A Cognitive Model of Project Success Delivery

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Abstract- **An incompatibility of data processing and integrated systems of data migration and system implementation is always happening in all organizations which rely on electronic transactions. Since implementation of hardware facilitate infrastructures and software applications is deployed on a different period. Service interruption may cause from many reasons such as, hardware failures, software failures, human errors, upgrading systems, and incompatible functions of system integration. To understand of system malfunctions and system failures, we need to comprehend on each level of user requirements, application designs, facility designs, system integrations, system operations, system maintenances, and quality service management to increase the system reliability and robust system operations. This research proposes to construct the novel model of the integral system reliability from resolving user requirements in data center process of; design and planning; implementation; monitoring and controlling; systems evaluating and development; throughout the system operations and delivering quality services. Primary investigations via data processing and data center experts and secondary literature search were conducted. The findings revealed such dominant factors as technology, consultant, contractor or implementer, marketing strategy, and operations and service team are the vital based on project success delivery.**

Keywords- **System Reliability, System Integration, Service Quality, Project Success Delivery**

1 INTRODUCTION

Business downtime cost of brokerage may cost $6.45 million US per hour. Credit card sales may cost $2.6 million US per hour [10]. This cost is directly impact on financial loss and business reputation. It does not matter, it happens from which section of business operation such as, power outage, data center operations, application operation, electronic transaction and communication, internet data center (IDC), or internet service provider (ISP). It will cost welfare loss and bad image to the end users. Business reputation is reflected directly to business quality of services. Financial sector is a good example of delivering quality service because they are integrated of facility infrastructure and marketing / application services. All banking systems need a unified operation and each system cannot leave without the others.

Problem reaction or fast respond to the problem is eliminated the accumulation costs of downtime [19]. Preventive cost is much cheaper than corrective actions. The problem is how to solve through the right root cause of the problem at the first time and prevent the trial and error. Comprehensive understanding on system design and system operation is the key to increase more on the system reliability. Interconnection and communication is the other key to reduce misinterpretation and reaction to the problem. This research investigates, what are the multiple facets or dimension on which they evaluate the success services? The example of data center project subject to design, planning, implementation, monitoring and controlling, maintenance, and operation; network, server, storage, operation system, application installation, and application operation; are concerned to find out the critical factors that impact on project success or quality service.

Design and operation on fault tolerance topology is the key to increase system reliability and robust service system to support the critical operation 24x7 hour. Moreover, the fault tolerance topology might come with high system reliability but it needs to tradeoff with the high investment as well. This paper aims to institute and combine the conceptual model of delivering quality service by complying with the international standards namely; TIA 942 [15], BS25999 [3], ITILv2 [6], ISO20000 [7], IEEE 1490 [27], and Thailand local codes.

2 BACKGROUND

2.1 Definitions

*Service qua*lity (SQ) defines as the extent of discrepancy between customers' expectations or desires and their perceptions [23].

Tangible (W_1, x_1) defines as appearance of physical facilities, equipment, personal, and communication materials.

Reliability (W_2, x_2) defines as ability to perform the promised service dependably and accurately.

Responsiveness (W_3, x_3) defines as willingness to help customers and provide prompt service.

Assurance (W_4, x_4) defines as knowledge and courtesy of employees and their ability to convey trust and confidence.

Empathy (W_5, x_5) defines as caring, individualized attention the firm provides its customers.

Reliability: An indication of the ability of a component or system to perform its intended function during a specific time [19].

2.2 Data Center (DC)

A data center is an IT infrastructure system built for storing and disseminating information nearly light speed on real-time over the earth observation via the Internet; LAN, MAN, and WAN. The data center is designed for all online requirement proposals. The certain data sets will be stored, updated, exchanged, and delivered to all computers or mobile units that are available and online connected. Reliability/ availability/ dependability of a data center become a competitive advantage for critical applications of each company's core businesses.

One of the most complex systems of IT project is a data center (DC) implementation and operation. Why? Because DC is comprised 16 sub-systems [16]. Moreover, all 16 sub-systems must be operated in synergy to contribute to DC performance subject to availability, reliability, scalability, flexibility, capacity, simplicity, and manageability. The other complexity of DC design is rapid technological changes, as suggested by Moore's law (1965), stating that "a chip density will double every 18 months" [8]. The result of Moore's law is directly impacted the data center design in terms of heat load and power consumption.

