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## Anti-Inertia –The Pro-change Tendency

*The inertia present in all bodies connotes resistance to change*

*Organic entities are also governed by law of anti-inertia or pro-change tendency*

*The pro-change tendency is visible in processes of growth, renewal and reproduction*

*The anti-inertial forces act at physical, intellectual, emotional and psychological levels*

*The same set of activities may develop inertia and anti-inertia simultaneously*

*The leadership should synthesize inertia and anti-inertia to balance stability and dynamism*

The concept of ‘inertia’ for the physical bodies is aptly reflected by Newton’s first law of motion; according to which “a body continues to be in a state of rest or uniform motion until and unless it is acted upon by an external force”. The inertia is inherent in all physical bodies which connotes resistance to change; it is also exhibited by organic entities such as plants, animals, human beings and organizations. It is a force which gives stability to any system.

However, the organic entities are not only governed by the law of inertia, but as living entities they also exhibit anti-inertial or pro-change tendencies. A counter law, which may be called as law of anti-inertia also acts upon the organic entities; according to which, “an organic body tends to change its current state by applying pro-change internal forces”. Such a pro-change tendency is visible in the processes of growth, renewal and reproduction, which are uniquely present in living organic entities.

For example, a seed grows into a big tree, an infant turns into a fully grown adult, and an entrepreneurial organization may grow into a global corporation such as Microsoft, Sony etc. These organic entities also renew on a continuous basis to remain vital, e.g. plants shed old leaves to be replaced by new ones, the cells are renewed, the organizations learn and innovate, and so on.

The anti-inertial forces act at various levels such as physical or operational, intellectual, emotional, psychological etc. Rarely any employee loves a monotonous job and normally looks for some change over time. Similarly, a stagnant compensation is highly demotivating. Each one strives to go for the fulfillment of higher level needs. Organizations cannot remain alive in a static framework and work towards creation of new product enhancements, processes, procedures, rules etc. on an ongoing basis.

The same kind of activities may result into both the inertia and anti inertia in the systems. Usually, the negative outcome of any activity would develop anti-inertia as a force to develop pro-change tendency. For example, repeatability of task develops habit which one finds easy to perform and doesn’t want to change. At the same time, it may also result in monotony which propels one to go for change. Another example can be taken of established systems and procedures as inertia but delays and red tapism leads to anti- inertia. Establishing a brand with a given set of customer value leads to brand recall and loyalty, but it may result into brand stagnation, which will propel for change.

Thus, the organizations exhibit resistance to change (inertia) and tendency to change (anti-inertia) at the same time. The balance of inertial and anti-inertial forces would result either into an organization with dominant inertia (or continuity and stability) or into an organization with more of anti-inertia (or change and dynamism). In order to take the best advantage of continuity as well as change, the leadership should synthesize inertia and anti-inertia appropriately, as one provides stability to the organization and the other creates dynamism.

**Sushil**

*Editor-in-Chief*





### Aim

The journal is intended to share concepts, researches and practical experiences to enable the organizations to become more flexible (adaptive, responsive, and agile) at the level of strategy, structure, systems, people, and culture. Flexibility relates to providing more options, quicker change mechanisms, and enhanced freedom of choice so as to respond to the changing situation with minimum time and efforts.

It is aimed to make the contributions in this direction to both the world of work and the world of knowledge so as to continuously evolve and enrich the flexible systems management paradigm at a generic level as well as specifically testing and innovating the use of SAP-LAP (Situation- Actor - Process-Learning-Action-Performance) framework in varied managerial situations to cope with the challenges of the new business models and frameworks. It is a General Management Journal with a focus on flexibility.

### Scope

The Journal includes the papers relating to: conceptual frameworks, empirical studies, case experiences, insights, strategies, organizational frameworks, applications and systems, methodologies and models, tools and techniques, innovations, comparative practices, scenarios, and reviews.

The papers may be covering one or many of the following areas: Dimensions of enterprise flexibility, Connotations of flexibility, and Emerging managerial issues/approaches generating and demanding flexibility.

### Coverage

The journal is organized into various sections to include following types of contributions: Research papers, Short notes/correspondence, Applications and case studies, Book reviews, Book summaries, Interviews and round tables, Information about relevant conferences and seminars, Educational and learning experiments, and any other relevant information related with the theme of the Journal.

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- \* The title and headings are brief and catchy.
- \* The author(s) name and affiliation are given only on cover page.
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- \* Focus on flexibility in management is kept.
- \* The paper incorporates innovative ideas/models in a practical framework.
- \* Mathematical models, if any, are given in Appendix.
- \* Tables/Figures are properly placed and numbered with brief titles/captions.
- \* References are in standard style.
- \* Few highlights (8-10) of two-three lines are provided to put in boxes.
- \* Few key variables (3-5) are identified for flexibility mapping on a continuum.
- \* Some key questions (2-3) are provided to reflect the applicability in real life.
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# Technology Transfer Induced Technological Dependency in an Electric Power Plant: Effects on Efficiency, Reliability and Flexibility

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## Abstract

*Most electric power generation technologies in developing countries are acquired through technology transfer from suppliers in advanced developed countries. Despite providing large benefits, such technology transfer could potentially perpetuate and deepen technological dependency between a technology transferee, the buyer, and a technology transferor, the seller. The big challenge of a technology transfer exercise is to satisfy the need for foreign technology while taking measures to minimize current and future technological dependency. The main objective of this paper is to examine the technology transfer reinforced technological dependency in an electric power plant based on a technological dependency assessment (TDA) model developed for this purpose. The model consists of four manifest components of technological dependency: technology, utilization, knowledge, and acquisition dependencies. Each manifest component has a number of elements and each element is assessed based on a number of indicators. In addition the model incorporates one attitude dependency component with four elements embedded in the four respective manifest components: technology attitude, utilization attitude, knowledge attitude and acquisition attitude dependencies. The elements and their assessment indicators are identified through literature review and expert opinions, and are confirmed by practitioners.*

*This paper presents an analysis of the most critical technological dependency, using the Bang Pakong Power Plant (BPPP) in Thailand as a case study. The results of assessment in the plant indicate that lack of flexibility for adaptation and lack of sufficient information are causes of the plant's poor performance. The paper suggests how BPPP could reduce the levels of technology transfer reinforced technology dependency to prevent unfavorable long-term effects in the effective and efficient operation of the power plant.*

**Keywords:** electric power plants; electric power generation technology; technology transfer; technological capability; technology dependency

## Introduction

The importance of reliable electrical power supplies in fostering national economic development is well established; low reliability of electricity supplies could hinder the progress of a country's economy. The reliability of electric power generation technology generally affects the reliability of electrical power supplies.

In developing countries, very often, the electric power generation technology has to be imported from industrially advanced developed countries. A firm in developing country often tends to be dependent on developed country firms for technology. The acquisition of advanced technology through technology transfer generally brings large benefits to buyers (Ortolani, 2005). However, it could also potentially perpetuate and deepen the technological dependency of developing country firms on developed country firms. The big challenge of a technology transfer exercise is to satisfy the need for foreign know-how while taking measures to

minimize technological dependency. After costs and benefits, technical and financial risks caused by unproven advanced technology have become an important third factor concerned in technology transfer projects (Tate, 1988). Risk corresponding to technological dependency on a transferor of an advanced technology is one of them. Unforeseen technical problems could occur with unproven advanced technology leading to increase in cost of production. Technological dependency, therefore, could reduce a firm's competitiveness resulting in deterioration of business performance and reduction in its earnings.

The main objective of this paper is to present an analysis of technology transfer reinforced technological dependency in an electric power plant in Thailand. The analysis is based on a technological dependency assessment (TDA) model that incorporates three dependencies, resource, capability, and attitude. This model is a refinement of the assessment model developed by Paukatong et al. (2003), which defines technological dependency as comprising *acquisition*,



*technical, utilization and knowledge dependency* components. The paper is based on the premise that understanding the causes of technological dependency could help to identify the weaknesses of a firm and eliminate these in order to enhance competitiveness and prevent unfavorable long-term effects on profitability and growth.

## Technological Dependency

Firms in the developing and less developed countries usually rely on technology transfer as an important means for acquiring technology (Mambula, 2002; Schatz, 1996). Due to insufficient capability, a firm typically depends on outside help to solve any technical problems in implementation and utilization of the transferred technology. Technological dependency resulting from technology transfer has historically been a major concern (Moxon and Fagafi-nejad, 1977). Some literature defines technological dependency only as reliance on the imported technology (Fabayo, 1996). Technology transfer is the sole mechanism for acquiring the needed technology. In-house technology development does not exist. Others refer to the interrelationships among the technical development of different technologies (Chiesa et al., 1999), where success of the development of a technology depends on the availability of one or more other technologies. Yet, others have focused on the effects of the decision-making process in technology acquisition or on innovation (Hakansson, 1987). After a decision has been made to acquire some technology, a firm has to stay with the acquired technology for a considerable period. However, to be considered as contributing to dependency, an acquired technology has to be critical to the continued profitability of the firm (Mabry, 1999).

There are two types of technological dependency, “mutual” and “asymmetric” (Fabayo, 1996). In the case of mutual dependency, one firm buys technology from another firm while pursuing its own technological developments. The imported technology is aimed at complementing local technology resources for further development. Two conditions are often found in this case. First, the imported technology is not usually used as it is; it is modified and integrated together with an already self-developed technological system. Second, mutual dependency enhances technological interdependence between the transferee and the transferor. Both transferor and transferee could make more efficient allocation of their resources for technology development to achieve the lowest overall cost and highest returns on investment. The mutual type of dependency is usually not a problem, and may be seen as contributing to faster, better and higher technology development in a firm. One good example is the successful history of technology improvement among firms in Munich, Germany. The mutual

dependency relationship between Siemens AG and small and medium enterprises (SMEs) has shown favorable results through diverse and intra-regional cooperation in innovation rather than posing threats to participating firms (Sternberg and Tamasy, 1999). However, often, it is very difficult to sustain mutual balance due to unaffordable huge investments by smaller firms (Ennis, 1989; Hooper, 1992).

In asymmetric dependency, technology flow is characterized by a one-way relationship. In such a situation, usually one firm buys technology from another without any involvement in the development of that technology. This situation frequently arises when the purchasing firm does not have the capability to develop the technology it needs and has to rely on external sources for its core technological requirements. Under asymmetric dependency, imported technology is adopted as it is without any modification, adaptation, or integration with in-house technology, as the capability of the transferee is very limited. Technology is bought to substitute rather than support in-house technological development. Such forms of dependency could lead to domination and exploitation by the technologically superior transferor firm.

In this paper, only asymmetric dependency at the firm level is considered. **T e c h n o l o g i c a l** dependency, in this paper, is defined as the reliance of a technology transferee firm, on a technology transferor firm for the acquisition and use of the transferred technology. It is the inadequate

*The big challenge of a technology transfer exercise is to satisfy the need for foreign technology while taking measures to minimize current and future technological dependency. This paper presents an analysis of technology transfer reinforced technological dependency in an electric power plant in Thailand and its effects on efficiency, reliability and flexibility.*

capability and knowledge of the transferee that prevent it from mastering the transferred technology, thus reinforcing its dependency on the transferor. While insufficient capability in operations may impede the effective utilization of the transferred technology, insufficient knowledge about the technology itself could limit the ability to transact the purchase and identify sources of funding thereby increasing the firm’s reliance on consultants. This limitation in knowledge could also indirectly reduce the number of potential technologies and transferors available to the firm. Moreover, it could hinder the technology development and diffusion processes of a firm and lead to perpetual reliance on the transfer of technology as the only means of acquisition.

The technological dependency could also be of two types: manifest and attitudinal. The manifest technological dependencies limit the transferee firm’s ability to use the technology it already has effectively without help from the transferor or some other party. The attitude dependencies are, in contrast, inherent in the transferee firm, which limit the firm from venturing out to source new technologies from current or new sources. More discussions on these two types of dependencies are presented in the following section.

## A Model for the Assessment of Technological Dependency

As mentioned above, technological dependency may occur when a firm has insufficient capability for acquisition, operation and maintenance (including acquisition of its spare parts) of a technology. Moreover, the dependency may resurface when the time comes for the replacement of the transferred technology. Thus, technological dependency could exist throughout the life cycle of the technology used in the production system of a firm. The nature and causes of some of the important elements of dependency are summarized below.

- **Problems with technology acquisition:** Insufficient acquisition capability could limit the ability of a firm to identify suitable technologies, their sources (transferors) and the appropriate mechanisms for transfer. A firm may look only at a limited number of technologies due to inadequate technology scanning skills. Prospective transferors may be confined to only a few large well-known firms. Inevitably, such firms wield tremendous bargaining power and may insist on the use of transfer mechanisms that they favor. Such constraints may well restrict the scope of the acquisition and hinder development of transferee technological capability.
- **Problems with plant and equipment:** Problems could arise here due to the transferred hardware not performing to specifications or due to the transferor not providing sufficient information for the effective utilization and maintenance of the hardware. Rectifying such problems requires considerable commitment and support from the transferor. Such a situation, while prolonging the duration of the technology transfer exercise, also reinforces dependency.
- **Problems related to operations:** Inadequate transferee capability for the proper and effective operation of the technology could lead to sub-optimal results and damage to the plant and equipment. Interventions from the transferor may be needed in taking corrective action reinforcing the dependency.
- **Problems related to maintenance:** Insufficient capability to maintain the technology could lead to dependency on the transferor in two ways. Firstly, the firm may need transferor support for “planned” maintenance due to inadequate capability in undertaking itself such a maintenance effort. Secondly, in situations of “unplanned” maintenance, if the firm lacks the capability to quickly troubleshoot and develop corrective actions, it may have no option but to seek support from the transferor.

*There are two types of technological dependency, “mutual” and “asymmetric”; under the asymmetric dependency, imported technology is adopted as it is without any modification, adaptation or integration with in-house technology, as the capability of the transferee is very limited.*

- **Problems related to the acquisition of spare parts:** When a firm has the capability to undertake effective “planned” maintenance, there is adequate time to look for alternative suppliers and negotiate prices. However, if there is only one source of spare parts (often the transferor) dependency is total. In the case of “unplanned” maintenance, time is of essence. To reduce downtime priority is given to suppliers whose lead-time is shortest and as a consequence dependency is reinforced unless the firm has the capability to undertake total productive maintenance and has sound spare parts inventory management practices.
- **Problems related to technology replacement:** Rapid technological change requires that a firm upgrade or replace its existing technology so that it can continue to enhance customer value. When making replacement decisions, problems outlined above under *acquisition of new technology* are likely to be encountered unless the transferee firm has upgraded its acquisitive capability during the period of first purchase and replacement.

To assess technological dependency, Barlas et al. (2001) have suggested that the measures related to contribution made by outsiders to the total profit of the firm, and contacts with outsiders

in search of advice, assistance, and information could be used. High values of such measures indicate higher capability dependency. Another measure suggested by Brockhoff and Chakrabarti (1997) refers to the “external dependence ratio”. A high external dependency ratio occurs when the firm spends relatively large amounts on acquiring external knowledge and technology. A high value of this measure would indicate high resource dependency. However, no previous studies explored *attitude dependency*, which stems from the feeling among decision makers in the transferor firm that outside help is required in the transfer of technology.

The TDA model used here focuses on the technological process in electric power plant operation at the firm level and is based on a modified version of a model of technology transfer and development at the enterprise level (Sharif and Ramanathan, 1995) and the “technology ball” (Lan and Young, 1996).

As shown in Figure 1, the technology utilization and development process in a firm can be divided into four parts. Firstly, starting with the process of technology ‘acquisition’, a firm acquires the needed ‘technology’ for its production system via either ‘technology transfer’ or in-house ‘technology development’. Secondly, inputs to the production system are ‘technology components’ such as hardware and software and other ‘inputs’ such as materials.

