

Matrix for Mapping ICT Roles in Small and Medium Enterprises with TRIZ Inventive Principles Based on Redesign Service Types

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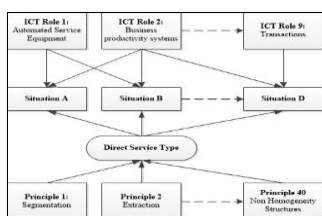
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Graphical abstract



Abstract

Information and communications technology (ICT) has a high impact on Small and Medium Enterprises (SMEs) business. It enhances capacity for innovation and adds greater value to services in order to attract more customers and produce greater returns to the company. This paper aims to map the ICT roles for SMEs with the TRIZ 40 inventive principles (IP). The methodology of mapping is based on using Service Redesign Types (SRTs) as bridge to link between the ICT roles and the 40 IP. The results produced a new TRIZ 40 IP matrix with ICT roles that add value to implement the 40 IP to support SRTs. This paper conducted a case study in order to demonstrate the usability of mapping ICT role categories with the 40 IP based on SRTs. The output of this study can enhance the way of thinking of redesigning current services and lead SMEs to consider particular technologies that may improve performing the service.

Keywords: Service redesign types; Small and Medium Enterprise (SME); 40 Inventive principles; TRIZ; ICT; ICT roles; innovation

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1.0 INTRODUCTION

Many studies have discussed information and communications technology (ICT) benefits and advantages for enhancing small and medium enterprises (SMEs) business [1-5]. Tektas, Gunay [6] reported that adopting a suitable ICT by SME enhanced its business productivity and profitability. The best way to enhance SME innovation in service is by integrating suitable ICT into their services [6]. However, there is no specific approach that can be used to guide SMEs what type of ICT should be used to improve service performance in order to satisfy its customers. In fact, the massive capabilities of ICT leave all options open for organizations to select suitable and effective technologies in order to improve their business. Study conducted by [7] grouped different types of ICT used by different SMEs in service sector into nine categories. The categorization was based on the roles that a particular ICT plays for performing services. The findings of that categorization offered organizations different ways to think about the existing ICT and its capability to improve their business performance.

The systematic innovation method such as TRIZ–The theory of inventive problem solving– helps a problem solver to produce effective and innovative solutions for product or service problems. TRIZ was developed by Genrich Altshuller and his colleagues, beginning in 1946. It has different tools for eliminating of contradiction problems in technical context, and the most important tool in TRIZ are the 40 inventive principles (IP) [8, 9]. However, 40 IP can be used in service context [10-12]. In order to facilitate the using of the 40 IP in service context, the study that was conducted by Gazem and Rahman [13]

grouped the 40 IP with five typical Service Redesign Types (SRTs), which were developed by L.Berry and Lampo [14]. The different SRAs–self-service, direct service, pre-service, bundle service, and physical service type–offer managers a way to improve existing services for the benefit of customers and the company. Studies to integrate ICT roles with the proposed grouping of the 40 IP based on SRAs is missing. This integration can bring innovation to the existing organizations’ services. Therefore, this study intend to develop matrix combining the 40 IP, ICT roles categories, and SRAs in order to enable SMEs to tap into a broader resource of ideas to generate solution(s) for a service problem.

The rest of this paper includes five sections. Section 2 highlights the related work for redesign existing services, grouping 40 IP with SRAs, and categorization of ICT for SMEs. Section 3 illustrates the methodology that has been used to conduct this study, and how the authors mapped the ICT roles with SRT and 40 IP. Section 4 presents the discussion. Section 5 demonstrates the usability of mapping ICT roles with 40 IP based on service types. Finally, section 6 concludes the paper and highlights the further work.

2.0 LITERATURE REVIEW

2.1 Service Redesign Types

The process of redesigning a service may lead to the innovation of new services. Study conducted by Metters, Pullman [15] pointed out that there are thirteen factors that should be take into

consideration by the designer when designing new services. However, the innovation option in services is formed not only when developing new services, but can also be achieved from redesigning services [14]. L.Berry and Lampo [14] also mentioned that existing service processes must be analyzed, outdated assumptions eliminated, and customer perspectives adopted to revitalize existing services. They categorized the process of redesign services to five typical types after analyzing many examples in redesign services as shown in Figure 1. The purpose from the five SRTs was to improve the innovation opportunities in companies' services. Although L.Berry and Lampo [14] suggested research on addressing the redesign service Types, yet the five type have not been updated yet.

