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IS Flexibility Planning for IT/Business Strategy Alignment via Future Oriented POC Analysis

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Abstract**—**Nowadays, IT/Business strategy alignment is still a key topic of concern among managers worldwide. Change has always being considered the primary challenge affecting the strategy alignment. Planning for alignment in uncertain and dynamic changing environments is burdened with risk as organizations seek to understand how much flexibility to build in their management information system so as to maintain high levels of alignment. The literature review showed that there is a tight relationship between IT infrastructure flexibility and the strategy alignment with strategic information systems (SIS) planning serving as a moderator of this relationship, and that emphasized the needs for organizations to use SIS planning consistently and to monitor the relationship between IS flexibility and the alignment. This paper presents the procedure of SIS planning with IS flexibility renovation via future oriented analysis of POC (penalty of change) as a function of cost and time. Using this SIS planning and monitoring IS flexibility and the alignment during periods of increased change in dynamic and uncertain environments reduces the risk that could transform IT into an inhibitor rather than an enabler of change.

Keywords**—**IT/Business strategy alignment, strategic information systems (SIS) planning, IS flexibility, penalty of change (POC).

I. Introduction

SINCE late 1990s, information technology (IT) and its applications in every organization's business have been dramatically changed. These changes have influenced the power structure and its players in the industry [1]. Organization's success depends strongly on IT, in a way that many organizations rely on their information system (IS) [2]. Sufficient and effective application requires IT strategies to be aligned with business strategies of the organization [3]. Although the concept of strategy alignment is introduced for more than one decade and is used for years, it's still a matter of intellectual concern for IT and business managers [4].

During one decade of study in the field, a wide range of definitions have been presented for strategy alignment by different scientists. For example: Strategic alignment is the degree to which IT programs, goals and missions support business ones and is also supported by them [5]. Strategic alignment helps the organization to have required flexibility in order to make quick and appropriate reactions against environmental opportunities and threats and enhances the organizations' efficiency [6]. More appropriate and focused investments on IT and balancing the IT activities, facilitates achieving competitive superiority and stability [7]. Although the importance of strategy alignment is widely recognized and well documented, many organizations still have alignment problems and this has led them to experience great failures such as excess or canceled projects, inefficient systems, malcontent users and costly ISs [8]

Moreover, change is considered to be one of the fundamental challenges facing this strategy alignment [9]. Characteristically, incidents like price wars, reduced demand, the launch of new product by a rival, to name a few, motivate business strategy changes [10]. However, different companies undergo different change processes.

What has been discussed above indicates that IT has increasingly grown in all industrial, commercial and governmental sectors. With the rapid growth of IT in all institutions, the role of IT plays in attaining strategic goals has come forth as the crucial issue for the managers of business institutions. To put it differently, alignment of business and IT has gained importance for managers. Therefore, understanding effective factors in the alignment is of prime importance. The literature indicates, various factors have been identified, by academic researchers and business practitioners, as effective issues in the strategy alignment. The main factor that is considered to be the most influential in creating the strategy alignment is IS flexibility, and to monitor and control IS flexibility, continuous strategic information system (SIS) planning is recommended [11]. On the other hand, IS flexibility planning procedure is proposed as a practical method to enhance IS flexibility from technological viewpoint [12].

The objective of this paper is to link IT/business strategy alignment [11] with IS flexibility planning procedure [12]. For this purpose, in Section II of this paper, we will survey the previous works on IT/Business Strategy Alignment in dynamic and uncertain business environment. In Section III, we will discuss the connection of IS flexibility and SIS Planning. And in Section IV, we will present the procedure of SIS planning consist of IS flexibility planning via POC (penalty of change) analysis.

II. IT/Business Strategy Alignment for Unpredictable Business Environment

A. IS Flexibility as a Competitive Tool

The strategy alignment refers to the degree that business mission, objectives and plans support and, at the same time, are supported by IT mission, objectives and plans [13]. In spite the emergence of an enormous number of new and embryonic technologies, executives still classify strategy alignment between IT and business strategy, and consider it as the most crucial factor they confront in their companies [14].

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Above-mentioned studies reveal that the importance of the strategy alignment is due to its impact on a number of its principle business performance, and suggest that strategy alignment is important due to the fact that organizations compete in a competitive turbulent environment full of changes which needs IT to be flexible in order to adapt with predicted changes and unforeseen. Consequently, IS flexibility could be considered as a crucial competitive tool [11].

B. IS Flexibility in Uncertain Business Environment

In the era where change has become a life style, it becomes even more difficult for companies to foresee changes in their respective competitive contexts. In the newly emerging and unconventional contexts, customers have become competitors, and competitors' partners. Businesses must go on despite potentially dramatically new business environments that are currently not well understood. IT investments, like others, need to continue in this uncertain environment [15].

Change has been considered by administrators as among the principal challenges in front of alignment [9]. With companies revising their objectives, strategy might evolve or alter its course [16]. The primary challenge with alignment, however, is whether IT can keep pace with the changes sought by firms, and, beyond this, how firms can better plan for, and architect, IT to respond to change. Not all firms experience change in the same way. In the case that organization are not only for preserving a sense of preparedness and agility but also attaining higher payoffs from IT, deciding on a strategy to deal with this sudden and unpredictable change is a crucial factor in SIS planning [17], [18]. IT might be considered as a source of sustainable profit only in the case that it changes quickly. If IT is slow to change—as is characteristic of legacy systems that lead to rigidity traps or organizational intransigence [19]—IT cannot be a source of sustainable advantage. On the other hand, if IT is responsive to change, firms are less likely to experience a decline in firm performance.

