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Published in:
IFAC-PapersOnLine

DOI (link to publication from Publisher):
10.1016/j.ifacol.2022.04.198

Publication date:
2022

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

Available online at www.sciencedirect.com

ScienceDirect

IFAC PapersOnline CONFERENCE PAPER ARCHIVE

IFAC PapersOnLine 55-2 (2022) 229–234

Prioritization of sharing economy barriers in British auto parts manufacturing SMEs

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Abstract: The sharing economy allows people to have access to resources and better consumption of resources with an aim for sustainability. The significance of sharing economy motivates scholars to study it from many contexts but there is lack of studies done from a manufacturing perspective. This paper attempts to analyze sharing economy from a British auto parts manufacturing SMEs perspective by commenting on the benefits and identifying the barriers. This paper analyzes the barriers using Best-Worst Method (BWM) with feedbacks from industrial experts. Analysis shows that "Lack of expertise" is the most influential barrier followed by "Lack of willingness to change". The most prevalent sharing economy barriers in the British auto parts SMEs are identified in this paper, which gives insight to researchers and practitioners to find solutions to overcome the most influential barriers.

Keywords: Sharing economy, best-worst method, manufacturing, barrier, auto parts

1. INTRODUCTION

The advent of the so-called sharing economy has attracted people's curiosity and sparked debate in the last few years. The sharing economy (SE) is a broad concept that lacks a clear and commonly acknowledged meaning. Regardless of definition, a common feature of SE is the efficient utilization of underutilized assets for economic gain (Munkøe, 2017) allowing people to exchange their underutilized assets with others with the help of Information technologies (Petropoulos, 2017). People have shown a positive attitude towards temporary accessing rather than owning permanently. Not only does SE improve consumption efficiency, but it also helps improving production efficiency, waste reduction, cost reduction as well as the development of a more humane society (Brkljac and Sudarevic, 2018; Relich 2016). Mainly the success of two sharing economy platforms, Airbnb and Uber, has sparked a surge of interest in the concept of SE in other sectors. Numerous businesses, particularly in the transport sector and accommodation sector, have benefitted from sharing economy (Brkljac and Sudarevic, 2018). The manufacturing sector is the least exploited in terms of SE concepts due to the complexity involved in adoption of such models. With the adoption of SE practice in manufacturing sectors, manufacturers can share their unused resources like excess raw materials, equipment, skills etc. to an organization that lacks resources for a fee, through the Internet platform. Also, manufacturers with excess production orders can share their orders with other sharing economy users to meet the demand and time.

SE seems an easy concept but the transition from a conventional method by incorporating SE is not easy and in some cases, it may fail. So, it is important to analyze the barriers present in implementing SE. Several studies have been already done to identify and analyze the barriers to SE, but are limited to specific sectors and applications. Very limited researches have been done on SE from an industrial perspective and is still in its infancy. No doubt that different industries will have different influential factors. None of the researchers has studied barriers to SE implementation from a specific manufacturing field. This paper's unique contribution is that SE barriers are analyzed from a specific manufacturing sector. In this paper, the barriers are analyzed from an auto parts manufacturing small and medium enterprises (SMEs) perspective. Auto parts manufacturing companies are facing difficulties in the adoption of SE because of the presence of various barriers. This paper investigates these barriers in the context of the British auto parts manufacturers so that industrial managers may be guided in its implementation by eradicating the influential barriers. The objectives of this study are as follows:

1. To provide insights for managers to underline the benefits of implementing SE in auto parts SMEs.
2. To identify the barriers that prevent auto parts manufacturing SMEs in the UK from implementing SE.
3. To rank the identified barriers for the British auto parts SMEs using the Best-worst method (BWM)

To achieve the aforementioned research objectives, an extensive literature review and industrial managers opinions were carried out which assisted in the identification of barriers and then Best-Worst Method (BWM) was used to rank the influential barriers.

