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Factors that Facilitate Systematic Problems Solving Process in Small and Medium Enterprises

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Abstract

Background/Objectives: Generating innovative services are not just related to analyzing the customer and market needs, or applying the systematic innovation process, but it is also related to other key success factors that can lead to the success of innovation. This theoretical study focused on Small and Medium-sized Enterprises (SMEs) performance during implementing systematic innovation analysis method, such as TRIZ- theory of inventive problem solving, in solving service problems. **Methods Analysis:** This paper reviewed the results from previous studies and highlighted important factors in facilitating the systematic problems solving process, and integrating the Information and Communications Technology (ICT) solution with the ultimate process outcome. **Findings:** The results of this paper emphasized on the two aspects for promoting the process. First aspect refers to necessary factors such as innovation champion and/or innovation team, important customer needs, create value, and organizational alignment for providing successful innovative services. The second aspect refers to individual, environmental, organizational, and technological factors which influencing the ICT integration with the process outcomes. **Improvements/Applications:** Taking in considering external and internal factors that may affect using systematic innovation analysis assists SMEs to find platforms to develop and improve their work.

Keywords: Information and Communications Technology (ICT), Small and Medium-Sized enterprises (SMEs), Systematic Innovation, TRIZ

1. Introduction

Small and Medium-sized Enterprises (SMEs) play development roles in the local economy^{1,2}. In most developing countries, SEMs that are in service sector (service-based SMEs) compose high majority of SMEs. This significant number in that sector increases market competitiveness between SMEs and make it imperative for them to think about different ways that support innovation when resolving their production or service problems³. According in^{4,5} SMEs can enhance their productivity and competitiveness by adapting suitable ICT in their business and promote their innovative thinking capability.

One of most famous method to promote the innovative thinking is TRIZ – the theory of inventive problem solving – which developed in⁶. TRIZ provides a set of tools and techniques that can be applied within a

framework to both business development and technical product development and in a manner that can be understood by the non-specialist innovator⁷. Solving service problems by the TRIZ method usually has typical stages. It begins with analyzing the current situation, defining the problem (Finding the contradiction, and analyzing the contradictions), Problem Resolution (eliminating the contradiction) and finally, evaluating the solution⁸⁻¹². Farther more, different studies efforts were devoted to integrate the ICT with TRIZ stages since the ICT has vital role in enhancing innovation in firms^{12,13}. However, the factors that may affect implement and integrated ICT with those stages in the TRIZ for solving the problem still uncovered.

In order to promote SMEs innovation capability in solving their problem when implementing the TRIZ, they should be able to answer the two questions: What are the

key factors that can facilitate the systematic innovation process for solving service problems, and what can affect the adoption of that solution especially if the solution involves ICT? Therefore, this paper devoted to uncover the factors that should be taken into consideration by service-based SMEs when they analysis their service problems and integrate ICT with their solutions based on the TRIZ method.

2. Related Works

2.1 Innovation in SME

The innovation process in SMEs differs from that of large firms. The innovation processes of larger firms are typically more structured and professionalised, which gives large organisations an advantage over small organisations from the aspect of innovation processes¹⁴. In¹⁵ indicated that organisations cannot simply depend on providing a superior service in their core products, but they should create a co-evolution of experiences with their customers which will enhance the organisation's services. In addition, in pointed out that, whether the organisation is large or small, the collaboration between customers and employees often yields innovation opportunities. A study conducted in 16 mentioned that innovation success in SMEs strongly depends upon keeping close to customers, focusing on the specific market segment that has your target customers, building effective collaboration in the organization, and bundling customized services with products.