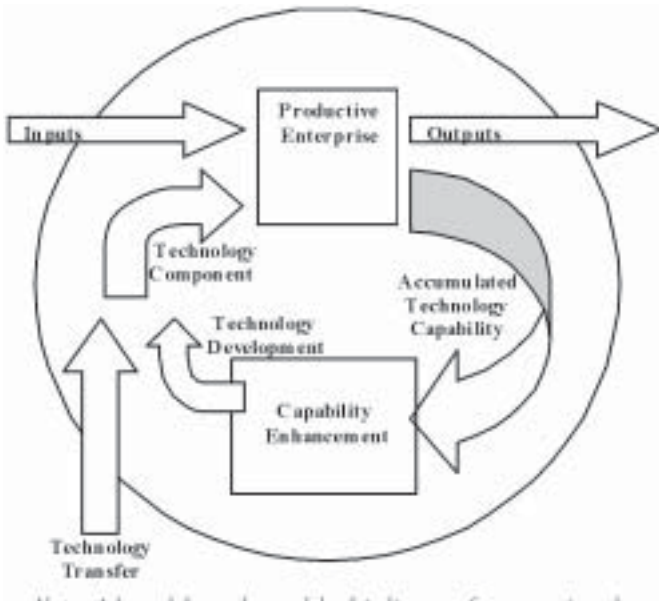


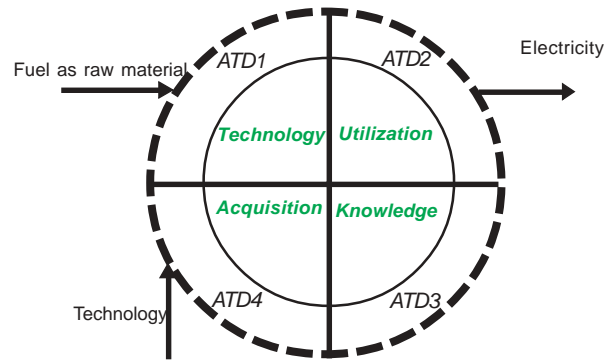
Figure 1. Technology Transfer and Development Process at the Enterprise Level

Note : Adopted from the model of indicators for assessing the elements of the technology transfer and development process at the enterprise level, Technology Transfer and Development: Implications for Developing Asia, *An Asia Development Bank Publication, May 1995* by Shari and Ramanathan (1995)

Thirdly, to produce the goods as ‘output’, here electricity, a firm has to utilize the technology effectively. Fourthly, ‘utilization’ capability could be built up and as experience accumulates, the ‘knowledge’ level of the firm would increase. With long experience, a firm could understand the reason behind ‘what to do’. It, then, knows ‘why to do’ which refers to ‘knowledge’ level. This ‘knowledge’ is useful for the ‘acquisition’ of the new ‘technology’ and the spare parts in the future. Technological dependency exists in these four parts, and the corresponding dependency components are defined as ‘acquisition’, ‘technology’, ‘utilization’, and ‘knowledge’ dependencies respectively, as shown in Figure 2.

From these four components, two technological dependency types could be identified. The first type called ‘resource’ dependency consists of ‘technology’ and ‘knowledge’ components. The second type called ‘capability’ dependency consists of ‘utilization’ and ‘acquisition’ components. However, as mentioned above, there is also a dependency syndrome based on the attitude and belief that the transferee themselves could not solve their own problems without outside help including some preference. The five components of the three types of technological dependency are identified in Figure 2. ‘Resource’, ‘capability’ and ‘attitude’ refer to ‘what a firm has’, ‘what a firm could do’ and ‘what a firm thinks it could do and actually does’, respectively. The five components of technological dependency are described briefly as hereunder.

- **Technology dependency:** occurs when chronic technical problems, which a transferee is unable to independently resolve, exists. The technical problems could be related



Technological Dependency

Figure 2. Technological Dependency Model

1. Resource: Technology & Knowledge
2. Capability: Utilization & Acquisition
3. Embedded Attitude
  - ATD1: Technology Attitude Dependency
  - ATD2: Utilization Attitude Dependency
  - ATD3: Knowledge Attitude Dependency
  - ATD4: Acquisition Attitude Dependency

to the ongoing requirements of effectiveness, efficiency, and reliability, the future requirements of flexibility, and the information requirements to utilize and maintain the technology.

- **Utilization dependency:** refers to the need for assistance from other firms in planning, performing and evaluating plant operations, and in planning, performing and evaluating plant maintenance.
- **Knowledge dependency:** occurs when the staff has inadequate supportive knowledge with respect to planning and implementing effective programs for obtaining funding and accessing raw materials and when the firm lacks of knowledge development on human resource and in-house R&D activities.
- **Acquisition dependency:** means depending on external sources for identifying a new technology, locating sources of the identified technology, negotiating and structuring appropriate mechanisms for its transfer, and for the eventual transfer and commissioning of the new technology transfer. Moreover, it also means depending on others for identifying good sources of spare parts, negotiating its purchase, and arranging business processes for completing such transactions.
- **Attitude dependency:** is an embedded technological dependency component of other components. It includes ‘Technology attitude dependency’, ‘Utilization attitude dependency’, ‘Knowledge attitude dependency’, and ‘Acquisition attitude dependency’.

Because one component of manifest technological dependency affects another, a chain of technological dependency may evolve and persist. For example, if *acquisition dependency* exists, a firm cannot acquire the right technology on its own. The acquired technology



could have a technical problem leading to *technology dependency* on the transferor. To solve this problem, the firm may rely on help from the transferor, thus leading to *utilization dependency*. Due to the continued long dependence on outside help for technology utilization, the knowledge of the firm's staff would not develop to an advanced level. Therefore, *knowledge dependency* may persist. With this *knowledge dependency*, the firm would not have the ability to acquire suitable new technology and spare parts in the future. Thus *acquisition dependency* continues and reoccurs.

**Methodology**

A single case study methodology is used in this study. Based on the model in the previous section, a detailed and in-depth investigation has to be conducted at the element and component levels of technological dependency. The case study methodology is ideal in such investigations (Feagin *et al.* 1991). Also, case study, as a triangulated research strategy, can ensure the accuracy of data and provide alternative explanations of the findings (Stake 1995). In this research, data and other information from four sources, documentation, archival records, interviews, and direct observations, were crosschecked. The case study methodology possesses the characteristics of analytic generalization, which ensures the external validity reflecting whether or not findings are generalizable beyond the immediate case (Yin, 1994). An analytical technique of within-case examination along with literature review was used in this study. For the validity of the measurement constructs three tactics suggested by Yin (1994) are used in this research, using multiple sources of evidence, establishing a chain of evidence, and having a draft report reviewed by key informant.

This research was conducted in two phases. Figure 3 shows the research activities conducted in order to develop

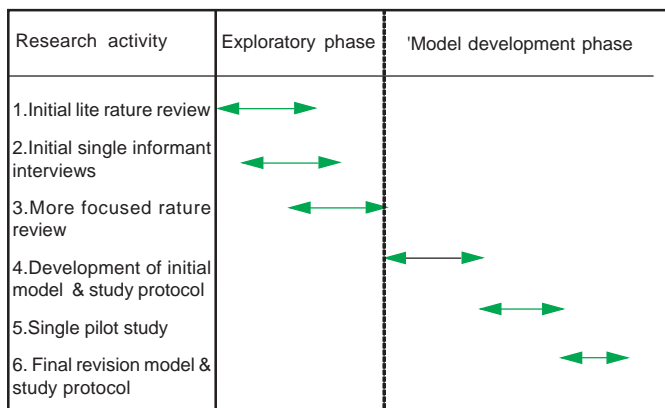


Figure 3. Research Activity Map

the TDA model. At the first 'exploratory', phase, there were three activities: initial literature review, initial single informant interviews, and more focused literature review. The published literature on technology transfer and technological dependency in the electric power generation was reviewed in order to develop the definition, cause and effect of technological dependency.

To ascertain the extent of the technological dependency in the electric power generation in Thailand, 'single informant' interviews were conducted with three groups of experts: two from the electric power generation business and one group from the transmission system business, of the Electricity Generating Authority of Thailand (EGAT). The experts were selected based on how technological dependency affected their tasks and responsibilities. There were two groups from the generation business because the study is about technological dependency in electric power generation. One group from the transmissions systems business was selected to provide an outside view of the technological dependency in electric power generation, as transmission is by far the closest outside customer/supplier of the generation business.

Each group from the generation business included top management (division directors and above) and middle management (from section to department managers) to represent strategy/policy and operational levels. The expert group from the transmission business system included only middle management because the experts thought that the views of the top management in this business would be similar to the views of the top management in the generation business. The members of the expert groups had between 10 –20 years of experience in their respective businesses. In each group, three persons were selected randomly. Each member informant was interviewed individually. The interview questions were open-ended 'what' and 'how' questions so that a wide range of opinions could be gathered from the informants regarding technological dependency in the electric power generation. The answers to these questions were used to develop the framework of the TDA model.

A focused literature review was carried out to explore in-depth the concerned issues of technological dependency identified through expert group interviews. Issues such as current and future technical needs of the existing technology, the operation and maintenance capability, the supportive knowledge required in operation and maintenance, knowledge development, acquisition of new technology and spare parts, and attitude were included in the focused literature review.

*The technological dependency could also be of two types: manifest and attitudinal. The manifest technological dependencies limit the transferee firm's ability to use the technology it already has effectively without help from the transferor or some other party. The attitude dependencies are, in contrast, inherent in the transferee firm, which limit the firm from venturing out to source new technologies from current or new sources.*

In the second phase of the research, an initial model is developed from the information obtained in the first phase. Elements on each component of technological dependency were developed based on literature review. The relevance of the assessment elements in the context of the electric power generation was then verified through consultations with experts. The summary of constructed elements is presented in Appendix I. A case study protocol was developed for data collection and analysis to ensure the reliability of the research. The protocol included preparing an overview of objectives, field procedures, case study questions, and a format for the case study report.

The developed initial model was used to make a preliminary assessment of the technological dependency at the Bang Pakong Power Plant (BPPP) owned by EGAT. According to the field procedure, permission was sought for data gathering at BPPP from the EGAT Governor (Head of the State Enterprise). Then permission of the top management at the site plant was sought to proceed with actual data collection. Initial information about the site was gathered from the website of EGAT (<http://www.egat.co.th>). An interview schedule was organized according to site plant management's availability. The top management of the plant named a site coordinator. The informants (groups of experts) were briefed in advance on discussion topics and issues related to each manifest component of technological dependency: technology, utilization, knowledge, and acquisition. However, the embedded *attitude dependency* was not informed in order to receive the actual information during the interviews.

In this study, in addition to the primary data collected by the researcher, secondary information from published literature are used to supplement the findings. For data collection, three principles are utilized: using multiple sources of data, creating a case database, and maintaining a chain of evidence. Chains of evidence in both forward and backward directions could help in securing the internal validity of the research (Stake 1995, Yin 1994). Four complementary data sources were identified for this research: documentation, archival records, interviews, and direct observations, as follows:

- **Interviews:** Three forms of interviews were used in different stage of research. During initial single informant interview, open-ended interviews were conducted to gather information regarding technological dependency in the electric power generation industry according to expert opinion. Structured interviews were used later in collecting data in the single pilot case study. Focused interviews were also used to verify some interesting evidence found during and after data

collection.

- **Documentation:** Any document showing some relationship with the technological dependency was copied with permission of the owner. These documents, used in the triangulation of evidence, corroborate evidence from other sources.
- **Archival records:** Service records, organizational records, and other records related to technological dependency were collected. Internet was used collect this kind of data. The accuracy of the records was examined before using them.
- **Direct observations:** Unobtrusive casual direct observations (Glesne and Peshkin, 1992) during site visits were used confirm some of the findings from other sources of data.

A tape recorder was used in order to capture all information during discussion with informants who had limited time. An informal environment during interview was created in order to avoid the cautious attitude of informants because of the use of tape recorder (Tellis 1997). In the single pilot case study, questions on prospective indicators were in a structured form to facilitate retrieval of specific

*The pertinence and feasibility of the model including the components, elements, and indicators of technological dependency were evaluated based on the experience in earlier steps and the model and study protocols modified to better suit the context. Problems faced during earlier data collection were identified and strategies for preventing them were developed.*

data for assessing each component of technological dependency. Some documents and archival records were requested from the informants in order to support their information. The list of documents, archival records, and names of responsible persons was put into the memo. This memo was submitted to the site coordinator for follow up information. The site coordinator assisted in organizing the direct observations and discussions with other staff to gather information on working processes and evidences of technological dependency. Staff at the site was informed that information collected was for academic purpose only in order to avoid the cautious attitude of the informants. The names, positions, and telephone numbers of all informants were collected for further contacts.

The pertinence and feasibility of the model including the components, elements, and indicators of technological dependency were evaluated based on the experience in earlier steps and the model and study protocols modified to better suit the context. Problems faced during earlier data collection were identified and strategies for preventing them were developed. The final version of the model and the study protocol were then released.

### Technological Dependency Assessment

As mentioned in the previous section, elements on each component of technological dependency from the TDA model (see Figure 2.) were identified. Indicators associated

with the element were also developed based on information received from the 'Exploratory' phase. The number of indicators may vary depending on the technological dependency element being assessed. These indicators must be measurable from available data and satisfy the validity of the measurement constructs as stated in previous.

Measurement criteria for analyzing the level of various technological dependency elements as 'high', 'medium', and 'low' were established based on Thai electric power generation norms (based on extensive discussion with experts at EGAT) and literature review. Some of indicators have a positive meaning. When arriving at the level of the technological dependency elements, the inverse meaning has to be taken (e.g. high degree of flexibility in the electric power generation technology means low technological dependency). For some indicators that have negative meaning, when arriving at the level of the dependency elements, the ratings and levels of indicators will have the same meaning. However, these proposed indicators will not be relevant for all electric power generation firms.

The most critical component is the Technology dependency. This paper discusses in details the elements, indicators, and measurement criteria for high, medium and low levels of this dependency (see Appendix II).

*There are a number of requirements the technology in a power plant has to meet. These are ongoing requirements for current operation, future requirements for modification and change, and information requirements for not only hardware but also effective utilization of the technology. Failure to meet these requirements independently leads to critical technology dependency.*

## Technology Dependency

There are a number of requirements the technology in a power plant has to meet. These are ongoing requirements for current operation, future requirements for modification and change, and information requirements for not only hardware but also effective utilization of the technology (Ting, 2004). The *technology dependency* has three elements under ongoing requirements (*TED1*, *TED2* and *TED3*) and one element each for future requirements for modification and change (*TED4*) and information requirements (*TED5*). These elements and their indicators are identified below:

### Ongoing Requirements

This issue concerns a user's requirements of the hardware of the electric power generation technology throughout its lifetime. Effectiveness, efficiency, and reliability are these requirements. Lack of ability to meet any of these requirements anytime can lead to *technology dependency* due to the need for help from the transferor or other parties.

***TED1. Lack of effective deployment of technology:*** Effective deployment of technology is crucial to the well being of any firm. Lacking the ability to do this by itself, a firm generally requires help from the transferor to correct, adjust, or modify the transferred technology. Failing to achieve the rated generating capacity and meeting the minimum

functional requirements (such as frequency control) inhibit effective utilization of the power generating technology. The difference between the rated maximum generating capacity and actual maximum megawatts generated is taken as one indicator of the ability to deploy technology effectively (*TED1-1*). The other indicator is the difference between the designed functional requirements specifications of the technology and the actual functional requirements met (*TED1-2*).

