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Full Length Research Paper

SSME architecture design in reserving parking problems in Malaysia

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Parking industries are so vital that no one functions if these industries do not function efficiently. Though this industry is undergoing a revolution, applying new technologies such as Service Science Management and Engineering (SSME) to achieve better performance and customer satisfaction, in Malaysia this industry is lagging behind. Against this concern, this study was undertaken with the purpose to unfold and understand the need for a more efficient parking management system to be implemented. The focus of this research is on integrating important components of business, management and technologies, in order to provide quality services for customers and thereby improve the management of parking systems. In a nutshell, the primary goal of this study is to improve the car parking service systems and this is carried out through service innovation which is inherently multidisciplinary. It further examines the many benefits of advanced parking management systems. This study used a quantitative approach and a questionnaire survey was used. The evaluation findings derived through a second survey showed beyond doubt that the proposed system has excellent advantages over the existing manual system.

Key words: SSME, MIS, IPS, car park management, intelligent parking system.

INTRODUCTION

SSME is a term introduced to describe services sciences. It is interdisciplinary approach to the study, design, and implementation of services systems. The service system becomes complex and it includes the use of people and integration of technologies in order to provide valuable improved services for users. Service-oriented thinking is one of the fastest growing paradigms in IT, with relevance to accounting, finance, supply chain management and operations, strategy and marketing (Demirkan et al., 2008). Teboul (2006) had said that we are all more or less in services. In fact, within the last five years, the service sector has become the most active sector in the global economy (Maglio et al., 2006). Services account for 75% of the US Gross Domestic Product (GDP) (Pal and Zimmerie, 2005). The economy of the world is now changing from a goods based economy to one in which there is value creation, employment and economic wealth. All these are dependent on the service sector (Spohrer and Maglio, 2008). SSME can be said to be an approach to integrating a variety of disciplines, including engineering, social sciences and management, to focus education and research on services. The world economy is currently transitioning from a goods based economy to an economy in which value creation, employment, and economic wealth depend on the service sector (Spohrer and Maglio, 2008). The role and contribution of the service sector is increasing day by day. Spohrer et al. (2007) defines a service as the application of competence and knowledge to create value between providers and receivers. The value that accrues is derived from the interactions of entities that are known as service systems (Vargo and Lusch, 2004). The service systems through configurations allow dynamic value co-creation. Basically

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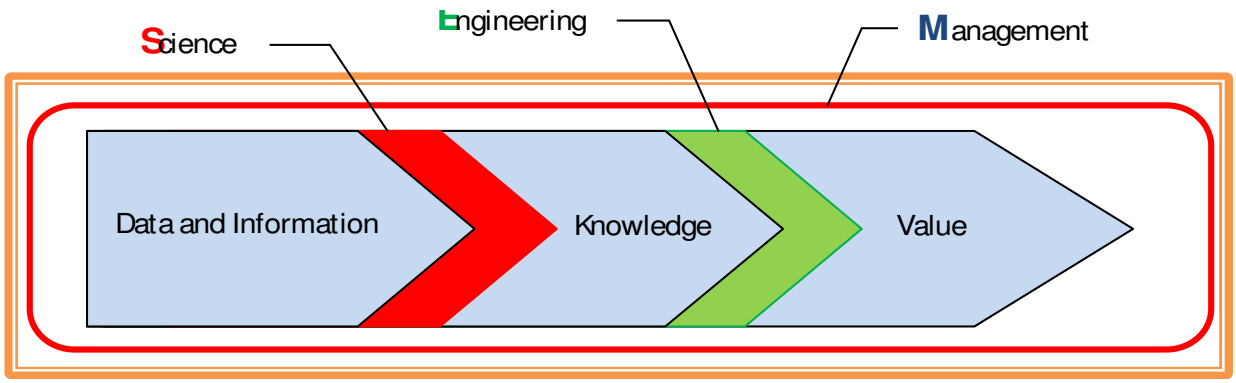

Figure 1. Multidisciplinary way of creating value (Maglio et al., 2006).

they are related to people, technology, organizations and shared information.

Services science is a multidisciplinary field that seeks to bring together knowledge from diverse areas to improve the service industry's operations, performance, and innovation. In essence, it represents a melding of technology with an understanding of business processes and organization. More precisely, SSME has been defined as the application of science, management, and engineering disciplines in providing services by incorporating SSME concept. SSME can also be a services science to create knowledge about services. Services engineering is a way to use knowledge to create valuable service (Figure 1). Services management aims to improve the process of creating and capturing service value.

The goal of the SSME discipline is to make productivity, quality, sustainability, learning rates, and innovation rates more predictable across the service sector (Hui et al., 2007). Today, SSME calls for academia, industry, and governments to focus on becoming more systematic and innovative in the service sector. Service is normally the largest economy sector in most industrialized nations, and is fast becoming the largest sector in developing nations as well.

COMPONENTS OF SSME

SSME contains three parts, based on the discipline it is associated to: Service Science (SS), Service Management (SM) and Service Engineering (SE) respectively. These three parts often work together. The activities and tasks of these parts are integrated to produce and improve the service systems (Song et al., 2008). These three parts can be briefly described as follows (Alam, 2010).

(i) Service science refers to understanding of the origins and life cycles of service systems, ranging from business components, to business models; to value networks of many businesses linked globally (Spohrer, 2006).
(ii) Management examines the process of creating things of value and administers, manages supplies, optimizes, and makes profitable this process (Spohrer, 2006).
(iii) Service engineering refers to the design, development, deployment, operations, and maintenance of service systems based on IT, knowledge workers, outsourced organizational or business components – all configured to co-create, deliver, and capture value between a provider and a client (Spohrer, 2006).