In the competitively flat and extremely unpredictable world [20], the opportunity cost of misalignment has been increased; preserving alignment has also been rendered to much more complicated issue [21]. Nevertheless, firms are reluctant to implement IT resources which are, in short term proved to be beneficial and in the long term could trigger rigidity traps [19]. In this case, changing the focus of IT and enabling it to support a revised strategy could be a complex task to perform for various reasons. Strategy considered as a dynamic response to environmental change [22], dynamic alignment or a procedure to preserve a tough link between IT and business strategy even confronting with the sever market changes is the main objective of the firms [21], [23]. Nevertheless, dynamic alignment achievement is indefinite.

Effective IS planning is due in part to qualifications like problem identification such as environmental scanning, being able to react to change, and being able to use these capabilities for aligning IT with business strategy [17], [24]. Implementation and the subsequent performance are the determining factors in the effectiveness of any planning [25]. Therefore, this study argues that utilizing IT infrastructure flexibility could be effective in producing tighter fit between IT and business strategy in the unpredictable and turbulent business environment.

III. Link with IS Flexibility and SIS planning

A. IT Infrastructure as a Fundamental Element

Flexibility is regarded as the degree of leveraging processes and procedures, by managers, in controlling their respective operative contexts [26]. Pervious literatures recognize the importance of applying IT infrastructure which is flexible, in supporting shared services, best-of-breed applications, as well as inter- and intra-organizational connectivity that could be scaled to accommodate growth in the user base [27]–[29]. More than half of the total IT budgets are consumed by IT infrastructure [29], [30]. It is claimed that the major share of this IT budget provides little business value to companies [32]. On the contrary, resource-based theorists argue that the expenditure of value generating capacities is high rather than that of IT [31]. Similarly, the previous studies accentuate the qualities which enable IT infrastructure to scale with regard to requirements of the end-user or to vary in scope in a way that infrastructure can contain an eclectic mix of IT applications, operating systems, and data formats [27], [33]. Additionally, in order to improve strategic ability, a flexible IT infrastructure is a fundamental element of organization [34].

In the case that the organization's IS is inflexible, the ability of IT infrastructure as an enabler might immensely be reduced. Being familiar with the elements that contribute in having a flexible IT infrastructure is crucial in avoiding implementing an inflexible IT infrastructure, which is constructed of the following: *hardware compatibility, software modularity, network connectivity, and IT skills infrastructure ability* in scaling and evolving easily, quickly and in accordance with the requirements of the changing business environment [26], [27]. Therefore, in the case that hardware is incompatible, networks cannot scale, software cannot be easily customized or changed, and skills are proprietary or linked to a specific technology platform and, with little relevance elsewhere, rigidity traps occur. Implementing these constructs, the flexibility of IT infrastructure is either an important predicator of agility or a factor which renders the organizational revision process of configuration in an easy and fast procedure [28]. And moreover, maturity of organizations' IS architecture is a predicator of adaption process and operational success [35]. The most prominent outcome of their study is the discovery that as infrastructure matures, through substituting either local or process-level flexibility for global of firm-wide flexibility, IT matures as well [11].

B. Relationship between IS Flexibility and SIS Planning

SIS planning is defined that "*the process of identifying a portfolio of computer-based applications that will assist an organization in executing its business plans and realizing its business goals*" [36]. Particularly, the aims of SIS planning are: (1) establishing symbiosis between ISs and business objectives; (2) outperforming rivals; (3) managing information resources effectively; and (4) developing an IT infrastructure and a portfolio of prioritized applications consistent with the information vision of the organization [37].

Previous research indicate that IS planning success is the result of capabilities such as problem identification, environmental scanning, and ability to embrace change, and an ability to use these capabilities for aligning IT with business strategy [17], [24]. As it is mentioned before, the literate on IS flexibility indicate that organizations with flexible IT infrastructure might sustain tight link between IT business strategy, since they are better able to support a change in business strategy. IS planning might contribute in maintaining the relationship through creating a platform for firms to study environmental or market factors which might result in a change in the business strategy. It might be claimed that SIS planning is a process that draws upon skills like knowing how to use IT to respond to market threats and opportunities. Drawing upon these arguments, it could reasonably be stated the SIS planning moderates the fit between IT infrastructure flexibility and strategy alignment, in positive manner [11].

C. The Impact of IS Flexibility on Strategy Alignment

The strategy alignment refers to the degree that business mission, objectives and plans support and, at the same time, are supported by IT mission, objectives and plans. Change has been considered by administrators as among the principal challenges in front of alignment. However, different companies undergo different change processes. The primary challenge with alignment, however, is whether IT can keep pace with the changes sought by firms, and, beyond this, how firms can better plan for, and architect, IT to respond to change. IT might be considered as a source of sustainable profit only in the case that it changes quickly. If IT is slow to change—as is characteristic of legacy systems that lead to rigidity traps or organizational intransigence—IT cannot be a source of sustainable advantage. On the other hand, if IT is responsive to change, firms are less likely to experience a decline in firm performance. Reviewing the literature showed that there is a positive relationship between IT infrastructure flexibility and strategy alignment with SIS planning serving as a moderator of this relationship. The fact that, effective IS planning is due in part to qualifications like problem identification, environmental scanning, being able to react to change, and being able to use these capabilities for aligning IT with business strategy has been pinpointed in the literature [11].

Therefore, this study argues that utilizing IT infrastructure flexibility could be effective in producing tighter fit between IT and business strategy in the unpredictable and turbulent business environment.

IV. IS Flexibility Planning via Future Oriented POC Analysis

To support the effort to assist an organization in executing its business mission, objectives, plans and realizing its business goals, an IS should be equipped with effective functions capable of data extraction and analysis with maximal ease. Moreover, since typically these solutions urgently demand prompt functional modifications involving the processing of relevant information, an IS should be so structured as to be relieved of its unwieldy complexity standing in the way of their prompt disposal. We have so far been referring to this property of general easiness built into an IS as IS flexibility, which we think should and can be enhanced through proper renovation of its architecture.