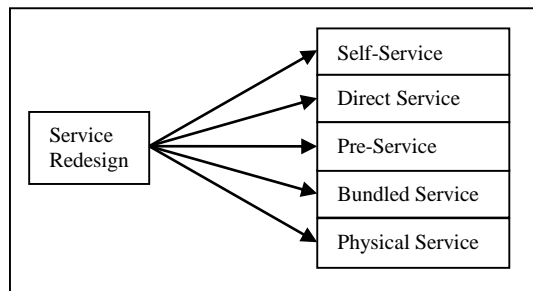


Figure 1 Service redesign types. *Source* from [14]

In each SRT, [14] developed a set of characteristics for each SRTs which are used as criteria to group a service examples based on the strongest fit. Those characteristics clearly present different service delivery situations that require redesigning current services using specific type of services. According to their study, it was obvious that innovation from different service industries could have the same basic pattern that fit to same situations. In this study the term “service redesign type situations” is used instead of “service redesign type characteristics” since characteristics refer to particular problem situations in each of the service types. For example, in self-service type, the characteristic: “Customers require frequent and flexible access” refers to situations when the customers need an easy way to access a service at any time. Thus service providers need to redesign services to be performed by customers with no need for direct interaction with service provider.

2.2 40 Inventive Principles with Service Redesign Types

The theory of inventive problem solving (TRIZ) which basically has developed for systematic innovation method can be helpful to be considered by service-based SMEs for generating new services, or solving current service problems. TRIZ has been getting attention from many researches in terms of using it in a service context [9, 11, 16-21]. In fact, implementing TRIZ in service contexts can lead to promote innovation which is critical to ensure revive services [22]. Many of the previous studies have been focused on the 40 inventive principles because this tool is commonly used for solving contradiction problems. However, it was mentioned that most of TRIZ problem solvers often have difficulty to manage and remember 40 IP [23]. Gazem and Rahman [24] interpreted the 40 IP for more illustration of using those principles in the service context. Later one, a study conducted by Gazem and Rahman [13] grouped the 40 IP in the services redesign context based on the interpretation. Each 40 IP was grouped within the five SRTs—self-service, direct service, pre-service, bundled service and physical service. Their study was focusing to scope the use of the 40 IP according to particular service type for eliminating the service contradiction problem and facilitating principles usage from service prospective. This

grouping has been used in this study for mapping purpose as this paper are going to show later in mapping process section.

2.3 ICT Roles

As ICT evolves, it has a pivotal role in almost all aspects of business activities, and different organizations use different types of ICT for diverse purposes. While many researches have focused on benefits, barriers, and adoption intention of ICT in SMEs [3, 25-28], little effort has been devoted to explore the types of ICT that are implemented by SMEs in different industries [1, 29-31].

The capability of ICT is vital to create opportunity for SMEs to improve their business performance as long as SMEs have the desire to invest in ICTs to survive in competitive markets. SMEs in different sectors may use same or different ICT tools. Moreover, SME adopt different ICT tools according to business needs. Adham and Ahmad [32] indicated that many SMEs use internet-based ICT for searching general information or product advertisements, while a few of them use it for online purchases to end customers. SMEs in manufacturing may adopt more complex ICT applications such as Enterprise Resource Planning (ERP) software [1]. However, investment in such complex ICT by some SMEs in service sector in developing countries is quite low [3]. Gazem and Abdul-Rahman [7] developed nine ICT categories that can correspond to service-based SMEs. The Table 1 shows each category with some illustration.

The categorization was based on the roles that a particular ICT plays for performing services. The findings of that categorization offered organizations different ways to think about the existing ICT and its capability to improve their business performance.