The interaction of the above three areas namely service science, service management and service engineering can be demonstrated through a diagram. Figure1 shows how science takes data and information and turns it into knowledge while engineering takes knowledge and makes things of value from it. Next, management examines the process of creating things of value and administers, manages, supplies, optimizes and makes profitable this process. These three components, Science, Engineering and Management are critical pillars of services activities. SSME is important as the world is becoming networked, dependent on information and information technology. Science will provide tools and methods to study services and develop solutions to prob-lems that span multiple disciplines. The goal of SSME is to improve service systems and this is carried out through service innovation which is inherently multidisciplinary (Figure 1). In a nutshell, SSME can be said to be a term introduced by IBM which brings together people from a variety of discipline or rather integrate knowledge from a variety of fields including computers and engineering, economics and business, social and cognitive sciences in support of service innovation, design, delivery and management. SSME important as the world is becoming networked, dependent on information and information technology.

Science will provide tools and methods to study services and develop solutions to problems that span multiple disciplines.

Key concepts

Service

Service involves at least two entities, one applying competence and another integrating the applied competences with other resources and determining benefit (value co-creation). We call these interacting entities service systems (Spohrer et al., 2007). Service systems are the sophisticated knowledge-value reasoning entities made up of (a) people who are perceiving, thinking, remembering, planning and experiencing together with (b) organizations and machines that can be viewed as populations of stakeholders interacting in service worlds (Bryson et al., 2004).

Value propositions

Value depends on the capabilities a system has to survive and accomplish other goals in its environment. Taking advantage of the service another system offers means incorporating improved capabilities. Value can be defined as system improvement in an environment. All ways that systems work together to improve or enhance one another's capabilities can be seen as being value creating (Vargo et al., 2008). In other words, value propositions is a kind of shared information between the entities that shape the interactions and are used to reason about win-win value co-creation outcomes (Kim and Mauborgne, 2005; Gummesson, 2007).

Governance mechanisms

Governance mechanisms is a type of shared information between the entities that shape the interactions between entities and is used to reason about collective win, dispute resolution, risk taking, and learning to improve performance (Omerod, 2005). The three basic concepts underlie the service systems worldview that is the view that the world is made up of service systems that interact via value propositions to co-create value, but often disputes arise and so governance mechanisms may be invoked to resolve disputes.

Service science

Service science consists of fundamental theories and research methodologies that deal with service structure, data in the analysis of service provided and management, service modeling and service processes (Glushko, 2008). Service involves both a provider and a client working together to create value. In other words, service involves at least two entities, one applying competence and another integrating the applied competences with other resources and determining benefit (value co-creation). We call these interacting entities service systems (Spohrer et al., 2007). For example a doctor interviews a patient, does some tests, and prescribes some medicine. The patient answers the questions, cooperates with the tests, and takes the medicine faithfully. Perhaps, technologies and other people are involved in the tests or in the assignment and filling of prescriptions. Together, doctor, patient and technologies co-create value requiring patient's health. These relationships and dependencies can be viewed as a system of interacting parts. In many cases, a service system is a kind of complex system, a system in which the parts interact in a non-linear way. As such, a service system is not just the sum of its parts, but through complex interactions, the parts create a system whose behavior is difficult to predict and model. In many cases, a main source of complexity in a service system is its people, be it as the client, provider or organization (Gou et al., 2008).

Service system

Service can be defined as the application of competences for the benefit of another, meaning that service is a kind of action, performance, or promise exchanged for value between provider and client (Maglio et al., 2006). Service is performed in close contact with a client; the more knowledge-intensive and customized the service, the more the service process depends critically on client participation and input, whether by providing labor, property, or information (Miles, 2008; Bainbridge et al., 2006). Service systems consists of service providers and service clients working together to co-produce value in complex value chains or networks. The customer is always a co-producer (Vargo and Lush, 2004). Providers and clients might be individuals, firms, government agencies or any organization of people and technologies (Maglio et al., 2006). The key is that providers and clients work together to create value the client owns or controls some state that the provider is responsible for transforming according to some agreement between provider and client. Value, however, depends on the capabilities a system has to survive and accomplish other goals in its environment. Taking advantage of the service another system offers means incorporating improved capabilities.

Value can be defined as system improvement in an environment. All ways that systems work together to improve or enhance one another's capabilities can be seen as creating value (Vargo et al., 2008). The 'Provider

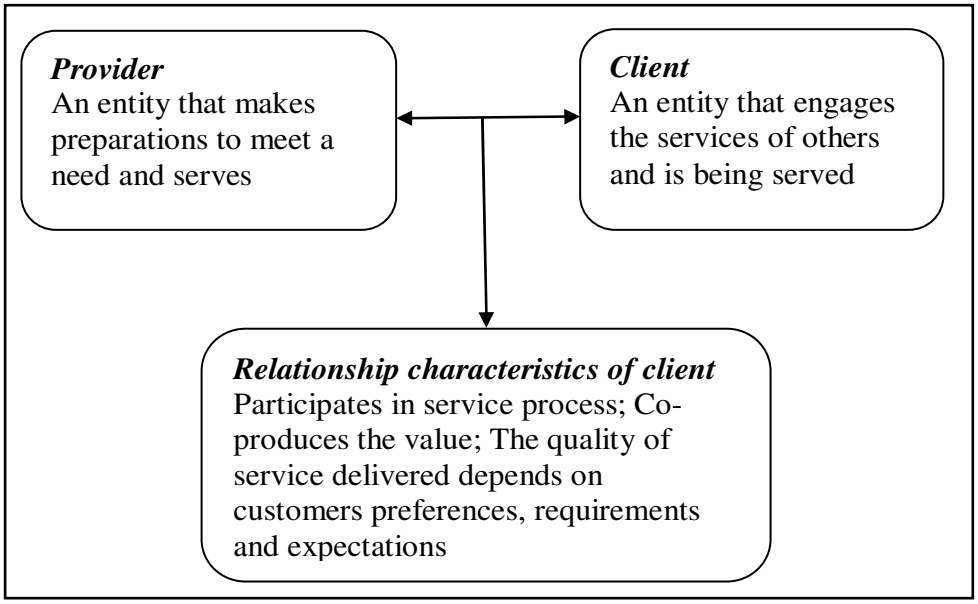

Figure 2. Provider-client relationship (Incorporated, 2006).