***TED2. Lack of efficient deployment of technology:*** The efficiency of the technology is the ratio of energy output to energy input. High efficiency generally provides low cost of electricity generated. Generally, an electric power plant selects highly efficient technology. However, this does not guarantee actual achievement of high efficiency. The lack of ability to deploy the technology efficiently based on original requirements forces a firm to request helps from the transferor for frequent technical modifications and calibrations. The ability to deploy the technology efficiently is measured by one indicator (*TED2-1*), which is the difference between the original efficiency specifications and actual efficiency achieved.

***TED3. Lack of reliable deployment of technology:*** Low reliability of technology normally leads to low productivity. Moreover, the malfunctions of

power plants resulting in low reliability make the power grid unstable. The blackouts in Moscow in 2005 and in the Philippines in 2001 are good examples. Similar problems occurred in Indonesia in January 1992, November 1994, and April 1997. Moreover, the reactor of the new Czech nuclear power plant at Temelin was shut down due to technical problems (Anonymous, 2001). Availability of the power plant can be enhanced if the failure of auxiliaries and their downtime is minimized (Srikrishna et al., 1996). The lack of ability to deploy technology reliability makes a firm seek help from the transferor of the technology, and is measured by one indicator (*TED3-1*), which is the difference between the Equivalent Availability Factor (EAF) of the electric power generation technology and the five-year EAF of the North America Electricity Reliability Council.

$$\text{EAF} = \frac{\{\text{Available Hours} - (\text{Equivalent Unit Derated Hours} + \text{Equivalent Seasonal Derated Hours})\}}{\text{Period Hours}}$$

EAF represents the availability of the electric power generation technology both in terms of time and capacity. The ratio of available hours to period hours shows availability of the technology in terms of time. However, it includes the period of time that the technology cannot generate electric power at the rated capacity called "derated" period. EAF is the actual availability of the electric power generation technology after deducting the "derated" hours.



### Future Requirements for Modifications and Change

These are a user's requirements of the electric power generation in the future for modifications, expansion, and replacement. The flexibility of the existing electric power generation technology provides a firm an opportunity to make changes to the current technology in the future by adding new modules, replacing some existing modules with new ones or replacing the entire plant. Without this flexibility, a firm will have to stay with the current transferor for all its future requirements. Moreover, inappropriate modification on the technology could lead to some technical problems and serious outage (Anonymous, 2005).

**TED4. Lack of flexibility for adaptation:** There are three indicators showing the flexibility for adaptation of the existing technology in the future. The first indicator (*TED4-1*) is the degree/type of standardization of the existing technology. Standardization would determine the extent to which modifications and changes could be made to an electric power generation system. The issue of flexibility with respect to upgrades assumes importance because plant and equipment may become unavailable or obsolete in the future. Moreover, hardware maintenance and software programming expertise may become unavailable (e.g. Neder et al., 1998). Often, low level of flexibility is found in proprietary systems. Public standardization, which is available to all, provides more flexibility than proprietary standardization, which is available to only particular owners and holders, does. Therefore, the degree/type of standardization ('Public', 'Proprietary', and 'None') would affect this flexibility.

The second indicator (*TED4-2*) is the cost of existing technology. Switching to other technologies is one of alternatives for modifications and change. However, if the cost of existing electric power generation technology is high, switching may be difficult. Thus the cost of existing technology would reduce the flexibility or change. Another option is to modify and change the technology only in some parts or modules. However, availability of this option depends on the degree of modularity of the technology. The electric power generation technology may come as either a single integrated system or several integrated modular subsystems. Therefore, the degree of modularity of the electric power generation technology is identified as the third indicator (*TED4-3*) of this flexibility.

### Information Requirements

The transferee has to transfer not just the hardware, but also the information on how the technology could be utilized effectively (Gross, 2004). Moreover, detailed technical drawings and design information, which is rarely given (Misseijer et al., 1996), is needed for upgrading the existing technology. If this information were not provided, the transferee would become dependent on the transferor.

**TED5. Lack of sufficient information:** We identify two indicators for lack of sufficiency of information: The availability of the information for the operation and

maintenance of the existing technology (*TED5-1*) and help needed from the transferor due to insufficient information (*TED5-2*).

### A Case Study of the Bang Pakong Power Plant

The technological dependency assessment described in Section 5 is applied to the Bang Pakong Power Plant (BPPP) of the Electricity Generating Authority of Thailand (EGAT), which was formed on May 1, 1969 by the merging of three former regional electricity authorities. The activities of the state owned utility, with an asset of about US\$10 billion, include construction, operation and maintenance of power plants and transmission networks, purchase of power from Small Power Producers and Independent Power Producers, and sale of power to regional electricity distribution authorities, some direct large customers and neighboring countries of Laos and Malaysia. The utility is also responsible for implementing demand side management programs under Thailand's government mandate energy policies. In order to comply with the government's policy of electricity supply industry reform, EGAT's new structure now consists of three business units, Transmission, Generation, and Development, and supportive units such as Policy and Planning, Accounts and Finance, and Administration (see Fig. 4).

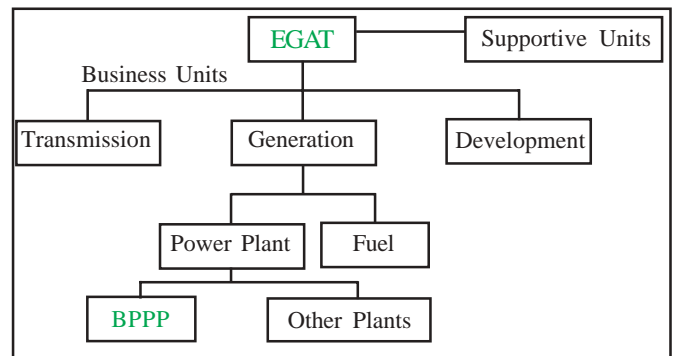


Figure 4. BPPP in the EGAT's Organization Chart

The BPPP is in the Generation business unit of EGAT. The plant with an aggregate capacity of 3,680 megawatts (MW) provides more than 20 percent of Thailand's electricity needs. The plant uses both thermal and combined-cycle power generating technologies. The 2,300 MW thermal power unit consisting of four conventional steam turbine generators, two of 550 MW each and two of 600 MW each, uses bunker oil and natural gas. The 1,380 MW combined cycle power unit consisting of two of 370 MW and two of 320 MW generators uses natural gas and diesel oil. At a total investment cost of over US\$1 billion, the Bang Pakong Power Project was developed in two stages. The first stage with two 550MW thermal generators and two 370 MW combined cycle generators started in 1979 and was completed in 1984. The second stage including two 600 MW thermal power generators and two 320 MW combined cycle generators started in 1988 and was completed in 1992. Its power generating technologies were transferred from developed countries such as Siemens from Germany and GE from the US. The following subsections describe the various



components, elements and indicators of technology dependency caused by transfer of these technologies.

**Technology Dependency**

**Ongoing Requirements**

**TED1. Lack of effective deployment of technology:** Although the required generating capacity could not be achieved at the early stage of commissioning at BPPP, all power generating units are meeting their generating capacities. Adjustment and modifications had to be carried out in order to ensure that all requirements of major functions were met during commissioning. The values of both TED1-1 and TED1-2 indicators show there is currently no negative deviation in effectiveness of the electric power generation technology. Technical dependency is ‘Low’ on account of this element.

**TED2. Lack of efficient deployment of technology:** All units of BPPP were able to satisfy efficiency requirements at the commissioning stage. However, during operation the efficiency had dropped from the original values but is still greater than 90% of the specified value. It is envisaged that by using ‘step factor’ during maintenance, the efficiency would be restored to earlier levels. The indicator TED2-1 is assigned a ‘Low’ value thus giving ‘Low’ dependency on account of this element.

**TED3. Lack of reliable deployment of technology:** In general, the availability of the power generating technology at BPPP is higher than the 5-year NERC’s average, which is about 80% for thermal plant and 85% for combined cycle plant. There is no negative deviation on reliability of the plant’s power generating technology. At the thermal power plant of BPPP, the average Equivalent Availability Factor

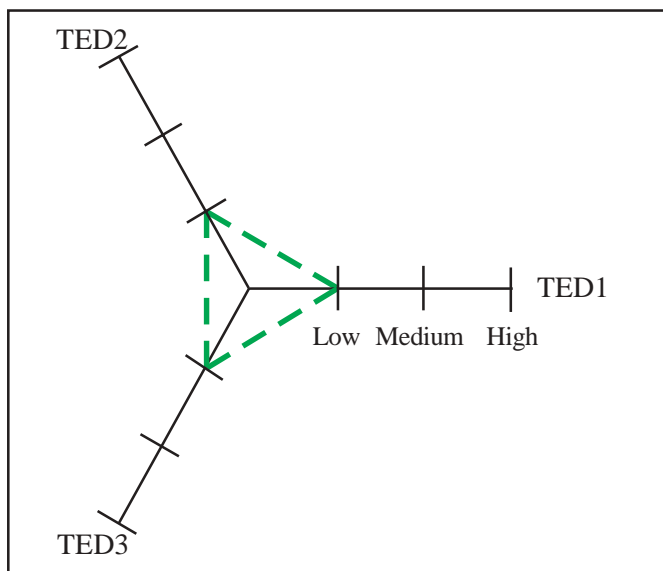


Figure 5. Technology Dependency - Ongoing Requirements

Element	Dependency
TED1: Lack of effective deployment of technology	Low
TED2: Lack of efficient deployment of technology	Low
TED3: Lack of reliable deployment of technology	Low

(EAF) (1997-2002) was higher than 80%. For the combined cycle plant, the average EAF of the plant was higher than 85%. Therefore, based on TED3-1 indicator, ‘Low’ dependency is identified on account of this element.

For the issue of lack of ability to meet ongoing requirements, based on three elements above, ‘Low’ dependency is currently assigned.

**Future Requirements for Modifications and Change**

**TED4. Lack of flexibility for adaptation:** The power generating technology at BPPP uses proprietary standards. The technology has been designed according to functional specifications. Therefore, ‘Medium’ dependency is assigned on the TED4-1 indicator. The cost of its technology is very high and depreciation time is 300 months. ‘High’ dependency, therefore, is given to the TED4-2 indicator. Only two combined cycle generators have been designed in modular pattern, and the other two form part of the integrated system. In case of the thermal plant, a modular design has been applied for all four generators. However, the reliability of combined cycle generators in the integrated system is less than the reliability of others. Since some of units have been designed in modular pattern and some have been designed as part of the integrated system, ‘Medium’ dependency value is assigned to the TED4-3 indicator.

Since two indicators indicate ‘Medium’ dependency and

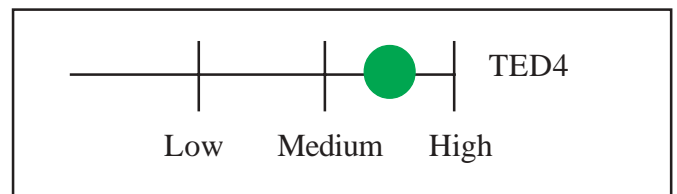


Figure 6. Technology Dependency on Future Requirements for Change

Element	Dependency
TED4: Lack of flexibility for adaptation	Medium-High

one indicator indicates ‘High’ dependency, ‘Medium-High’ dependency is assessed on account of this lack of flexibility element resulting in ‘Medium-High’ dependency on the issue of future requirements for modification and change.

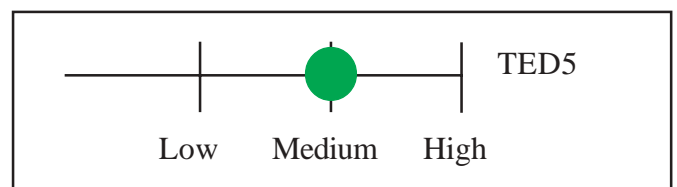


Figure 7. Technology Dependency - Information Requirements

Element	Dependency
TED5: Lack of sufficient information	Medium

## Information Requirements

**TED5. Lack of sufficient information:** Existing information is sufficient to operate and maintain the electric power generation technology at BPPP. However, some information such as detail drawings and design information is not available to carry out improvements. Management at BPPP stated that the transferor, if requested for design details and related drawings, usually responded positively within a reasonable time. Hence, 'Medium' dependency is assigned to both TED5-1 and TED5-2 indicators. Consequently, the overall *technology dependency* on account of information requirements is 'Medium'.

## Conclusions

The highest level found is 'Medium-High' in TED4 (Lack of flexibility for adaptation), which are related to technology management for the future such as modification and expansion. The power generating technology at BPPP uses proprietary standards. Its cost is very high with 300 months in depreciation time. Moreover, only some units of power generation are designed in modular pattern. Therefore, the lack of flexibility for adaptation (TED4) is rated 'Medium-High' as shown in previous section. The second highest level, 'Medium', is associated with element TED5: Lack of sufficient information in *technology dependency*. The second highest rate of technological dependency at BPPP is related to information and knowledge of a firm. Existing information is sufficient to operate and maintain the electric power generation technology at BPPP. However, some information such as detailed drawings and design information is not available to carry out improvements. The transferor, if requested for design details and related drawings, usually responded positively within a reasonable time. Therefore, TED5 (Lack of sufficient information) is rated as 'Medium'.

All other technology dependency elements (TED1: Lack of effectiveness, TED2: Lack of efficiency, TED3: Lack of reliability, are rated as 'Low'. The 'Low' rated dependency related to regular tasks related to on-going requirements of the technology (TED1, 2, and 3). Since they are rated as 'Low', it is not necessary to take any action on these dependencies.

## References and Bibliography

Ahmad, S.S. (1996) 'Life Assessment study of a 400 MW steam boiler at Ghazlan power plant', *Journal of Quality in Maintenance*, Vol. 2, No. 4, pp. 48-58.

Anonymous (1998a) 'Use of alliances trims MRO buying cost at PacifiCorp', *Purchasing*, Vol. 124, No. 6, pp. 118-119.

Anonymous (1998b) 'India: A global mentality', *Asian Review of Business and Technology*, Hong Kong, January 1, p. 1.

Anonymous (2001) 'Glitch Closes Czech N-plant', *Financial Times*, London, August 20, p. 1.

Anonymous (2005) 'Vt. utility seeks reimbursement from Entergy for power it bought during nuclear outage', *Global Power Report*, New York, February 24, p. 17.

Baker, P. (2004) 'A picture of maintenance in practice', *Works Management*, Vol. 57, No. 11, pp. 18-20.

Barlas, Y., Damianos, D., Dimara, E., Kasimis, C. and Skuras, D. (2001) 'Factors influencing the integration of alternative farm enterprises into the agro-food system', *Rural Sociology*, Vol. 66, No. 3, pp. 342-358.

Betz, F. (1993) 'Cyclic incremental innovation process', *Strategic Technology Management*, Vol. 26, McGraw-Hill Inc., New York.

Brockhoff, K.K. and Chakrabarti, A.K. (1997) 'Take a proactive approach to negotiating your R&D budget', *Research Technology Management*, Vol. 40, No. 5, pp. 37-41.

Chen, X. and Sun, C. (2000) 'Technology transfer to China: alliances of Chinese enterprises with western technology exporters', *Technovation*, Vol. 20, pp. 353-362.

Chiesa, V., Giglioli, E. and Manzini, R. (1999) 'R&D corporate planning: Selecting the core technological competencies', *Technology Analysis & Strategic Management*, Vol. 11, No. 2, pp. 255-279.

Domingo, B.S. (2005) 'JBIC willing to grant loans to buyers of power plants', *BusinessWorld*, Manila, February 1, p. 1.

Ennis, P. (1989) 'Technology Transfer Are Now Flowing Both Ways', *Tokyo Business Today*, Tokyo, September, pp. 24-27.

Fabayo, J.A. (1996) 'Technological dependence in Africa: its nature, cases, consequences and policy derivatives', *Technovation*, Vol. 16, No. 7, pp. 357-370.