According to [29], SME would be able to improve their ICT adoption if they have adequate knowledge about suitable and effective technologies. Therefore, the effort of this study is to improve the capability limitation of the way of thinking of redesigning current services, The Table 1 used in this study for mapping between each ICT role category and different SRTs in order to help SMEs to consider particular technologies for their solution.

3.0 RESEARCH METHODOLOGY

Mapping between ICT role categories and 40 IP is difficult because each inventive principle gives brief and general suggestions to look at solutions that may solve the problem. In fact, generating ideas by each inventive principle can be associated with all ICT roles. This issue of using ICT roles rely on how the SMEs comprehend each principle and how they intend to use it to solve a problem. For example, principle “2: Extraction” provides a brief suggestion that extract most wanted or most unwanted process from the service to work alone. A problem solver can use any to ICT roles for achieving that process such as using internet for distribute knowledge, online marketing, tracking buyers behaviour, change way of physical payment to virtual payment, etc. On other hand, mapping between ICT roles and SRTs can be precise in certain level when we refer to the usefulness of ICT roles with each service redesign situations. For instance, we can note that using entertainment technology can not support a situation of assisting customers to perform self-service in order to secure private customer information during service delivery.

Table 1 Categories of ICT role

Category	Explanation	Example
1- Automated Service Equipment Technology	A company uses Automated Service Equipment Technology to allow customer to perform self-service. The main focus here is on tangible means which often has characteristics of hardware devices. Customers interact directly with these devices to serve themselves with no direct interaction with service provider.	Auto phone answer, automated ticket machines, automated Sale Devices, automated teller machines, Barcode Scanner, etc.
2- Business productivity systems Technology	A company involves sophisticated information technologies in order to improve the efficiency and proactivity of its business. The main focus here is on the available ICT systems that can be worked through Internet or intranet to improve the efficiency of the company. This category includes any software that can be used for controlling and managing company resources for better serving of customers.	Supply Chain Management, HR Management, Finance/Accounting, Inventory Management, etc.
3- Contact Technology	A company uses technology to facilitate contacting with customers for better relationship between customers and service provider. The main focus here is on means that assist the peer-to-peer contacting between the customer and service provider.	Email, cellular phones, fixed line phone, fax, VOIP, Mobile technology, Social network, Wireless networking, etc.
4- Entertainment Technologies	A company uses technology that can play role in enhancing the service environment and gives value in term of pleasant and satisfaction. The main focus here is on any technology that can be used for entertaining, convenience, or satisfying customers or employees in service facility.	Lighting, sound, video, Internet, Wi-Fi, flat screens, etc.
5- Knowledge Dissemination Technology	A company uses this technology for educating or share information with customers. The main focus here is in visual and audiology means that allow customers to receive a particular service.	Radio, Television, CCTV for broadcasting events, E-Learning, forums, blogs, Informative websites, etc.
6- Marketing Technology	A company uses this technology for online marketing, shopping, or trading. Marketing technology mainly focuses on means that gives opportunity of online trading, and facilitates customer online shopping, booking, reservation, or any task to streamlines activation of the service.	E-commerce, Social network, Websites for advertising, etc.
7- Storage Technology	A company uses this technology for storing and conserving data. The main focusing here is on any means that facilitate and promotes the concept of the storing, retrieve, process and analyze data.	Servers, storage devices such as keychain RFID device, recorded audio and video, members card, cloud computing, files, storage area network such as Dropbox.com, Google Drive.com, etc.
8- Tracking Technology	Tracking technology covers a wide range of ICT types. It can be used for security context, or business context. A company uses this technology for tracking customers' behavior, needs, or monitoring service delivery such as purchase order tracking systems, and for security purpose such as using anti-theft sensor gates. The basic focusing here is on getting feedback, controlling service and managing security issues.	For business context: barcode scanner system for monitoring store repository, tracking systems such as global positioning system (GPS), wireless networking, etc. For security context: CCTV cameras, security technology such as fingerprint locks, electronic gates, etc.
9- Transactions Technology	A company uses this technology to streamline the financial issues. The transactions technology mainly focus on hardware or software that assist in money transaction process.	Electronic Funds Transfer point of sale (EFTPOS), Electronic Point Of Sale (ESOP), debit cards, Smart Card, e-banking, etc.