In this section, we will define the nature of IS flexibility more exactly and clarify the necessity of predicting future change demands on an IS, such as those to be shown below, and what it means to renovate its architecture to make it maximally flexible in dealing with these anticipated demands.

A. Definition of IS flexibility in Terms of POC

Here, let us try to describe the above mentioned SIS scheme precisely. When an IS provides an application function (*F*) that is "utilized effectively" (*U*), the IS yields the "usefulness" of contributing to the performance of an organization as the resources for competitive advantage. We consider this usefulness as a reward (*IS reward*) that the organization receives by utilizing its IS appropriately. We then express *IS reward* as follows:

$$IS\, reward = f(F, U) \tag{1}$$

This means that *IS reward* is a mathematical function (*f*) of the combination of the functions (*F*) that the IS provides and the organization's ability to utilize the functions (*U*).

Irrespective of their sizes, most organizations these days utilize their own IS for business management. It is no exaggeration to say that without the aid of an IS no organization can hope for efficient and effective business management. This being the case, the performance of an organization can even be defined as a product of the interaction of the business accomplished due largely to the utilization of the functions and their quality provided by its IS and the cost and time required to develop and maintain them.

"Information Economics [38]" identified six kinds of *IS value*, and defined the value of IT infrastructure (ITI) which supports to generate the others.

Let us then postulate the IS's contribution to the performance of the organization as the "value of the IS (*IS Value*)" and represent it in the form of (2):

$$IS\ Value = \frac{IS\,\mathrm{Re}\,ward}{g(C,T)} = \frac{f(F,U)}{Penalt\ Of\ Change} \tag{2}$$

where the denominator *g(C, T)* is a function of the cost (*C*) and time (*T*) required to develop and maintain the organization's IS and can be regarded as a penalty that every IS manager needs to pay for changing their organization's IS. We will hereafter refer to this penalty as '*POC*' (penalty of change) [39]. The value of the IS (*IS Value*) newly yielded increases in proportion as the value of the numerator *f (F, U)* increases and/or as that of the denominator *POC* decreases. As we have so far clarified, this requirement can be satisfied by the enhancement of *IS flexibility*. Then, if we for our present purpose leave the numerator part out of account, we might be allowed to posit *IS flexibility* in the form of (3):

$$IT\ Flexibility = \frac{1}{Penalty\ Of\ Change} = \frac{1}{POC} \tag{3}$$

Note that (3) represents the relationship between *IS flexibility* and *POC*, i.e. the higher the *IS flexibility,* the smaller the *POC* and, conversely, the lower the *IS flexibility,* the larger the *POC*. Obviously the larger the reward and the smaller the penalty (*POC*), the better will it be. Enhancement of *IS flexibility* would alleviate the *POC* payable by IS managers like ours and their other related problems. The formula indicates that *POC* is usable as an index of *IS flexibility,* that is to say, that *IS flexibility,* i.e. the in-built ease with which to modify an IS, can be evaluated quantitatively in terms of *POC*.

B. Probabilistic Definition of POC and IS Flexibility

A 'change' can be described as a probabilistic event of a transition from a certain state to another [40]. Helpful as it is for our present purpose, let us use this idea and express the probabilistic calculation of potential *POC* payable for possible future changes in the form of (4):

$$POC = \sum_{i=1}^{n} POC(X_i)\Pr(X_i) \tag{4}$$

where X_i stands for the state after *change i*, *POC* (X_i) for the penalty of change *i* (a function of cost and time) and Pr (X_i) for the occurrence probability of change *i*.

POC (X_i) means the potential penalty to be incurred to meet the demand. And, Pr (X_i), a variable in the determination of *POC*, means the probability of the possible occurrence of a future change demand, and is the probability that the change demand X_i will occur in the future. However, this probability is derived from business strategy. Moreover, it is a subjective probability that the IS division can consider in its decision making. Therefore, we translate (4) into the next questions:

"How flexible should we make the existing IS of our organization in order to absorb possible future change demands?"

The underlying assumption of this paper, as we postulated in (3), is that *POC* is a critical variable affecting *IS flexibility.* Therefore, to answer the above question in concrete terms, we need to seek for answers to the next question:

"How can we at the time of its proactive architectural renovation properly incorporate into our IS such flexibility factors as will serve to minimize the potential POC to be incurred by the disposal of possible future demands for its functional modifications?"

C. IS Change Demands and the Need of Enhanced IS Performance

In order to acquire *IS value*, a corporation has to deal with environmental change demands. Typically change demands on a corporate IS are for provision of newly required business applications together with their user interfaces to be implemented on an external design. These demands are attributable to the need of response to new organization-external and -internal developments [38]:

a) Organization-external: new policies by the government (e.g. implementation of environment accounting, change of the consumption tax rate, etc.).

Note that demands for IS functional modification in this regard typically require disposal by the appointed time. Delay in due-date delivery on these demands will only aggravate the business disadvantage that the organization concerned may have been sustaining against its competitors.

b) Organization-internal: new management strategies or SOPs (standard operating procedures), aimed at higher ROI (return on investment), enhanced management information, acquisition of a competitive edge, etc.

Needless to say, implementation of IS changes in response to these change demands requires management resources (throughput in terms of cost and time and computer storage capacity, person-hours to be spent by experienced technical staff, etc.). In actuality, however, it is rarely the case that these required resources are adequately provided for immediate use when change projects are going to be undertaken, and it is often the case that a corporate IS division cannot process all the change demands by the due time. Such delays in IS modification can lead to delays in the execution of management strategies, to those in the renovation of business processes, etc., and consequently, to the corporation's loss of a golden opportunity of gaining an inter-corporate competitive superiority. Our view is that the only way to break out of this vicious circle is for the IS division to acquire the expertise to predict future change demands and renovate the IS architecture with a view to equipping it with sufficient anticipatory preparedness to manage with minimal *POC* when faced with these change demands. This calls for adaptability of innovative technologies such as exchange of IT infrastructural components.