10.1016/j.ifacol.2022.04.198

2. LITERATURE REVIEW

2.1 Sharing economy in manufacturing

Sharing economy has the potential to boost productivity by using underused assets, develop new opportunities through disruptive innovations and bring innovation among existing businesses (Codagnone and Martens, 2016). There are many expensive equipment or machines which some of the SMEs cannot manage to purchase. In such cases, it makes sense to access the resources of other businesses based on the SE principle (Grondys, 2019), allowing SMEs to obtain required resources at a lower cost and operate with greater flexibility. Manufacturing SMEs, which have limited resources owing to the complexity of products and operations can benefit greatly from involving in SE practice. Market risk is handled within the concept of SE, and the shared resources might increase the potential of previously ignored market possibilities without requiring further investments (Chien and Kuo, 2013). SE is a new phenomenon in the manufacturing sector and therefore needs to be explored in depth. There are very limited studies done on SE from a manufacturing industrial perspective. More studies need to be done to unearth the possible benefits of SE in the manufacturing field. From an Industrial perspective, SE is defined as "an economic system in which industrial resources or assets are shared between two or more industries, with their mutual consent utilizing technology" (Govindan, Shankar and Kannan, 2020). Ellen Brandt (Ellen, 1990) introduced a concept called "shared manufacturing" in which large enterprises share their idle machines and technologies with small businesses to improve their business. He, Zhang and Gu (2019) studied some of the significant impacts of SE on the Chinese manufacturing industry. They convey that the shared manufacturing activities through advanced IT have an advantage over the traditional manufacturing model as it is more cost-effective and flexible. Yu et al. (2020) studied a concept called "shared manufacturing" which is analyzed with "servitization" and "Industry 4.0". They studied the benefits of integrating manufacturing and service sectors. Jiang and Li (2019) introduced a new conceptual model called "shared factory", where SE is analyzed from a manufacturing perspective by identifying the key-enabled technologies for configuring and running a shared factory to build a sharing manufacturing ecosystem. Govindan, Shankar and Kannan (2020) analyzed the barriers to the implementation of SE in Indian industries. Their study shows "Lack of trust" as the most influential barrier and "Capital cost" as the least influential barrier for implementing SE. One of the limitations of their study is that they analyzed the barrier considering only one case company constraint to a single demographic area in a big country. Considering this limitation, this research will study the barriers from a developed context taking the United Kingdom as a case country.

For SE implementation in the manufacturing sector, it is important that sharing resources takes place within the same field of application. SE in the same field will allow for better utilization of assets and productivity growth. Furthermore, SE in the same field of application will have common resources including required skills and knowledge (Relich, 2013). From the literature review, it is clear that none has studied SE from a single manufacturing field. As the influential barriers might differ from a particular industry to one another, this paper aims to study and analyze barriers from a specific manufacturing sector, i.e., from an auto parts manufacturing SMEs perspective. This research will also compare Govindan, Shankar and Kannan (2020) analyzed results.

There is evidence that SE might provide significant economic benefits to the UK if barriers are eliminated and provide better legal frameworks for the SE platform (Petropoulos, 2017). UK has shown a huge acceptance of SE in many of the sectors such as transportation, accommodation, fashion, on-demand services, and UK aims to be the world's leading SE which is evident from the government plan to make UK the "global centre for sharing economy" (Government of UK, 2014). The UK government is very supportive in terms of SE and manufacturing industries in the UK can greatly contribute to the country's economy by implementing SE.

Society of Motor Manufacturers and Traders (SMMT) estimates that only 44% of the total auto parts required to build a car are made in the UK and the rest of the components are outsourced (SMMT, 2019). To increase local parts manufacturing, the country needs additional manufacturing plants or expansion of existing manufacturing plants, but for this, very high investment is required and SMEs are struggling to invest and are also concerned over the ecological footprint. It is estimated that 90% of auto parts manufacturers in the UK are SMEs. SMEs often face challenges in obtaining human resources, technology, and machines and are therefore inherently reliant on intense cooperation and integration with other companies to overcome this limitation. This is where the SE can play a vital role by collaborating with existing auto parts manufacturers. Implementing SE in auto parts manufacturing industries will allow not only better utilization of machines and materials but also more efficient parts production. It can also reduce the percentage of imported on-demand auto parts by locally sourcing. Moreover, UK automotive industry follows the 'just in time model'. Any delay in the delivery from another country will cost them a huge loss. SE in the auto parts industry will lower this risk by manufacturing most of the parts in the UK within the auto supply chain. With the SE in practice, the amount of locally sourced auto parts can be possibly increased to more than 60% from the current estimated 44%.