There are different previous studies indicated innovation key factors that facilitate SMEs innovation. Some of these factors are related to internal or external factors. In¹⁷ identified five factors to measure the company success such as country and business environment, firm internal environment, firm expertise, owner related factors and institutional support. In18 emphasized on stage of industry, demand, industry-university linkage, attitude toward change and size and age as most influence factors affecting innovation in SMEs. Recently, Bayarcelik, Tasel identified eleven critical factors that influence innovation performance of SMEs such as financial factor, firm size institutional factor, technological capability, consumer preferences, market orientation, culture factor, management skills, learning capability, market orientation, and competitive advantage. Such studies usually presented as theoretical models to SMEs, or as recommendation to government to support developing SME, which eventually assist innovation and employment growing in the economy¹⁹. However, they are not sufficient to direct SMEs to be better in the systematic innovation thinking especially with improving or solving current product or service problem.

Stanford Research Institute (SRI), a non-profit international scientific research institute²⁰, has listed five disciplines of innovation: important customer and market needs, value creation, innovation champions, innovation teams, and organizational alignment. These five elements are critical for improving innovation in any organization.

Important customer and market need indicates that success in innovation starts by identifying important customer and market needs, not just problems that are interesting to an investor. Important needs are the ones customers really want addressed, thus they are willing to pay a premium for solutions. In addition, important needs allow an enterprise to make a great effort and contribution to the economy. In²¹ argued that fluctuating customers' needs bring innovation to the market.

Value creation refers to those innovations which are the result of a continuous value creation process. This value is basically created for the customer²². If a firm does not create customer value faster than its competitors, it will go out of business. Customers measure only this value and will spend their money if they believe they will benefit from that product or service. Typically, customers see the value if they perceive that benefits exceed the costs associated with making buying decisions.

Another aspect that should be taken into consideration is *Innovation Champion*. The successful project should have a person who shows commitment to making this project work. An innovation champion is the one who has passion and value creation skills to make something important happen. Pursuing innovative ideas does not depend on the organization's performance, but depends on the innovation champion^{23,24}. In addition, in many cases the innovation process depends not only on the innovation champion, but also on *Innovation teams*. Teams who have different capabilities and knowledge offer the collective intelligence needed to achieve ideas and the means to improve the ideas for solutions²⁵.

The last aspect for a successful innovation process is *Organizational alignment*, which is about ensuring that the key elements - such as organization vision, strategies, and innovation processes - are all aligned toward deliver-

ing the highest customer value and good quality service to customers²⁶. SMEs that have effective vision, mission and clear organizational objectives are good in innovation.

2.2 ICT with SME

Generally, the fastest way to enhance innovation in SMEs can be related to the adoption of ICT to their business. Appropriate ICT can help SMEs to cut the costs by improving their internal processes, and products through faster communication with their customers, and better promotion and distribution of their products through an enhanced online presence²⁷. However, adopting ICT solutions to produce or enhance current services in SMEs could encounter obstacles such as individual factors, environmental factors, type of organizational factors) and technological factors²⁸. Table 1 shows those factors with different studies indicated to them.

Table1. Factors affect ICT adoption by SMEs in literature

Context	Factors	Authors
Individual context	ICT knowledge Technical skills Experience Manager's innovativeness	29; 30; 28, 27; 31; 32.
Organizational context Technological context	Financial resources Firm characteristics (operational, managerial, strategic in nature, and size) Management support Relative advantage Complexity Compatibility	33; 30; 28; 27; 32. 33; 28; 27; 34.
	Observability Trialability Security Cost	
Environmental context	External competition Government pressure Suppliers pressure Public Policy	29; 33; 28; 27; 31; 32.

2.3 TRIZ for Designing Service in SME

Beginning, TRIZ was first developed in and his colleagues in the former Union of Soviet Socialist Republics (USSR). As TRIZ was mainly developed in engineering, many of its principles and tools were originally designed to resolve technical problems. TRIZ and its knowledge base

in non-technical areas may have different applications in technical ones. The trend now is to use TRIZ to resolve non-technical problems, such as those found in the service sector³⁵⁻³⁸.

