - to look at the market." KTF* *"An IT company on the premises has begun a [networking] 'club' where we donate space for the meetings, so things are changing." KTF*
2→13	Interaction is largely pointless unless there is potential for a project to be funded. KTFs will not arrange for interaction to occur unless there is potential to gain funding.	*"...the difference that the [Seed Funds] have made in enabling easy access to finance, bringing about a cultural change and creating role models to aspire to." MSC* *"...helping bring academics together in cross-disciplinary programs for major project, prompted by the JIF (joint infrastructure fund); come and gone now." KTF* *"If I can give them something - help them out - they don't care that I'm a student." SKT*
3→1	Institutions like to see their efforts to foster KT rewarded by participation by knowledge-holders. It allows those within who have taken a risk by supporting KT to justify it. This is in contrast to the launch of a project, which itself is not an outcome.	*"The milestones (for the seed fund) are nothing to do with 'outcomes' or 'success', only that you are complying with the rules and your cash reserves are running down." MSC* *"Because it was government funded, we were paid on bums on seats basis - and bonuses for outcomes - those being people getting jobs. This is the problem of using government funding - where outputs as opposed to outcomes are important." KTF* *"[The university] created a 4 million pound fund managed from [KT Office], open to anyone within the university. The fund is now fully invested and is supporting 68 projects. Has been an enormous success: 21 resulted in the fund owning shares in spin-outs, 4 licensing deals and various other ongoing projects. Due to the success, the university has agreed to commit more funds." MKT*
3→6	Observing and interacting with projects allows KTFs to accumulate knowledge regarding the outcome of policies, to hone their skills, and thereby increase their own abilities.	*"Unless we're prepared to follow the whole process through…we don't know where the ball's been dropped." KTF* *"...licensing deals seem to create less resistance from departments than spin-outs." MSC* *"The consultant model doesn't work. There's no use a commercial body coming in and telling the academic what he or she should be doing." MSC*

Effect	Explanation	Illustration of quotes
3→8	Working within a KT project will allow for ongoing interaction between diverse knowledge holders, producing new opportunities. These may turn out to be distractions (see 8 → 3).	*"… [It] is a spin out business started by a Ph.D. student who went to the VC and said we ought to be building [device] at a time when the market was depressed... it is very successful…it trains Ph.D., it trains people, researchers on a commercial footing. The research program keeps it 10 years ahead of the competition". STF* *"there are also outcomes [from student internships (KTPs)] for the university such as scientific papers and journal entries, more modern teaching methods around case studies built around modern industry rather something that used to happen 10 years ago" KTF* *"We started there with a program where we seconded recent graduates to work for 6 months in a small business to assist growth and development. By 'smuggling in' expertise - a fresh pair of hands, a fresh pair of eyes,- into small companies through the auspices of a seconded graduate. The problem is we're all so close to our businesses and we can't see the wood for the trees - having someone questioning things can be mutually beneficial." KTF*
3→12	Those participating in a viable KT project will appreciate their connection with the sponsoring KTF. That success story will form the basis of their ongoing relationship, even if there is no communication for substantial periods. Conversely, if no project ever results, that signatory failure will underlie their connection, and neither participant will wish to maintain it.	*"...so they've come through the process of the [successful] group dynamics. the group formation. the decision about the business. the negotiation of a consultancy contract. drawing up the parameters of a brief with the business owner. then they go off and do the work and report to the business owner three months later. how good is that!!!" ACA* *"If you have a [KT] Office that is over protective; overprotective of the IP and of itself I guess. You then have researchers trying to work around the side of the [KT] Office. Real [KT] opportunities get 'stuck'. The researchers realise they are getting 'stuck' and so they avoid using the machine." MKT* *"The trick to pull off is to get the accountants, lawyers to work for you for free on the basis that when you have some money you might pay them. That works very well in and around [University] because there is a good track record of setting up high-tech companies." MKT*
4→3	Launching a project signals its' commencement. It gives it a separate identity to the institutions the actors had previously belonged to, allowing them to dedicate energies to the new venture.	*"...go out and just do consultancy - learn about the consultancy process. Going in there, defining objectives, negotiating these objectives, keeping the owner informed and reporting back to them." ACA*