The data center implementation has to concentrate not only on the chain reaction of Moore's law, but also on how to implement data center to meet the golden triangle or iron triangle objectives [22]. The criteria for measurement is under the concerns of time, budget, delivery exactly specification and quality of data center performance [4]. It seems that DC project needs to do concurrent engineering (CE) [2], as the same time it needs to answer and achieve by Moore's law in terms of DC size, power consumption, and forecasting heat loaded.

How to make a DC project success? Many researchers mention it in the literature reviews in the topic of "Key Success of Project Management". In this topic, the researchers try to concentrate on project management processes of DC. During DC project, there are many parties that are involved namely DC owners/end users, consultants, main contractors, sub contractors, suppliers, and technology owners. Each party has their own concerns. On this process, the most concerning part is to focus on consultants and contractors. Experiences and project site references are the key factors that contribute to project management success [9], [17].

2.3 Service Quality (SQ)

The evaluation of service quality is the most difficult for customers to make a decision rather than a goods quality. Hence, the evaluation of service quality needs the standardized criterion. It may be more difficult for the provider to comprehend. Zeithaml, Parasuraman, and Berry (1990) research defines the service quality as the gaps between customer's expectations and perceptions. Moreover, their research proposes key factors; internal factors for instance, knowledge; needs, feelings, and emotions; and past experience; external factors such as, word-of-mouth and communication channels; that influence customer's expectations.

The difference between expected service and delivered service is the perceived service quality. The Fig. 1 illustrates a pictorial summary of their findings which included; dimensions of service quality, internal imagination, external illusion, SLOs, perceived service quality, service quality level (SQL) and service quality index (SQI). Customer and service provider may have different perspective on service quality however the scope of service quality must be under SLOs. More than SLOs, we called "the value added or the great expectation" which can be measured by SQI.

The analytical sets of potential outcomes are sorted into grouping or cluster that has similar influences or effects. The procedure of decision making is involved as follows:

1. Structure a problem with a model that explains the problem's key factors and their interaction.
2. Extract judgment that reflects knowledge, needs, feelings, emotions, and past experiences.
3. Correspond to those judgments with significant numbers.
4. Apply these numbers to calculate the priorities of the factors of the hierarchy.
5. Synthesize these results to ascertain an overall result.
6. Analyze sensitivity to change in judgment.

Analytic hierarchy process (AHP) is applied through the quality service model. It assists decision making by organizing perceptions, needs, feelings, judgment, and memories into a model that illustrates the forces that impact a decision [13].