Fagre, N. and Wells, L.T.Jr. (1982) 'Bargaining power of multinationals and host governments', *Journal of International Business Studies*, Fall, pp. 9-24.

Feagin, J., Orum, A. and Sjoberg, G. (1991) *A case for case study*, Chapel Hill, NC: University of North Carolina Press.

Fitzpatrick, E.W. (1995) 'Assessing the worth of new technology', *Journal of America Society of CLU & ChFC*, Vol. 49, No. 4, pp. 37-38.

Gilbert, S. (1993) 'Off-the-shelf components cut upgrade costs', *Power Engineering*, Vol. 97, No. 8, p. 29.

Glesne, C. and Peshkin, A. (1992) *Becoming qualitative researchers*, New York: Longman.

Gross, J.M. (2004) 'Asset management plays key plant shutdown role', *PEM*, Vol. 28, No. 5, p. 22.

Haeri, S. (2005) 'Booshehr nuclear plant has serious technical problems', *Iran Press Service*, February 27, <http://www.iran-press-service.com/ips/articles-2005/february/booshehr-nuclear-plant-ha.shtml>.

Hakansson, H. (1987) *Industrial Technological Development: A Network Approach*, Croom Helm, London.

Hammer, K., Egleston, P.C.Jr., Steinert, M.P. and Goldstein, M. (1992) 'Computerized Maintenance Boosts Reliability, Trims Costs', *Power Engineering*, Vol. 96, No. 1, p. 30.

Hansen, T. (2005) 'Long-term maintenance matters', *Power Engineering*, Vol. 109, No. 2, pp. 32-33.

Hennagir, T. (1996) 'Creating project profitability', *Independent Energy*, Vol. 26, No. 4, p. 6.

Hill, G.D. (1989) 'SaskPower Contracts-Out Meter maintenance',

*The case power plant scores medium to high dependency on areas such as flexibility for adaptation and sufficient information for improvements and low dependency on effectiveness, efficiency and reliability in current operations*

*Transmission & Distribution*, Vol. 41, No.3, pp. 126-129.

Hooper, L. (1992) 'Europe's Computer Makers Seek Allies—Aim Is To Get Vital Help, But retain Independence', *Wall Street Journal*, New York, January 24, pp. B5E.

Hu, Y. (1981) 'The World Bank and Development Finance Companies', *Journal of General Management*, Vol. 7, No. 1, pp. 46-57.

Karagozoglu, N. (1988) 'Innovative Behavior of Firms in a Developing Country: An Empirical Study', *Engineering Management International*, Vol. 5, No. 2, pp. 121-128.

Karagozoglu, N. (2001) 'Economic development and environmental management: Comparing environmental management practices in Turkey and the United States', *The Mid-Atlantic Journal of Business*, Vol. 37 No.2/3, pp. 111-122.

Kofas, J.V. (1997) 'The politics of foreign debt: The IMF, the World Bank, and U.S. foreign policy in Chile, 1946-1952', *The Journal of Developing Areas*, Vol. 31, No. 2, pp. 157-181.

Lan, P. and Young, S. (1996) 'International technology transfer examined at technology component level: a case study in China', *Technovation*, Vol. 16, No. 6, pp. 277-286.

Lecraw, D.J. (1984) 'Bargaining power, ownership and profitability of subsidiaries of transnational corporations in developing countries', *Journal of International Business Studies*, Spring-Summer, pp. 27-43.

LeMay, B., Willyard, B., Polasek, S. and Clarkson, C.W. (1995) 'Valves: Part3 – Design, maintenance extend FGD system slurry valve life', *Power Engineering*, Vol. 99, No. 8, p. 45.

Mabry, L.A. (1999) 'Multinational corporations and U.S. technology policy: Rethinking the concept of corporate nationality', *Georgetown Law Journal*, Vol. 87, No. 3, pp. 563-673.

Malik, K. (2004) 'Intra-firm technological knowledge transfer: a capabilities perspective', *International Journal of Technology Transfer & Commercialisation*, Vol. 3, No. 4, p. 470.

Mambula, C. (2002) 'Perceptions of SME growth constraints in Nigeria', *Journal of Small Business Management*, Vol. 40, No. 1, pp. 58-65.

Misseijer, R.C., Thabit, T.I. and Mattheij, J.H.G. (1996) 'Operational evaluation of patch required combustion gas turbine transition pieces', *Journal of Quality in Maintenance*, Vol. 2, No. 4, pp. 59-70.

Moxon, R.W. and Fagafi-nejad, T. (1977) 'Technology Transfer and the Transnational Enterprise: The Outlook for Regulation', *Journal of Contemporary Business*, Vol. 6, No. 4, p. 147.

Murtha, M.J. (1995) 'Upgrading fire protection with a new breed of system', *Power Engineering*, Vol. 99, No. 3, p. 49.

Nadesan, M.H. (2001) 'Fortune on globalization and the new economy', *Management Communication Quarterly*, Vol. 14, No.3, pp. 498-506.

Neder, R.K., Ramsey, D.V., Semmler, M.G., Colaianni, R.P. and Robison, G.D. (1998) 'How Oconee plans to reach 60', *Nuclear Engineering International*, Vol. 43, No. 533, p. 30.

Ortolani, A. (2005) 'Technology transfer is critical to winning China reactor job', *Wall Street Journal*, New York, May 12, pp. B4.

Pampillon, R. (1993) 'The technological deficit of Spain', *Management Research News*, Vol. 16, No. 8, p. 13.

Paukatong, T., Paul, H., Igel, B. and Ramanathan, K. (2003) 'Technological Dependency in the Electricity Industry: An Assessment Framework', Paper presented at IAMOT 2003, ENSGSI, Nancy, 54063, France.

Percy, D.F. and Kobbacy, K.A.H. (1996) 'Preventive maintenance modeling: a bayesian perspective', *Journal of Quality in Maintenance Engineering*, Vol. 2, No. 1, pp. 15-24.

Poynter, T.A. (1982) 'Government intervention in less developed countries: The experiences of multinational companies', *Journal of International Business Studies*, Spring-Summer, pp. 9-25.

Ramanathan, K. (1997) 'An analytical framework for technological transfer', *Contemporary Issue in Technology Transfer*, Eska Publishing, Paris.

Ramanathan, K. (1998) 'An eclectic classification of technological capability', *Technology Management Education and Training*, Asian and Pacific Center of Technology, ESCAP/United nations, New Delhi.

Rogers, P. (2002) 'California's Reliance on Natural Gas Puts State at Risk', *Knight Ridder Tribune Business News*, Washington, July 17, p. 1.

Rothenberg, R. (2001) 'Despite technology's advance our tolerance for defects rises', *Advertising Age*, Vol. 72, No. 16, p. 18.

Saad, M. and Zawdie, G. (2005) 'From technology transfer to the emergence of a triple helix culture: the experience of Algeria in innovation and technological capability development', *Technology Analysis & Strategic Management*, Vol. 17, No. 1, p. 89.

Schatz, S. (1996) 'The World Bank's Fundamental Mis-Conception in Africa', *The Journal of Modern African Studies*, Vol. 34, No. 2, pp. 239-47.

Sharif, N. and Ramanathan, K. (1995) *Technology Transfer and Development: Implications for Developing Asia-Overall Report*, An Asian Development Bank, Manila.

Smith, D.A. (1997) 'Technology, commodity chains and global inequality: South Korea in the 1990s', *Review of International Political Economy*, Vol. 4, pp. 734-762.

Smith, D. J. (2004) 'Outsourcing O&M allows utilities to remain competitive', *Power Engineering*, Vol. 108, No. 7, p. 50.

Srikrishna, S., Yadava, G.S. and Rao, P.N. (1996) 'Reliability-centred maintenance applied to power plant auxiliaries', *Journal of Quality in Maintenance*, Vol. 2, No. 1, pp. 3-14.

Stake, R. (1995) *The art of case research*, Thousand Oaks, CA: Sage Publications.

Sternberg, R. and Tamasy, C. (1999) 'Munich as Germany's no.1 high technology region: Empirical evidence, theoretical explanations and the role of small firm/large firm relationships', *Regional Studies*, Vol. 33, No. 4, pp. 367-377.

Tate, P. (1988) 'Risk! The Third Factor', *Datamation*, Vol. 34, No. 8, pp. 58-64.

Taylor, D. (2000) 'The master plan: A blueprint of the future', *Broadcast Engineering*, Vol. 42, No. 11, pp. 76-81.

Tellis, W. (1997) 'Application of a Case Study Methodology', *The Qualitative Report*, Vol. 3, No. 3.

Ting, A. (2004) 'Outsourcing in China', *Industrial Engineering*, Vol. 36, No. 12, pp. 46-50.

Wisniewski, J. (1991) 'How to manage HRIS consultant', *The Human Resource Professional*, Vol. 4, No. 1, pp.5-8.

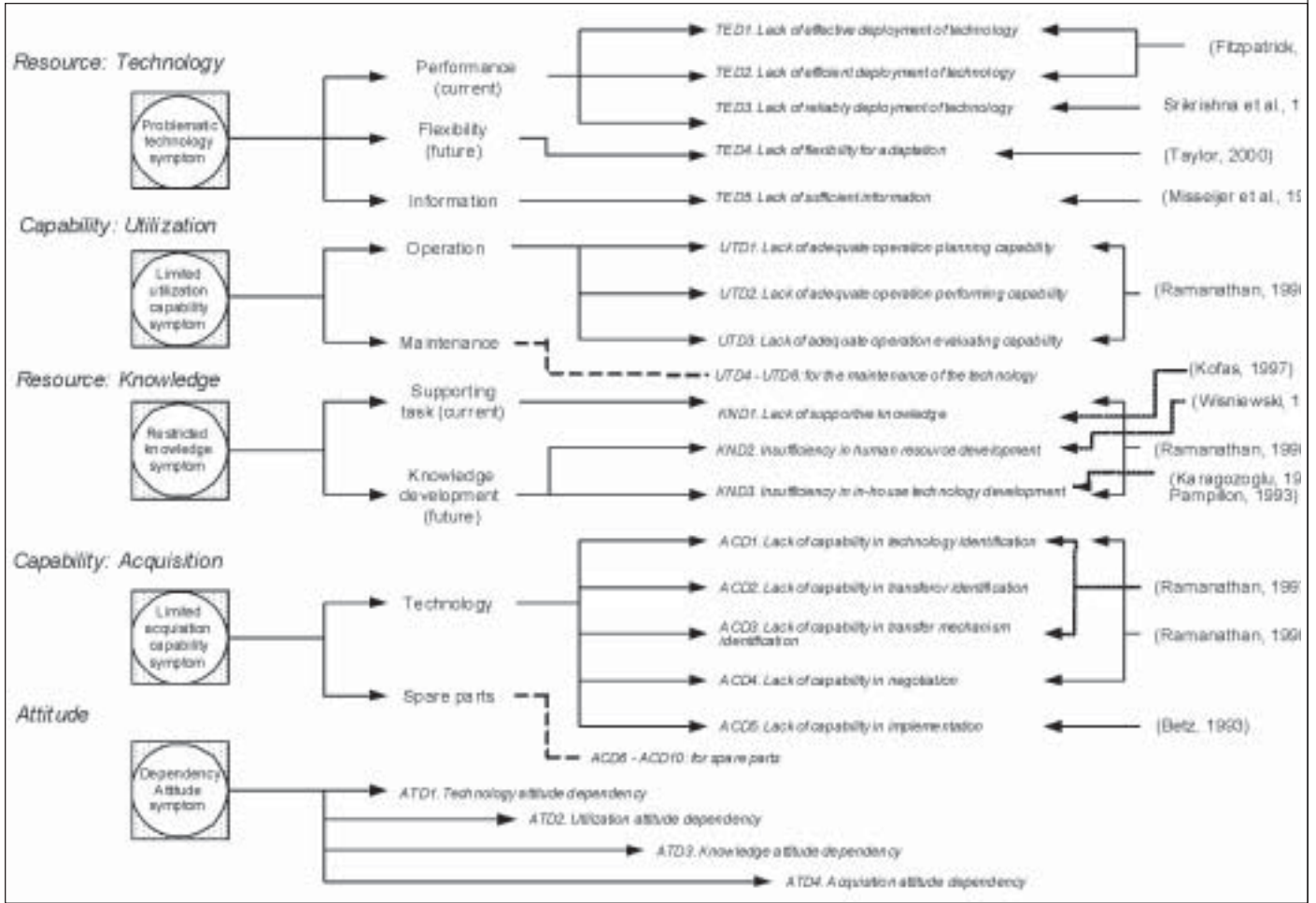
Witt, P. (1998) 'Strategies of technical innovation in Eastern European firms', *Management International Review*, Vol. 38, No. 2, pp. 161-182.

Yam, R.C.M., Tse, P., Ling, L. and Fung, F. (2000) 'Enhancement of maintenance management through benchmarking', *Journal of Quality in Maintenance Engineering*, Vol. 6, No. 4, pp. 224-240.

Yin, R. (1994) *Case study research: Design and methods (2<sup>nd</sup> ed.)*. Thousand Oaks, CA: Sage Publishing.

Zink, J.C. (1998) 'Competition dictates maintenance decisions', *Power Engineering*, Vol. 102, No. 5, pp. 22-26.

APPENDIX I  
Elements of technological dependency components





APPENDIX II  
Elements, Indicators and criteria of technology dependency

<b>Technology Dependency</b>				
<b>Element</b>	<b>Indicator</b>	<b>Criteria for dependency</b>		
		<b>Low</b>	<b>Medium</b>	<b>High</b>
TED1. Lack of effective deployment of technology	TED1-1. Negative deviation in Megawatt (MW) from the specified power generating	The required MW level can be achieved	n.a.	The required MW level cannot be achieved. capacity
	TED1-2. Negative deviations of the functions from original expectation	All functional requirements are met not been fulfilled but this imperfection does not cause any trouble in the operation comparing to the original expectation	Some functional requirements have been fulfilled and this imperfection causes unease in the operation comparing to the original expectation	Some functional requirements have not
TED2. Lack of efficient deployment of technology	TED2-1. Negative deviation of the plant's efficiency index from its original requirement	The efficiency index of the plant is not less than the original required level at commissioning stage. Moreover, during actual operation, the efficiency is not less than 90% of the specification. With the overhaul, the efficiency can be recovered.	The specification on efficiency could not be met. The efficiency of the plant is less than the original required level but more than 90% of the requirement. The overhaul could not help recovering the efficiency	The efficiency of the plant could not reach
TED3. Lack of reliable deployment of technology	TED3-1. Negative deviation in reliability (Equivalent Availability Factor: EAF from North America Electricity Reliability Council: NERC) of technology (Average 5 year period)	Low: EAF of the plant is higher than the NERC value	Medium: EAF of the plant is between the average one and 81.73% of the average one	High: EAF of the plant is less than 81.73% of the average value
TED4. Lack of flexibility for adaptation	TED4-1. Negative degree in standardization of technology for checking the availability of alternatives	Low: A public standardization exists	Medium: A proprietary standardization exists	High: No standardization of the technology
	TED4-2. Switching cost of technology for evaluating the difficulty in decision making of modification in monetary term	Low: If the depreciation time is less than 10 years	Medium: If the depreciation time is between 10 to 20 years	High: If the depreciation time is more than 20 years
	TED4-3. Negative degree in modularity of technology for evaluating the difficulty in decision making of modification in technical term	Low: If the system of technology is designed as an integration of several	Medium: If the technology is not designed as modularity but able to be modules	High: If the technology cannot be grouped to several modules grouped to several modules
TED5. Lack of sufficient information	TED5-1. Insufficient information for operation and maintenance for peration and maintenance.	All information has been transferred and sufficient	Information is sufficient for operation and maintenance but detailed drawings and design information are not transferred.	Existing in-hand information is not sufficient for operation and maintenance.
	TED5-2. Existence of help from transferor due to insufficient information	None	Some with acceptable response time	Some with unacceptable response time