However, that type of technology can support a situation like customizing the service by including different services in order to convince customers to use the service, e.g., providing video channels for hotel guests. Therefore, mapping between ICT roles 40 IP needs to be done through using SRTs situations as bridge for that purpose. The Figure 2 gives example on how the mapping process has been done.

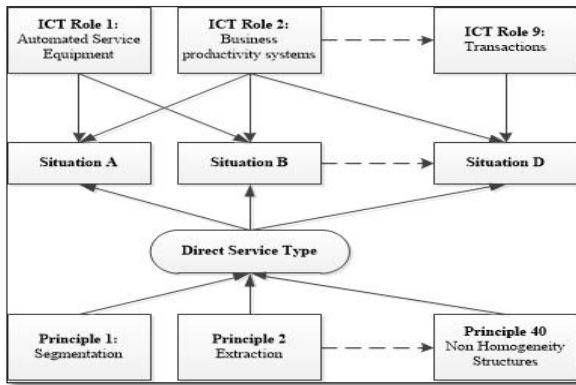


Figure 2 ICT roles and 40 IP mapping based on direct service type

In the beginning, the ICT roles and SRTs were mapped. Then the outcome of the first mapping was used to map ICT roles with each TRIZ inventive principle that grouped under each SRT situation. Then, the ICT roles exist within interaction between a specific principle and all situations in each SRT were selected according to the ICT roles frequency.

3.1 Mapping ICT with Service Redesign Types

The process of mapping is based on the ability of each ICT roles to improve each situation in SRTs. However, it is not easy to do direct mapping between each SRTs with ICT. Therefore, mapping should have certain criteria in order to facilitate mapping process. The situations in each SRTs can represent that criteria. For example, any ICT role can assist to achieving Self-service situation (A): “Customers require frequent and flexible access” should be mapping with this situation. Thus in order to highlight the technological criteria in each SRT situation, each situation was revised so that be understandable from technological perspective. Table 2 shows the suggestions from technological perspective that has been offered to achieve each situation.

Table 2 Service redesign types and technological suggestions for improvement

Service Redesign Types	Characteristics/ Situations	Suggestion from Technological Perspective
Self Service	A. Customers require frequent and flexible access.	Use technology that assists customers to perform self-service in order to allow more flexible access to a service.
	B. Speed of service delivery is paramount.	Use technology that assists customers to perform self-service in order to increase the speed of service delivery.
	C.	
	D. Service performance requires limited skills that are easily transferable to customers.	Use technology that assists customers to perform self-service in order to improve customer skills that shift tasks from a service provider to customers for operating a service.
	E. Technology exists to enable customers to perform the service.	Use technology that assists customers to perform self-service without any supervision from a service provider.
	F. Customers may be concerned about disclosing private information to service personnel.	Use technology that assists customers to perform self-service in order to secure private customer information during service delivery.
	G. Gross margins are low, making cost-saving alternatives especially attractive.	Use technology that assists customers to perform self-service in order to improve customer participation in the service for lower service operation cost.
Direct Service	A. Customers must significantly disrupt their normal routines to receive the service.	Use technology that assists to direct a service to customers' location in order to prevent disruption of their normal routines to receive the service.
	B. Customers' inconvenience in visiting the service facility outweighs the benefits of their service.	Use technology that assists to direct a service to customers' location in order to make customer receipt of service more convenient.
Pre-Service	A. Customers must supply detailed information to receive the service.	Use technology that assists to support advanced preparation of the service operations by service provider in order to streamline activation of the service.
	B. Customers are usually in a hurry to receive the service.	Use technology that assists in shifting tasks from customer to service provider by supporting advanced preparation of the service operation by service provider in order to quicken and shortcut customer waiting time to receive the service.
	C. Customers plan service consumption ahead of time.	Use technology that assists customers to customize a service before receiving the service.
	D. Customers use the service frequently.	Use technology that assists to support advanced preparation for most frequent consuming of service part(s) by customers in order to insure the continuity and simplicity of receiving the service.