4→9	The launch of a project is an event that can be advertised widely, increasing general awareness, but more importantly demonstrating potential for personal gain.	*"There's a bit too much enthusiasm from academics for spinning out when they see some of these success stories." KTF* *"Every time you invest in something and it is successful (it gets a license or its gets other funds and gets its own legs) and word gets around." MSC* *"Never underestimate greed. Greed is good. As researchers see the guy beside them making half a million by taking a stake in a business." MIB*
5→9	Intelligent policies provide incentives and options for stakeholders to pursue knowledge transfer. This includes those currently within a project, and specific policies related to that project alone.	*"Some of the taxation laws have changed… the pipeline at most universities has almost closed up… it's a complete disincentive." MPA* *"...and then you have pressures on departments to publish in high quality journals so you get the highest rating and some extra money from the government. That's fine - but its a vicious circle - like leaving the MCG after a match- where everyone is striving to get to the same place - creating huge competition." KTF* *"...we try to structure a deal that meets those expectations [from stakeholders]." KTF* *"Academics have 25 days consultancy time per year." KTF*

Effect	Explanation	Illustration of quotes
5→10	If wishing to engage in knowledge transfer with those from an 'alien' institution, it is useful to speak to a person with the power to offer you meaningful and well-informed assistance. The alternative is a bureaucracy, tied down to protocol, and unable to respond emphatically and quickly, nor able to accommodate the realities of your unique situation. Facilitators with autonomy are therefore an incentive towards knowledge transfer.	*"I ran an founded an identical in 1987 at [University] called 'Research for Enterprise'. It's still going strong *said with pride*. I also started a prior elective for the undergraduates called 'venture creation' or something. One of the programs I came across that I really liked was called the 'Small Business Institute Program'. I also founded another identical project here at the marketing department called 'Applied Marketing Projects'. It's essentially the same thing where groups of students do a marketing project but theirs is specifically on marketing." ACA* *"Again it's one of the problems of us not being a university department, therefore we sit on the fringe of the campus. The difficulty is you've got to find an individual within a department within the university who is capable and willing to help you. Therefore it does make it quite difficult for us to get access, get it quickly, get the job done and move on from there." MIB* *"Initially we were able to take people who had been unemployed for 2-3 days, and folks who said 'I'll give this a go!'. Then the situation changed quite a bit due to the funding government department changing its attitude to people who could join. They said we have to change tack and we will only accept people who have been unemployed for 6 months. Folk's motivation had taken a kick in the proverbial ghoulies after 6 months - and sometimes even longer than that. The big problem was that we were not councilors." KTF*
6→5	Good personnel will have the insight to understand how policy may be improved.	*"The difficulty and the downside, and everybody's learning from this, is that it (student businesses) was optional and voluntary, and so they were doing it as an extra curricula activity…".KTF* *"[Ex-director of KT Office] is extremely good at the detail of designing a company structure to keep it moving forward, but keep it innovative." KTF*
6→10	Quality personnel will take the initiative and push boundaries; maximizing opportunities for leadership and innovation. In other words, power is wasted on those unable to take advantage of it.	*"...people like [KTO director or VC or business angel] were brought in as head of IP and it brought a much more professional, focused service into being." KTF* *"You have to be careful about the competence of the TT office because you do hear stories of the TT office stopping things happening. [They may be] inexperienced in terms of what works for the university and what is going to work for the company." MKT* *"So they needed someone to lead it, and I was lucky enough to get the job - I'd always wanted a role like that - like president but with entrepreneurship." ACA* *"There were [Seed Funds] that hardly spent a penny. That were so selective it was like 'oh my god we can't possibly spend any of this money'." MSC*