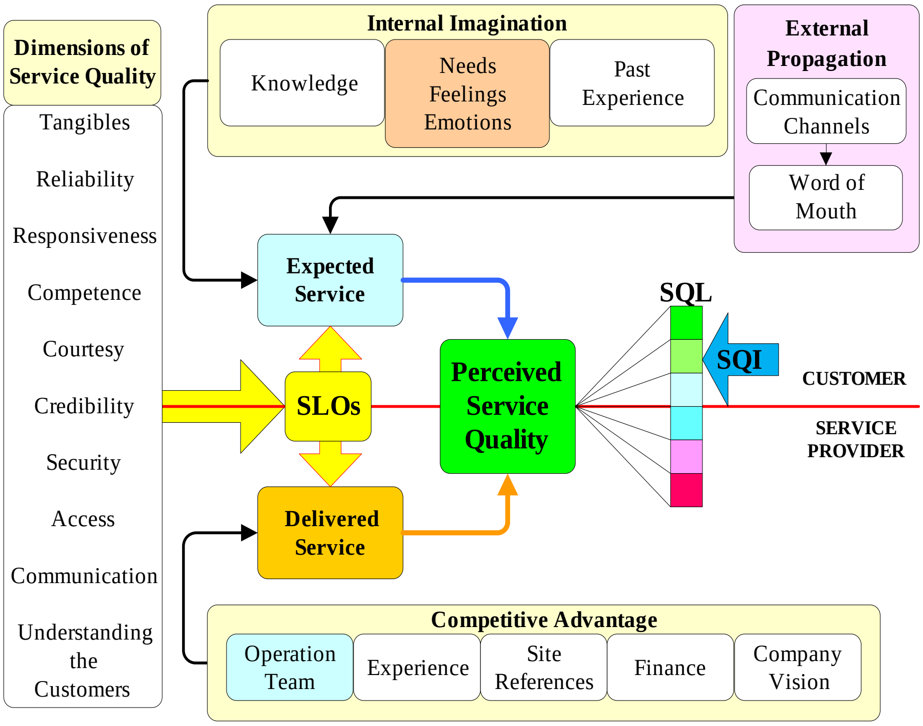

Fig. 1. Customer assessment for service quality.

3 METHODOLOGY

3.1 Corporate Population Model

To understand a crucial role in the assessment of service quality, we need to answer which factors are influenced the service quality to become success. According to the limitation of experts on DC, this research conducted an exploratory study consisting of 5 focus-group interviews (G1, G2, G3, G4, and G5); each group comprised 20 companies/ experts, the total 100 persons will have direct interview and questionnaire; technological supplier, designer & consultant, contractor or implementer, operator or service system owner, and IT specialist, as depicted in Fig. 2. The research selected a broad spectrum of data center operation and services to study of this research because we are looking for the factors that reflect and transcend the scopes of specific data center service businesses. The research conducted five focus groups in Thailand, and international conferences such as IEEE IEMC [18], IEEE ICMIT [20], IEEE ICSET [21], and ACIS-NSPD [19]. Additional information supports from literature review are referred to Zeithaml, Parasuraman, and Berry (1990), Saaty (1994), and Wiboonrat and Jungthirapanich (2007).