Innovation in service can be taught and produced in a systematic way, providing a good opportunity for organizations such as SMEs that have limited resources to find better solutions to their service problems. Therefore, the systematic analysis provided by TRIZ can facilitate the process of innovating service in the SME. It gives the problem solvers different tools such as contradiction tools, patterns of evolution, ideal final result, trimming, Algorithm of Inventive Problem Solving (ARIZ), and other tools³⁹. It is worth mentioning that the wide recommendation of solutions that are produced from TRIZ and its 40 inventive principles is very important for SMEs. These proposed solutions would be more benefit if they comprised utilizing ICT solutions⁴⁰.

SMEs often try to imitate a competitor's service innovation because they do not have enough knowledge about their competitors and their product, and they often look at what their competitors do in order to learn how to be on the right level of competition⁴¹. Therefore, a knowledge base of solutions produced by the 40 inventive principles would be a great benefit for such firms to predict the innovative solution and bring benefits to the organization.

Recently, solving service problem by using TRIZ has become attractive to different researchers. A study conducted in⁴² interpreted 40 inventive principles with the examples in service operations management. In developed model for create new service based on TRIZ and they used 40 IPs for predicting problem solutions through two case studies. In pointed out that 39 parameters formed a contradiction matrix and 40 IPs can be used in the service sector for identifying the solutions. In recommended adopting a model for linking service decision factors and 40 IPs modified for the service industry by 'Zhang' - seein their study to generate solutions. In pointed out on new method for grouping the inventive principles with service redesign approaches in order to improve generating solutions. Proposed a new approach to use TRIZ tools with service engineering by integrating TRIZ system modeling and problem-solving tools.

3. Methodology

As it was mentioned in introduction section, this study tries to associate the TRIZ stages with factors and shows the role for each factor in each stage. According to the literature review, we listed our the factors basically according to the five innovation elements which proposed by SRI International, a nonprofit scientific research institute. These five elements are important customer and market needs, value creation, innovation champions, innovation teams, and organizational alignment. According to SRI, those elements are critical for any organization to be successful in providing innovative products/services. In addition, this study integrated factors that affect ICT adoption by SMEs. We noticed that important factors cited by previous studies about innovation factors and ICT adoption factor were fit with those five elements. However, factors such as technological, Environmental factors were a new factors to SRI elements, thus we added them to the element list. In addition, factors that show low important based on results of others studies were not took in consideration. For instance, even though Ilevbare, Phaal listed eleven factors, but they found that the most factors influencing the innovation performance of SMEs were management skills, technological capability, financial factor, and firm size. Thus we just matched those factors with our list. After we constructed our theoretical model based on TRIZ stages and list of elements (factors), we included the theory of diffusion of innovation (DOF) for supporting this study result.

4. Results

According to different researchers work, the TRIZ framework is comprised of 4 main steps - Situation Analysis, problem Definitions, Problem Resolution and Solution Evaluation – as shown in Figure 1. This study added new step –ICT Integration - since this study aims to illustrate the factors that may affect the innovation solving problem process and involve ICT with this process.

The dashed arrows in Figure 1 link between factors that affect the innovation and ICT adoption in the organization. Above each arrow simple of letters that reflect which factor(s) would effect in each step in the framework.

In the beginning of process of systematic innovation process the innovation champion, important customer and market need, value creation, and organizational alignment help SMEs to answering the question "What does a SME need to come up with an innovation idea?" Therefore, before SME start the process of systematic

innovation, it needs to be sure that the organization is ready for innovation process by considering these factors within the organization.

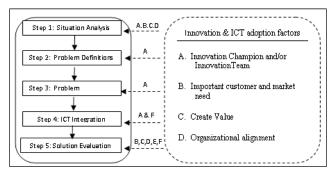


Figure 1. Factors affect the systematic innovation process service by TRIZ

The early stages of using systematic innovation – step 1: situation analysis –in the framework indicates that to design a service requires an innovation champion that able to influence changes in the firm's strategy and policies before the framework is used. This person is a critical factor to the innovation solution. An innovation champion should have adequate education, experience, and have a positive attitude toward changes in the service operation if the situation requires. In fact, organizations have to first prepare the resources needed such as number of experts and consultants for adopting better implementing systematic problem solving tools⁴⁴.