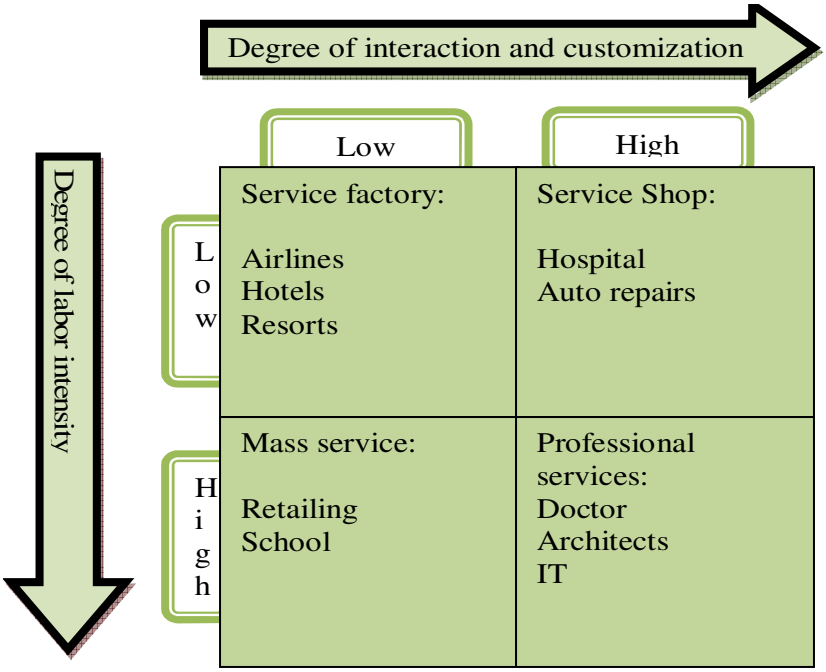

Figure 3. Service Process Matrix (Lovelock, 1983; Fitzsimmons and Fitzsimmons, 2003).

-Client Relationship' that operates in co-creation of values in the SSME approach is depicted in Figure 2. The service process matrix which reflects the degree of labor intensity and degree of interaction and customization is depicted in Figure 3. Intelligent Parking System would fall into the second box under 'Service Shop' which has

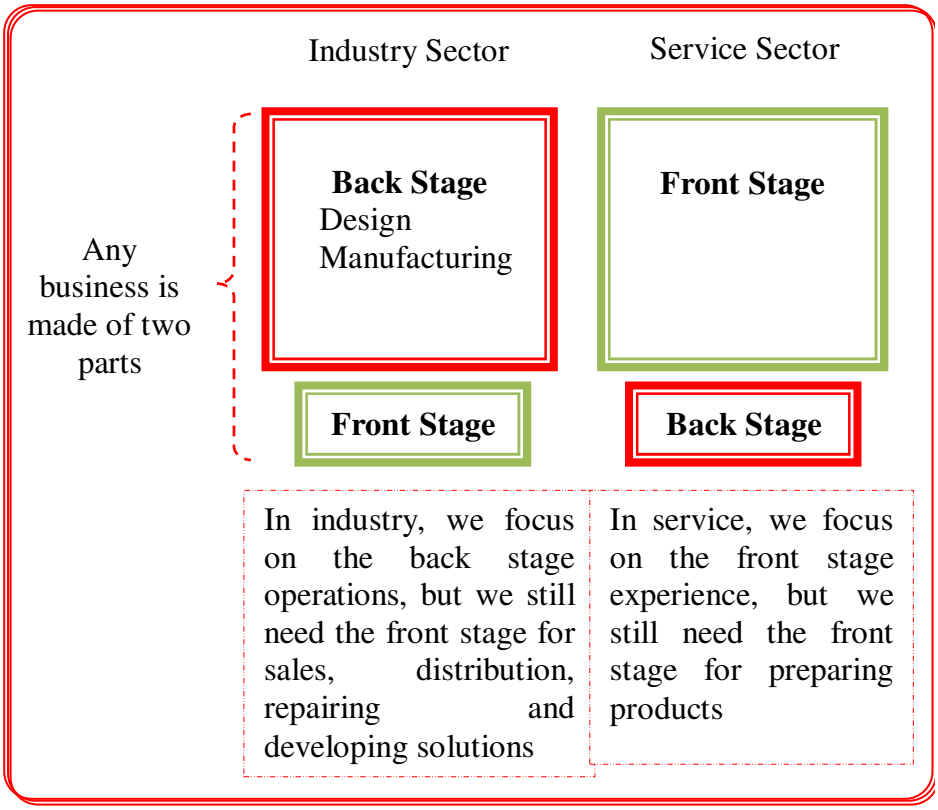

Figure 4. Back stage and front stage activities (Glushko, 2006).

a high degree of interaction and customization

CRITICAL REVIEW ON THE APPLICATION OF SSME APPROACH

Based on the SSME approach, a system is any set of available variables selected by an observer to identify fundamental objects, the influential attributes of the objects, and the relationships of these objects that result in a phenomena. There are notably three types of systems and they comprise Natural Systems, Manufactured Systems and Socio-technological systems. The socio-technological system is a combination of natural and manufactured systems where the key characteristics are the interacting elements that occur between sociological and mechanical aspects. Thus, in a socio-technological system there may be any number of elements, interconnections, attributes, and stakeholders interacting to satisfy the request of a known client and create value. Examples of the socio-technological systems can be seen in the business sector, government departments and in the services industry. The intelligent parking system falls under the services industry. What has actually happened is that document engineering had taken place. Document Engineering is a synthesis of information and systems analysis, user and task analysis, business process modeling, information architecture, and distributed computing (Glushko, 2005). In this business transaction, according to the SSME approach, one should not forget the backend of the business process. It is important to note that services are not just front stage only but are also part of both front and back stages. The front stage represents the interaction the customer or service consumer has with the service (Figure 4).