6→11	The smarter the KTFs, the better they can correlate and communicate their contact information to identify which people should be brought together, and how. Apart their contact's respective knowledge and intentions, it also includes other subjective (personality, politics) and objective (time, money) considerations.	*"I have three customer groups I have to keep happy. As far as the academics are concerned, they're my client, and ii have to try to sign off on a contract that satisfies their needs. I am employed to manage risk on behalf of the university. Thirdly the sponsor or the company that has paid for the work to be done. Doing a job like this is kind of a black art, you're in a tricky position trying to balance everyone's needs and expectations." KTF* *"You're assessing [the] skills [of the student placement] and how they will fit in from an interview and a tour around a factory". KTF* *"We feed people into other networks as well (usually for free), and inform people that the opportunity's there." SKT* *"The key [to making assistance by MBA students to a commercialization project work] is matching the project to the students (interests and capabilities). It feed people into other networks s us [- the KT Office] using our skills to spot a project that can benefit from a 4 month analysis and injection of energy and enthusiasm by the MBA's." MKT*

Effect	Explanation	Illustration of quotes
6→12	Better personnel will be more effective at making and maintaining connections with stakeholders.	*"From my perspective, some of the young people in the office aren't as skilled at negotiating as perhaps they should be. it's easy to receive an email with a difficult point in it and say 'I've got to discuss that with my colleagues'. To me it's sad because it is quite a significant skill-set that people can only develop through practice." KTF* *"My interpersonal skills are very important. I have to deal with all kinds of people. Even people off the street." SKT* *"[I am a] university spin-out company development officer. My role is to mentor academics who are bringing forward potential new spin-out opportunities. To liaise with existing spin-out companies and represent the universities' interests in those companies it retains a large shareholding in. KTF*
6→13	The ability of KTFs to assess the reliability of who they meet and what they are being told, allows them to weed out the inappropriate, or even the delusional and deceitful, participants. <u>Note</u>: This ties into not wasting people's time.	*"...sometimes you've got a fundamentally flawed new technology that makes a nonsense of the claims that the company or an academic team have been making." KTF* *"We make a judgment on 'does this guy or girl know what they're talking about?' - do they have some credibility." MPA* *"You have to look at 'how big is the problem, how big is that potential market'. Whereas I think they do it visa versa - they look at what interests them and then try to match it to a commercial or business problem that is out there." MIB*
7→2	KT office personnel are often required to help fill in grant applications, or satisfy fund metrics. <u>Note</u>: Assisting grant applications may be done without specific knowledge of the team involved; just the technical details of the proposal. Grant assistance cannot be assumed to have been done by KTF's, and therefore does not take away from Interaction activity.	*"…A lot of the [academics] already have contacts they can use [in putting an industry-research grant together], but we would be there to facilitate that". SKT* *"We'll look for the relevant expert, and then we'd like to see the chemistry build up with the company over the period of preparing the bid." KTF* *"[We act as an] 'intelligent reader' service. I've seen many business plans. We pick up common mistakes; like not explaining the technology." RKT*
7→11	The more personnel involved in KT, the more difficultly will be experienced coordinating between them.	*"...in trying to structure this [KT Office], should it be done on a faculty basis, or funding source basis?" KTF* *"There was a sense of competition between [the KT Office] and the management school in running the business plan. Next time we'll have just one." MKT* *"[In order to form a cross-faculty project] You would need to tell [the academics] about what [other programs] complements [their research] In addition to the Management School,] You would need to pull in our colleagues [from the KT office]." KTF*

Effect	Explanation	Illustration of quotes
7→13	Staff are often required to manage/oversee projects. Again, this is not a question of personnel quality, but of time, since this is not a core skill. Also, management is less problematic when people are already connected and fully engaged. Note: non-KTF personnel may be engaged, and time for interaction activity is not be affected. Note: It may be assumed that autonomy extended to KTFs entire office.	*"They (the academics) expect us to manage the programs [while] they act as consultants [to] business." KTF* *"Before [KT Office] came along there was only one spin out every few years, but with an increase in the size of [KT Office] that has increased dramatically" MKT* *"For large collaborative projects we have been asked from time to time to come in and do a bit of project management. But that's not our core skill-set. Post-award (of the grant or commercial deal), as soon as the contract's signed, we're out of it." KTF*