The champion should look at different problems within the organization regarding the delivery of services or the internal processes of the firm that will enhance its business. Overall innovation process, Innovative Situation Questionnaire (ISQ) should be conducted in situation analysis phase in order to help service designers for deeply understanding the situation of the original problem though document information about the system, problem situation, available resource, etc. Therefore, it is required from the champion in this stage focus on important customers and market needs, value creation, and organizational alignment.

It is most important when the firm has an idea to know who is going to need this idea. In other words, it is not important to have an idea, but it is important to have customers for this idea. When organizations work on important needs, its efforts have a far greater impact when compared to settling for just interesting ones. In addition, defining the specific market segment that contains important unmet customer needs will lead to

improvements that will positively impact the organization revenue. van de Vrande, de Jong indicated that most SMEs innovation motivated by ever-changing customer and market demand to stay competitive.

Value creation for customers is substantial in innovation because service brings value to customers, and only customers can determine this value. The most important question the designer of the service (innovation champion) can ask is "Does improvement in the current situation, or the resolution of problems bring great benefits (e.g., increased sales, delight and attract more customers) to your organization?"45. When SME strive to add customer value to its product (services), it will be easy to give convincing reasons for customers to consider the firm offering instead of other competitors.

Moreover, the champion's effort to uncover problems with the current service in order to enhance it should be in alignment with the organization's mission, vision, values, strategies, policies, and business performance. In addition, SMEs with limitation of capability should better utilize their resources (human resources, financial resources, physical resources, and information resources) effectively to build the internal environment to drive value creation and innovation.

According to the step 2 and 3 in the framework, the champion and his/her team play a main role in define the problem and generating different solutions using different tools available with TRIZ such as contradiction tools, patterns of evolution, ideal final result, trimming, algorithm of inventive problem solving (ARIZ), etc. Define problem need from the designer to modeling and formulating the problem. The champion should have the analysis skills in order to expose what cause the problem in service system? Once the champion identifies the source of problem, he/ she can use appropriate TRIZ tool(s) to predict suitable solution. Since the TRIZ solution will generate several solutions, it may contain solutions that do not need to use ICT. Thus generating a solution will mainly depend on the individual characteristics. This is shown in Figure 1, precisely instep 3 where innovation champion will have a strong effect on the process of generating solutions.

Mostly, the champing would look for solutions that involving ICT that can be utilized in order to solve the service problem. However, during solution evaluation stage (step 4) factors such as environmental, organizational, technological, and individual factors (innovation champion) affect the SMEs decision to adopt of the ICT. Evaluation of the proposed solutions would require

answering different questions for different factors. For instance, what is the impact of the solution on organizational factors? Is it in alignment with the organizational strategy? Will it be supported by the top management? What is the impact of the solution on the environment? Will it conflict with public policy, or government's roles? Will it bring competitive advantages, what is the impact of the solution on technology? What are the relative advantages of that solution? Is it complicated to implement? Is it compatible? And how much it will cost?

Diffusion of Innovation with the Innovation Factors

Diffusion Of Innovation (DOI), which was developed in46, includes four major theories that explain the diffusion of innovation. These theories include the innovation decision process, the rate of adoption theory, individual innovativeness, and the theory of perceived attributes. Individual innovativeness theory mentions five categories of adopters. The first category is innovators. The most important characteristics for innovators are being the first individuals to adopt an innovation, a willingness to take risks, being very social and having close contact with scientific sources and interacting with other innovators. The second category is early adopter. An early adopter has the highest degree of opinion leadership among the other adopter categories, has a higher social status, advanced education, is more socially forward than late adopters, and has more financial lucidity. Other categories include the early majority, the late majority, and the laggards. These are usually influenced by the first two categories in the matter of the adoption of innovations.

The theory of perceived attributes indicates the five main attributes: relative advantage, compatibility, complexity, trialability, observability. In47 elucidated each attribute, as shown in Table 2. The perceived attributes refer to the influence of an innovation's success in a social system or an organization.