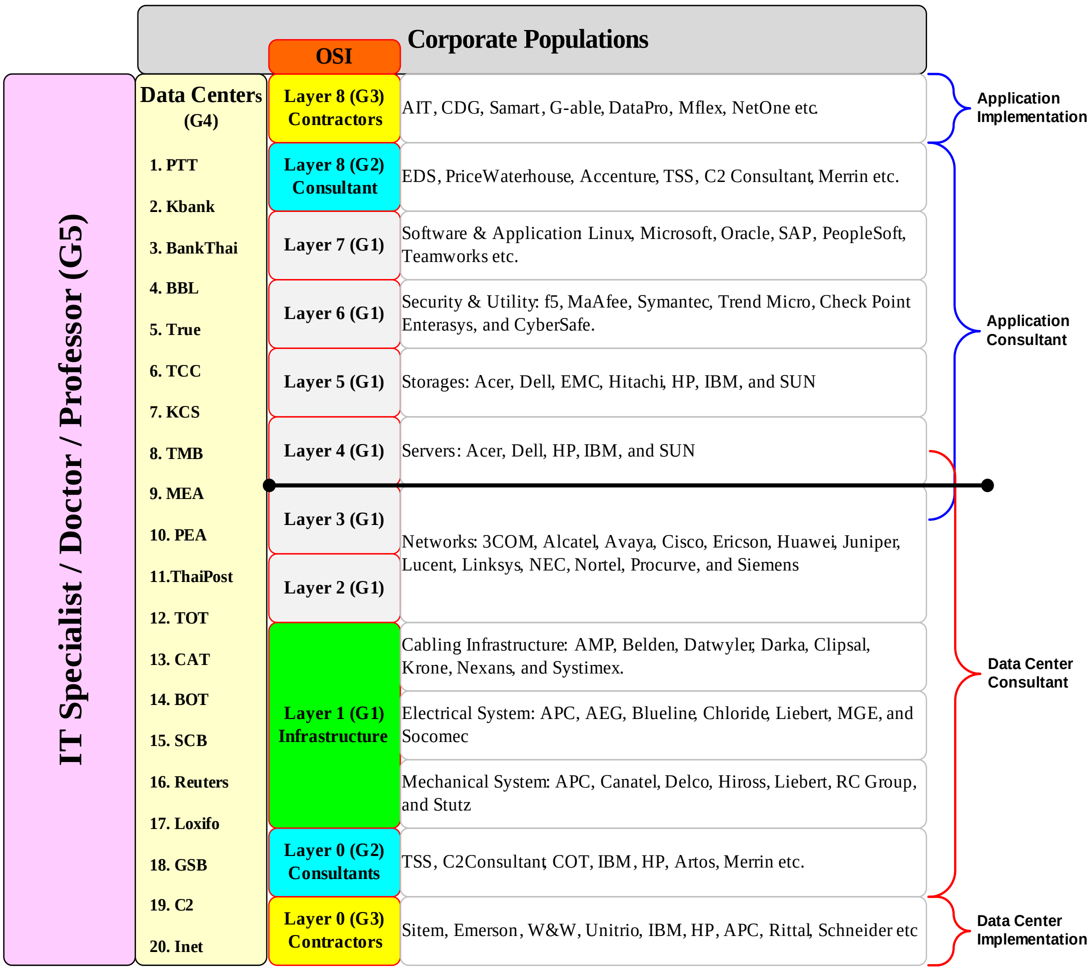

Fig. 2. Corporate population and IT specialist model.

3.2 Interview Model

A presentation of the related impact model of communication framework of data center project team depicts in Fig. 3. It shows an intermediate result of action and interaction between each party e.g. requestor, commander, interpreter, implementer, and end user. The external impact (independent variables) will affect the internal factors (dependent variables) of project success.

Deliverability is the most important factor for consultant and contractor for project management success. Consultant and contractor point of view concerns on the project achieved by contract agreement and got paid by sponsor. Sponsor/Project owner allows consultant/contractor to use DC as a site reference and an official citation notice. That is the other way that the consultant and contractor accept a project success. The biggest achievement of a successful project is when sponsors/clients recommend the consultant or contractor to other companies or his friends with guarantee on the working quality.

Assessment for project success criteria is different for each stakeholder. For an investor/sponsor, the most important factor is the return on investment. Improve on business reputation, productivity, efficiency, and competitive advantage is a compelling function of data center that must be achieved when creating the benchmark with other competitors in the same market.

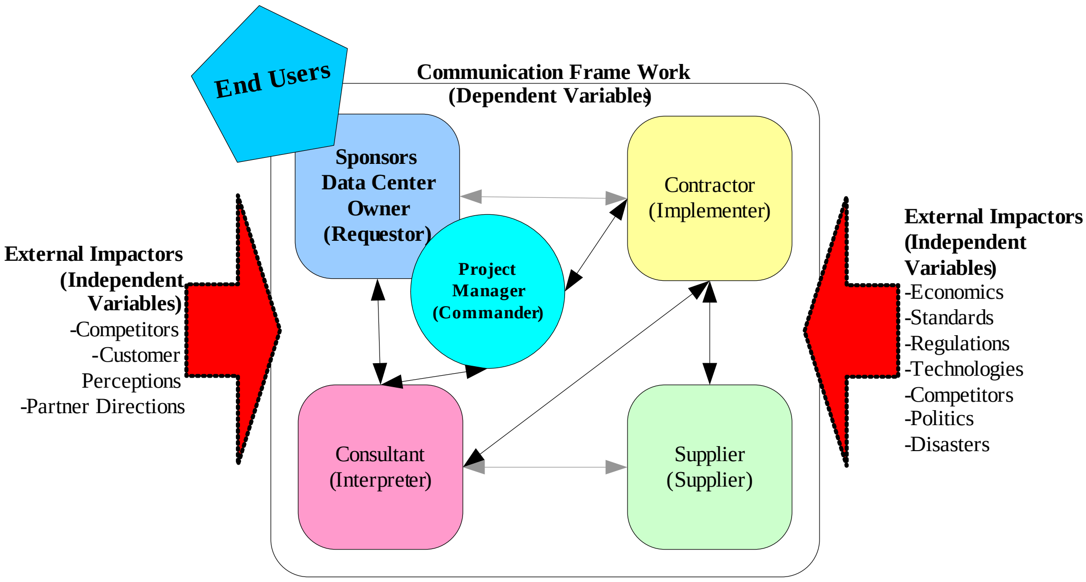

Fig. 3. Data center conceptual framework from direct interview and factors analysis

4 CONCEPTUAL MODEL

The first objective of qualitative model is to investigate the key success factors and key success criteria that are normally applied for project measurement in the market and research. The second objective is to examine and analyze two sources of the result directions, i.e. literature reviews and direct interviews, to resolve the conclusion of the chronological project success model. It delineates to a simple mathematical model as "*project management success (PMS) + quality products / services success (QPSS) = project success (PS).*" This is different from Baccarini (1999) that defined "*project success = project management success x project products/services success*".