2.2 Benefits of implementing SE in auto parts industries

Sharing economy offers many benefits for many sectors that embrace it. Similarly, auto parts SMEs will also enjoy the benefits like other SE models if involved in sharing practice. No study links the benefit of SE for auto parts SMEs but has focused on the SE-related opportunities in the other sectors like accommodation and transportation. Still little is known about the benefits of SE in the manufacturing sector. This paper outlines some of the benefits of SE for auto parts SMEs. These benefits are identified based on literature reviews on conventional SE benefits. In many auto parts manufacturing SMEs, there is at least one resource that sits idle for a long time and is used only when necessary. These idle resources can be shared with other manufacturing SMEs using an online platform and utilize those resources while earning money from users. The SE will allow SMEs to have access to additional resources which they are not capable of by sharing. Eventually,

sharing of idle assets increases the turnover and improved return on investment.

Sharing economy can be a further step for start-ups to start their business without having to invest in high-cost machines or equipment like the CNC, Lathe, etc. Generally, high investment is needed to start an auto parts manufacturing plant for buying expensive machines, workspace, etc., but with SE in place, start-ups can make use of the idle resources available in other auto parts manufacturing industries. Hence, paying only for the usage (and other costs) without having to own those expensive machines and expand their business. Sharing economy in auto parts manufacturing will lead to sustainability, where raw materials are used effectively by existing machines leading to less wastage and can reduce the production of new equipment. It will result in the reduction of the amount of energy and materials and hence can contribute to a more sustainable economy.

Participating in sharing economy will be highly beneficial for companies as they can focus on their strength while outsourcing the rest (Eschberger, 2020). Sharing economy in the auto parts industry will allow better allocation of resources/assets and therefore enhance productivity and economic efficiency (Munkøe, 2017). Sharing economy will help the auto parts industry to reduce the ownership costs for new machines (including the storage space and the maintenance involved). For example, a manufacturing industry might need a machine/equipment that they need to acquire for temporary use to manufacture a part, then with SE in practice, they can complete the task by matching an idle asset of their need using a sharing platform without actually owning them. Hence, saving the ownership costs as well as maintenance costs and only paying for the amount of usage of that asset. Auto parts SMEs can also share their warehouse facilities with other industries which can lower their warehousing and logistic costs.

2.3 Barriers to implementing SE in auto parts SMEs

An extensive literature review is conducted to identify the SE implementation barriers in British auto parts manufacturing SMEs. As mentioned earlier, the SE implementation barriers in auto parts industries remains largely unexplored in existing literatures. However, studies were conducted in various other fields such as transportation, hospitality, and tourism sectors (May, Königsson and Holmstrom, 2017; Frenken and Schor, 2017; Onete, Plesea and Budz, 2018). After reviewing literature on barriers to SE and consulting auto parts industry experts in the UK, twenty barriers pertaining to the British auto parts SMEs were finalized and clustered into four groups. These barriers are presented in Table 1.

2.4 Gap analysis

From the literature review, it is evident that only a few studies have focused on SE from a manufacturing perspective. Govindan, Shankar and Kannan (2020) focussed on analyzing the barriers to Industrial SE in the Indian context. However, after a thorough literature review on SE and to the best of the authors' knowledge, no previous work has been done on SE from a British manufacturing perspective. Moreover, no one has focussed on one specific manufacturing industry. Different industries will have different opinions on the SE barriers. This paper tries to resolve the shortcomings by considering a specific manufacturing area. This paper focuses on the auto parts manufacturing SMEs in the UK and analyzes what hinders them from implementing SE in their industries. The barriers are analyzed using the Best-worst method approach.