Suggestion from Technological Perspective	*ICT Roles								
	1	2	3	4	5	6	7	8	9
operation by service provider in order to quicken and shortcut customer waiting time to receive the service.									
Use technology that assists customers to customize a service before receiving the service.									
Use technology that assists to support advanced preparation for most frequent consuming of service part(s) by customers in order to insure the continuity and simplicity of receiving the service.									
Use technology that assists to multiple services into one offering for segmented customers based on use or needs.									
Use technology that assists to efficient consumption a service by improving customer knowledge of the value added in service bundle.									
Use technology that assists to combine core and complimentary services that improves the perceived value in order to meet a customer expectation.									
Use technology that assists to support customizing the service by including different services in order to convince customers to use the service.									
Use technology that assists to support tangible aspects associated with the service in order to attract customers to visit the service facility.									
Use technology that assists to support tangible aspects associated with the service in order to improve customer experience at the service facility.									
Use technology that assists to support improving service environment in order to make customers more comfortable within the facility location.									
Use technology that assists to support tangibles aspects associated with the service in order to differentiate the company performing the service from other competitors.									

* 1: Automated service equipment Technology; 2: Business productivity system Technology; 3: Contacting; 4:EntertainingTechnology; 5: Knowledge Dissemination Technology; 6: Marketing Technology; 7: Storage; 8: Tracking Technology; 9: Transactions Technology.

The next step in this paper is to use Table 3 findings to map between the ICT roles and TRIZ inventive principles.

3.2 Mapping the ICT Roles with the 40 Inventive Principles

At the beginning, the findings of the previous study of grouping IP with the SRTs by [13] was used to determine the interaction between each SRTs situations and the 40 IP. According to that study, principles 21, 22, 23, 24, and 25, for instance, can be used with self-service situations B, C, D, E, and F (see Table 4). The gray cells in the Table 4 mean that a particular inventive principle has grouped under a specific service redesign type situation.

Table 4 service redesign types with inventive principles

Principles	Self-service type Situations					
	A	B	C	D	E	F
21: Skipping						
22: Convert Harm Into Benefit						
23: Feedback						
24: Intermediary						
25: Self-Service						

In each interaction—the gray cells in Table 4—some of the ICT roles were filled in according to the mapping between each SRTs situations and ICT roles (see Table 3). For example, according to Table 3, self-service situation (B) has interaction with the Automated service equipment, contacting, knowledge dissemination, marketing, storage, and transaction technology. Therefore, those ICT roles placed in the interaction between principle “skipping” and self-service situations. Same process of filling in was repeated with self-service situation (D and E)—see Table 5.

Table 5 ICT Roles filled in interaction between skipping principle with self-service type situations

Principles	Self-service type Situations		
	B	D	E
21.Skipping	1:Automated Service Equipment	1:Automated Service Equipment	1:Automated Service Equipment
	3:Contacting	5:Knowledge Dissemination	3:Knowledge Dissemination
	6:Marketing	7:Storage	6:Marketing
	7:Storage	8:Tracking	7:Storage
	9:Transactions	9:Transactions	9:Transactions

The result of Table 5 was analyzed in order to identify the frequency for each ICT role listed in all situations of self-service type that have interaction with principle “skipping”. Table 6 shows the output from this step.

Table 6 The frequency of each ICT role with “Skipping Principle”

Principles	ICT roles	Frequency
21.Skipping	1:Automated Service Equipment	3
	3:Contacting	2
	5:Knowledge Dissemination	3
	6:Marketing	3
	7:Storage	3
	8:Tracking	1
	9:Transactions	3

The last step was arranging ICT roles that have equine frequency number with descending order. This is to show priority of ICT roles in the final matrix. Therefore, outcome from Table 6 was arranged like: Automated Service Equipment, Knowledge Dissemination, Marketing, Storage, and Transactions have first equal priority, the Contacting technology has the second priority,

and Tracking technology has the third priority. This arrangement was shown in the interaction between self-service and principle “Skipping” in the Table 7. After repeating this process with each principle and SRAs situation, the TRIZ matrix with ICT roles for each SRT was produced as it shows in the Table 7.

