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Redesign Services using Inventive Principles: A Case Study

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Abstract - Systematic redesign services could help to produce new service innovation. The Theory of Inventive Problem Solving (TRIZ) with its tools such as the 40 inventive principles and matrix of contradiction developed by Genrich Altshuller and his colleagues are important tools to generate new ideas and solutions for problem solving. Although TRIZ was developed for technical problems, the 40 inventive principles still can be used in a service context. However, an accurate matrix of contradictions for the service sector does not exist. The designer would need to go through all inventive principles to find a suitable solution. That method may be confusing, complicated and time consuming. In this paper, the researchers demonstrate how grouping the 40 inventive principles into service redesign categories (SRCs) helps reducing the time needed to get the appropriate principles that can then be applied to find solutions. This study uses a case study to illustrate usefulness grouping 40 inventive principles with SRCs to generate solutions in service sector. The research shows that if service designer knows the service characteristics of a service redesign, it will be easier to identify appropriate inventive principles that may assist in finding a solution.

Keywords : TRIZ; service; redesign service; 40 inventive principles

1. INTRODUCTION

There are many methods to recreate service and each method has its tools or steps that designers follow. One method is to use a systematic innovation method known as TRIZ. Mann and Domb [10] indicated that TRIZ eliminates contradictions rather than use conventional methods such as compromise or tradeoff. Within the many different toolsets of TRIZ, 40 Inventive principles are the most popular and frequently used for the elimination of contradiction problems [4, 9]. Generally, contradictions in technological systems are usually caused by engineering parameters for objects (such as weight, length, shape, strength, etc.). For example, the weight of an object needs to be reduced, but a lower weight would require thinner material, which is more likely to breakdown if overstressed. Therefore, the contradiction analysis in TRIZ uses a contradiction matrix formed by 39 parameters. This contradiction matrix indicates corresponding inventive principles that guide a designer to overcome the conflict.

Unfortunately, such a matrix is not available in the service context. Furthermore, the biggest problem is that most problem solvers find the principles difficult to remember [11]. Consequently, the problem is that designers need to go through all or most of the Inventive principles looking for applicable principles to solve the service contradictions. Therefore, this study uses 40 inventive principles under five types of services categories: self-service, direct service, pre-service, bundled service, and physical service, which was developed by [8] to make it easier for designers to find the corresponding principles and hence the solution in less time.

The remainder of this paper is divided into five sections. The second section describes the related works in TRIZ with service design, and implementing Inventive principles in the service sector. The third section presents the grouping of inventive principles with SRAs. The fourth section illustrates the usefulness of the proposed grouping using a case study. The fifth section discusses the generated solutions for the case study. The sixth section presents the conclusions.

2. TRIZ WITH SERVICE

The hypothesis of TRIZ, which was developed by [1], indicates that there are universal principles of invention that are the basis for creative innovations, and if these principles could be identified and codified, they could be taught to people to make the process of invention more predictable. As TRIZ was first developed in engineering, many of its principles and tools were originally designed to resolve technical problems. The trend now is to use TRIZ to resolve non technical problems in other sectors, such as the service sector [10, 12-14].

Traditionally, service ideas are obtained from methods such as brainstorming, synectics, lateral thinking, morphological analysis, and mind mapping [6]. These traditional methods rely on human experience and knowledge. TRIZ can be applied to generate service ideas but this time in a more systematic and more innovative way that isn't affected much by personal experience or intellectual because TRIZ helps to structure how we think about problems, not just how a problem can be solved. In other words, TRIZ provides problem solvers with tools to guide them to reduce the barriers which make it difficult to generate ideas thereby making it easier to solve difficult problems [1].

It is hard to say which methodology is most suited to eliminate the service contradictions in designing a new service or solving a service problem. Generally, the classical method in the TRIZ to create or solve service problems has three stages: define the problem, generate solutions, and evaluate solutions [9]. The generate solutions stage provides the problem solver with a variety of tools such as technical contradictions/inventive principles, physical contradictions, Su-Field analysis, ideal final result, resources, etc. In this context, different studies have used several of these tools to help the solver find the solution for service system contradiction. Lin and Su [9] pointed out that 39 parameters can be formed in the contradiction matrix and 40 inventive principles can be used in the service sector to identify the solutions. [7] adopted a model for linking service decision factors and 40 Inventive principles modified for service industry by "Zhang" – see [7] – in their study to generate solutions. In addition, a study conducted by [15] interpreted 40 inventive principles with examples in service operations management.