V. STRUCTURE OF IS FLEXIBILITY ENHANCEMENT

In order to discuss our present theme in more practical terms, let us translate our definition of IS flexibility into the following question:

"How flexible an IS should we acquire at the time of its implementation so as to be able to accommodate possible future demands for its modification as and when they occur?"

TABLE I
MIS FLEXIBILITY AND INDEXES FOR ITS EVALUATION

Category		Meaning	Risk-prone change	Risk	Evasion Strategy	Index for Evaluation			
						Viewpoint	Cost	Time	Utility
Hardware	Exchangeability	Easiness of exchange and change of hardware	Machine replacement;	System unusable;	Enhancement of Connection interchangeability; Enhancement of Upper compatibility (open protocol; open system);	Enhancement of Connection interchangeability; Enhancement of Upper compatibility (open protocol; open system);	Human resources (Man-month);	Time distance (exchange speed);	Shortening of exchange time; reduction of cost;
			Upgrading basic software;	System unusable;	Enhancement of Connection interchangeability; Enhancement of Upper compatibility Multiplexing; back up & recovery; insurance & maintenance contract; out-sourcing (external equipment);				
	Fault tolerance	Ability to continue to provide service on given application functions	Trouble outbreak from bugs in basic software;	System uncontrollable; System breakdown;	Back up & recovery; preventive maintenance;	Availability	Opportunity loss; Recovery cost;	MTBT; MTTR;	Reduction of opportunity loss and recovery cost;
			Trouble outbreak from bugs in application programs;	System unusable; System failure;	Thoroughness of testing; standardization; educational training; back up & recovery;				
			Trouble outbreak from operational err;	System failure;	Educational training; job enrichment; out-sourcing (skilled engineer);				
Application system	System structure	Ability to add new application function (degree of structuring)	External environmental changes; Enterprise-internal changes in managerial function and /or in business process;	Delay in due date delivery; excess over the estimates; productivity deterioration; malfunction; system failure;	technological strategies: standardization of protocol (open system); structured-based approach (analysis; design documentation and programming); data-oriented approach (database normalization);	Structuring of Systems and programs;	Cost for change demands; Cost for structuring;	Time for change demands; Time for structuring ;	Reduction of POC for design
					Organizational strategies: Accumulation of engineers' experience and enhancement of skills; educational training of users; Workload (reduction of engineers' overload); Job enrichment; Practical use of external consultants;	Quality of database (Number of access paths from application program to data; Number of programs and data requiring change; ratio of management-target entities included in database); Tendency of backlog volume on the time axis;	Cost for change demands; Cost for database development;	Time for change demands; Time for database development;	Reduction of POC for design
	Service area	Ability to provide unexperienced service for the first time	Request for unexperienced business field;	Delay in due date delivery; excess over the estimates; productivity deterioration; malfunction; system failure;	Rearranging management-target entities and Building database;	Ratio of BPs and management-target entities given a service;	Cost for change demands; Cost for new service;	Cost for change demands; Cost for new service;	Reduction of POC for design;
	IT adoption	Ability to provide a service with unexperienced technology and/or method	IT innovation; Implementation of new technology;	Delay in due date delivery; excess over the estimates; productivity deterioration; malfunction; system failure;	Accumulation of engineers' experience; R&D; Standardization of system development; Educational training (dissolution of skill deficiency);	Technological continuity and degree of experience;	Cost for change demands; Cost for expertise enhancement depending on proficiency levels;	Time for change demands; Time for expertise enhancement depending on proficiency levels;	Reduction of POC by learning;

For the rest of this paper we will continue to use the concept of 'IS flexibility' in this sense.

When an IS division undertakes a change of the IS, the change demand is likely to have originated from outside the IS and from inside the IS itself:

- Changes in business strategy to cope with IS-external change demands:

Policy changes by governmental agencies, e.g. implementation of environment accounting, change of the consumption tax rate, etc.

These change demands typically require accomplishment by the appointed time:

- Changes in the organization's business function:

E.g. change of management strategies and/or change of SOPs aimed at enhancement of ROI (return on investment), enhancement of management information, strengthening of support for management strategies and/or acquisition of a competitive edge.

These change demands differ in urgency and importance depending on what they are aimed at.

- Renovation of IT infrastructure to cope with IS-internal change demands:

Changes demanded by the IS division itself aimed at better service for the IS user, e.g. implementation of CASE (computer-aided system engineering) and/or change of a DBMS (data base management system), etc.

These multiply motivated IS changes should be such that they can enhance both the effectiveness of an existing IS and its preparedness to meet potential change demands in anticipation.

A. Meaning of the Renovation of IT Infrastructure

An IS, as we noted above, is a system comprising both hardware and software. A change (including modification) of this system is vulnerable to risks (e.g. system breakdown). If these risks are realized, the system incurs cost and loss of time before it is restored. Table I lists changes of a system, risks accompanying system changes, and well-known IT items available for use in evasion strategies against risks.

It is a matter of common knowledge that proper renovation of IT infrastructure lowers not only change risks but also the *POC* (cost and time) for future system development, i.e. it facilitates subsequent system developments. But a renovation itself incurs a high *POC* of its own, which acts as a self-limiting factor against one. Moreover, an IS division might not be able to obtain enough resources from the management to execute a renovation unless they have a well-established method for evaluation of the ROI the renovation might involve. This accounts for the reluctance of many IS departments to venture to undertake a renovation of IT infrastructure.