8→3	The realization of academic opportunities may distract from their business goals, or the realization of a business opportunity may distract from their academic goals.	*"I think researchers get sidetracked very easily. We were running this experiment but this happened - it takes them off at a tangent - and they're going 'that's very interesting'. 'Forget interesting' - you're going down this road - and you need to finish going down this road before running off at tangents." MIB* *"...the academic doesn't want to 'lose their baby' and they're 'cards close to the chest' and the manager's just trying to get them to put it out to the market." MSC* *"...the academic having control of the money they can become sidetracked. Little eureka moments can cause the academic to go off on tangents to the original idea." MSC*
8→4	An opportunity must arise before a project can be formed.	*"…bringing in new technologies and techniques [through post-graduate placement in an SME] that otherwise would be unavailable to them, since they aren't core business or they don't have time…" KTF*
9→3	The background of project stakeholders dictates how difficult it will be to balance competing obligations. This recognises that stakeholders do not abandon their background when they join a project. Note: The inner workings of a project are of course important, but too fine for this model.	*"...usually what happens is the head of the research group will stay in the university. Some of his research team might move across into the {newly-formed spin-out] company." MIB* *[Important factors are] researchers who want to bother, a local environment that is receptive to new opportunities and a [KT] office making it happen." MKT* *"From Aug 2003 to June 2004 we didn't spin out any companies because of changes to the tax legislation. This has been a major problem, where tax is paid on the paper value of an asset rather than the actual income." MKT*

Effect	Explanation	Illustration of quotes
9→12	Stakeholder support provides a mindset that is more likely to respond positively to either an approach made by a KTF, or to an opportunity discovered by the stakeholder. Note: In the latter case, the opportunity arose outside of the KT system – and therefore is not captured in the model.	*"Most of our programs are brought to us by academics (and already have a relationship with the company)" KTF* *"...academics know that when they have an idea *ding* they know to come and talk to myself [having responsibility for bioscience] or [another KTF] in the physical sciences." KTF* *"It's a catch-22 where one has to develop a reputation for a successful network before one can be a successful network." MSC*
10→3	Autonomy allows KTFs to take a monitoring role (responsibility) in projects, and intervene if a problem arises. Note: the design of the company structure or collaboration agreement is seen as a policy issue.	*"...it saves us having to cull the project which is a difficult thing to do." KTF* *"We try to get [the student placement] back on track. We say; "this wasn't what we agreed, that wasn't the work area, you're (the company) using the graduate for the wrong things." KTF* *"I can think of some spin-outs that have been held back because the academic involved has been reluctant to let go of the reins" KTF* *"There are a lot of 'bad [VC] angels' around. I've seen a number of extremely bad deals done from the entrepreneur's perspective. They don't have the kind of networks and experience within a start-up framework to be of huge value to the businesses. But I want a job in that company. But they're not adding real value. But they've still got a share in the company. Then it's very hard to get further investment into the business." MIB*
10→8	Autonomy creates the risk that KTF's will take the lead on creating projects, or stopping projects that otherwise have had support. The participant's initiative and wishes must be respected.	*"I don't believe a scheme that marries up academic X with student Y who's interested in commercialization would work. If things are to come about they are to come about through someone's initiative. The initiative of the academic who wants to commercialize his technology. If something is happening at the initiative of the facilitator - he's trying to drag the team together." MSC* *"Last year we had 3 teams of MBA students working on [KT Office] projects as part of their module. We put a certain amount of effort in and got back more, in terms of having 4-5 enthusiastic intelligent people working on a project. We got a very good comprehensive analysis of the market, we helped them get there, but it was work we hadn't done. They said if you want to commercialize this technology you're going to have to license it to one of these three companies. Its not to say they're right because we haven't done the deal yet. But that was helpful information." MKT* *"There are some things that university entrepreneurship centers get involved in where frankly they are competing with either private or public sector suppliers. Any time we wander off on peripheral and marginal activities I think we've got to be quite careful about what we do. Universities should be quite careful to target their activities towards their strengths - which is a research and learning base." ACA*