The Chai, Zhang [2] framework proposed a new approach to systematic service design that comprises three main stages. The Framework starts with an identified service problem. At Stage 1, identification and definition problems are "translated" into the language of TRIZ to provide insightful information for further problem solving. At Stage 2, the problem is structured into typical TRIZ contradictions by conducting contradiction analysis. TRIZ knowledge-based principles such as the 40 inventive principles and 4 separation principles may then be employed to eliminate the contradictions. In Stage 3, the generated ideas are evaluated using the unique TRIZ criteria, which is the ideal final result. The final output is a list of possible innovative conceptual solutions to service design. These framework steps are used by the researchers of this paper in the case study analysis to illustrate how categorizing the inventive principles will improve the generation of solutions.

3. 40 INVENTIVE PRINCIPLES

Emergence innovating new services can be from redesign present services. L.Berry and Lampo [8] argued that the innovation option in services is not limited to developing new services but it can redesign services. They categorized five typical ways of redesigning service approaches after analyzing many examples in redesign services. Those categories are self-service, direct service, pre-service, bundled service, and physical service. They also listed several characteristics for the each category.

This study has used the five types of service categories developed by [8] as the basis for grouping the 40 inventive principles under each category. Thus, time consumed looking through all 40 inventive principles to generate solutions can be reduced, and the designer of the service can predict how to efficiently redesign the services, reducing the time required and offering a more accurate solution by focusing on the most appropriate principles that can be applied to a given problem.

The method of grouping particular inventive principles with the SRCs depends on three phases. The first examines text similarity between the inventive principles with each category identity. The second is concerned with meaning similarity between the sub-principles and each characteristic of the SRCs. Finally, the third phase deals with meaning similarity between service examples of the inventive principles and each characteristic of the SRC. Tables 1,2,3,4 & 5 show each characteristic with the principles that fit that characteristic.

TABLE 1: Inventive Principles with Self-Service Approach Characteristics

Characteristics	Principles
Customers require frequent and flexible access.	2:Taking out 20:Continuity of useful action
Speed of service delivery is paramount.	1:Segmentation 2:Taking out 21:Skipping 25:Self-service
Service performance requires limited skills that are easily transferable to customers.	10:Preliminary action 25:Self-service 38:Strong oxidants (Boosted interactions)
Technology exists to enable customers to perform the service.	7:Nested doll 13:The other way round 17:Another dimension 24:Intermediary 35:Parameter changes

Customers may be concerned about disclosing private information to service personnel.	2:Taking out 13:The other way round 39:Inert atmosphere
Gross margins are low, making cost-saving alternatives especially attractive.	5:Merging 8:Anti-weight 25:Self-service

TABLE 2: Inventive Principles with Direct Service Approach Characteristics

Characteristics	**Principles**
Customers must significantly disrupt their normal routines to receive the service.	1: Segmentation 12:Equipotentiality 13:The other way round 14:Spheroidality - Curvature 28:Mechanics substitution 37:Thermal expansion (Strategic expansion)
Customers' inconvenience in visiting the service facility outweighs the benefits of their service.	2: Taking out 10: Preliminary action 13:The other way round 28:Mechanics substitution 35: Parameter changes
Customers dislike personally interacting with the service provider.	2:Taking out 13:The other way round
Technology allows the remote delivery of services.	4:Asymmetry 13:The other way round 31: Porous materials.