The analysis and evaluation of chronological project success model is contributed to the success pattern of the data center project success in term of project implementation, project operation, and delivering quality service.

4.1 Service Success Model (σ)

This research model uses multiple criteria based on AHP to analyze the service success or subjective value (σ) of DC complex problems [13]. σ is comprised numerous subjective values such as, tangibles, reliability, responsiveness, assurance, and empathy [23].

From definition **(2.1)** we given by;

$$W_1 + W_2 + W_3 + W_4 + W_5 = 1 \quad \textbf{(1)}$$

$$W_1x_1 + W_2x_2 + W_3x_3 + W_4x_4 + W_5x_5 = \sigma,$$
where by σ = [0.1,…, 1] **(2)**

Since the result from 100 questionnaires an average weight on each W_i is 0.2412, 0.1859, 0.1840, 0.2021, and 0.1868 respectively. Substitution each value of W_i in (2), we will receive (3) as follows:

$$0.2412x_1 + 0.1859x_2 + 0.1840x_3 + 0.2021x_4 + 0.1868x_5 = \sigma \quad \textbf{(3)}$$

4.2 Project success Model

Project success is under the time domain of multi-activities that consist of operation management, marketing management, and service management. Beyond project management success, project success is an uncertain strategy. It is a dynamic solution. Project success can be defined into short run success and long run project success. Fig. 4 illustrates the integration of each activity from project start to project management success. Short run project success may be measured a few days or a few months after project management success. Short run project success may be marketing campaign or the project announcement to the market. Sometimes, it works as a rise up of company stock for a short period. For the real operation, it is a trial period for the real functional testing for revealing bugs and how easy for users to use. Besides, the reliability and availability of connection, accuracy, and security of transfer data is the critical process to evaluate the achievement of the international standards before receiving the certifications.

For DC project, the international standard certifications are a kind of competitive advantage in the business segment. However, it is declared as a short run project success on reliable operation.

A long run project success depends on time. It may be a few months or a few years or longer than that. As it has many factors affecting the project success, this research is limited only to the controllable and predictable factors or called "internal factors". Operation management and marketing management are the key factors that lead to project success, as depicted in Fig. 4.

Project success can be defined into objective value or financial figure and subjective value or reputation. Project success is recorded in many literatures, it must have at least one characteristic objective or subjective, or both. Financial figure is easy to calculate by time value of money (TVM) as return on investment (ROI), as shown in (6). Normally, on calculation for budget approval, most people forgot about the operation costs and marketing costs, as on (5), that distorts ROI of each year because operation costs and marketing costs could be 1.5-2 times of investment on (4).