Here let us take a brief look at the mission of an IS division. Obviously its major role is to dispose of demands for change of an existing IS originating from internal and external changes. The division is called upon to perform this mission efficiently, i.e. at a minimum cost and in a minimum time. This in effect means that to get the system well enough organized to absorb future change demands it is only allowed to pay a minimum *POC*. A moderate "renovation of IT infrastructure" can ensure greater ease and efficiency in IS modification. But it will cost us a *POC* of its own as well. Here, let us represent this fact in the whole structure of IS flexibility in terms of the substitute index of *POC* as in Fig. 1. Fig. 1, however, suggests that the *POC* paid for a moderate renovation of IT infrastructure can have the benefit of reducing the *POC* required to cope with future change demands since such a renovation serves to lower the risk vulnerability of IS change. Let us refer to this benefit as the utility of renovation (UTL_R). Renovation of IT infrastructure can thus be redefined as meaning "*moderate application of IT for evasion of change risks accompanying IS implementation.*"

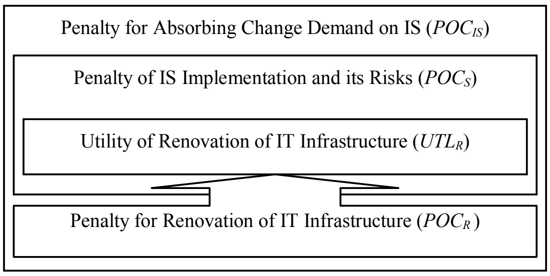

Fig. 1 Structure of IS flexibility

Thus the *POC* of a whole IS change (POC_{IS}) can be represented formulaically as follows using the abbreviations shown in Fig. 1:

$$POC_{IS} = POC_S + \left(POC_R - UTL_R\right) \qquad (5)$$

Before proceeding further into our present theme, let us here recall the question form we provided above to define IS flexibility in practical terms:

"How flexible an IS should we acquire at the time of its implementation so as to be able to accommodate possible future demands for its modification as and when they occur?"

To give an answer to this question, we need to be able to predict what kinds of change demands are likely to be made on an existing IS. As we saw above, some of these change demands are IS-external and others are IS-internal. Our task here is to elucidate in a structured way the nature of each kind of change demands and the flexibility characteristics that an IS should secure and enhance in relation to these demands.

B. Characteristics Required of an IS to Cope with Change Demands (External Factors)

Change demands on an IS must be predicted separately for the two kinds of demand sources. Besides, if we are to cope with all predicted change demands, we need to execute capacity requirement planning (CRP).

For proper implementation of CRP, we need to see to the following:

- *System alternatives*: system options available for disposal of each change demand,
- *Estimate of management resources*: volume of resources (computer power, volume of storage, manpower, etc.) required to execute each alternative,

- *Capacity for change demands*: volume of resources available for disposal of change demands.

Here we will confine our analysis of flexibility characteristics that an IS should enhance to the three external flexibility characteristics (hereafter to be referred to as "external factors") and explain them in concrete terms. As for "internal factors," we will deal with them in the next subsection primarily in relation to the incorporation of risk-evasion strategies into IT infrastructure but also in their correlation to "external factors".

- *Product*: This stands for an ability to build a system capable of creating various application functions with the same pieces of equipment. In the short term, this ability means that the system has the adaptability to the fluctuating volumes of different change demands in the sense that it is capable of dealing with each change demand economically and promptly. In the long term, the fact that the same system is shared by several application functions enables it to extend its life cycle and accordingly generate higher returns on investment. This life cycle extension is constrained by the internal flexibility characteristics to be discussed in the next subsection.
- *Volume*: This epitomizes the facility of a system to absorb the quantitative fluctuation of change demands within the bounds of the budget, that is to say, the facility to cut down or expand its own scale. Its validity as a characteristic of IS flexibility is easily understandable seeing that the development and maintenance of an IS have something in common with order production in manufacturing systems. This ability is also constrained by the internal characteristics.
- *Working sequence*: This refers to the ability to handle the working sequence of various kinds of hardware, data and operations, which affects the creation of application functions. This ability is constrained by the flexibility of the structure of the system itself (i.e. by the internal characteristic of "system structure" below). This external factor implies that the system will be able to continue service to its user, even if the system suffers a partial breakdown and/or the operator is absent.

When considering these flexibility factors, one important point we should focus our analysis on is "the volume of change demands that must be absorbed". Since disposal of external change demands resembles order production in manufacturing systems, the planning method of CRP in manufacturing systems is applicable to IS planning as a means of absorbing maximum change demands with an existing capacity.

In the evaluation of the ability to absorb change demands, affecting as they do the *POC* and the quality of a finished system, the following factors must be taken into consideration: the "availability" of hardware, the "structure" of an existing IS, "experience and knowledge" regarding the service area of a subsystem to be built and the technologies to be chosen. All these factors have something to do with the characteristics of an IS itself (internal factors), which will affect the relative ease or difficulty of IS change. These will be discussed in detail in the next subsection.

C. Change Risks and their Evasion Strategies (Internal Factors)

An IS consists of hardware such as computers with basic software built into it, storage, communication equipment and software such as programs and data for business use. A typical change of hardware occurs where there is a need for 1) an exchange for expansion of the capacity to cope with entire change demands, or for 2) an exchange for expansion of the availability to reduce the probability of system breakdowns. 1) and 2) involve the internal factors of Exchangeability and Fault tolerance, respectively.

On the other hand, a change of application systems occurs when there is a call for an IS to provide support for new business strategies. This kind of change differs in difficulty depending on whether it involves the internal factor of the "system structure" (including the data structure) of the existing system, or the other internal factors of the "service area" and "IT adoption" new to an IS division.

Before we go on to define these internal characteristics below, let us illustrate the sources of change demands, risks accompanying changes, evasion strategies for risks, and evaluation methods for these changes. For these see Table I.

If we look back to (5) bearing in mind the relationship between those risks and their evasion strategies, we might redefine POC_S as risks involving IS change, POC_R as the penalty of risk evasion strategies, and UTLR as the utility of risk evasion strategies. The structure of the problem confronting us can be depicted as in Fig. 2 via AHP (analytic hierarchy process).