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# Impact of Information Technology on Organizational Effectiveness: A Conceptual Framework Incorporating Organizational Flexibility

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## Abstract

*In a doctoral thesis submitted to IIT Delhi in 1994, this author had proposed a conceptual framework of the impact of information technology (IT) on organizational effectiveness. This framework hypothesized a series of impacts of IT on various organizational variables categorized as (a) process variables; (b) structural variables; (c) performance variables; and (d) effectiveness variables. A hierarchy of objectives was then developed amongst these variables using Interpretive Structural Modeling (ISM). The emerging structure indicated a series of facilitating relationships between IT applications in the organization and various organizational variables, eventually contributing to organizational effectiveness. Amongst the process variables identified, one was "enhancing operational efficiency and flexibility". In the hierarchy of objectives, this element had appeared as one of the direct impacts of IT. Thus, the significance of flexibility in the organization, as a variable influenced by IT applications, and in turn, influencing certain other organizational variables was highlighted. After more than a decade of this work, there have been enormous changes in the applications of IT in organizations, opening up new market opportunities, delivering improved services to customers, creating new IT-based products and streamlining internal business processes, etc. At an academic level, the concept of flexibility has taken deeper roots, with scope of flexibility also encompassing the concepts of organizational flexibility, strategic flexibility, product flexibility, manufacturing flexibility, and technology flexibility etc. The concept of systemic flexibility coupled with SAP-LAP framework has also been propounded. This Paper proposes a revised conceptual framework of the impact of IT on organizational effectiveness, incorporating the dimension of organizational flexibility in the earlier conceptual framework. Empirical data from published literature on the impact of IT on organizations has also been provided, which demonstrates the validity of the revised conceptual framework.*

**Keywords:** flexibility, information technology, operational flexibility, organizational effectiveness, organizational flexibility, performance variables, process variables, strategic flexibility, structural flexibility, structural variables

## Introduction

A research study was conducted by this author during the period 1990 to 1994 as a part of a doctorate theses with IIT Delhi primarily with a view to examine the nature and extent of the impact of IT on organizational effectiveness. (Batra, 1994) Based on the available theoretical perspectives at that time and through application of consensus methodologies, a conceptual framework was developed. This framework analyzed the impact of IT on various organizational variables, categorized into process, structural, performance and effectiveness variables. Organizational effectiveness was conceived to comprise of three effectiveness variables, namely, ability to meet current organizational objectives, adaptability to external environment and ability to match organizational objectives with personal objectives of employees. From this conceptual framework a set of hypotheses about the impact of IT on individual organizational variables and inter-dependence among various categories of organizational variables was generated. The empirical study carried out in selected organizations adopting the methodology described in detail in the said theses,

validated many hypotheses of inter-dependence amongst organizational variables and revealed additional linkages amongst them. It also helped in identifying factors contributing to the success of IT in enhancing organizational effectiveness and highlighted various situational factors to which the variations in the impact of IT could be attributed. Lastly the study led to the development of recommendations for planning and managing IT in organizations.

Over the last decade, the scope of the term IT has undergone considerable change. The almost instantaneous capability of IT for information acquisition, processing, transmission, storage and retrieval continues to be its basic essence. However, the modes through which this happens have been transformed. The basic premise that IT reflects the convergence of computer and communication technologies remains unaltered, yet this convergence has much bigger meaning than indicated – the convergence now implies an almost total fusion of technologies and products, which create global impact. IT has created a new information society characterized by availability of large amounts of information, facilitating increased power, wider choices and



heightened awareness. The revolutionary changes in IT have given pre-eminence to the role of knowledge, which has a much larger connotation than information, and which subsumes data, information, interpretation of the information and derivation of new meanings and insights from such interpretation. The explosion of content on the Internet, for instance, has led to availability of tones of ever-changing and ever-growing information, both relevant and irrelevant, and has made the task of carving out knowledge from this heap of information a difficult art. It however demonstrates the capability of IT to generate knowledge. Systematic IT interventions are now being increasingly adopted to acquire knowledge from customers, employees and other stakeholders, and distribute and leverage this knowledge in accordance with the strategic needs of the organization.

At a conceptual level a far-reaching work has emerged over the last decade in the field of flexibility. At least two key streams on flexibility in organizations are seen in the literature. One of these is the concept of systemic flexibility (Sushil, 2000). This coupled with the related methodology of SAP-LAP framework (Sushil 2001) provides a useful framework for understanding and implementing flexibility in organizations. The other is a comprehensive conceptual work on “Building the Flexible Firm” (Volberda 1998). While the conceptual framework proposed by the present author recognized flexibility as an important organizational variable influenced by IT, he gave flexibility a limited connotation of “Operational Flexibility”. However, the literature on flexibility in the last decade has given a paradigm shift to the meaning and vision contained in the word “flexibility”. It has become apparent that flexibility is not confined to operational flexibility, but can be viewed in a much wider perspective to encompass structural flexibility or even strategic flexibility. It is now recognized that IT influences flexibility in all its dimensions. Not only IT has an impact on operational flexibility as hypothesized in the original conceptual framework suggested by this author, it also has impact on other forms of flexibility such as structural flexibility and strategic flexibility.

This paper examines the concepts on flexibility that have emerged over the last decade through the work of Sushil and Volberda, and proposes changes to the earlier conceptual framework with regard to the impact of IT on new organizational variables based on different types of flexibility. Empirical evidence of the impact of IT on operational flexibility, structural flexibility and strategic flexibility has also been provided. Some of the empirical observations reflecting a deviation from the proposed conceptual framework have also been highlighted, and the reasons for such deviations have been examined.

*The basic premise that IT reflects the convergence of computer and communication technologies remains unaltered, yet this convergence has much bigger meaning than indicated – the convergence now implies an almost total fusion of technologies and products, which create global impact.*

## The Original Conceptual Framework

The original conceptual framework was developed based on inputs from the literature survey findings, key propositions of the then existing partial frameworks and application of consensus methodologies. The steps involved in this exercise included the following:

- (a) Identification of Organizational Variables on which the impact of IT needs to be examined (This was done through a Nominal Group Technique exercise)
- (b) Classification of Organizational Variables into broad groups
- (c) Developing a hierarchy of the impact of IT on various organizational variables identified above
- (d) Developing an integrated framework based on the above
- (e) Defining and identifying contingency factors

The organizational variables identified through step (a) above were categorized into three broad groups designated as *process variables*, *structural variables* and *performance variables*.

**Process variables** are those organizational variables which are either related to the conduct of various managerial role functions in the organization or are concerned with carrying out important

organizational processes such as decision-making, communication and control.

**Structural variables** are those organizational variables, which are related to the structure of an organization and cover aspects such as levels of hierarchy, centralization/ decentralization and reporting relationships etc.

**Performance variables** are those organizational variables, which are related to tangible or intangible indicators of the performance of an organization.

The various organizational variables were synthesized into a smaller number of variables under each category, with a view to develop a manageable set of objectives, which could be considered for the development of a hierarchy of objectives. A total of ten objectives were synthesized from the process variables, six from structural variables and three from performance variables. The next step was to develop a hierarchy of these objectives to obtain an understanding of the nature of facilitating relationships amongst them, if any. For this purpose, an Interpretive Structural Modeling (ISM) approach was adopted. The final step was to interpret the structure emerging from ISM and synthesize the same into an integrative framework. This is presented at Figure 1 and described as follows:

- (a) The direct impacts of IT on organizations are to provide timely and relevant information on key issues to those



- concerned, streamlining procedures work flows and job designs and providing operational flexibility in the organization.
- (b) IT's ability to provide timely and relevant information helps in enhancing intra-organizational communication and communication with external agencies.
- (c) IT's ability to enhance intra-organizational communication and communication with external agencies facilitates improvement in the quality of decision-making at top management, middle management and operating levels.
- (d) IT's ability to streamline procedures work flows and job designs and to provide operational flexibility, coupled with its ability to enhance intra-organizational communication and communication with external agencies facilitate enhancement in the monitoring and control methods.
- (e) Improvement in the quality of decision-making at various levels, coupled with enhancement in the monitoring and control methods, facilitate adoption of participative management, rationalization of the manpower strength and reducing the number of hierarchical levels in the organization.
- (f) The above structural changes facilitate either decentralization or centralization of decision-making and creation of innovative structural forms for the organization.
- (g) These structural impacts of IT, in turn, facilitate

- geographical expansion of the business of the organization, enhance interaction with the external agencies and promote synergy of operations between various parts of the organization.
- (h) These impacts, in turn, help the organization in enhancing customer services and in providing a competitive advantage.
- (i) The above impacts promote achievement of current organizational objectives, increase the ability of the organization to adapt to its environment and help in increasing the match between organizational objectives and the personal objectives of the organizational personnel.
- (j) Thus, on the whole, these impacts result in enhancing the overall organizational effectiveness.

Additionally, there exist several contingency factors, which influence the way IT has an impact on the organizations. These factors can be defined as those, which exert a significant influence on the possible direction in which the impacts of IT on various organizational variables may take place. These include: *top management style and commitment, organization culture and value system, adequacy of financial resources, training of personnel, involvement of external change agents and meticulousness of planning.* These contingency factors influence how IT is used for changing the process and/or structural variables.

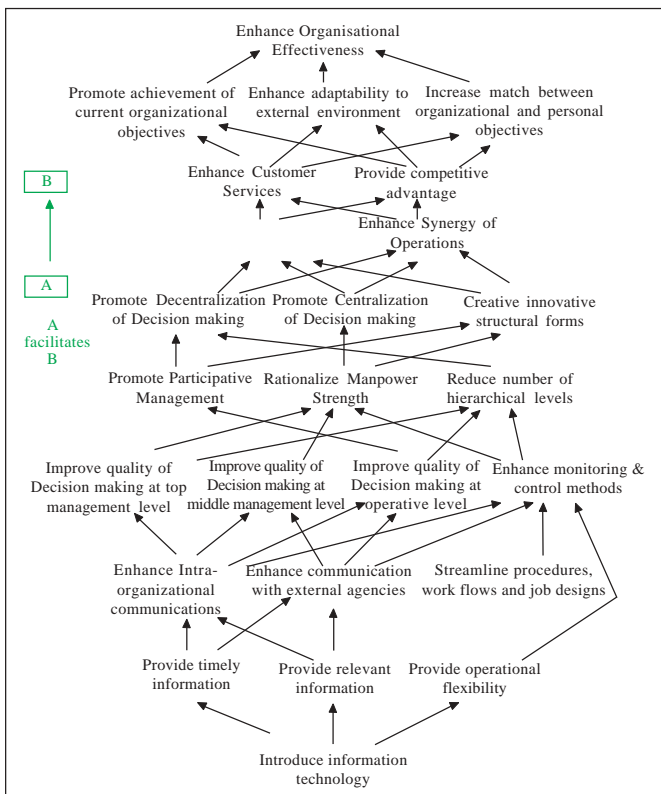


Figure 1: Hierarchy of Objectives of the Impact of IT on Organizations

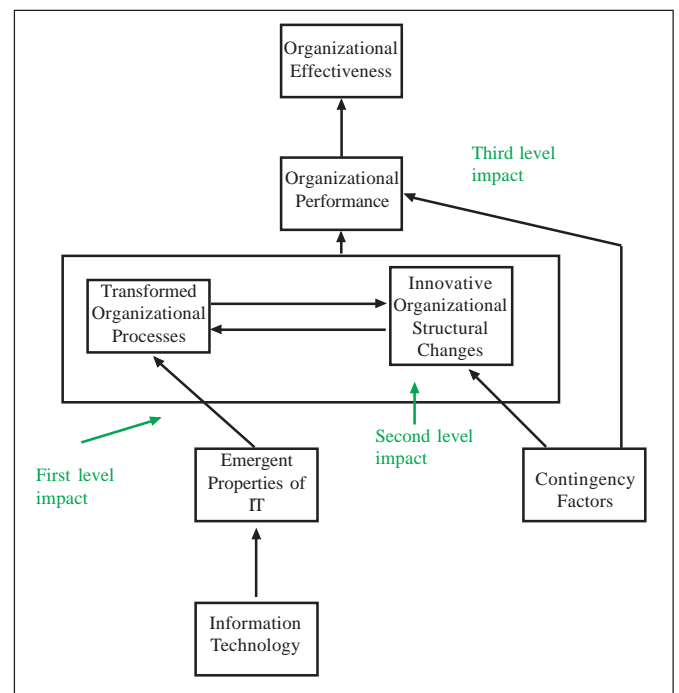


Figure 2: Generic Conceptual Framework of the Impact of IT on Organizational Effectiveness

This conceptual framework has also been expressed into a more generic framework, as diagrammatically represented at Figure 2. This generic framework (Batra 1993) envisages three stages of the impact of IT on organizations. In the first stage, IT through its emergent properties influences process

variables identified above. However, these first stage impacts are enabling in nature and it is not necessary that they would actually take place. If, however, they do take place, a range of options is thrown open for second stage impacts, which relate to the structural variables. These may be in the nature of diverse impacts on organization structure such as reduction in the number of hierarchical levels, centralization or decentralization and creation of innovative structural forms like the matrix structure or the network organization. The specific changes in the structural variables, however, depend upon various contingency factors identified above. In the third stage, the impact on structural variables is expected to be symbiotic with changes in the process variables. This means that the process changes will reinforce structural changes and vice versa. The actual selection of the combination of various possible options will be, however, based on a conscious need for enhancing the achievement of organizational effectiveness, triggered by the understanding of the environment by the management. This is manifested through its three dimensions, namely, achievement of current organizational objectives, adaptability of the organization to its external environment and match between organizational objectives and personal objectives of the individual employees. Thus eventually organizational effectiveness may be enhanced as a result of IT applications. In this third stage also, the contingency factors play a prominent role. If they act favourably, they will facilitate transformation of organizational processes and emergence of organization structures, which promote achievement of the conceived performance variables. However, if they act in a counterproductive manner, IT may fail to have any significant impact on various organizational variables and organizational effectiveness.

*Both the concepts rely on the connotation of a paradox. While Sushil's framework mentions about the paradox of a thesis and an anti-thesis, Volberda refers to the paradox of change and preservation, as desirable consequences of flexibility.*

### Concepts on Flexibility

This section outlines a brief overview of the general concepts of flexibility followed by the frameworks proposed by Sushil and Volberda respectively. In Webster's Collegiate Dictionary, flexibility is defined as the quality of being capable of, responding to or conforming to changing or new situations. Upton (1994) defines flexibility as "the ability to change or react with little penalty in time, effort, cost and performance". According to Bahrami (1992), flexibility is "a multi-dimensional concept demanding agility and versatility, associated with change, innovation, and novelty, coupled with robustness and resilience, implying stability, sustainable advantage and capabilities that may evolve over time". Both these definitions suggest a positive connotation of flexibility.

In the context of organizations, different types of flexibility have been discussed in the literature. Prabhat Kumar in his paper (2002) lists various types of flexibilities, namely, manufacturing flexibility, organizational flexibility,

financial flexibility, strategic flexibility, human resource flexibility and flexibility in information systems. In all types of flexibility, however, the key features are openness in thinking, adaptiveness to changing environment, responsiveness to change, versatility of action, contingency, non-rigidity, freedom, liberalization, adjustment, multiplicity of process setting, resilience, compromise, autonomy of function, broadening of the mind and vision etc. Within Manufacturing Flexibility, Gupta and Singh (2002) have quoted Brown et al (1984) citing eight types of flexibilities namely machine flexibility, process flexibility, product flexibility, routing flexibility, volume flexibility, expansion flexibility, process sequence flexibility and production flexibility.