This research focuses on improving the car parking system. Many studies have looked at the quality and facilities of the parking system suggested remedies.

JUSTIFICATION ON THE USE OF SSME APPROACH TO IMPROVE THE DEVELOPMENT OF IPS

Three figures namely Figures 5, 6 and 7 are used to explain how SSME principles could be used to improve the development of IPS. Figure 5 depicts the Open-Systems View of Service Operations that need to be considered when designing an Intelligent Parking System. Service science principles where interactions shape value propositions and appropriate governance mechanisms are

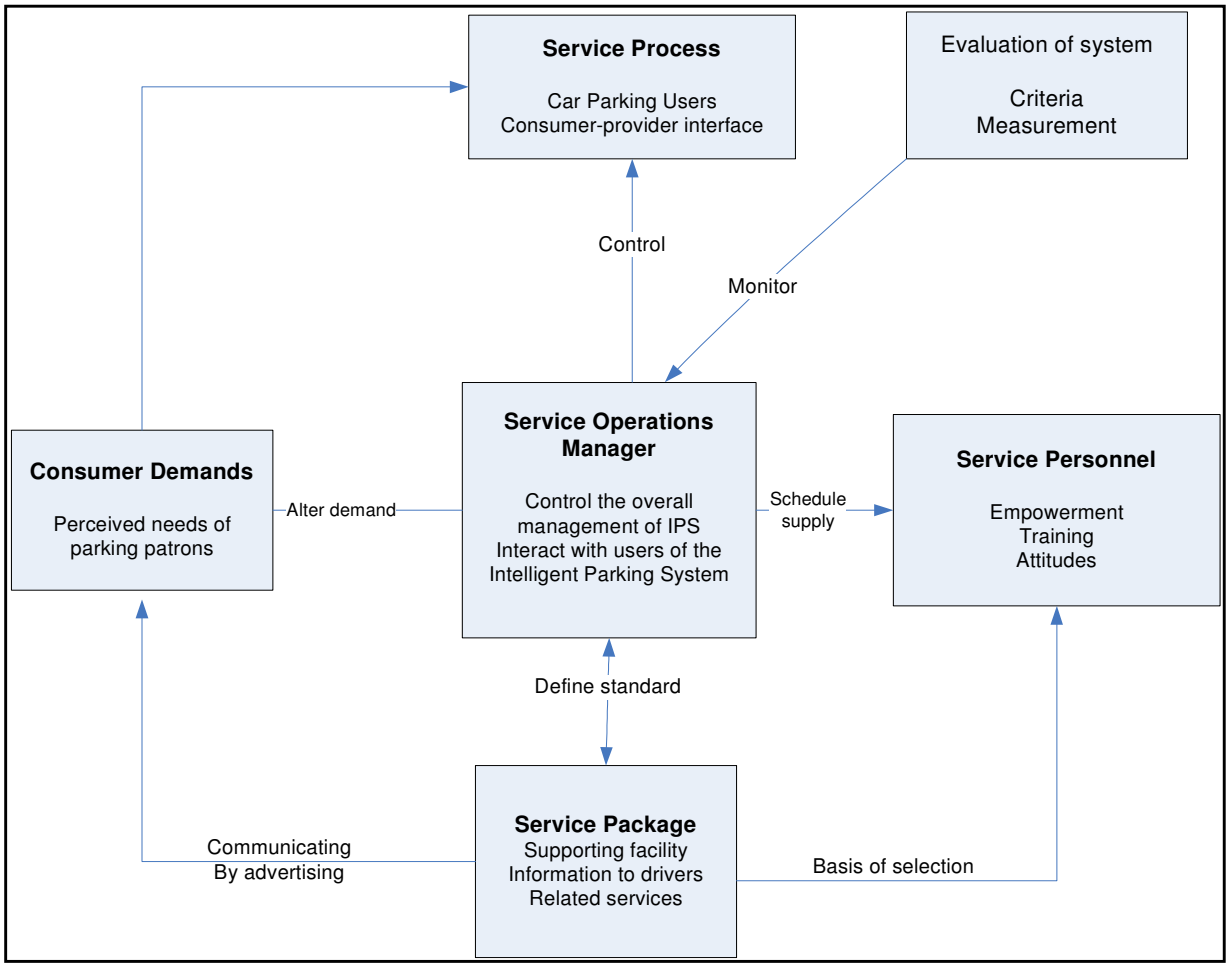

Figure 5. Open-systems view of service operations (Adapted from Fitzsimmons and Fitzsimmons, 2006, p. 30).

carried out in creating an Intelligent Parking System. Management strategies which measure progress and maintain viability and a competitive edge are taken into consideration during implementation of a parking system. Valuable feedback from parking patrons are sent to the engineering partners so that scaling of service systems be improved by the invention of new technologies or the reconfiguration of existing ones (Spohrer and Kwan, 2009). In this manner, the provision of parking services does not become stagnant but are continuously improved for the satisfaction of customers.

In an IPS, the role of the frontline employees who render assistance to drivers (patrons/customers) are important as they too can collect much needed information for the parking management. Hence, there is co-creation of value between all stakeholders in the company which is providing the parking service. A win-win situation is created where the parking patrons are completely satisfied with the services rendered by IPS such as convenience of parking, better security, reasonable parking charges and state of the art car parking technology (Anderson et al., 2005). Figure 9 depicts the Service-Profit Triangle which emphasizes the point that the role of the frontline employees is crucial in increasing service productivity which would indirectly boost the profit margin of the company implementing the IPS.