TABLE 3: Inventive Principles with Pre-Service Approach Characteristics

Characteristics	**Principles**
Customers must supply detailed information to receive the service.	23: Feedback 30: Flexible shells and thin films
Customers are usually in a hurry to receive the service.	2: Taking out 10: Preliminary action 13:The other way round 21:Skipping 31: Porous materials
Customers plan service consumption ahead of time.	9: Preliminary anti-action 10: Preliminary action 11: Beforehand cushioning 15: Dynamics 19: Periodic action 27: Cheap short-living objects 34: Discarding and recovering 36: Phase transitions
Customers use the service frequently.	14:Spheroidality – Curvature 18: Mechanical vibration 19: Periodic action

TABLE 4: Inventive Principles with Bundled Service Characteristics

Characteristics	Principles
Customers can be segmented based on use or need.	1: Segmentation 4:Asymmetry 5: Merging 17: Another dimension
Efficient consumption requires technical knowledge.	3: Local quality
Customers associate core service with other related services.	6: Universality 16: Partial or excessive actions 24: Intermediary
Customers are convenience minded.	3: Local quality 5: Merging 6: Universality 7: Nested doll 19: Periodic action 29: Pneumatics and hydraulics (Intangibility) 33:Homogeneity

TABLE 5: Inventive Principles with Physical Service Characteristics

Characteristics	Principles
Consumption requires the customer's presence at the service facility.	3: Local quality 15: Dynamics 19: Periodic action 24: Intermediary 35: Parameter changes
The service is difficult for customers to evaluate prior to purchase.	34: Discarding and recovering
Physical comfort is an important determinant of customer and/or employee satisfaction.	3: Local quality 5: Merging 6: Universality 32: Color changes 40: Composite materials
Competing services are quite similar to one another in operational performance.	4:Asymmetry 8: Anti-weight 13:The other way round 16: Partial or excessive actions 21: Skipping 22: "Blessing in disguise" or "Turn Lemons into Lemonade" 26: Copying 37:Thermal expansion (Strategic expansion) 40: Composite materials

4. CASE STUDY

The case study was conducted for a company called Green Tree workshop, which is an Auto Repair & Service workshop located in Kempis Baru, Pasir Gudang, Johor, Malaysia. This company is an auto repair & service business which fixes all kinds of vehicles. The process of registering a vehicle to be fixed involves the customer filling in a form called a Job Card (JC). The customer selects what services he/she needs and signs the form. The form then goes to a clerk to record the customer data into an excel file and at the same time the operational manager assigns the task to mechanics who have the required experience and skills for particular vehicles or problems. After the mechanic finishes the job, he signs the job card and sends it to the clerk to record the data again. If the job is completed the clerk issues a receipt to the customer. Customer invoices are sent out twice a month. The problem with this process is that if the mechanic needs to fix something that the customer did not ask for in the JC, he must ask the operation manager for all the spare parts that are needed, a step which adds a new service to the JC. Changing spare parts causes disagreement between the company and its customers because this matter adds additional cost to the invoice, which causes customer dissatisfaction. Therefore, they need another way to allow necessary changes in the JC, hopefully eliminating dissatisfied customers. A new service design framework by [2] was used to conduct the analysis of the problem. Stage 1 and stage 2 are to help understand the problem and the organization's ability to integrate systematic innovation in its problem solving process. Moreover, this step was to model the problem. Figure 1 shows the problem model and identifies harmful and useful functions. In modeling the problem, we need to identify the primary useful function (PUF), useful function (UF), primary harmful function (PHF), and harmful function (HF). In this case study, the functions are:

(PUF) – Get customer satisfaction.
(PHF) – Job card service changes.
(UF) – Customer fills up job card.
(UF) – Clerk records job card.
(UF) – Job card service changes.
(UF) – Desired performance service.
(HF) – Waiting for permission from the customer.

In addition, in figure 1 there is a cross line between "JC service changes" and "get customer satisfaction" to indicate of influencing the customer satisfaction if Job card has changes.