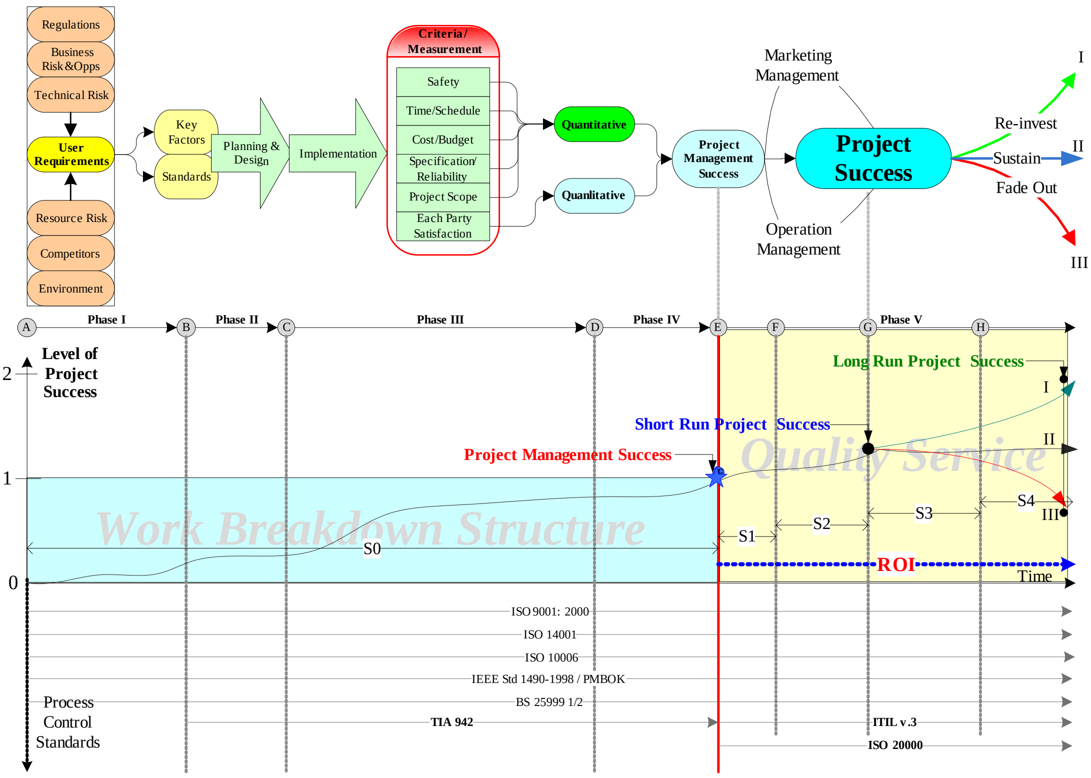

Fig. 4. Chronological of data center project success: delivering quality service model.

Facility Infrastructure Investment + Interest Rate (yr) = A*

*Software License, Servers and Network Hardware + Interest Rate (yr**) =B* **(4)**

Operation Costs (mth) + Marketing and Service Costs (mth) = C

$$\frac{A+B}{Monthly\ \ Income} = ROI\,(Years) \tag{5}$$

$$\frac{A+B+C}{Monthly\ \ Income} = ROI\,(Years) \tag{6}$$

* is calculated since the investment on the project started.

** is calculated after the payment fully finished.

TIA 942 (2005) shows the life cycle of IT equipment, which is around 3-5 years but the facility infrastructure's life cycle is around 10-15 years. IT equipment and facility infrastructure depreciation may need to include the calculation to ROI. However, it is shown only in accounting.

$f(PMS_i) + f(QPSS_j).\frac{1}{\sigma} = f(PS_k)$; σ = Subjective Values, by σ = Value range is among [0.1, 0.2, ..., 1]. **(7)**

Where by: *i* = Stage of project management failure or success

$$f(PMS_i) = \begin{cases} 0,\ PMS_i = Stage\,0 \\ 0 < PMS_i < 0.999,\ PMS_i = Stage\,1 \\ 0.999 \le PMS_i < 1,\ PMS_i = Stage\,2* \\ 1 = PMS_i,\ PMS_i = Stage\,3** \end{cases} \tag{8}$$

* Stage 2 must be transferred to Stage 3 at the final process of PMS with corrective actions and executions to satisfy the business objective and subjective values, for all stakeholder profits.

$$f(QPSS_j) = \left[\frac{ROI_{j(Real)}}{ROI_{j(Expected)}}\right].\frac{1}{\sigma}\text{, j = year on measurement} \tag{9}$$

ROI of the project is derived from Equation (6)

Substitute (3), (8) and (9) in Equation (7), we will have Equation (10).

$$f(PMS_i) + f(QPSS_j).\frac{1}{\sigma} = f(PS_k) \begin{cases} OUTSTNADING,\ PS_k < 2 \\ EXCELLENT,\ 2 \le PS_k < 2.75 \\ GOOD,\ 2.75 \le PS_k < 4.167 \\ FAIR,\ 4.167 \le PS_k < 7 \\ POOR\ or\ may\ be\ failure,\ PS_k \ge 7 \end{cases} \tag{10}$$

At Stage 3 in Fig. 5 which defines as a project success in the short run, however, a FAIR or GOOD project at Stage 3, when it cannot perform as expectation it may become project failure in the long run measurement.