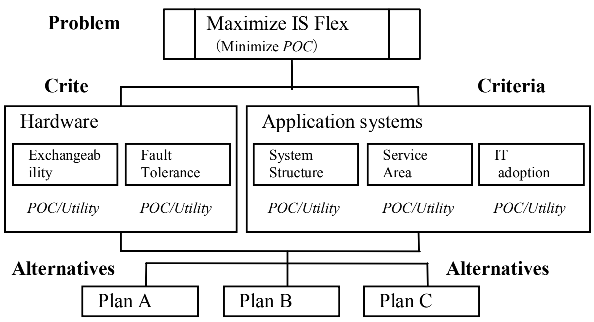

Fig. 2 Structure of the Problem

D. Relationship between Internal and External Factors

Before considering the scheme for *POC* evaluation, let us consider the relationship between internal and external factors.

- *Exchangeability*: Facilitation of exchange of hardware makes it possible to provide demanded application functions in the form of a variety of "products". Facilitation of a combination of hardware items will make it easier to change "working sequence". Accordingly, high exchangeability enhances the external flexibility factors of "product" and "working sequence".
- *Fault Tolerance*: Enhancement of system availability (even in the face of a partial or total system breakdown) enhances the external flexibility factor of "volume", which in turn enhances the external flexibility of "working

sequence".

These factors of IT infrastructure indicate hardware compatibility and network connectivity, and software modularity stands for the next factor.

- *System Structure*: A well-structured application system can easily provide a "product" that will satisfy the requirements for an IS function to be provided and this in the form of a combination of components of an existing IS. It can therefore reduce the "volume" of the program to be newly developed or modified. Moreover, enhancement of the flexibility factor of "volume" enhances the flexibility of "working sequence". The internal flexibility factor of "system structure" in effect contributes to the enhancement of the external flexibility factors of "product", "volume" and "working sequence".

The following factors represent IT skills infrastructure ability in scaling and evolving easily, quickly and in accordance with the requirements of the changing business environment.

- *Service Area*: The larger the coverage of an IS in business, the larger the number of already served entities and the lower the POC paid to provide against future change demands on an IS. A high degree of experience in a targeted "service area" facilitates "product" design. Likewise the listing of entities for management will enhance the flexibility of "product" since it will reduce the POC payable for design and development of an IS function in a new service area and so will contribute to the satisfaction of the requirements for the function to be provided. The reduction of labor for system design will enhance the flexibility of "volume", which in turn will enhance the flexibility of "working sequence".

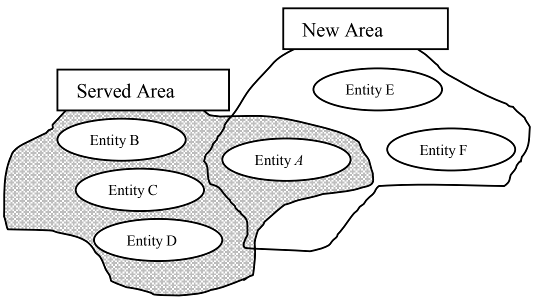

Fig. 3 Entity Shared by Served Area and New Area
Entities A, B, C, D are implemented into database. Entity E and F are not implemented.

- *IT Adoption*: The degree of learning on new technology enhances (or lowers) the facility of realizing a "product," and positively or negatively affects the degree to which the product will satisfy the requirements for the IS function. The increase (or decrease) in person-months for system design due to the degree of proficiency affects the flexibility factor of "volume" positively or negatively, which in turn correspondingly affects the flexibility factor of "working sequence".

Here let us recall (5), in relation to which strategies for the renovation of IT infrastructure were discussed in terms of risk evasion strategies. Moreover, it is worth noting that the cost and utility of an IS (i.e. implementation, use process and renovation of IT infrastructure) must be evaluated on the time axis (see Fig. 4, Table II).

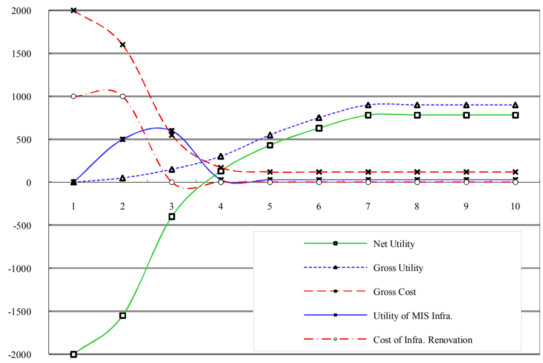

Fig. 4 Net Utility of IS on the Time Axis

VI. Scheme for Evaluation Procedure of IS Flexibility

Let us note that the first step in strategic management is to decide on several goals and that the next step is to work out strategies to attain these goals. IS flexibility needs to be just sufficient to accomplish these strategies and this much flexibility must be secured in advance. Therefore we propose that IS planning should be executed according to the following procedure. To begin with, we will predict future demands for changes likely to be made on an IS and through the other three steps we will have to consider how to provide against these change demands.