Table 1. Sharing economy barriers

Main Barriers	Sub-barriers	Definition	Supporting literature
Organization related barriers (A)	Lack of cooperation among multiple stakeholders (A1)	There is limited cooperation among stakeholders for implementing a very new strategy (SE) in their industry.	Govindan, Shankar and Kannan (2020)
	Lack of pressure from stakeholders (A2)	Due to less awareness of how SE can work in and less awareness of the economic benefit it can bring to the organization, there is no push from the top management to implement it.	May, Königsson and Holmstrom (2017); Govindan, Shankar and Kannan (2020)
	Lack of willingness to change (A3)	Auto parts companies want to continue their traditional way of working and do not want to implement this new strategy because of fear of a completely new model with no clear idea of their advantages.	May, Königsson and Holmstrom (2017); Govindan, Shankar and Kannan (2020)
	Lack of providers (A4)	There is currently no auto parts SMEs in the UK involved in SE practice.	Chasin et al. (2018)
	Brand or company reputation risk (A5)	Auto parts SMEs fear it might affect their brand name if involved in sharing practice.	Expert's opinion
	Absence of government guidelines and policies (A6)	Since the SE model is a new face to the auto parts industry, there are no guideless or policies for industries regarding this aspect in the UK.	Munkøe (2017)
Financial related barriers (B)	Cost implication (B1)	The cost involved in implementing SE can hinder SMEs from adopting it.	Govindan, Shankar and Kannan (2020)
	Lack of Funding (B2)	Auto parts SMEs lack funding for implementing SE.	Govindan, Shankar and Kannan (2020)
	Economic uncertainty (B3)	Companies are not aware of the economic benefit and productivity gains it can bring.	This paper

Information related barriers (C)	Lack of awareness (C1)	There is little awareness about how SE can be implemented in auto parts SMEs and how they can benefit.	May, Königsson and Holmstrom (2017); Govindan, Shankar and Kannan (2020)
	Lack of sharing economy model (C2)	Currently, there is no SE model in the UK for the manufacturing sector to follow.	Govindan, Shankar and Kannan (2020)
	Lack of trust (C3)	Industries are ready to share their resources including logistics, warehouses, and finished products during periods of high demand if they sign a collaboration agreement, but due to lack of trust, they are unwilling to share their resources.	Hawlitschek, Teubner and Gimpel (2016); May, Königsson and Holmstrom (2017); Govindan, Shankar and Kannan (2020)
	Lack of sharing partner evaluation (C4)	There is no information to evaluate the sharing partners.	Govindan, Shankar and Kannan (2020)
Technology/ Technical related barriers (D)	Lack of advanced technology (D1)	There is a lack of advanced technological solutions for the aid of implementing SE in auto parts industries (like IoT, blockchain).	Grondys, (2019); Onete, Plesea and Budz (2018); Govindan, Shankar and Kannan (2020)
	Lack of Expertise (D2)	Experts having knowledge about SE in industries are needed to help resolve any conflict that might happen.	Govindan, Shankar and Kannan (2020)
	Lack of forecasting on resource flow (D3)	The sharing resource may not be available at a time of high demands.	Hawlitschek, Teubner and Gimpel (2016); Govindan, Shankar and Kannan (2020)
	High level of risk (D4)	There is a risk that the sharing resource industry might fail to supply the resources or finished goods on time.	Govindan, Shankar and Kannan (2020)
	Lack of access and transparency to data (D5)	There is less transparency and little available data about the companies which hinder participation in SE.	D'Hauwers, van der Bank and Montakhabi (2020); Govindan, Shankar and Kannan (2020)
	Performance risk (D6)	The shared resources may not meet the expected performance quality.	Expert's opinion
	Lack of interactive platforms (D7)	There is currently no platform for auto parts SMEs to interact and share their resources.	Onete, Plesea and Budz, (2018); Govindan, Shankar and Kannan (2020)

Table 2. Expert information

	Current Position	Experience
Expert 1	Exports Sales Manager	10
Expert 2	General Manager	28
Expert 3	Sales Manager	25
Expert 4	Aftermarket Production Head	12
Expert 5	Applications Engineer	13
Expert 6	Sales and Marketing Director	29

3. METHODOLOGY

This research was carried out in three phases. The first phase dealt with a literature search on sharing economy in manufacturing and identifying the benefits of implementing SE in auto parts SMEs and also, identifying the barriers for implementing SE in the British auto parts manufacturing SMEs. The second phase aimed at collecting expert's opinion on the identified barriers and finalizing the barriers and this was done using a short questionnaire. Six experts from six British auto parts manufacturing industries participated in the study and their profiles are given in Table 2. A total of 20 barriers were finalized with their help and clustered into different groups (refer to Table 1). In the third phase, barriers were ranked using a multi-criteria decision making (MCDM) method called the Best-worst method discussed in the next section.