Table 7 ICT roles mapped with 40 IP base on SRTs

Principles	Self-Service	Direct Service	Per-Service	Bundle Service	Physical Service
1. Segmentation	<u>1, 2, 3, 5, 6, 7, 9.</u> *	<u>1, 3, 5, 6, 8, 9.</u> *	<u>2, 3, 6, 8, 9, 5.</u> * **	<u>5, 6, 1, 3, 7, 8.</u> * **	
2.Extraction	<u>1, 5, 6, 7, 9, 3, 8.</u> * **	<u>1, 3, 5, 6, 8, 9.</u> *	<u>2, 3, 5, 6, 8, 9.</u> *		
3.Optimal Resource		<u>1, 3, 5, 6, 8, 9.</u> *	<u>3, 5, 6.</u> *	<u>4, 5, 6, 3, 9.</u> * **	<u>4, 1, 5.</u> * **
4.Symmetry Change	<u>1, 3, 5, 6, 7, 8, 9.</u> *	<u>3, 5, 6, 8, 1, 9.</u> * **		<u>5, 6, 3, 4, 1, 7, 8, 9.</u> * ** ***	<u>1, 4, 5, 9.</u> *
5.Consolidation	<u>1, 3, 5, 6, 7, 8, 9.</u> *			<u>5, 6, 3, 4, 1, 7, 8, 9.</u> * ** ***	4.
6.Multi-functionality				<u>5, 6, 4, 3, 9.</u> * ** ***	<u>4, 1, 5, 9.</u> * **
7.Nesting	<u>1, 5, 6, 7, 8, 9.</u> *	<u>2, 3, 5, 6, 8.</u> *		<u>4, 5, 6, 3, 9.</u> * **	<u>1, 4, 5.</u> *
8.Counter Balance	<u>1, 3, 5, 6, 7, 8, 9.</u> *			<u>5, 6, 3, 4.</u> * **	
9.Prior Counteraction			<u>3, 5, 6, 1, 7, 8, 9.</u> * **		
10.Prior Action	<u>1, 3, 5, 6, 7, 9.</u> *		<u>3, 6, 2, 5, 8, 9.</u> *		
11.Prior Cushioning		<u>2, 3, 5, 6, 8.</u> *		<u>3, 4, 5, 6.</u> *	
12.Remove Tension		<u>1, 3, 5, 6, 8, 9.</u> *			
13.Inversion	<u>1, 5, 6, 7, 9, 3, 8.</u> * **	<u>3, 5, 6, 8, 1, 9, 2.</u> * ** ***	<u>3, 6, 2, 5, 8, 9.</u> *		<u>1, 4, 5, 9.</u> *
14.Curvature		<u>1, 3, 5, 6, 8, 9.</u> *			4.
15.Dynamization	<u>1, 5, 6, 7, 8, 9.</u> *	<u>1, 3, 5, 6, 8, 9.</u> *	<u>3, 5, 6.</u> *		<u>1, 4, 5.</u> *
16.Slight Less/Slightly More				<u>4, 5, 6, 9.</u> *	<u>1, 4, 5, 9.</u> *
17.Another Dimension	<u>1, 5, 6, 7, 8, 9.</u> *			<u>1, 3, 5, 6, 7, 8.</u> *	<u>1, 4, 5, 9.</u> * **
18.Resonance			<u>3, 5, 6.</u> *		
19.Periodic Action			<u>3, 5, 6.</u> *	<u>3, 4, 5, 6.</u> *	
20.Continuity of Useful Action	<u>1, 5, 6, 7, 8, 9.</u> *	<u>2, 3, 5, 6, 8.</u> *	<u>3, 5, 6, 8, 9, 1, 2, 7.</u> * **	<u>4, 5, 6, 9.</u> *	
21.Skipping	<u>1, 5, 6, 7, 9, 3, 8.</u> * ** ***	<u>1, 3, 5, 6, 8, 9, 2.</u> * **	<u>3, 5, 6, 8, 9.</u> *		
22.Convert Harm Into Benefit		<u>1, 3, 5, 6, 8, 9.</u> *	<u>3, 5, 6.</u> *		<u>1, 4, 5.</u> *
23.Feedback			<u>3, 6, 2, 5, 8, 9.</u> * **	<u>1, 3, 5, 6, 7, 8.</u> *	<u>1, 4, 5.</u> *
24.Intermediary	<u>1, 5, 6, 7, 9, 3, 8.</u> * **	<u>3, 5, 6, 8, 1, 9.</u> *		<u>4, 5, 6, 9.</u> *	
25.Self-Service	<u>1, 5, 6, 7, 9, 3, 8.</u> * **	<u>1, 3, 5, 6, 8, 9.</u> *	<u>2, 3, 5, 6, 8, 9.</u> *		
26.Copying		<u>2, 3, 5, 6, 8.</u> *		<u>3, 4, 5, 6.</u> *	<u>1, 4, 5, 9.</u> *