Effect	Explanation	Illustration of quotes
10→9	KTFs can tend to push too hard, and annoy those they are trying to convince. This often manifests as a culture clash between academic and commercial objectives, expectations and norms of behaviour.	*"…its quite tough, universities are always going out looking for placements or looking for projects, so industry gets a bit frustrated" KTF* *"...there's a fine line between engendering an entrepreneurial culture and policing academics." Ba01* *"[Regional Venture Capital Fund] already had a fund management contract with [University Seed Fund]. Even so,* *"[Regional Venture Capital Fund] had very little understanding of the academic mind, the university research situation and how it could be commercialized." MSC* *"[Regional Venture Capital Fund] have strong targets, measurable targets, project plan deliverables that outline key tasks, when things are happening. So it's a very aggressive approach. That's perhaps alien to the university context -- unlike perhaps an academic approach where it's not as strategic and aggressive [but rather] structured and committee-driven and perhaps the pace is slightly different". SKT* *"We seconded - for the equivalent of a couple of days a week - a full-time academic from the business school - who became a member of [company's] management team. It was a real challenge for academics, because they have to apply their knowledge (or lack of perhaps) and stick their head above the parapet. You get all sorts of wonderful excuses - 'too busy', 'got my research to do', 'administrative pressures'." KTF*
10→11	If taken too far, autonomy can lead to KTFs acting in their personal interest rather than that of the KTF team; discouraging cooperation and information-sharing.	*"This office doesn't take anything off the top of any contracts and I think that's an important part of the credibility. And that's different to some other universities who do incentivisation or performance pay. Well, it comes down to carve-ups - everyone would be fighting to do the 5mill pound contract. Where offices are set up with performance pay and bonuses, people don't trust their judgment." KTF*
10→12	Giving KTF's autonomy encourages them to proactively find new contacts, perhaps via innovative means.	*"If you want to promote interactions between the universities and the (technology) park, you've almost got to build that in…they're not going to come here for the links to the university…so facilitating links means building that into the proposition". MPA* *"What works best is when I organize a lunch between half a dozen people that are working in the same area." KTF* *"Some of [the KTFs] are on [university] committees…I attend regular meetings and get to know everybody…make personal contacts…through just knocking on doors and wandering around the corridors" KTF* *"We had previously been organizing events up here - and there was no real point to them - they were boring. The old [Regional Entrepreneurs Network] - had no leadership and achieved nothing - it turned into a committee. I thought to myself - what's this got to do with entrepreneurship because you aren't actually doing anything." SKT*
11→8	Good coordination allows the right people to be put in the right place, leading to opportunities arising.	*"It's vitally important that you build a team who can work together. My job is to make the introductions; they make the decision if they can work together." KTF* *"You're building an entrepreneurial team around the person whose idea it is. Most people who have an idea, they're not the entrepreneurial drivers. We've got to build around them a team of people to complement their skills" KTF* *"The problem was we didn't give the companies any choice over who they got, and the punters didn't have any choice over where they went. You could have spent all your time as a recruitment agency and we weren't getting paid for that. If the financial resource was there you could have spent a lot more time 'getting the match'. But sometimes it didn't work out - an absolute disaster - and that was essentially when the fit wasn't right." KTF*

Effect	Explanation	Illustration of quotes
12→8	The larger the contact pool to draw upon, the more likely it is that any interaction will lead to the respective stakeholders to discover an opportunity.	*"[Regional Venture Capital Fund] also have a very big network of contacts: so they can introduce successful entrepreneurs to the academic teams to become a part of the team" MSC* *"...company within science park asks if we can recommend a venture capitalist. We'll recommend one or two of these three VC companies who have all said they want to work with [University]. If you don't get along with any of those, come back and we'll try to think of some more for you." KTF* *"Each group of [KTFs] will invite people who are interested in their area, and arrange the seating to mix it up. We have a top table, a life sciences table, and physical sciences table and a business innovation table. They then sit down and sell to each other." MKT*