Parking management

A survey of the existing car parking management systems are carried out and their pros and cons are noted in relation to the SSME approach. Parking is an essential component of the transportation system. Vehicles need to park at every destination. A typical automobile is parked at a certain period of time during the

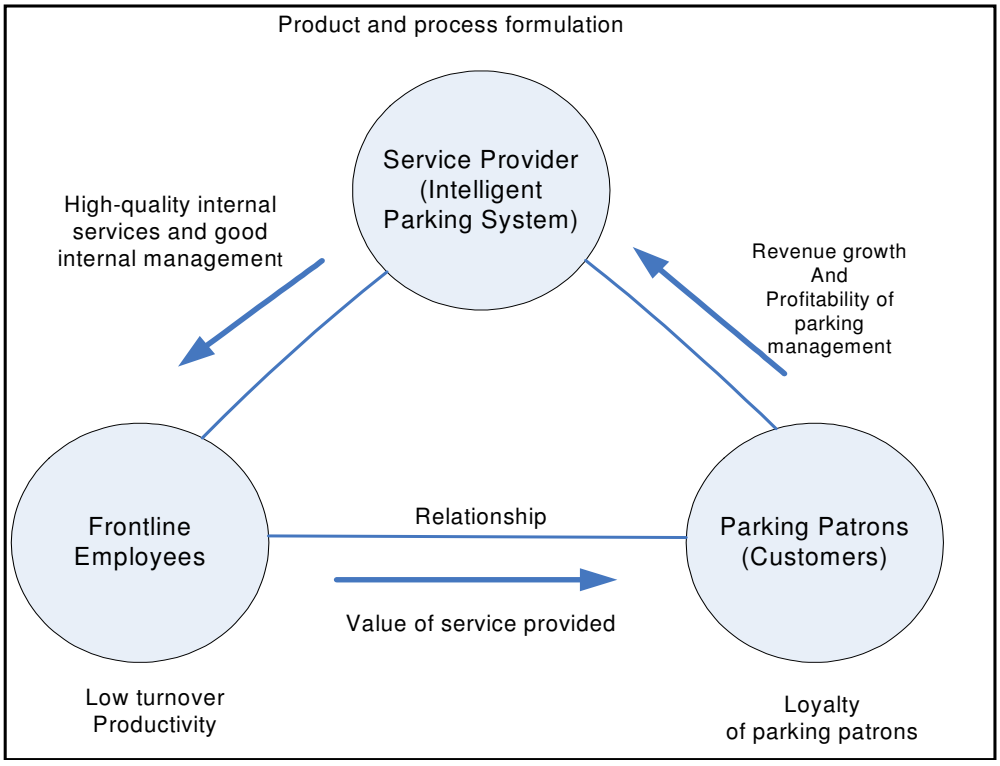

Figure 6. Service-profit triangle (Teboul, 2005: p 33).

day and uses several parking spaces each week. There is another problem of shortage of space to park cars in shopping centers. Parking facilities are a major cost to society, and parking conflicts are among the most common problems facing designers, operators, planners and other officials. Such problems can be often defined either in terms of supply (too few spaces are available, somebody must build more) or in terms of management (available facilities are used inefficiently and should be better managed). There is a need to provide better customer service by using the available car parking spaces more efficiently. Parking management refers to policies and programs that result in more efficient use of parking resources. Parking management includes implementing strategies which if appropriately applied can significantly reduce the number of parking spaces required in a particular situation, providing a variety of economic, social and environmental benefits.

Parking management benefits (Litman, 2006)

(i) Facility cost savings: Reduces costs to governments, businesses, developers and consumers.
(ii) Improved quality of service: Many strategies improve user quality of service by providing better information, increasing consumer options, reducing congestion and creating more attractive facilities.
(iii) More flexible facility location and design: Parking management gives architects, designers and planners more ways to address parking requirements.
(iv) Revenue generation: Some management strategies generate revenues that can fund parking facilities, transportation improvements or other important projects.
(v) Reduces land consumption: Parking management can reduce land requirements and so helps to preserve green space and other valuable ecological, historic and cultural resources.
(vi) Supports mobility management: Parking management is an important component of efforts to encourage more efficient transportation patterns, which helps reduce problems such as traffic congestion, roadway costs, pollution emissions, energy consumption and traffic accidents.
(vii) Supports Smart Growth: Parking management helps create more accessible and efficient land use patterns, and supports other land use planning objectives.
(viii) Improved walk ability: By allowing more clustered development and buildings located closer to sidewalks and streets, parking management helps create more walkable communities.
(ix) Supports transit: Parking management supports