The innovation decision process and the rate of adoption theory are not the focus of this study since the innovation decision process theory explains the stage of accepting a product of the innovation, while the rate of adoption theory measures a number of people who have adopted the innovation.

To show the correlation between the individual innovativeness theory and the theory of perceived attributes with innovation factors that highlighted in Figure 1, the authors have made briefly discussion for each factor as following:

Table 2. Five perceived attributes of an innovation

Attribute	Definition
Relative Advantage	The degree to which the innovation is perceived to be superior to current practice.
Compatibility	The degree to which the innovation is perceived to be consistent with socio-cultural values, previous ideas, and/or perceived needs
Complexity	The degree to which an innovation is difficult to use or understand, its simplicity.
Trialability	The degree to which the innovation can be experienced on a limited basis
Observability	The degree to which the results of an innovation are visible to potential adopters

5.1 Innovation Champion and/or Innovation Team Factor

Obviously, the relationship between the innovation champion and the first two categories of adopters in individual innovativeness theory (innovators, early adopters) is very clear. It shows the importance of individual characteristics in the matter of innovation. In⁴⁸ pointed out that the innovation champion should have technical skills, a clear understanding of the company's needs, knowledge of the market, be aggressive in pushing the idea, and be politically astute.

5.2 Important Customer and Market Needs Factor

The important customer and market needs factor is influenced by the relative advantages and compatibility attribute. The SME will provide innovation advantages as long as it seeks to promote its service, which needs to be more advantageous than the existing one, and the value of new innovation must be perceived as being consistent with the existing values, past experiences and needs of potential adopters.

5.3 Value Creation Factor

In general, customers perceive a new service as an innovation if they see a new value has been added to it; which at

the end is going to fulfill their needs. Therefore, it can be say that the observability and relative advantages attribute influence the value creation. SMEs should take in consider the visibility of an innovation results and add new value while they design or redesign their services. When SMEs identify the benefit from offering a service to their customers, they will have very good reasons to convince their customers to purchase the firm's service instead of the services of competitors.

5.4 Organisational Alignment Factor

A successful innovation process will be achieved if aligns with the organization's mission, vision, values, strategies, policies, and business performance in order to deliver the highest customer value and good quality service to customers. SMEs will have a great chance to produce innovative services when they understand the correlation between success service innovation with perceived attributes (the relative advantages, observability, complexity, trialability and compatibility attributes). Producing services that bring new value to customer and organisation can be tested before adopted, not difficult to use, and have visible results will have great opportunity for success.

5.5 Environmental Factor

The complexity and observability attributes of the innovation would affect the organization external competition. Others studies pointed out that competitive pressure is a powerful driver of ICT adoption and diffusion⁴⁹⁻⁵¹.

5.6 Technological Factor

All perceived attributes has very high affective in adopt any technology. Organization basically will decide to adopt ICT after valuate the relative advantages, observability, complexity, trialability and compatibility attributes of that ICT.

6. Conclusion

Innovation in service sector can be taught and produced in a systematic way, providing a good opportunity for organizations that have limited resources such as SMEs to find better solutions for their problems. Create or redesigning the services may add new value to customers and will improve the service delivery, thus benefiting both the customer and the company. In addition, solving service problems in SMEs using TRIZ with its knowledge base in

ICT solutions will have a great impact and benefit in SMEs business. It is important for SMEs to have an innovation champion and/or innovation team who can identify important customer and market needs, not just problems that are interesting to investors. The innovation champion/team factor also plays a major role in selecting the best solutions to the service problems in the organization. In addition, important customer and market needs, value creation, and organizational alignments are important factors during situation analysis, evaluating the final solution. Technological factor, which involve the complexity, compatibility, cost, and relative advantage, influences the ICT adaptation and evaluation during the implementation TRIZ framework. Taking in consideration that the factors that may enhance using TRIZ framework is going to open new opportunities for SMEs to find platforms for developing their work and bring more customers and revenue to the firms.

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