3.1 Best worst method

Rezaei (2015) developed a new MCDM technique called Best Worst Method (BWM) in 2015. The problem of inconsistency with other MCDM methods during pairwise comparison is avoided by using this approach which involves fewer pairwise comparisons in contrast to other MCDM approaches and hence gives a more reliable weight/ranking.

Steps for BWM are outlined below (Rezaei, 2015; 2016):

Step 1: Identify a set of barriers for analysis

Step 2: Experts will choose the best (most important) and the worst (least important) from the given set of barriers.

Step 3: On a scale of 1 to 9, experts are advised to indicate their preferred score for the best barrier over all other barriers resulting in 'Best-to-others' (BO) vector represented as:

$A_B = (a_{B1}, a_{B2}, a_{B3}, \ldots, a_{Bn})$,

where a_{Bj} indicates that the best criterion 'B' is preferred over barrier 'j' and in this case, $a_{BB} = 1$.

Step 4: Similarly assign the preference of all other barriers over the worst barrier which would result in 'others-to-worst' (OW) vector represented as: $A_W = (a_{1W}, a_{2W}, a_{3W}, ..., a_{nW})^T$,

Table 3. Barrier weight and ranking

Main barriers	Main barrier weight	Consistency ratio	Relative rank	Sub-barrier	Sub-barrier weight	Consistency ratio	Relative Rank	Global weight	Global Rank
Organizational related barriers (A)	0.3567	0.0959	2	A1	0.1469	0.0935	4	0.0524	**11**
				A2	0.1023		5	0.0365	**14**
				A3	0.2745		1	0.0979	**2**
				A4	0.1919		3	0.0685	**5**
				A5	0.2056		2	0.0733	**3**
				A6	0.0788		6	0.0281	**16**
Financial related barriers (B)	0.1670		3	B1	0.3581	0.0756	2	0.0598	**7**
				B2	0.2203		3	0.0368	**13**
				B3	0.4216		1	0.0704	**4**
Information related barriers (C)	0.0821		4	C1	0.2581	0.1009	2	0.0212	**17**
				C2	0.2247		3	0.0184	**19**
				C3	0.4217		1	0.0346	**15**
				C4	0.0958		4	0.0079	**20**
Technology/ Technical related barriers (D)	0.3943		1	D1	0.1608	0.0907	2	0.0634	**6**
				D2	0.2679		1	0.1056	**1**
				D3	0.1399		4	0.0552	**9**
				D4	0.1376		5	0.0543	**10**
				D5	0.1463		3	0.0577	**8**
				D6	0.0939		6	0.0370	**12**
				D7	0.0536		7	0.0211	**18**

where a_{jW} indicates that the barrier 'j' is preferred over the worst barrier 'W' and in this case, $a_{WW} = 1$.

Step 5: Calculating the optimal weights (w_1^*, w_2^*, ..., w_n^*) of all the barriers.

The aim is to determine the optimal weights of the barriers so that the maximum absolute differences for all j is minimized for $\{| w_B - a_{Bj}w_j |,| w_j - a_{jw}w_w |\}$ or equivalently

$$\text{Min Max } \{| w_B - a_{Bj}w_j |,| w_j - a_{jw}w_w |\} \quad (1)$$

subject to; $\sum_j w_j = 1$

$w_j \geq 0$, for all j

Equation (1) is solved by transforming to a linear model:

$$\text{Min } \xi^L \quad (2)$$

subject to; $|w_B - a_{Bj}w_j| \leq \xi^L$, for all j

$|w_j - a_{jw}w_w| \leq \xi^L$, for all j

$\sum_j w_j = 1$

$w_j \geq 0$, for all j

Solve the linear model (2) to get optimal weights (w_1^*, w_2^*, ..., w_n^*) and optimal value ξ^L. Consistency ($\xi^{L)}$ close to 0 is desired because the value of ξ^L close to 0 is considered to be more consistent (Rezaei, 2016).