The result from (10) could be probable in 3 scenarios: *Firstly*, scenario I (*OUTSTANDING* and *EXCELLENT*), gradual increase in sales level, fully occupied space may take 2-3 years, until it is sustained or sold out because the space of data center is limited. Vast increase in sale level and sold out, may take 1-2 years or less than that. The reinvestment for the next data center could be on this. *Secondly*, scenario II (*GOOD* and *FAIR*), sustain on sales and keeps the same amount of space left in data center, this scenario may keep data center sustain on operation but not too long to survive. *Lastly*, scenario III (*POOR*), no more sales, space of data center still existing there, the data center operation costs will kill this project success or fade out the project from this business, as shown in Fig. 4.

Each phase process of Fig. 4 reveals a big picture of factors that reflect on DC project success. Requirements of international standards, system reliability on data center operations, and delivering quality services are catalyzed data center project team to have the same project objectives, as follows:

Phase I: **C**onverting; the standards which are required to comply are ISO 9001 (2000), ISO 10006 (2003), ISO 14001 (2004), IEEE 1490 (2003), and BS 25999.

Phase II: **I**nterpreting; the standards which are required to comply are the same as Phase I.

Phase III: **I**mplementing; the standards which are required to comply are the same as Phase I and TIA 942, IEEE 446 (1995), IEEE 493 (2007), and IEEE 1100 (1999).

Phase IV: **C**omplying; the standards which are required to comply are the same as Phase I and TIA 942, IEEE 493, and IEEE 1100.

Phase V: **S**ustaining Quality Service; the standards which are required to comply with the international standards. Mostly of this phase are related to delivering quality service which must comply with ITIL v.3 or ISO 20000.

$f(PS_k)$ Dynamic function could be changed which depends on the time domain, internal and external variables, as shown in Fig. 5.

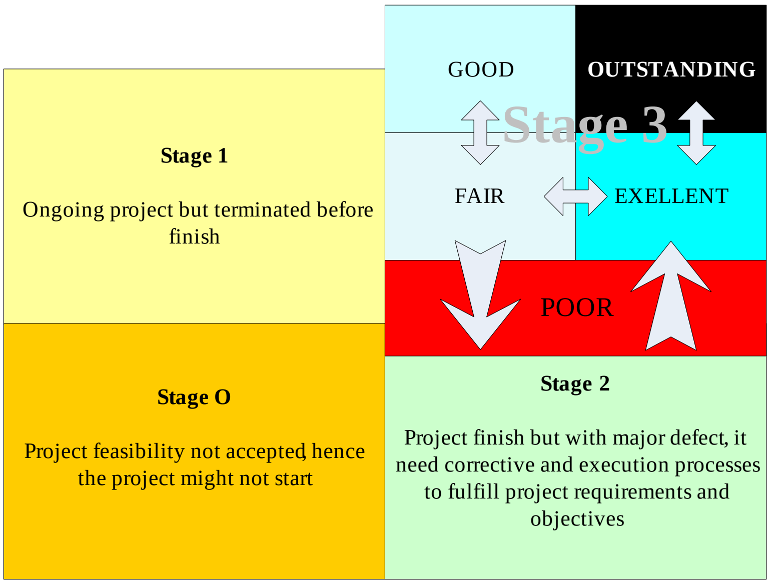

Fig. 5. $f(PS_k)$ Dynamic of Project Success and Project Failure

Phase I-IV is necessary to comply with PMBOK (2007) processes of work breakdown structure (WBS), as depicted in Fig. 4. Microsoft project software, WBS, helps project manager trace, update, monitor, and control all activities as project planning. The completion of WBS lead to project management success at the first step before moving on to the second step, chronological theory, of project success that project success is reflected on human activity and time dependent. Return on investment (ROI) of data center depends on: first, internal factors or human activities, e.g. marketing support, reliable operation, problems handling, and customer services; second, external factors, e.g. economic, politics, regulations, customer trends, technology trends, national disaster. ROI must be generated after the project management success and not before, because products and service are created after data center project operation. According to chronological theory, one set of events should be pursued by another. The reverse order is impracticable [5].