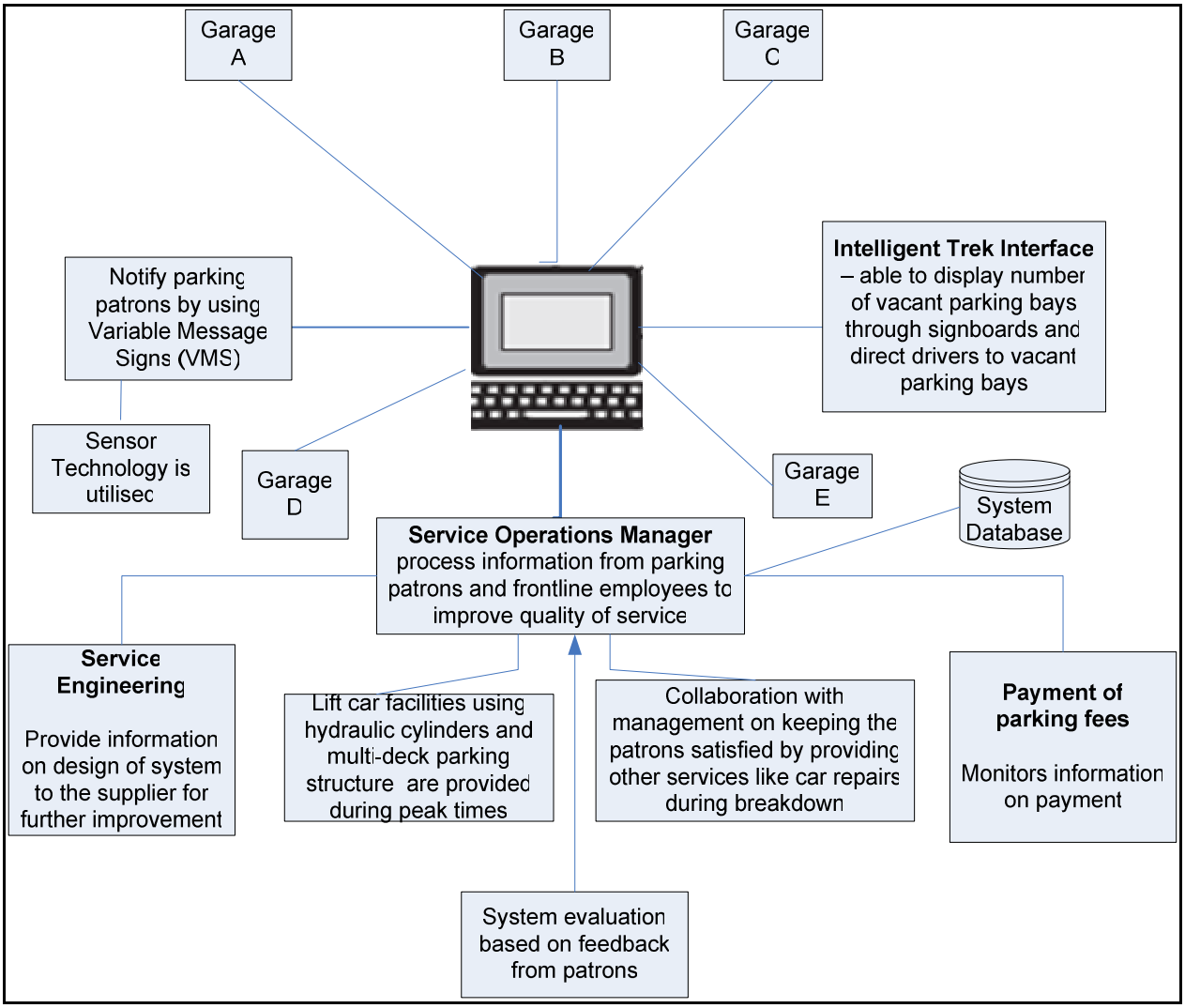

Figure 7. Initial architecture for proposed intelligent parking system.

transit oriented development and transit use.
(x) Reduced storm water management costs, water pollution and heat island effects: Parking management can reduce total pavement area and incorporate design features such as landscaping and shading that reduce storm water flow, water pollution and solar heat gain.
(xi) Supports equity objectives: Management strategies can reduce the need for parking subsidies, improve travel options for non-drivers, provide financial savings to lower-income households, and increase housing affordability.
(xii) More livable communities: Parking management can help create more attractive and efficient urban environments by reducing total paved areas, allowing more flexible building design, increasing workability and improving parking facility design.

Intelligent parking system architecture

An Intelligent Parking System would not only have elements from advanced parking information systems but it would incorporate essential elements of SSME approach. The initial architecture of the proposed Intelligent Parking System is shown diagrammatically in Figure 7. The service operations manager is in control and he is responsible to the management and all the other stakeholders in the parking company or organization. Co-creation of values takes place through feedback from users of the system. Any suggestion on design is referred to the engineering section and feedback from frontline employees is noted to further improve quality of service.

Table 1. Breakdown in terms of age, nationality and gender.

Age	Value	Nationality	Value	Gender	Value
17 - 21	9	Local	20	Male	14
22 - 26	11	International	11	Female	17
>26	11				

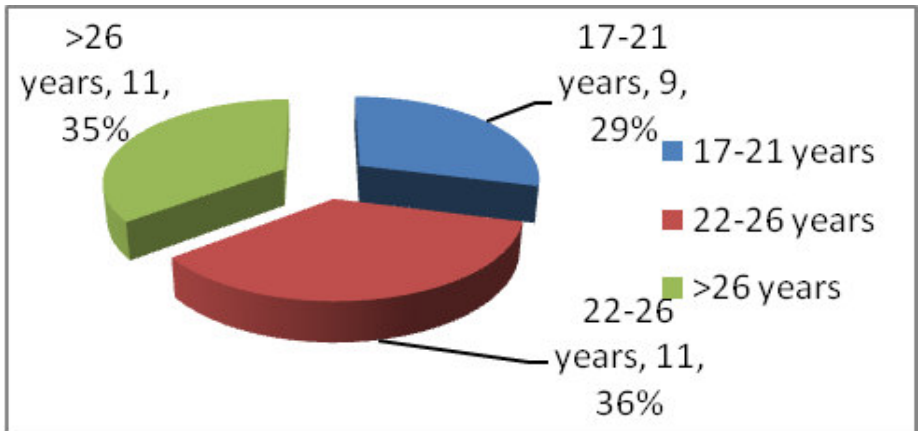

Figure 8. Responses according to their age groups.

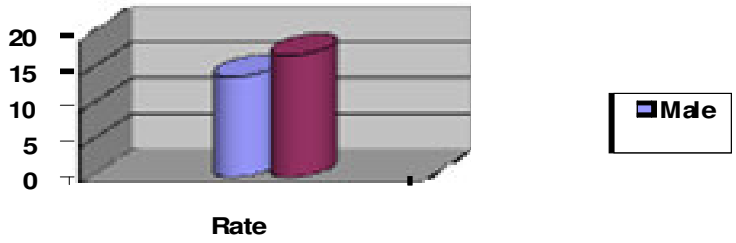

Figure 9. Ratio of male compared to female.