### Systemic Flexibility and SAP-LAP Framework

According to Sushil (2000), flexibility has multiple connotations as per the situation. Some of the important ones are: adaptiveness to the changes in environment, adjustment to situation, agility in action, amiability in relationships, autonomy in functioning, balance in competing opposites, broadening of mind, compromising for betterment, contingency in planning etc. This is only a representative list. Besides, there are various types of flexibilities in an enterprise, such as strategic flexibility, organizational flexibility, manufacturing flexibility, information systems flexibility, operational flexibility, technology management flexibility etc. Under each category, there are further many types of flexibility. For example, the manufacturing flexibility encompasses product flexibility, process flexibility, volume flexibility, routing flexibility, tooling flexibility, labour flexibility, etc. Thus, the concept of flexibility is multi-dimensional in nature.

Sushil uses the concept of paradox to further elaborate this multi-dimensionality of flexibility. A paradox is in the form of a pair of polar opposites: a thesis and an antithesis, forming a continuum from thesis to antithesis. In the organizational context, some leading paradoxes are centralization-decentralization, continuity-change, stability-dynamism and so on. He argues that simply by moving from the thesis to the anti-thesis, one does not necessarily bring in flexibility; rather the system may lose its identity if pushed to anti-thesis. For example, if an organization with high degree of centralization opts for extreme decentralization, it may lead to disintegration or fragmentation of the organization. A flexible organization would be a collective bimodal or multi-modal organization having centralization and decentralization at the same time and changing their degree over time as per the requirement. From the above elaboration, Sushil defines flexibility as "the exercise of free will or freedom of choice on the continuum to synthesize the dynamic interplay of thesis and anti-thesis in an interactive and innovative manner, capturing

the ambiguity in systems and expanding the continuum with minimum time & efforts.”

Sushil has developed a flexible systems methodology or a methodological construct, which has been used by a number of management researchers in real life organizational cases. This methodology envisages a SAP-LAP framework. The SAP (Situation – Actor - Process) analysis first maps these three components, namely, “situation”, “actor” and “process” out of the existing organizational state to define the dynamic interplay of reality. “Situation” is the present status, potential for growth or decay and present and future state-of-the-art etc. The participants who influence the situation and alter it by their actions or inaction are termed as “actors”. The procedural steps taken by the “actors” who alter the “situation” are termed as the “process”. Any dynamic behaviour that alters the “situation” has the potential of being a “process”. The situation, actor and process and their interplay comprise the SAP framework, where the freedom of choice lies with the actors. If the actors have more freedom, the processes will become flexible and adaptive to cope with the changing situation.

The SAP analysis leads to the second phase of the analysis called LAP synthesis, which has three components, namely, “learning issues”, “actions” and “performance”. Learning issues emphasize the typicality of the situation as well as some features of its uniqueness. One has to learn about the situation, actor and process and bring out key learning issues of interest. Based on the learning, action is to be taken on the fronts of the situation, actor or process or the relevant interfaces. Depending upon the effectiveness of actions, performance is generated in terms of improved processes/actors and better situational parameters. In a business situation, the performance parameters could be market share, profitability, quality, productivity, competitive advantage, core competence etc. Improved performance results from the sum total of the SAP analysis and LAP synthesis.

### Volberda: Building the Flexible Firm

According to Volberda (1998), managers intuitively understand flexibility to mean mobility, responsiveness, agility, suppleness or liveness. The term has a positive connotation, and flexibility seems to be the answer for the turbulent, competitive context that organizations face. However, from the existing frameworks of flexibility, there appears to be no added value in providing answers to the questions such as what exactly a flexible firm is; how can flexibility be diagnosed or measured; and how a more flexible organization can be developed. He examines three existing approaches to the issue of flexibility, namely, the “general”, the “functional” and the “actor”. The general

approach assumes that effective organizations have to cope with the acceleration of change in the business environment, and need flexibility to adapt to the environment. However, in this approach, the underlying concept of flexibility is too abstract to have any descriptive or prescriptive value. In the second, functional, approach, organizational flexibility is reduced to certain aspects of the organization such as flexible employment contracts, labour flexibility and flexible forms of financing etc. However, organizational flexibility cannot be divided into isolated functional elements. Finally, the actor approach postulates that special personal traits of actors such as the entrepreneur, management, employees or customers endow an organization in stimulating or restricting flexibility. This approach assumes that if we want flexible organizations, we must first have flexible individuals. This approach according to the author substantially under-estimates the impact of managerial and organizational traits, as it holds individual variables more important than structural and cultural variables.

The author provides what he calls a more integrated approach to flexibility and elaborates a strategic framework, which can help managers to organize

for flexibility. He argues that while organizations cannot survive without changes to adapt to changing conditions, yet they must also be stable enough to exploit the changes they have made. The organizations need to reconcile these conflicting forces. Thus, the concept of flexibility is inherently paradoxical. It requires change as well as preservation. The flexible organizations are able to manage opposing forces. On the one hand they facilitate creativity, innovation, and speed while on the other hand they maintain coordination, focus and control.

The framework suggests two important tasks to resolve the paradox of flexibility. First, it is argued that flexibility is a managerial task, and managerial capabilities endow the firm with flexibility. Secondly, flexibility is also an organisational design task, and is concerned with the controllability or changeability of the organization, which depends upon the creation of right conditions to foster flexibility. Combining these two tasks involves a process of matching and resolving paradoxes. Management must develop dynamic capabilities that enhance flexibility, and the firms must have an adequate organizational design to utilize those capabilities. In the light of the above framework, the author defines flexibility as “the degree to which an organization has a variety of managerial capabilities and the speed at which they can be activated, to increase the control capacity of management and to improve the controllability of the organization.”

The author distinguishes between three types of flexibility namely *operational flexibility*, *structural*

***Both the frameworks give pre-eminence to the role of “actors”, who are instrumental in bringing about the right kind of flexibility. In Sushil’s terminology, an “actor” is inherently embedded in the SAP (Situation- Actor-Process) framework. In Volberda’s framework, the managerial task or the task of actors is a core component in endowing flexibility to the firm.***



flexibility and strategic flexibility.

- (a) **Operational flexibility** consists of routine capabilities for alternative actions that are based on present structure or goals of the organization. It relates to the volume and mix of activities rather than the kind of activities undertaken within the firm. The routines used are directed primarily at the operational level and are reactive. The operational flexibility provides rapid responses to changes that are familiar, and often lead to a temporary change in the level of activity of the organization. The combinations of conditions are sufficiently predictable to develop routine capabilities to reduce uncertainty. There is no substantial shift in the relationship between an organization and its environment.
- (b) **Structural Flexibility** consists of managerial capabilities for adapting the organization structure and its decision & communication processes to suit changing conditions in an evolutionary way. When faced with revolutionary changes, management needs greater internal structural flexibility to facilitate the renewal or transformation of current structures and processes. It can also be external in terms of inter-organizational leeway in supporting and sheltering new technologies or developing new products or markets. Structural flexibility facilitates restructuring of the organization in line with new opportunities or ideas.
- (c) **Strategic flexibility** consists of managerial capabilities related to the goals of the organization or the environment. This most radical type of flexibility is much more qualitative and involves changes in the nature of organizational activities. It is necessary when the organization faces unfamiliar changes that have far-reaching consequence and needs to respond quickly. The issues and difficulties related to strategic flexibility are unstructured and non-routine. Strategic flexibility encourages the exploration of new opportunities or new ideas.

The author argues that the organization structure indirectly influences the potential for operational and strategic flexibility. When only operational flexibility is required, the need for structural flexibility is minimal. Operational flexibility can therefore be found in a mechanistic structure with low potential for flexibility. On the other hand, strategic flexibility can be found only when there is structural flexibility and it can therefore be developed only in an organic structure with a large potential for structural flexibility.

*While on the one hand, some IT applications have promoted operational flexibility, some other IT applications at operational level have focused on streamlining business processes and/or optimizing solutions.*

## Commonalities in the Two Schools of Flexibility

A close look at the above two concepts of flexibility provides several interesting revelations regarding their common characteristics. Some of these are as follows:

- (a) Both the concepts consider flexibility as multi-dimensional and not just the opposite of rigidity.
- (b) Both the concepts rely on the connotation of a paradox. While Sushil's framework mentions about the paradox of a thesis and an anti-thesis, Volberda refers to the paradox of change and preservation, as desirable consequences of flexibility.
- (c) Both frameworks are open-ended, accommodating within them different types of flexibility, such as operational flexibility, structural flexibility and strategic flexibility.
- (d) Both the frameworks give pre-eminence to the role of "actors", who are instrumental in bringing about the right kind of flexibility. In Sushil's terminology, an "actor" is inherently embedded in the SAP (Situation-Actor-Process) framework. It is the actors' role to deal with the situation, and he/she has the requisite freedom of choice to initiate the processes, which will alter the situation. In Volberda's framework, the managerial task or the task of actors is a core component in endowing flexibility to the firm. It is through the managerial task that the organization design task is also performed.

## Organizational Flexibility as a Strategic Asset

Volberda also puts forth the concept of organizational flexibility as a strategic asset in situations where anticipation is impossible and strategic surprise likely. In the linear model of strategic management described by him, the focus is on planning strategies and deciding the direction in which the organization's position in the environment should change. In this model, strategic flexibility is essentially the capacity of management to quickly develop strategic plans. He also describes a second model called adaptive model of strategic management, which focuses upon the ways of configuring organizational resources for effective responses to unanticipated changes. In this model, the goal of strategy is to develop flexible resources and capabilities, and flexibility is an organizational capability for facilitating emergent spontaneous strategies. He also defines a third, interpretive model, which beckons the organization to have more foresight, and be capable of imagining products, services and entirely new businesses that do not yet exist. It still requires flexible configuration of resources, but for facilitating emergent strategies and creating strategic schemas, which enhance the creation of multiple interpretations. The organization can respond to surprises and initiate novel action, but is also able to resist



certain changes or squash destructive initiatives. Flexibility in this model is an imaginative capacity for creating strategic schemas broad enough to encourage strategic initiatives.

### Impact of IT on Organizational Flexibility: Empirical Evidence

Substantial empirical evidence already exists to demonstrate that IT has an impact on different types of organizational flexibility, namely, process flexibility, structural flexibility and strategic flexibility. In this section, examples of the impact of IT on these three flexibility types have been cited.

#### *IT has an Impact on Operational Flexibility*

There exist innumerable examples of the impact of IT on operational flexibility, particularly in service sector enterprises. The simplest example of operational flexibility achieved through IT relates to the redesign of front-end customer interface counters such as airline reservation systems at travel agents' offices; railway reservation systems of Indian Railways; check-in counters at almost all airports; and service counters at Banks. It may appear unlikely today, but not very long ago, one could still find service sectors dedicated to a particular sector or customer segment or specific service at these organizations. Successful applications of IT enabled the provision of whole sets of services at each counter, providing flexibility to the customers to choose any counter at their will or convenience.

Additionally, this meant flexibility in allocation of customer service employees at any of the counters. In fact, the introduction of PNR System in airline bookings (and later in Railway reservations) and the resultant capability of the ticket booking staff to offer changes in travel itineraries based on latest updated information on seats availability is an excellent example of operational flexibility through IT. Placing reservation terminals at travel agent desks, loaded with globally accessible computerized reservation system with information on travel schedules of different airlines is an example of operational flexibility. Another example comes from the flexibility of on-line stock trading, which has picked up in the last decade, and has almost totally replaced the floor-based trading. Ability to order books on-line through websites such as amazon.com, Internet auctions through E-bay and various other e-commerce/ e-business transactions highlight the operational flexibility impact of IT. Use of computer-aided design software for design work demonstrate yet another form of operational flexibility achieved through IT.

While on the one hand, some IT applications have promoted operational flexibility, some other IT applications at operational level have focused on streamlining business processes and/or optimizing solutions. For example,

computerized inventory and production control systems in manufacturing aim at optimum decisions at the operating level. Business Process Reengineering (BPR) aims, not at automating the existing business processes, but in streamlining the business processes, using IT as an enabler. Hammer & Champy in their classical, "Reengineering the Corporation" (1994) have documented case studies of several companies, such as Hallmark, Taco Bell, Capital Holding and Bell Atlantic, where IT has led to successful re-engineering of business processes. The point to be noted is that IT had the ability to provide operational flexibility, but the BPR application focused on utilizing this operational flexibility for zeroing in on the best processes, which yield greatest results in terms of performance variables. Enterprise Resource Planning (ERP) applications in manufacturing enterprises aim at institutionalizing the best practices already coded into the ERP software, derived from the experience and requirements of several organizations. While many organizations implement ERP modules as provided by the vendors, thereby changing their processes according to the available packages, many other organizations seek a re-engineering of the existing processes before implementing a package, and also seek to customize the packages according to their unique optimized internal processes. Thus,

the managerial team of the organization can exercise operational flexibility available from IT.

#### *IT has an Impact on Structural Flexibility*

Structural flexibility encompasses several

structural variables, such as participative management, rationalization of manpower strength, number of hierarchical levels, decentralization/ centralization and creation of innovative structural forms for the organization. Structural flexibility implies that, depending upon the contingencies of the situation and the organisation's value system, the management may move the organization towards greater participative management, may rationalize its manpower strength and/or may reduce the number of hierarchical levels. These actions are, however, guided by management's philosophy on whether decentralization or centralization (or a mix of the two) would be most desirable and whether any innovative organizational form is favoured. The flexibility/freedom of choice lies with the management in deciding the most desirable structural form, which can range from mechanistic to organic corresponding to the opportunities for adaptive capabilities.

That IT has an impact on structural flexibility has been well documented in the management literature. The debate on whether IT promotes centralization or decentralization in organizations was initiated by Leavitt and Whisler (1958) in their first classical paper on this subject. The key predictions in this paper were that as an impact of IT, the jobs at middle management level will become highly

*Structural flexibility implies that, depending upon the contingencies of the situation and the organisation's value system, the management may move the organization towards greater participative management, may rationalize its manpower strength and/or may reduce the number of hierarchical levels.*

structured, and IT would promote centralization of organizations. Several other authors supported this hypothesis through empirical observations. Contrary views were also expressed by several researchers. However, the most prevailing view appeared to be that IT is a “malleable” tool, which can be used to achieve whatever form (whether centralization or decentralization) is intended to be achieved. (See, Batra, 1994 for a comprehensive literature survey). Later, Hammer & Champy (1994) made the point that with the help of IT as a disruptive technology, businesses can simultaneously reap the benefits of centralization and decentralization. Lucas (1997) provided examples of virtual organizations – networks of people working from home (telecommuters), “negotiated agreement” organization and “vertically integrated conglomerates”, all IT-enabled structural forms. The author referred to “Technology-form organizations”, which have a flat structure, made possible through use of e-mail and groupware to increase the span of control and reduce managerial hierarchy. In such organizations, employees coordinate their work with the help of e-communications and linkages. Supervision of employees is based on trust because there are fewer face-to-face encounters with subordinates and colleagues. Managers delegate tasks and decision-making to lower levels of management. IT is used to form temporary task forces focused on a specific project. The organization is linked extensively with customers and suppliers.