Principles	Self-Service	Direct Service	Per-Service	Bundle Service	Physical Service
27.Cheap Disposables			<u>3, 5, 6.</u> *	<u>3, 4, 5, 6.</u> *	<u>1, 4, 5.</u> *
28.Another Sense					<u>4, 1, 5.</u> * **
29.Intangibility				<u>3, 4, 5, 6.</u> *	
30.Thin and Flexible	<u>1, 3, 5, 6, 7, 9.</u> *	<u>1, 3, 5, 6, 8, 9.</u> *			
31.Holes	<u>1, 5, 6, 7, 8, 9.</u> *	<u>2, 3, 5, 6, 8.</u> *	<u>2, 3, 6, 8, 9, 5.</u> * **	<u>4, 5, 6, 9.</u> *	
32.Color Changes				<u>1, 3, 5, 6, 7, 8.</u> *	4.
33.Homogeneity				<u>4, 5, 6, 3, 9.</u> * **	
34.Rejecting and Regenerating Part			<u>2, 3, 6, 8, 9.</u> *	<u>5, 6.</u> *	<u>1, 4, 5.</u> *
35.Transformation of Properties	<u>1, 5, 6, 7, 8, 9, 3.</u> * **	<u>3, 5, 6, 8, 1, 2, 9.</u> * **		<u>1, 3, 5, 6, 7, 8.</u> *	<u>1, 4, 5.</u> *
36. Phenomenon Utilization			<u>3, 5, 6.</u> *		
37. Relative Change		<u>1, 3, 5, 6, 8, 9.</u> *			
38. Enriched Atmosphere	<u>1, 3, 5, 6, 7, 8, 9.</u> *			<u>4, 5, 6, 3, 9.</u> * *	
39. Calm Atmosphere	<u>1, 3, 5, 6, 7, 9.</u> *				4.
40. Non Homogeneity Structures				<u>1, 3, 5, 6, 7, 8.</u> *	<u>1, 4, 5, 9.</u> *

• The numbers within matrix cells refer to: 1. Automated service equipment Technology; 2. Business productivity system Technology; 3. Contacting; 4.EntertainingTechnology; 5. Knowledge Dissemination Technology; 6. Marketing Technology; 7. Storage; 8. Tracking Technology; 9. Transactions Technology.
 *: Refers to set of ICT Roles that have equal first priority.
 **: Refers to set of ICT Roles that have equal second priority.
 ***: Refers to set of ICT Roles that have equal third priority.

■4.0 DISCUSSION

From Table 3, the authors noted that some technologies can have different roles to improve a particular service situation. For example, ICT tool such as social media (Facebook, Google plus etc.) can be used for marketing and at the same time can play a role in providing a method of contact between customers and a service provider. In addition, the different association of ICT categories that have been shown in Table 3 with many situations showed different benefits of ICT category. For instance, auto service equipment can assist to improve situations 1,2,3,4,5,6,7,8,9,14,15,19,20 and 22 as shown in Table 3. Similarly, a particular situation in a service type can be achieved and improved by taking into consideration more than one ICT role category. For example, the suggestion linked with situation (A) in self-service type: “Use technology that assists customers to perform self-service in order to allow more flexible access to a service” can be achieved by considering auto service equipment, knowledge dissemination, marketing, storage, tracking, or transactions technology.