DATA COLLECTION

For the collection of data, a questionnaire survey form was designed and distributed to car park users. Besides the basic demographic questions, eight other questions were asked pertaining to problems faced by car park users. A sample questionnaire distributed on a total of 31 respondents participated in the questionnaire survey. The respondents consist of patrons who used Mid-valley Megamall parks. This particular place was chosen because of its popularity among shoppers. The focus of the survey questions were mainly directed to find the problems faced by car parkers every time they visit a shopping mall, and to record their suggestions on improving the existing parking facilities. A summary of the responses is depicted in Table 1.

FINDINGS OF THE SURVEY

The survey questionnaire was administered to people who had visited the shopping mall in Mid-Valley city. The primary objective of the survey was to collect data to be used as user requirements to build an intelligent parking system. Once the prototype parking is developed, it would then be tested and subsequently implemented through simulations.

After having implemented, another questionnaire survey would carry out to evaluate the new system and ascertain if the new intelligent parking system meets the requirements of the users.

As depicted in Table 1 and Figure 8, the responses revealed that nine out of the 31 respondents are from the 17 – 21 category of age while eleven of the respondents are from the 22 – 26 category of age. In the more than 26 years of age category, eleven or 35% of the respondents fall into this category. This breakdown shows that most of

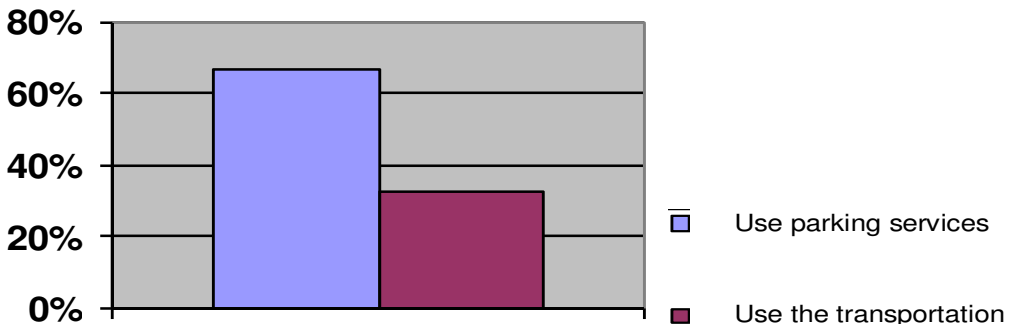

Figure 10. Transportation differences.

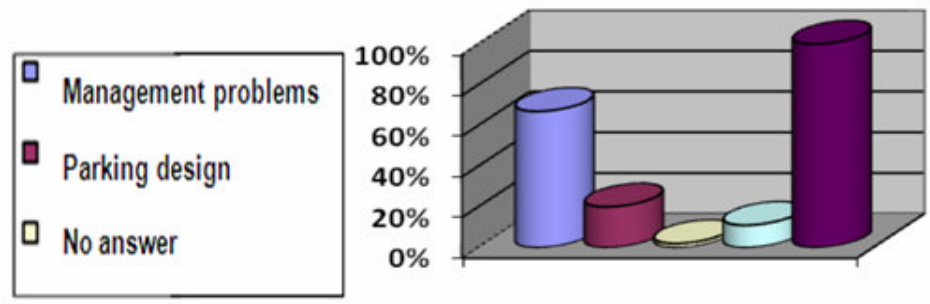

Figure 11. Responses about the parking systems problems.

the car owners are more than 21 years of age.

Figure 13 reveals that most of the people who use the car parks are locals. Eleven of the respondents are international users and this indicates that quite a sizeable number of the respondents in the Kuala Lumpur area are foreigners. Figure 9 reflects that 17 out of 31 respondents are female users reflecting that most of the users involved in this survey are females.

Main survey questions

Question 1: Do you often use your car for shopping or use it as a mode of transport to go from one place to another?

The bulk of the respondents (67%) answered that they preferred to use their own vehicle when they go for shopping while 33% preferred to use other modes of transportation. This indicates that there is a necessity for an efficient parking system. Figure 10 show the ratio of people who prefer to use their own car compared to people who use other modes of transport.

Question 2: Have you ever faced parking problems?

This question asked the respondents if they faced any parking problems. As depicted in Figure 11, all the car owners agreed that they faced parking problems and 67% of the respondents blamed the management system for the parking problems. About 20% of the respondents said that the existing parking system was not able to resolve their parking problems intelligently. A small number (2%) of the respondents were not non-committal and abstained from answering while another 11% of the respondents said that the management or main stakeholders do not care about the park users. They gave no answer, while 11% said the stakeholders do not care about the customers.

Question 3: What kind of solution would you suggest?

Question 3 asked the respondents to suggest a suitable solution to the existing problems. Based on Figure 12, 86% of the respondents suggested that a new parking system ought to be developed with modern parking facilities. About 4% of the respondents had no comments as they had no idea of better parking facilities and another 4% preferred to switch to other modes of transportations while 6% do not care because they use other kinds of transportations.