A number of examples of structural flexibility through IT can be empirically observed. For example, the ability of no-frills airlines such as Air Deccan to successfully operate without city offices signifies structural flexibility, facilitated by IT. DELL sells its computers directly through internet-based systems, without field based sales persons, branch sales offices or sales agents to support sales. Amazon sells books without having bookstores anywhere, again through Internet. Banks offer ATM-based and internet-based banking services, supplementing the traditional banking outlets and thereby reducing demand for physical outlets and customer interface personnel. The software development companies are known to adopt matrix kind of organizations to support formation of project teams with a variety of specializations in accordance with the skill requirements of the projects. These specializations range from functional to sectoral to geographical to hardware/ software platform etc. The ability to form matrix structures with ease, considering their having large numbers of software professionals (in several thousands), geographically spread all over the country and abroad and available dynamically with projects getting completed and new projects ready to start, is achieved with the help of IT. Business Process Outsourcing (BPO) represents another form of structural flexibility as the organizations

outsourcing their business processes are saved the need of hiring high cost employees and can keep their internal organization structures lean and mean. The call centres set up by Airlines such as Indian Airlines, Jet Airways and Air Deccan and telephone service companies such as MTNL, illustrate structural flexibility achieved through IT.

Enterprise-wide applications such as ERP have also an impact on structural flexibility. These applications necessitate a change in the roles of different departments requiring different skill sets and changes in authority and responsibilities. The resulting changes may promote centralization in procurement, or may provide a means of injecting greater discipline into decentralized organizations

*E-business technologies influences all strategic aspects of the enterprise such as redefining the products/ services offered by incorporating IT-enabled features to add value to the product; redefining the marketing strategies; redefining the market itself; and redefining the way products/ services are delivered to the customer, including how the financial transactions related to e-business are handled.*

– reflecting the structural flexibility advantage. Use of IT-enabled Supply Change Management, enabled by new technologies such as RFID, have provided large retail organizations the ability to track status of inventory and closely monitor various

decisions related to supply chain management without having an elaborate structure in place for these functions. Overall, IT applications offer organizations the opportunity of functional integration, multi-skilled staff, rapid & flexible decision making structures, greater autonomy of operating units and a more flexible and organic approach.

### *IT has an Impact on Strategic Flexibility*

Strategic flexibility may be manifested through variables such as geographical expansion of the business of the organization; enhancement of customer service and provision of competitive advantage to the organization. Achieving geographical expansion of a company’s business is a click away from designing and hosting appropriate websites for such e-business applications. Customer Relationship Management (CRM) is another good example of achieving strategic flexibility through IT. The Banking, Insurance & Financial Services Sectors, known as most aligned to CRM applications, showcase how IT helps in providing customer-oriented services to meet the life time needs of the customers through better understanding of and addressing customers’ preferences and priorities. This CRM philosophy is ably supported by business intelligence applications such as data mining. Another example of strategic flexibility through IT is provided by designing and implementing Knowledge Management (KM) systems in organizations. By imaginatively designing KM systems and aligning them with business strategy, it can be ensured that IT is used for acquiring, consolidating, transferring and utilizing organizational knowledge in a strategic manner. In the Indian context, companies such as Infosys Technologies Ltd., and Wipro Technologies Ltd. in the computer software industry are known to have successfully leveraged their

organizational knowledge through IT for gaining competitive advantage (Lahiri, 2005). Decision support systems (DSS) developed by various companies for specific business decisions provide another example of strategic flexibility through IT. Many airlines, for example, have developed DSS for flexi-fare modeling, aircraft and crew scheduling etc., which provide them several decision-making options.

It has been mentioned earlier that BPO represents a form of structural flexibility. More importantly, BPO also reflects strategic flexibility. The need for BPO arises out of strategic considerations, both for the outsourcing client and the BPO service provider. It is a strategic initiative to improve competitiveness through focus on core competencies and ability to serve larger markets. It gives the advantage of capitalizing on the low cost structure of the outsourcing service provider, and thereby reducing operational costs. However, in absence of enablement through IT, BPO as a strategic option wouldn't have been available.

*It is obvious that IT has an impact on all three types of flexibility, namely, operational, structural and strategic flexibility. The combination of operational, structural and strategic flexibility, or the overall organizational flexibility, has an impact on organizational performance, eventually leading to organizational effectiveness.*

E-business provides another important example of the strategic flexibility provided by IT. It covers business processes along the whole value chain, including e-procurement, supply chain management, electronic order processing, customer service and cooperation with business partners. E-business technologies influences all strategic aspects of the enterprise such as redefining the products/ services offered by incorporating IT-enabled features to add value to the product (e.g., advanced versions of computer software); redefining the marketing strategies (for example through various nuances of internet marketing); redefining the market itself (e.g., auction sites) and redefining the way products/ services are delivered to the customer (e.g., upgrading anti-virus software over the net), including how the financial transactions related to e-business are handled (e.g. e-money). E-business strategies must address how various internal and external processes can be e-business enabled or improved via technological advances. E-business strategy must also integrate various other strategies like the IT strategy and organizational strategy (Sharma and Gupta, 2004)

**Proposed Revision in the Conceptual Framework**

The analysis of various forms of flexibility and empirical evidence of the impact of IT on various forms of flexibility suggests that there is a scope for revision of the original conceptual framework to incorporate operational, structural and strategic flexibility. Specifically, the following hypotheses are proposed:

(a) IT has an impact on operational flexibility, which had been identified as one of the process variable in the existing conceptual framework proposed by this author.

In addition, IT has an impact on all the other process variables.

(b) IT also has an impact on structural flexibility. This is manifested in the form of IT's impact on centralization-decentralization and creation of innovative organizational forms. As observed earlier, IT provides the ability to move in any of these directions, which might be in conflict with each other. The actual direction is based on the decisions made by the management, and depends upon management's style and organization value system.

(c) IT also has an impact on strategic flexibility. Strategic considerations governed by the organizational effectiveness criteria help define various strategic options to be pursued for achieving competitiveness. The top management exercises strategic flexibility in choosing the desirable strategic options and even creating new strategic options. This choice is facilitated by IT's impact on structural flexibility, and its symbiotic relationship with operational flexibility and other process variables. Jointly these flexibilities

facilitate strategic flexibility to the organization.

(d) The combination of operational flexibility, structural flexibility and strategic flexibility can be called organizational flexibility. This organizational flexibility has an impact on organizational performance, which

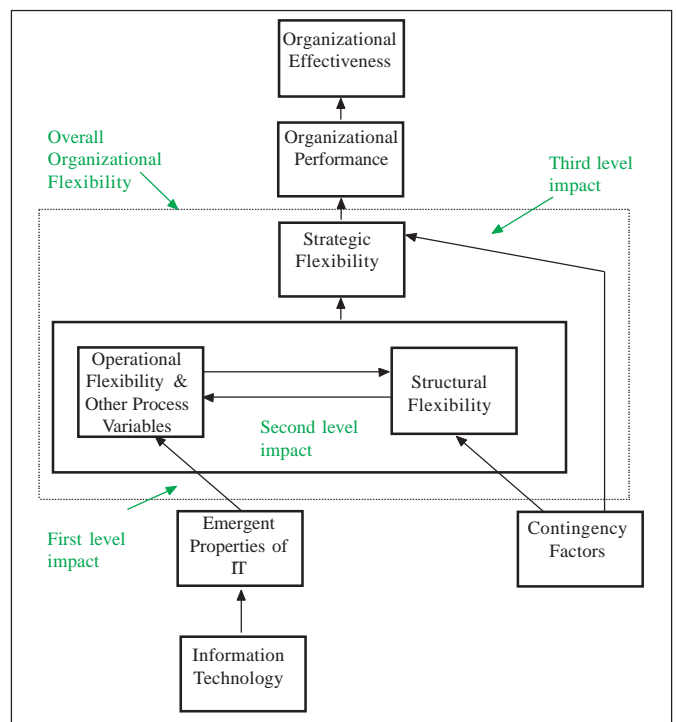


Figure 3: Revised Conceptual Framework of the Impact of IT On Organizational Effectiveness



eventually leads to organizational effectiveness.

Figure 3 diagrammatically represents the proposed revised conceptual framework of the impact of IT on organizational effectiveness.

### Interdependence of Strategic, Structural and Operational Flexibilities

The above framework suggests that organizations would first focus on their effectiveness needs and use the strategic flexibility enabled by IT to innovate and identify desirable strategy. This then becomes the starting point for making structural changes compliant with the proposed strategy, taking advantage of the enablement of operational and structural flexibility by IT. For example, a company venturing into e-business may first take strategic decisions on products/ services offered through e-business, the CRM methodologies adopted and business models used for Internet marketing etc. This is followed by decisions on organization structure, hierarchical levels, span of control etc. – such decisions being influenced by the power of IT to provide timely and relevant information, better monitoring and control and operational flexibility, as well as the corresponding structural flexibility to make structural changes. However, some deviations may occur in practice, when structural changes may be bypassed, or may be marginal in nature. For example, while giving a historical account of strategy-structure interrelationships, Kaplan and Norton (2006) have given examples of organizations avoiding structural changes. According to them, corporations have usually attempted to match their structures to strategies. They have created business units structured around products and geographical markets, which became more flexible and adaptable to local conditions. Next to follow has been the BPR model, in which the corporations have organized around processes. However, reorganization often creates more problems than it solves, because (a) it takes time for employees to adapt to new structures; (b) loss of tacit knowledge occurs due to exit of key personnel; and (c) the organization is saddled with vestige of previous organizational decisions. Hence, companies do not always need to find the perfect structure for their strategy; they rather chose an organization structure that works without major conflicts and then design a customized strategic system to align that structure with the strategy. In this regard, the authors have given examples of two organizations, namely, Du Pont and Royal Canadian Mounted Police, which made strategy choices aligned with the existing structure. This might be viewed as exercising structural flexibility for deciding not to make structural changes.

Wu et al (2005) cite the example of “Soni de Mexicali”, the Television Assembly Unit of Sony Corporation in Mexico, which utilized the ability of IT to provide strategic and operational flexibility for better organizational effectiveness, without disturbing the structure. Set up as a subsidiary in Mexico in 1995, this company faced competitive pressure from many companies. It was recognized that low labour cost ceased to be the source of

competitive advantage, and a key strategic initiative necessary to meet the competition, was to concentrate on the speed of delivery and customer-focused supply chain management. The company developed what it called its e-nervous system to integrate the supply chain. The key features of this e-nervous system were that: (a) it delivered manufacturing information to key managers like human nerves relay instantaneous information to the brain; (b) it was responsive to changing user demands; and (c) it was scalable to meet future needs of the company. The managers were able to access results on-line and then make important decisions related to scheduling, quality control and manufacturing processes in a flexible manner. The company also switched over to flexible manufacturing systems, providing agility in producing wider range of products. The system acted as IT enabled supply chain integrator providing connectivity with supply chain members, thus shifting the competitive advantage from low labour cost to high customer response. No significant structural changes were reported, as making structural changes didn't appear critical for adopting the desired strategy.

### Conclusions

It is obvious that IT has an impact on all three types of flexibility, namely, operational, structural and strategic flexibility. The impact on operational flexibility is enabling in nature. The impact on structural flexibility is manifested in the form of centralization-decentralization and creation of innovative organizational forms. The symbiotic relationship of structural flexibility with operational flexibility provides to chose structural variables in accordance with management's style and organization value system. In this process, strategic considerations governed by the organizational effectiveness criteria help define various strategic options to be pursued for achieving competitiveness. The top management exercises strategic flexibility in choosing the desirable options. This choice is facilitated by IT's impact on structural and operational flexibility, and jointly in a symbiotic manner these flexibilities provide strategic flexibility to the organization. The combination of operational, structural and strategic flexibility, or the overall organizational flexibility, has an impact on organizational performance, eventually leading to organizational effectiveness. However, situations do arise when major structural changes may be avoided or may not be considered critical, and the strategy may be chosen based on its compatibility with the existing structure.

### References

- Batra, S. K. (1993) Impact of Information Technology on Organisation Structures and Processes – in Ghosal A. & Murthy, P. N. (Ed.), “*Recent Advances in Cybernetics and Systems: Proceedings of the Ninth International Congress on Cybernetics & Systems*, January 18-23, 1993”, Tata McGraw Hill Publishing Company Limited, New Delhi, 201-209.
- Batra, S. K. (1994) *Information Technology and Organisational Effectiveness: A Diagnostic Study in the Indian Environment*, Ph. D. Thesis, Department of Management Studies, Indian Institute of Technology, Delhi, August.
- Bahrami H. (1992) The Emerging Flexible Organisation: Perspectives from Silicon Valley, *California Management Review*, Summer.





Brown J, Dubois D., Rathmill K., Sethi S.P., and Stecke K. E. (1984) Classification of Flexible Manufacturing Systems, *The FMS Magazine*, 114

Gupta A. B. & Singh T.P (2002) Manufacturing Flexibility in a Filter Manufacturing Enterprise: A Case Study (2002) *Global Journal of Flexible Systems Management*, Vol. 3, No. 1, 25-32

Hammer, Michael and Champy, James (1994) *Reengineering the Corporation: A Manifesto for Business Revolution*, Nichola Brealey Publishing, London.

Kaplan, Robert S. and Norton, David P. (2006) How to implement a new strategy without disrupting your organization, *Harvard Business Review*, March, 100-109.

Lahiri, Abhijit (2005) *Knowledge Management in Indian IT Companies*, MBA Dissertation, Faculty of Management Studies, University of Delhi, March.

Leavitt and Whisler (1958) Management in the 1980's, *Harvard Business Review*, Nov. -Dec., 41-48

Lucas, Henry C. (Jr.) (1997) *Information Technology for Management*, McGraw Hill International Edition, Management Information Systems

Series, Singapore.

Prabhat Kumar (2002) A Comparative Analysis of Flexibility Practices in Two World-Class Companies – General Electric and Cisco — *Global Journal of Flexible Systems Management*, Vol. 3, No. 1, 11-23

Sharma, Sushil K. and Gupta, Jatinder N. D. 2004 e-Strategy Model for Creating Flexible Organisations", (2004) *Global Journal of Flexible Systems Management*, Vol. 5, Nos. 2 & 3, 1-8

Sushil (2000) Concept of Systemic Flexibility, *Global Journal of Flexible Systems Management*, Vol. 1, No. 1, 77-80

Sushil (2001) SAP-LAP Framework, *Global Journal of Flexible Systems Management*, Vol. 2, No. 1, 51-55

Upton. D. M. (1994) The Management of Manufacturing Flexibility, *California Management Review*, 36 (2), Winter, 72-89

Volberda, Henk W. (1998) *Building the Flexible Firm: How to remain competitive*, Oxford University Press, Oxford.

Wu, Haw-Jan, John; Decker, Jeffrey N; and Huerta, Rey (2004) IT saved the day: Gaining new competitive advantages with a digital nervous system, *Fortune Journal of International Management*, New Delhi, Vol. 1, No. 1, Oct.-March 2005.



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# Impact of Supply Chain Collaboration on Customer Service Level and Working Capital

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## Abstract

*Collaborations in supply chains as a business strategy is now getting increasing attention at business leadership level. In most cases, collaboration appears to imply vertical integration on both ends of the supply chain, that is, collaboration with suppliers and dealers/retailers. Although horizontal collaboration (that is, between supply chains) is sometimes mentioned, old business model of competition with peers still holds. While benefits of collaboration in general and vertical collaboration in particular have been studied from different angles, research continues to focus on soft issues of collaboration like trust, building partnership and so on because benefits of collaboration are taken for granted. Considering the disorganized retail industry in India which is close to Rs 5,00,000 crores today, we feel there is substantial scope for horizontal collaboration during the consolidation phase. Industry practitioners and researchers are interested to identify quantitative benefits of horizontal collaboration. The area offers a lot of decision flexibility that may be employed to ensure good benefits. However, as our experience indicates sometimes horizontal collaboration may be counter-productive also. Therefore, it would be prudent to investigate its benefits in quantitative terms. Accordingly, we construct a simulator having two parallel supply chains and run it in independent and horizontal collaboration mode. We find that there is substantial reduction in system inventory leading to reduced working capital requirement. More importantly, horizontal collaboration also improves fill rates, a result counter-intuitive to the well understood concept of higher inventory needed to improve service levels. We also find that with increasing demand uncertainty, benefits of horizontal collaboration rise significantly. In our opinion, disorganized Indian retail industry has a golden opportunity to analyze and adopt horizontal collaborations. This paper attempts to offer suitable motivation in this direction.*

**Keywords :** customer service level, decision flexibility, supply chain collaboration, working capital

## Introduction

The optimal deployment of inventory is a vital business function for an enterprise. The well-documented benefits of running a manufacturing, distribution or retailing operation with leaner inventory is largely understood. The concept ranges from a permanent reduction in working capital to increased sales and higher customer satisfaction. Managing inventory in a buyer-supplier relationship presents major pitfalls. One is the failure to achieve true network inventory optimization, because replenishment strategies are applied to one echelon without regard to its impact on the other echelons. A network view of inventory usage up and down the demand chain is often lacking when one is only dealing with a single entity objectives. Optimization on a single supply chain as a subsystem (with single entity objectives) of a larger system of many supply chains results in:

- The single supply chain carries excess inventory in the form of redundant safety stock.