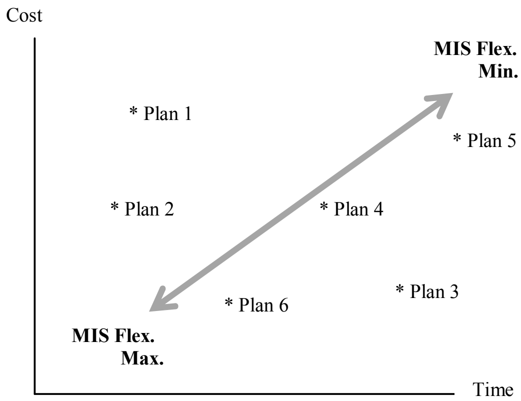

Fig. 5 IS Plans Mapped

TABLE II
NET UTILITY OF IS ON THE TIME AXIS

Fiscal Year	Net Utility	Gross Utility	Utility			Gross Cost	Cost			Utility of IS Infra.	Cost of Infra. Renovation
			IS1	IS2	IS3		IS1	IS2	IS3		
1	-2,000	0	0	0	0	2,000	1,000	0	0	0	1,000
2	-1,550	50	50	0	0	1,600	100	1,000	0	500	1,000
3	-400	150	100	50	0	550	50	100	1,000	600	0
4	130	300	150	100	50	170	50	50	100	30	0
5	430	550	300	150	100	120	50	50	50	30	0
6	630	750	300	300	150	120	50	50	50	30	0
7	780	900	300	300	300	120	50	50	50	30	0
8	780	900	300	300	300	120	50	50	50	30	0
9	780	900	300	300	300	120	50	50	50	30	0
10	780	900	300	300	300	120	50	50	50	30	0
Total	360	5,400	2,100	1,800	1,500	5,040	1,500	1,450	1,400	1,310	2,000

Step 1: Prediction of Future Demands

Our task in this step is to predict change demands likely to be made on an IS, which may have originated from management strategy to cope with outside changes and/or from renovation of IT infrastructure to cope with inside changes demanded by the IS division itself.

Step 2: External Factor Analysis

The first part of this step is devoted to enumerating as many candidate system alternatives as possible (for system implementation) to provide against all change demands predicted. The questions for us to ask in doing the above are:

Product: What kinds of system alternatives are applicable to the accomplishment of this IS change?

Volume: What amounts of resources will a combination of system alternatives require in the development of this system and in its use process?

Working sequence: Does the existing IT infrastructure have enough tolerance for absorption of operation order changes when an unexpected disturbance (a change demand on the IS and/or a system breakdown) occurs?

Our work in the rest of this step is to estimate the required resources for each system alternative based on the present condition of the system and the IT we have available. Since we must dispose of multiple change demands predicted, the last thing to do here is to enumerate combinations of system alternatives to be used.

Step 3: Internal Factor Analysis

This step addresses the question of how to secure enhanced internal IS flexibility, such that it will serve to maximize the efficiency in the disposal of change demands. We will first enumerate, for each combination of system alternatives above, future system risks, their probability of occurrence and strategies for their evasion (e.g. method for system structuring and for normalizing data). See Table I. Next we will evaluate the efficiency of these risk evasion strategies and after studying their feasibility, we will enumerate several sets of evasion strategies (i.e. strategies for renovation of IT infrastructure) to be applied to each of the combinations of system alternatives.

Step 4: Decision Making on the Combinations of System Alternatives

With all prerequisites for IS planning provided as in the above three steps, our next step is to map each combination of system alternatives onto IS planning. By comparing the mapped combinations with each other, we will be able to identify a combination with maximum flexibility as in Fig. 5. In this figure, Plan 6 shows the lowest value of *POC*.

VII. CONCLUSION

In this paper, to link IT/business strategy alignment with IS flexibility planning procedure, we have focused on and presented the following: the sources of change demands on an IS, the internal and external flexibility factors that an IS should maintain and enhance to cope with change demands, and the procedure for evaluation of IS flexibility via future oriented POC analysis.

Specifically, we have elucidated the following:

- IS flexibility is an index of the ability of an IS to absorb future change demands on it.
- IS flexibility can be evaluated quantitatively in terms of the index of *POC* (penalty of change).
- IS flexibility consists of internal and external factors. Evaluation of external factors focuses on the volume of change demands an IS can absorb, and evaluation of internal factors focuses on a variety of strategies to evade change risks. We have treated *POC* as a common index to evaluate the two categories of IS flexibility factors.
- External factors of IS flexibility are constrained by internal factors.
- Renovation of IT infrastructure means application of IT for evasion of change risks accompanying IS implementation (and modification).
- Proper renovation of IT infrastructure will enhance the internal characteristics of IS flexibility.

The challenges awaiting us are detailed and practical studies on the quantitative relationship between internal and external factors of IS flexibility.