12→11	More contacts means more information to manage, more people to accommodate, making coordination more difficult.	*"There is a business account manager in each university. I am building up a knowledge of other south west universities: their capabilities, the colleagues and the way they are working." MSC* *"[Student placement] programs are big and demanding and it is much better that you have short term placements that allow you to build up to [the full program]." KTF* *"Doing a job like this is kind of a black art, you're in a tricky position trying to balance everyone's needs and expectations." KTF*
13→8	Opportunities arise from interaction between stakeholders. This may be direct, or indirect – such as via published material or a KTF.	*"...but its impossible to bring academics together that don't really want to work together, and I don't think its right anyway quite frankly." KTF* *"It tends to be technology people looking for commercial people - or commercial people looking for technology people. Its strange how it always tends to revolve around people - not technology." MPA* *"[Business forums] develop links with industrial partners in the region. Facilitating future relationships with those guys. Trying to get further consultancy. To get feedback from them as to what relevance the research has to their sector…how the research might have been moulded." KTF*
13→9	Interaction can itself be a positive experience, even fun, but the idea is to build a positive image, and educate stakeholders. A marketing team might be employed as a proxy for face-to-face interaction, if not yet a contact, or to save the KTF having to explain everything.	*"[University Entrepreneurship Network] is incredibly useful. It creates a network of companies that are interested in [KT Office], [University] and [University] technologies generally. Three times a year we hold a meeting and dinner where we invite 120 people to come together. Its 6 hours of socializing, drinking, eating and forming relationships. Half way through we blow a whistle and half the people change seats. They listen to some academic presentations on some modern research and a business lecture. Its massive technology transfer opportunities and its lots of fun." MKT* *"Traditionally people might have regarded the marketing team as there to supply marketing materials to back up deals. That's not really what they're about, they have a big internal marketing job. Encourage academics to use us in a positive way and at the right time. Rather than when the deals' done and it's too late and you can't make any difference in the deal." KTF* *"At a more strategic level, people in the office use seminars as an opportunity to promote the office. Not in a pushy way - if people see you there and form an opinion that you're a good guy then you've done a good job. Maybe that particular piece of business doesn't work out but if you form a favorable impression in their minds. A few months later they can come back to you with something slightly different and say 'hope you can help me out here'" KTF* *"What we're trying to do is educate the deans with regard to all the component parts of the commercialization process." MIB* *"Once students get involved they really love it - you get to meet like-minded young people." SKT*

Effect	Explanation	Illustration of quotes
13→11	Finding out from contacts what they want so that KTFs can help them allows critical information to be collected, and it may be that an opportunity is recognized immediately. In this way, KTF's act like a human 'telephone exchange'; allowing messages to pass to those who need to hear them.	*"Each [KT Office] project manager has a portfolio of academics in the life or physical sciences. Find out what they're doing. Why they think its great. Find out what the commercial opportunities are." MSC* *"If you start from scratch, if you don't know the university, you need to identify other new people, and get involved with them at the start of their career, first time lecturers, research assistants etcetera. Introduce yourself to them; find out what's going on, what they need from you, so build up what they need as you go along." KTF* *"...and [networking event] also enabled us to build the network where we can gather the data about what is happening in the universities." RKT*
13→12	Attending functions and interacting with people can be a source of annoyance. It will consume time, and a contact may be lost when this occurs.	*"If it's something beneficial, let's go for it. Otherwise, why waste everybody's [technology park's company] time [interacting more with the university]." KTF* *"The simple reason [professional service providers] do it is they get clients who might grow into being bigger clients. [But] We have to be careful. If we pushed lots of opportunities to them that didn't become companies they'd soon work it out and stop bothering." MKT*

Note: gray area denotes a negative relationship