Project success is defined as "*the delivered benefits of the project to stakeholder in terms of financial forms or quantitative values, against with the commitment of returning times, and non-financial forms or qualitative values, e.g. business reputation, quality service, brand loyalty, new market segment, social responsibility, competitive advantage, problem solving, and respond to functional requirements.*"

5 DISCUSSION

A project success is not about delivering a project on time, on budget, and with specific products or high quality services, but project success needs parallel processes of marketing management, quality service management, and operation management of project to push the project's success. Project success cannot be success by itself. Project success requires more time consumption. It depends on which model to prove the project success. Only the *Chronological Project Success Model of Data Center* may not be enough to push the project become success but effectiveness operation, excellent marketing support, and delivering quality service should handle and solve the problems. Good project managers need to understand the value of their work, and they comprehend their work will contribute to a project result on schedule and on estimated investment with a good level of satisfaction from the customer and the project team. Project manager, operation manager, marketing manager and team members with experiences and knowledge are the major key factors to keep and support project success to be faster and sooner. On the other hand, it may be faster and sooner to fail. These project success and failure are suggested by Pinto and Slevin (1998), Pinto and Mantel (1990), and Shenhar and Dvir (2007).

The high reliability, six's nine or zero downtime, of data center is one kind of the criteria that show DC project management success. The history data of IEEE 493 are changing every 10 years according to the evolution and development of technology. Simulation of DC shall be adjusted following by technology changes. It is approximately every 1.6 years as Moore's law [8].

The effective operation and service of DC to the clients is now one of the most critical competencies that successful business needs in today's unpredictable world. The DC which providing a highly efficient and flexible infrastructure controlled by a common system management will support a rapid scale of dynamically business growth with the highest performance. Furthermore, DC that incorporate virtualization, dynamic load, allocation, and built-in management can leverage the specific space, power saving, and performance advantages of comparative advantage for clients.

In order to obtain the levels of data center availability, the system requires the preventive processes for the critical loaded points. The necessary processes need to take into consideration as follows:

1) Operators require a comprehensive training on existing system design, power distribution system layout, common problems and solutions. These activities are preventing the manmade from commission and omission during the daily operations and regularly maintenances.

2) In the beginning of a design process, consultant or designer needs to consider and concern with the international standards, the latest equipment technologies and the mature technologies before designing, planning, implementing, operating and maintaining procedures. The high reliability (MTTF) and correct sizing of selected equipment are prevented, short life operation period, overloaded current (trip), energy effectiveness, optimal investment, and maintenance costs, as a perfected synergy.

3) Contingency plans are required to institute to prevent the unexpected incidences of national disasters that are unpredictable and uncontrollable situations.

The relation for downtime cost model and reliability model is called "optimum availability and investment tradeoffs" that designer and investor needs to discuss on what is the enough point of system availability with constrained investment that can achieve? While, absolutely service pays off with ROI because it creates the true and loyal customers. The essence of marketing success is quality service success as well. Quality service and ROI is a reciprocal correlation. Any project cannot take its both as the same time that why we called trade-offs.

6 CONCLUSION

Data center project success is not only considered simply as a construction project or a capability to deliver services but as factors that have an impact on almost every standards, business constraints, history problems, customer expectations, management methods and real practices. DC project success does not always have the same pattern which is a predictable process. At the stage of project institution, even the most novel project engages the uncertainties and many unknown factors. It is complicated to predict exactly how to management and delivering service through a project success. What are the appropriate criteria to measure the project success? Since one solution cannot apply to all projects. Data center project management is in dynamic structure; project planning requires not only onetime activity for a whole project but needs multi alternative options, rethinking and reconsidering, flexibility, and consequence of actions to weight a decision. Adaptation of change requirements for the project is necessary to make throughout the project lifecycle, regarding to the nature of project's evolution and the technological development that changes the project's characteristics according to the external factors for example, economics, breakthrough technology, uncertainty politics, regulations, customer trends, natural disaster, and man made.

Data center planning shall be engaged at the early stage of project identification of what are the user expectations, business objectives, and business constraints?, and how to solve the problems from the limitation of the project in terms of company's objectives, constraints, regulations, reputations, and customer expectations? Rather than setting project time, budget, and results requirements objectives as the critical criteria of project success, a team needs to settle on how the project can be judged and delivered results when the project is completed and operating for quality services as a chronological project success.

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