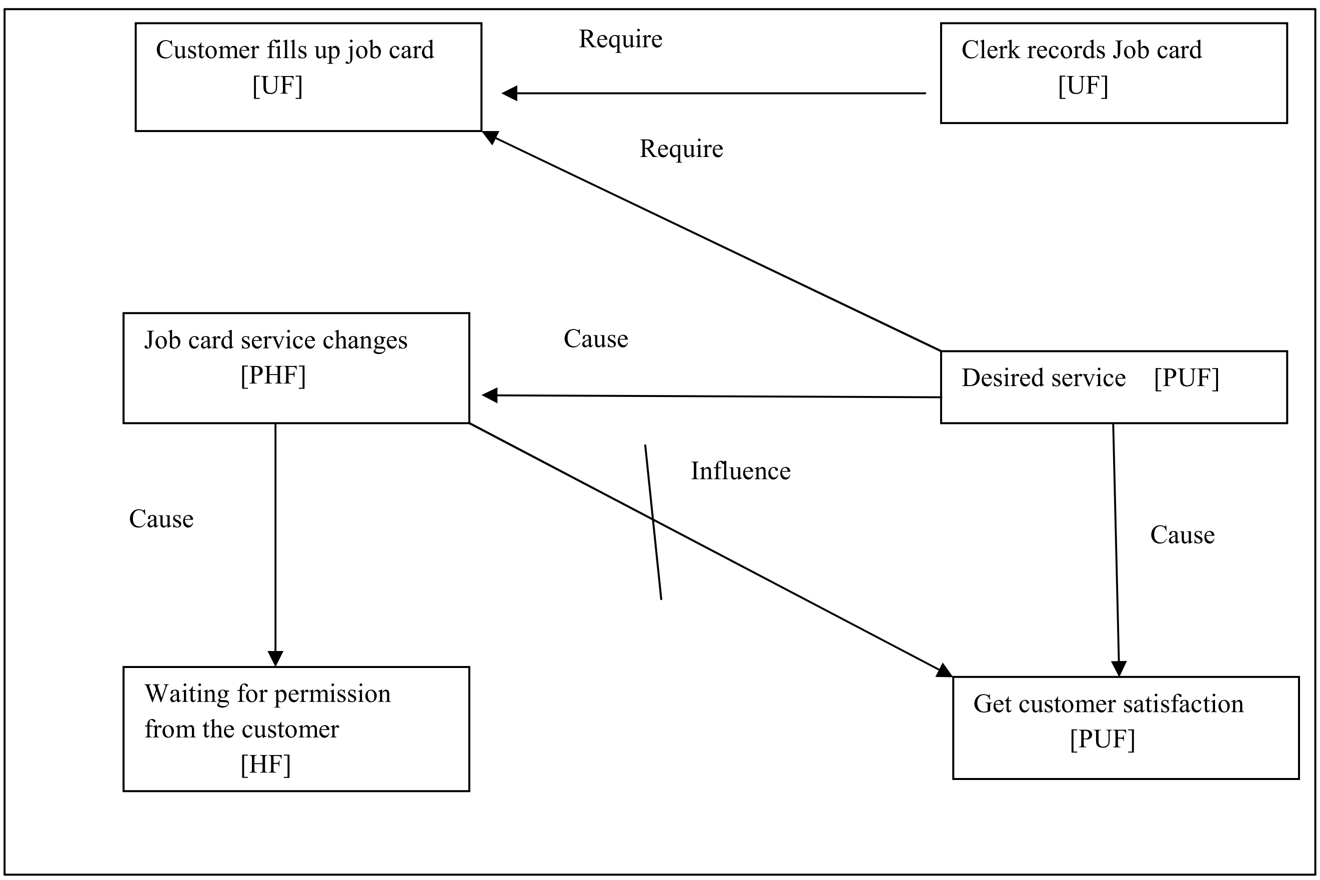

FIGURE 1: Problem modeling

The modeling function step helps the designer to understand the problem clearly, and at the same time helps to formulate the problem statements and identify the inherent contradictions in the service system [2]. Basis on functional diagram, the problem formulations for this case study are:

Find an alternative way for the clerk to record JC that doesn't require customer fill up.
Find a way to enhance how customers fill up a JC.
Find a way to enhance how Clerk records a JC.
Find alternative way to desire perform service that doesn't require customer fill up and doesn't cause service changes.
Find a way to enhance desired service performance that results in customer satisfaction.
Find a way to enhance desired service performance causing customer dissatisfaction.
Find a way to eliminate or reduce service changes to avoid waiting for permission from the customer.
Find a way to benefit from the JC service changes.
Find a way to eliminate, reduce or prevent the harmful function of JC service changes to avoid influencing of "get customer satisfaction.