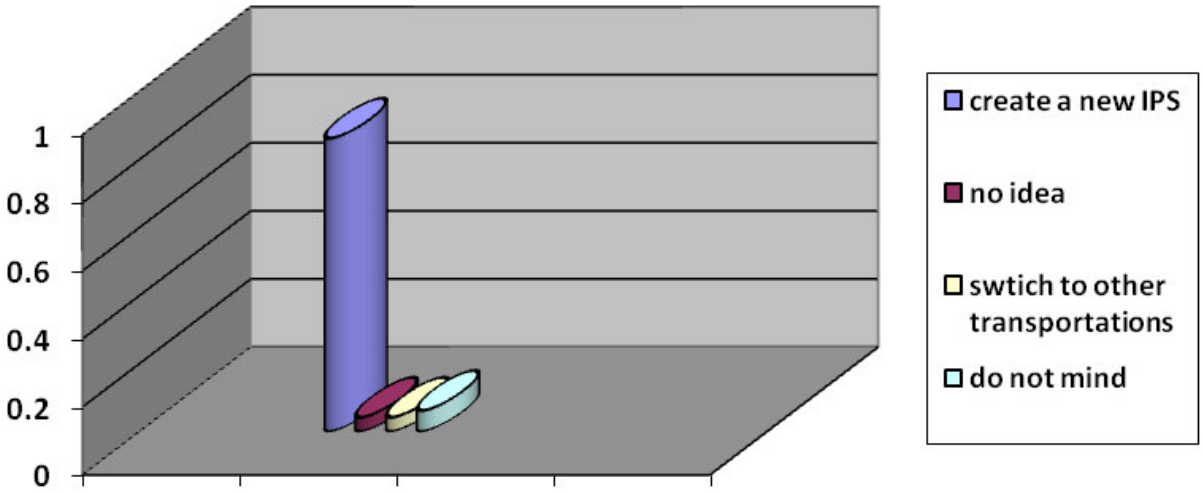

Figure 12. Suggestions.

Question 4: How long have you been using the current parking systems?

More than 80% of the respondents said that they have been using the car parking facilities in Mid-Valley Megamall for more than three years.

Question 5: Do you prefer building a new computerized parking system so that the weaknesses in the current parking systems could be overcome?

In relation to building a new parking system, a special question was directed to the people who work on the parking system especially people who work on the software development and others who work in the management of these places. They were asked if they preferred to build a new automatic parking system in the light of weaknesses in the current parking systems. This question was directed to ten specially chosen people. 90% of the respondents in this category preferred to implement a new Intelligent Parking System (IPS) that is managed efficiently and uses up-to-date technology. Furthermore, they wanted the new system to be cheaper. The respondents in this category think that due to mismanagement, a lot of available space is wasted while 10% of the respondents think that just increasing the parking space would resolve the parking problem. Figure 13 depicts the special survey.

Question 6: How is your evaluation to the current parking system?

Out of a scale of 5, (1 being very bad and 5 being very good), the bulk of the respondents said that the present manual system is bad. Very often, cars have to queue in order to park.

Question 7: Are you aware that the Service Science Management and Engineering Approach (SSME) can improve the parking system in Mid-Valley Megamall?

Yes ☐ No ☐

Almost all except one said that they have no idea of what SSME approach is about. Five respondents wrote that if this approach is going to benefit the car parkers, then they would like the Megamall authorities to use this approach.

Question 8: If your answer to question 7 is positive, please provide more details. One respondent explained that SSME is related to service science and service system and many stakeholders are involved in this approach. All the other 30 respondents did not answer this part.

Observations

The researcher noted the following points after analyzing the responses in the questionnaire.

(i) All the respondents faced problem using the current parking system.
(ii) The age range between18-30 signifies the group of people who like to do shopping and see movies are young.
(iii) Different kinds of people were involved and this means that foreigners were also involved with the parking problem.

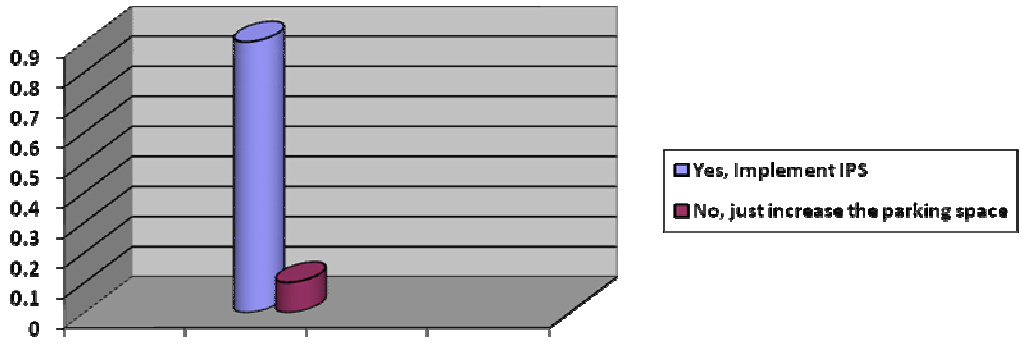

Figure 13. Special survey.

(iv) Analysis of the responses indicated that 63% of the respondents have problem in finding the parking space. This indicates that there is a serious problem with the management of the current parking system.
(v) Two types of problems namely management and technology problems were emphasized. To address these problems, the author aims to implement a new parking system.

The three components, Science, Engineering and Management which are critical pillars of services activities are not integrated in the existing system. In fact there is an absence of any sort of management information system. The SSME principles are disregarded in the existing system.

Conclusion

SSME Approach or Service, Science, Management, Engineering approach deals with research which is related to human life. Quantitative study using a questionnaire survey was used to obtain the user requirements and the system that was developed was evaluated by asking for users' opinions. This research presents one of the most service oriented systems used nowadays. SSME Approach had been successfully used in creating IPS and further in testing and in implementation of the new intelligent parking management. Currently, management information system plays an important role in our lives. Many systems are still poorly designed. This research had focused on improving the Malaysian parking system using information technologies to implement a high management parking system and thereby reduce the problems that exist in the Malaysian parking system. Sensor notification was used to solve the problems faced by users and this technology enabled the system to ease the problem of locating vacant parking bays and thereby reduce waiting time and avoid the hassle of locating vacant parking lots.

The proposed system was shown to 40 respondents and the findings of the data analysis of the second survey showed that the SSME features included in the design of IPS help to improve the overall performance of the system.

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