In Table 7, the ICT roles have been mapped between SRTs and the 40 IP. In addition, it is more reasonable when SMEs need to redesign the service to look for applicable ICT roles that can be related to a specific principle to generate innovative ideas. ICT roles listed under an interaction between 40 IP and a SRTs can give a SME new opportunities to integrated the ICT with the suggested solutions as discussed in the case study in this paper. Even though a particular principle grouped under specific SRT’s situation, other IP still can be used. The only limitation is our imaginations. Same with ICT roles in Table 7,the SMEs still can

explore other ICT roles though they do not listed under an interaction place.

■5.0 EMPIRICAL CASE STUDY

The case study was conducted in a commercial company named I-SIHAT. This company provides customers with nutrition, weight management and skin-care products. This company coaches and monitors their customer so they get better health and awareness while customers consume nutritional products. This monitoring needs to be periodic in order to check customer progress in losing weight or sometimes in gaining weight. When a customer comes first time, they open one document (time table). They record customer weight, body fat, age, problems in bodies, and other information. This record should be updated once or twice a month with new data according to customer health achievement. The problem they have is that whenever they want to set a meeting with some customers, the customers keep changing the meeting time. Sometimes the company does not have time to see them because changing the time may interfere with other customer monitoring time. After analyzing the problem, we found that the closest situation to this problem is that customers must significantly disrupt their normal routines to receive the service. This situation can be found under direct service type. According to the 40 IP grouping with this direct service’s situation[13], principles “segmentation”, “extraction”, “optimal resource”, “remove tension”, “inversion”, “Dynamization”, and “rejecting and regenerating Parts” were selected. After reviewing those principles, we choose “inversion”

principle. This principle suggests to do the service in opposite way[24]. Therefore, the solution was: instead the customer come to the company, the company needs to direct the service to his/her place. At this point, we can look to Table 7 and see if this solution can be improved. This table suggests taking in consideration the ICT role 3, 5, 6, 8, 1, and 9. The priority was to look at 3 (Contacting technology). If this ICT role can not support or improve the solution, the next ICT role can be examined and so on. After investigating the suggested ICT roles, we found that contacting technology can support the solution. The company can use any ICT tools such as mobile application such as WhatsApp, email, fix line phone, etc., to facilitate contacting with the customer and set the meeting time according to the customer free time. Thus the company can send one of its employees to check the customer progress in the customer location.

6.0 CONCLUSION

Redesigning existing service and adopting a suitable ICT by a firm can achieve the innovation option in services. This study focused on mapping between ICT roles and TRIZ 40 inventive principles base on different service redesign types in order to create innovative service problem solutions. The methodology of mapping consists of three stages. First stage depended on the SRTs situations and using suggestions from technological prospective as criteria to map ICT roles with each situation. Second stage used the outcome from the first stage to map ICT roles with each TRIZ inventive principle that grouped under each SRT' situation. Third stage selected the ICT roles a according to the ICT roles frequency exist within interaction between a specific principle and all situations in each SRT. The result of mapping showed that each SRT can associate with more than ICT role, and vice versa. In addition, mapping the ICT roles to the 40 inventive principles can be assist SMEs in redesigning the service to generate innovative ideas to solve their problem. Therefore, developing TRIZ matrix that list ICT roles within the interaction between the inventive principles and service redesign types facilitated integrated ICT roles with TRIZ 40 inventive principles. The case study showed the feasibility of the matrix in enhancing the service problem solutions. With capability limitation in research and development in SME, this study can improve the way of thinking of redesigning current services. Moreover, it can lead the SME to consider particular technologies that may improve performing the service. Future work will involve integrating the mapping result with the systematic innovation process in order to enhance generating problem solutions according to a firm service redesign plan.

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