According to the TRIZ method, the most important thing is that we obtain an ideal solution. An ideal solution means that we have a solution that maintains the benefits in the service system, removes the service system deficiencies, does not introduce new deficiencies, and does not further complicate the service system [3]. In our case study, problem statements 5 & 6 indicated the ideal solution. Since we are looking to eliminate the inherent contradiction, problem statements 5&6 show that in this situation the JC should not add new service to ensure the satisfaction of the customer, and at the same time we need the JC service to add a new service, one that requires the agreement of the customer on changes in the JC. Therefore, after analysis we found that the object of this contradiction is the JC itself and the action that must be taken is contradiction, the addition of a new service. Thus, to solve this problem we need to focus on the object and the action. This led us to think that before we add a new service, we need the customer to agree to it. If the company tries to get each customers approval to add a new service, they need to send a letter to each specific customer, and await his/her reply. If the company gets the green light from the customer, they proceed with reforms. This may result in delays in service. As a result, fast approval before adding the new service is required. According to this analysis, we can see clearly that the type of service needed is pre-service. Accordance of the SRCs, pre-service characteristic "Customers must supply detailed information to receive the service" lead us to use principles "30. Flexible shells and thin films" – see table 3. This principle hints that "interaction between the employees and top management may be like thin film. Employees can break through the company hierarchy to access upper-level management without hindrance" [5]. This hint can lead the company to think of giving the mechanic authority to contact the customer directly instead of beginning the long process of contacting the operations manager who will later contact the clerk who then contact with the customer and ask him/her permission to add a necessary new service to JC. Another characteristic of pre-service is "Customers plan service consumption ahead of time" which leads us to principle 4.dynamic principle" – see table 3. The dynamic principle suggests changes in your product or service to allow for relative movement, or to allow your service to be modified so that the user can customize its function for optimal operating conditions. This can give a clue that the user (the user of the JC either the mechanic or customer) can customize the JC service based on a set of conditions. Therefore, the company can put one more approval check box in the JC which tells the customer that the company will have the right to add the new service to the JC if changes are deemed necessary. Moreover, the company could provide the customer with a checkbox system where the customer indicates an upper limit to how much may be added to the invoice without prior customer approval. If the maintenance exceeds this upper limit, the company should stop the maintenance until they contact the customer to obtain approval from the him/her for the new cost. The customer should then sign this agreement.

5. CASE STUDY DISCUSSION

The solution of giving the mechanic authority to directly contact the customer instead of the long process with the operational manager and clerk will make the service system more complex and we still not solve the problem of time required while the company waits for the customer to agree to the new service addition to the JC. The second solution is to put an approval check box in the JC which tells the customer that the company has the right to add new service to the JC if changes are necessary, and the customer should authorize if this agreement is acceptable. The ideal solution should maintain the benefits of the service system, remove service system deficiencies, introduction no new deficiencies, and not further complicate the service system.

The framework for designing a new service by [2] suggests that the designer should analyze problem formulation then analyze all the problem statements. In some cases, problem function modeling is very complex and involves many functions. Thus, we will have many problem statements to analyze and this process consumes time. Thereafter, we skipped the step of analyzing the problem statements and proceeded to the step of contradiction analysis and contradiction elimination as we discussed in case study analysis. In addition, by knowing the object of the contradiction and the action in which the contradiction occurred helps the designer to focus on the particular SRCs with appropriate characteristics of the service, thus leading in the end to specific inventive principles. In this way, the process of generating solutions will be more efficient than examining each principle for clues. However, the problem statements analysis may have some solutions to the problem, and the designer can do such analysis in case he/she couldn't get a clue of the solution from skipping to contradiction, although this way may consume time, especially if we have a long list of problem statements.

6. CONCLUSION

40 inventive principles are the more popular tools used with TRIZ to eliminate inherent contradiction. The problem with 40 inventive principles is that they are hard to memorize and going through all 40 principles will takes time. The best way to solve this problem is to categorize the principles under the five service redesign categories in order to direct the designer to service characteristics with principles listed below them to solve the service problem. The case study demonstrated how the designer goes direct to the ideal solution using the proposed grouping tables. Moreover, grouping inventive principles has an advantage in terms of focusing on particular principles instead of looking at all 40 principles, and cuts the time needed to search for appropriate principles that would help to overcome the problem. In order to prove the efficiency of using the proposed grouping inventive principles, more empirical studies would be recommended.

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