REFERENCES

[1] Ward, J. and Peppard, J.. *Strategic Planning for Information Systems .3rd Edition*, John Wiley and Sons, Incorporated, 2007.
[2] Jorfi, S.; MD Nor, KH. and Lotfi, N., "Assessing the Impact of IT Connectivity and IT Capability on IT- Business Strategy alignment: An Empirical Study", *Computer and Information Science*, Vol. 4, No. 3, pp. 76-87, 2011.
[3] Luftman, J.N., "Assessing Business/IT Alignment Maturity", *Communication of the Association for Information System*, Vol. 4, No. 14, PP. 1-51, 2000.
[4] Luftman, J.N., "Key issues for IT executives 2004", *MIS Quarterly Executive*, Vol. 4, No. 2, pp 269-285, 2005.
[5] Reich, BH. and Benbasat, I., "Factors that Influence the Social Dimension of Alignment between Business and Information Technology Objectives", *MIS Quarterly*, Vol. 24,No. 1, PP. 81-113, 2000.
[6] Avison, D.; Jones, J.; Powell, P. and Wilson, D., "Using and Validating the Strategy alignment Model", *Journal of Strategic Information Systems*, Vol. 13, PP. 223-246, 2004.
[7] Cumps, B.; Martens, D.; Backer, M.; Haesen, R.; Viaene, S.; Dedene, G.; Baesens, B. and Snoeck, M., "Inferring Comprehensible Business/ ICT Alignment Rules", *Information and Management*, Vol. 46, PP. 116-124, 2009.
[8] Chen, leida., "Business-IT Alignment Maturity of Companies in China", *Information and Management*, Vol. 47, PP. 9-16, 2010.
[9] Luftman, J.N., Papp, R., and Brier, T., "Enablers and inhibitors of business-IT alignment", *Communications of the AIS*, Vol. 1, No. 11, pp. 1–32, 1999.
[10] Mendelson, H., and Pillai, R.R., "Clockspeed and informational response: evidence from the information technology industry", *Information Systems Research*, Vol. 9, 4, 415–433, 1998.
[11] Jorfi, S., Md Nor, K., Najjar, L. and Jorfi, H., "The Impact of IT Flexibility on Strategy alignment (with Focus on Export)", *International Journal of Business Management*, Vol. 6, No. 8, pp. 264-271, 2011.
[12] Furukawa, M. and Minami, A., 2012, "Management Agility depends on well-Renovated IT Infrastructure", International Journal of Computer Technology and Application, Vol. 3, No. 8, pp. 564-577, 2012.
[13] Reich, B. H., and Benbasat, I., "Measuring the linkage between business and information technology objectives", *MIS Quarterly*, Vol. 20, No. 1, pp 55-81, 1996.
[14] Luftman, J.N., Kempaiah, R., and Nash, E., "Key issues for IT executives 2005",.MIS Quarterly Executive, Vol. 5, No.2, pp. 27–45, 2006.
[15] Luftman, J.N., *Competing in the information age: strategy alignment in practice*, Oxford University Press, New York; Oxford. Press, 1996.
[16] Porter, M.E., "Towards a dynamic theory of strategy", Strategic Management Journal, Vol.12 (Winter), pp. 95–117, 1996.
[17] Segars, A.H., and Grover, V., "Profiles of strategic information systems planning. Information Systems Research", Vol. 10, No. 3, pp.199–232, 1999.
[18] Tallon, P.P., Kraemer, K.L., and Gurbaxani, V., "Executives' perceptions of the business value of information technology: a process-oriented approach", *Journal of Management Information Systems*, Vol. 16, No. 4, pp. 145–173, 2000.
[19] Bharadwaj, A., "A resource-based perspective on information technology capability and firm performance: an empirical investigation", *MIS Quarterly*, Vol. 24, No. 1, pp. 169–196, 2000.
[20] Friedman, T.L., *The World Is Flat*, New York: Farrar, Straus, and Giroux, 2006.
[21] Venkatraman, N., Henderson, J.C., and Oldach, S.H., "Continuous strategy alignment: exploiting IT capabilities for competitive success", European Management Journal, Vol. 11, No.2, pp. 139–149, 1993.
[22] Porter, M.E., "What is strategy?" *Harvard Business Review*, Vol. 74, No. 6, pp. 61–77, 1991.
[23] Sabherwal, R., Hirschheim, R., and Goles, T., "The dynamics of alignment: insights from a punctuated equilibrium model", *Organization Science*, Vol. 12, No. 2, pp. 179–197, 2001.
[24] Earl, M.J., "Experiences in strategic information systems planning", *MIS Quarterly*, Vol. 17, 1, 1–24, 1993.
[25] Mintzberg, H., and Waters, J.A., "Of strategies, deliberate and emergent", *Strategic Management Journal*, Vol. 6, No. 3, pp. 257–272 1985.
[26] Byrd, T.A., and Turner, D.E., "Measuring the flexibility of information technology infrastructure: exploratory analysis of a construct", *Journal of Management Information Systems*, Vol. 17, No. 1, pp. 167–208, 2000.
[27] Keen, P., *Shaping the Future: Business Design Through Information Technology*, Boston: Harvard Business School Press, 1991.
[28] Tallon, P.P., *Inside the adaptive enterprise: an information technology capabilities perspective on business*, *Information Technology and Management*, Vol. 9, No. 1, pp.21-36, 2007.
[29] Weill, P., and Broadbent, M., *Leveraging the New Infrastructure: How Market Leaders Capitalize on Information Technology*, Cambridge, MA: Harvard Business School Press, 1998.
[30] Gurbaxani, V., Melville, N., and Kraemer, K.L., "Disaggregating the return on investment to IT capital", In J.I. DeGross, R. Hirschheim, and M. Newman (eds.), Proceedings of the Nineteenth International Conference on Information Systems, Helsinki, Finland: Association for Information Systems, Atlanta, GA, pp. 376–380, 1998.
[31] Bharadwaj, A., "A resource-based perspective on information technology capability and firm performance: an empirical investigation", *MIS Quarterly*, Vol. 24, No. 1, pp. 169–196, 2000.
[32] Carr, N., IT doesn't matter. Harvard Business Review, Vol. 81, No. 5, pp. 41–49, 2003.
[33] Duncan, N., "Capturing flexibility of information technology infrastructure: a study of resource characteristics and their measure. Journal of Management Information Systems", Vol. 12, No. 2, pp. 37–57, 1995.
[34] Weill, P., Subramani, M., and Broadbent, M., "Building IT infrastructure for strategic agility", *Sloan Management Review*, Vol. 44, No. 1, pp. 57–65, 2002.
[35] Ross, J.W., Weill, P., and Robertson, D.C., *Enterprise Architecture as Strategy*, Cambridge, MA: Harvard Business School Press, 2006.
[36] Hartono, E, Lederer, A.L, Sethi, V., and Zhuang, Y., Key predictors of the implementation of strategic information systems, *DATA BASE for Advances in Information Systems*, Vol. 34, No. 3, pp. 41–53, 2003.
[37] Brown, I.T.J., "Testing and extending theory in strategic information systems planning through literature analysis", *Information Resources Management Journal*, Vol. 17, No. 4, pp. 20–48, 2004.
[38] Parker, M. M., and Benson, R. J. *Information Economics: Linking Business Performance to Information Technology*, New Jersey: Prentice Hall, 1988.
[39] Chryssolouris, G., and Lee, M., "An Assessment of Flexibility in Manufacturing Systems", *Manufacturing Review*, Vol. 5, No. 2, pp.105-116, 1992.
[40] Chryssolouris, G., "Flexibility and Its Measurement", *Annals of the CIRP*, Vol. 45, No. 2, pp. 581-587, 1996.