3.2 Data collection for ranking barrier

The weights of the finalized barriers were calculated using BWM, as detailed in section 3.1. Six experts from the auto parts industries in the UK were identified for this approach. They were asked to select the most crucial barrier and the worst barrier from the main category. They were then asked to make pairwise comparisons by expressing their preference of "Best" barrier over other barriers and other barriers over the "worst" barrier using a nine-point scale. Similarly, they were asked to do the same for all the barriers under each category. The weights and consistency ratio of main category barrier as well as sub-barriers under each category were calculated as per BWM procedure. The calculated weights and consistency ratio obtained from the evaluation of each respondent are computed to get the average weight and consistency for eliminating the biasness of responses. The final weight of main category barriers and their sub-barriers are presented in Table 3. The consistency ratio is close to zero signifying that the pairwise comparison is reliable and consistent (Table 3). The global weights are calculated by multiplying the sub-barrier weight with their respective main barriers weight. The importance of the barriers was ranked based on global weight.

4. RESULTS AND DISCUSSION

This paper identifies the sharing economy implementation barriers in the auto parts manufacturing SMEs and examines the importance of these barriers by taking experts' viewpoints to rank these barriers utilizing BWM. The results show that among the main category barriers: 'Technology/Technical related barriers' hold the most weightage (0.3943), followed by 'organizational barriers' (0.3567), 'financial barriers' (0.1670), and 'information related barriers' (0.0821).

Among sub-barriers, lack of expertise (D2) is the most influential barrier (rank 1) for implementing SE in auto parts SMEs. SE in the auto parts industry is relatively a new concept and SMEs lack experts who have sufficient knowledge about SE in industries. Lack of willingness to change (A3) is the second most influential barrier. Organization's unwillingness to amend a new strategy where resources are shared with other competitors can be a major roadblock for SE implementation in auto parts industries. Industries are not aware of the full potential of this model and assume it is complex to implement and run. Moreover, organization feel that it would endanger their productivity due to less knowledge of SE advantages for the company. Hence, there is a need to educate the importance and benefits of SE in their organization. Brand or company reputation risk is the third most influential barrier that hinders the auto parts SMEs from involving in SE practice. This barrier act as a roadblock for many reputed SMEs to implement SE practice in their industry. Economic uncertainty (B3) is the fourth influential barrier. The decision-makers are not aware

of the economic benefits and other benefits it can bring for the company including sustainability because of lack of studies. Govindan, Shankar and Kannan (2020) analysis show "Lack of trust" as the most influential barrier but this paper counteracts their study as it is one of the least influential barriers. This is true if we take the case of a developing country like India where "TRUST" is limited and rules are not strict compared to the UK where they have a strict law to ensure trust and show support in terms of SE as evident from the literature review. The least influential barrier in this study is the "Lack of sharing partner evaluation" (C4).

5. CONCLUSIONS

Sharing economy is evolving in many sectors and more studies need to be done to unearth its benefits. There is a lack of studies on SE from a manufacturing perspective. This paper will be a pioneering work on focussing SE in a specific manufacturing field and analyzing the influential barriers to SE. SE barriers are analyzed from British auto parts SMEs. A total of 20 barriers were finalized and clustered into 4 groups through an extensive literature study and feedback from experts. Best-worst method is utilized to rank these barriers because it gives a consistent result in contrast to other MCDM approaches. BWM analysis reveals that the "Lack of expertise" is the most crucial barrier followed by "Lack of willingness to change". "Lack of sharing partner evaluation" is found to be the least influential barrier in the context of the UK auto parts SMEs in adopting SE. This study has many managerial implications that will help the decision-makers realize the necessity of such a model in the auto parts industry and come up with measures to eradicate the most influential barriers. One of the limitations of this paper is that the results are based on a specific industry in a particular country. In the future, the same study can be applied to other manufacturing fields and different countries to identify their influential factors.

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