- End customer service failures occur even when adequate inventory exists in the network of supply chains.
- Customers facing locations experience, undesirable stock-outs, while service between echelons is more than acceptable.
- External suppliers deliver unreliable performance, because they have received unsatisfactory demand projections.
- Shortsighted internal allocation decisions are made for products with limited availability.
- Though there is a potential for decision flexibility to collaborate in mutually useful directions, it is never examined.

It is thus apparent that supply chains have to move much beyond the current boundaries by adopting greater vertical and horizontal collaboration opportunities.



## Supply Chain Collaboration

Thomas L. Friedman (2005), the foreign affairs columnist for the New York Times, in his about to be published book argues that “the most important force shaping global economics and politics in the early twenty-first century” is not the admittedly important war on terrorism but a “triple convergence — of new players, on a new playing field, developing new processes and habits for horizontal collaboration.”

There is a general agreement on collaboration being a win-win situation. Despite this, successful collaboration – both internally and with its extended value chain – is still widely uncharted territory. Charles et al (2004) argue that the concept of collaboration has largely eluded most companies—and there’s little evidence that anything has changed much in recent years. Apparently, the idea of working with willing business allies to advance the supply chain remains too contemporary for many. The traditional, largely adversarial business model still holds sway in most organizations. Part of the reason is that today’s definition of collaboration goes far beyond what companies have been striving for over the last few years. Manufacturers have spent the better part of the last decade applying principles of lean manufacturing and collaboration techniques within their own organizations to improve efficiencies and streamline processes, all with an eye towards reducing cost and eliminating waste. Collaboration today, however, is a totally different ball game. It means opening up these same processes and sharing critical information with suppliers, partners and sometimes customers. This has dramatically changed the collaboration equation, forcing companies to deal with even more complex business and information technology problems. In this context, Wadhwa et al (2002) and Wadhwa and Rao (2003) have promoted the idea of developing demonstration models to promote the benefits of decision and information sharing in supply chains.

In addition to internal collaboration within a company, there is also a growing interest in collaboration among different companies on various supply chain functions, such as demand forecasting, product design, transportation and procurement. This type of collaboration is referred to as horizontal collaboration. Such inter-company collaboration is sometimes enabled by market intermediaries in the industry. In the petroleum sector in India, oil companies freely enter into swap arrangements supplying their products from each other’s refineries. This substantially reduces the amount of product moved, saving on distribution costs, compressing delivery times and benefiting the environment. However, it tends only to happen during periods of crisis, when companies assist each other in the event of production or supply chain breakdowns.

Being a new research area, horizontal collaboration has not received due attention of the researchers. This paper aims to fill this gap by developing useful insights in the area of horizontal collaboration by the use of demonstration models. These demonstration models could be used by the

management to evaluate the benefits or risks involved in the horizontal collaboration.

But what are the enablers for collaboration? What are the obstacles that must be overcome to achieve this? Is it really worth the effort? To address these issues, Mentzer, Foggin and Golicic (2000) interviewed (individually or in focus groups) 20 supply chain executives from various companies. Their purpose was to understand what supply chain collaboration is, how much is taking place, how it can be achieved and the benefits obtained. Specifically, they explored the enablers of supply chain collaboration, its impediments. They identified 12 benefits listed in Table – 1. However, as can be seen these are expressed in generic terms and do not address the issue of tangible benefits in measurable terms. In our opinion greater deployment of decision flexibility can help improve the supply chain performance by exploiting the benefits of supply chain collaboration. It is useful to view each supply chain as a flexible system. Then exploiting various types of decision choices within the network of entity flows in the flexible system can result in improved performance. This has been shown by Wadhwa and Browne (1989) using three basic types of decision points for guiding the entity flows. Similar concepts can be evolved for guiding the entity flows between different supply chains to promote horizontal collaboration. Wadhwa and Rao (2004) have shown such decision flexibility use within supply chains with a focus on lead time reduction. However, it is useful to enrich the study by focussing on cost benefit parameters also.

**Table-1 Supply Chain Collaboration Benefits**

<ul style="list-style-type: none"> <li>• Reduction in inventory</li> <li>• Reduction in personnel</li> <li>• Improved customer service</li> <li>• Better delivery through reduced cycle times</li> <li>• Increased speed to market of new products</li> <li>• Focus on core competencies</li> <li>• Public image</li> <li>• Strengthened trust and interdependence</li> <li>• Increased sharing of information, ideas, and technology</li> <li>• Working toward the goals of the supply chain and not the individual companies</li> <li>• Increased shareholder value</li> <li>• Competitive advantage over other supply chains useful to enrich the study by focusing on cost-benefit parameters also.</li> </ul>
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## Horizontal Collaboration

Horizontal collaboration differs from vertical in the sense that it considers collaboration among only those on the buyer side or the supplier side. In many companies, purchasing is done by multiple functional divisions (or purchasing organizations within the company) which either

act independently or have minimal interaction with each other. For example, until very recently, purchasing was done locally by managers at each of the Ashok Leyland Plants. It was typical for buyers at one plant to buy the same raw material as a buyer at another plant from two different suppliers at different prices. This approach was ineffective in taking advantage of Ashok Leyland's volume and corporate-wide buying power. One prospective solution was to rearrange decision flexibility so as to improve collaborative buying. Similarly, until 1997, purchasing at Siemens Medical Systems was done locally, where buyers at Siemens' ultrasound, electro-medical, computer tomography, magnetic resonance imaging and angiography divisions independently bought the components and material that their individual plants needed and rarely communicated with each other. There was no pooling of component demand for leveraging purposes (Carbone (2001)). Recently both companies have moved with great success towards centralized procurement, which allows collaboration among internal purchasing units. In India, this scenario is getting repeated at many SBUs.

In addition to internal collaboration within a company, there is also a growing interest in collaboration among different companies on various supply chain functions, such as demand forecasting, product design, transportation and procurement. Such inter-company collaboration is sometimes enabled by market intermediaries in the industry. For example, the Internet-based logistics network, Nistevo, consolidates orders from multiple shippers and creates round-trip or dedicated tours. This reduces the costs of the carriers due to better utilization of truck capacity and in turn results in lower prices for the shippers (Strozniak, 2001). Land O'Lakes Inc. has saved \$40,000 a month by coordinating its shipping routes with companies such as Georgia-Pacific (Keenan and Ante, 2002). In the petroleum sector in India, oil companies freely enter into swap arrangements supplying their products from each other's refineries. This substantially reduces the amount of product moved, saving on distribution costs, compressing delivery times and benefiting the environment. However, such flexibility to ensure desirable entity flows is used only during periods of crises, that is, breakdowns and so on. Based on the proactive flexibility concepts of Wadhwa et al (2005), the use of flexibility to improve entity flow performance is useful in normal operations too. The area offers a lot of decision flexibility that may be employed to ensure good benefits. Horizontal collaboration may also help to reduce the level of flexibility required in each chain to deal with dynamic demand. Since flexibility is costly, horizontal collaboration will help decision makers to deploy judicious level of flexibility in each collaborating chain.

Horizontal collaboration has also received the attention of researchers recently. Horizontal coordination and collaboration in the supply chain enabled by quantity discounts is studied by Gurnani (2001) in a single supplier two buyer setting. Some existing research considers the interaction of buyers and suppliers from a resource allocation

perspective. Ledyard, Banks and Porter (1989) test allocation mechanisms with uncertain resources and indivisible demand. The results indicate that high efficiency could be obtained if collaboration is enabled among buyers. Griffin (2004) studied the interaction between multiple buyers and multiple suppliers, where horizontal collaboration is enabled by a central mechanism or an intermediary.

### Analysis of Supply Chain Interaction and Collaborations – Current Research

Interactions among participants of a supply chain have been analyzed along several directions. One line of related research focuses on de-centralized versus shared information. When the information is decentralized, the primary focus of studies is on constructing different mechanisms to enable coordination in a two-stage setting and eliminating inefficiencies stemming from double marginalization. Cachon and Zipkin (1999) and Lee et al. (2000) analyze coordination mechanisms in the form of rebates or transfer payments. Weng (1995) considers a system where coordination is established through quantity discounts and franchise fees. Jin and Wu (2001) study supply chain coordination via transfer payments in the presence of e-market intermediaries. See Cachon (2003) for an analysis of coordinating contracts under different supply chain settings.

Another line of research focuses on collaboration. Internet and technology have made information sharing possible at every stage and this leads to different collaborative efforts in supply chains. Examples include vendor managed inventory (VMI), just-in-time distribution (JITD) and collaborative planning, forecasting and replenishment (CPFR), in which trading partners such as vendors and retailers collaborate vertically.

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### Lead time and Customer Service

Lead-time refers to the time lag between placing an order and receiving it (Li, 2000). It is one of the most important causes of bullwhip effect. The safety stock component is derived from the lead time plus the ordering frequency and minimum and maximum quantities ordered. Lead-time has established roots as a measure of order management and supply-chain performance, having been used in multiple



studies of related phenomena (Mabert et al. 2000; McAfee 2002). The general importance of cycle time has been demonstrated in studies of customer service (Stalk et al., 1990) and manufacturing performance (Hayes et al., 1988). Customer service and timeliness have also been identified as primary reasons for IT investment (Brynjolfsson et al., 1996).

Chopra et al (2004) investigated the effect of lead time uncertainty on safety stocks. They show That for cycle service levels above 50%, reducing lead time variability reduces the reorder point and safety stock. For cycle service levels above 50%, they aver that reducing lead time variability is more effective than reducing lead times because it decreases the safety stock by a larger amount.

Cheong (2005) investigated differentiated delivery lead times in supply chain networks from the point of groupings and conclude that the network cost reduces as the facility grouping increases. This cost reduction is because more customer locations can be served from the same facility, thus sharing the fixed cost.

Yan (1999) studied the behaviour of supply chain network (SCN) under different lead-time distributions. He simulated an extendable multi-agent linear supply chain to evaluate the impact of different lead-time distributions on bullwhip effect and supply chain performance under centralized and decentralized information sharing strategies. His findings are that given a fixed total lead-time across the supply chain, centralized information sharing and disintermediation improve the supply chain performance. He concluded that though the bullwhip effect remains unchanged, different lead-time distributions will lead to different supply chain performance.

Eyal Bialogorsky and Oded Koenigsberg (2004) analyzed how production lead time affects decisions in a distribution channel facing uncertain demand. In particular, they considered which channel member, the retailer or the manufacturer, should carry the inventory in the channel and how lead time affects promotional activities. They found that, in most cases, the channel, the retailer and the manufacturer all benefit from the manufacturer carrying the inventory in the channel. However, when there is uncertainty about market size and the difference between the possible demand states is large, the channel and the retailer are better off if the retailer carries the inventory but the manufacturer still prefers to carry the inventory on its own.

Globalization of trade has added complexity to the lead time. As the companies go global, they discover cost competitive sources of supply with comparable quality. However, lead time tends to increase manifold, specially for bulk items like steel where only way of getting material is though shipping which can be very slow. We need to factor in increased lead time and investigate if horizontal collaboration can mitigate the impact of long lead time.

### Investigation Objectives

By simulating a network of supply chains, we would attempt

to investigate the following issues in horizontal collaboration

- (i) The impact of horizontal collaboration on working capital in the form of inventory holding at:
  - a. Supplier/manufacturer end
  - b. Retailer/ dealer end
  - c. At system level
- (ii) The impact of collaboration on customer service levels at:
  - a. Supplier/ manufacturer end
  - b. Retailer/ dealer end
- (iii) The impact of lead time on horizontal collaboration.
- (iv) Collaboration response to unexpected surges in demand

### Basic Definitions

#### Product Availability

A primary objective of inventory management is to ensure that product is available at the time and in the quantities desired. This is commonly judged based on the probability of fulfillment capability from current stock. This probability, or item fill rate, is referred to as the service level, and, for a single item, can be defined as

$$\text{Service Level} = 1 - \left( \frac{\text{Expected Number of units out of stock annually}}{\text{Total Annual Demand}} \right)$$

Service level is expressed as a value between 0 and 1. We will be converting it into percentages, as is the industry norm.

#### Reorder Point Model with Uncertain Demand

We will be using reorder point inventory control method. When inventory is depleted to the point where its level is equal to or less than a specified quantity called the reorder point, an order of quantity  $Q$  is placed on the supplying source to replenish the inventory. The effective inventory level at a particular point in time is the quantity on hand plus the quantity on order. We have assumed no backorders. The entire quantity  $Q$  arrives at a point in time offset by the lead time. Between the time when the replenishment order is placed at the reorder point and when it arrives in stock, there is a risk that demand will exceed the remaining amount of inventory. The probability of this occurring is controlled through raising or lowering the reorder point and by adjusting  $Q$  as under:

$$\text{Reorder Point} = \text{Mean Demand} \times \text{Lead Time} + \text{Safety Stock}$$

$$\text{Safety Stock} = \text{Demand Rate Standard Deviation} \times \text{Safety Factor}$$

$$\text{Demand Rate standard deviation} = \sigma \sqrt{\text{LeadTime}}, \text{ where } \sigma \text{ is the standard deviation of daily demand.}$$

*Safety Factor* - We have used 1.04 for 85% confidence level With this as the background, we now proceed to simulate

two supply chains with a view to analyze the impact of collaboration on service level and inventory holding (which translates to working capital requirement). Although we have assumed lead time to be deterministic, we will be varying it to see the sensitivity of collaboration to different lead times

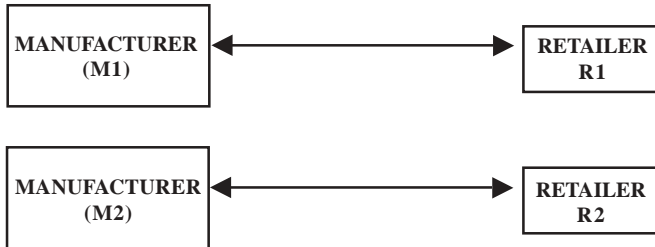


Figure 1: Supply Chains Operating in Independent Mode

### The Simulation Model

There are two supply chains with one manufacturer (M1& M2) and one retailer (R1&R2) each as shown in Figure 1. Both chains are in the same business and are operating in the same market. They may belong to one company or to two different supply chains. But we assume that all four elements are currently operating independently, optimizing their own operations. Both Chains are operating under same parameters, that is, the manufacturing capacity, lead times, all costs of retailer (Holding cost, shortage cost and transaction costs) are assumed to be the same. We simulated this system for one item, as under:

**Independent Mode** (Figure 1): Here the two chains operate independently. There is no interaction among the chains. Retailer1 meets the demand from own stock or by sourcing it from Manufacturer1. Similarly, the other chain operates in the same manner.

**Formal Collaboration (FC) Mode** (Figure 2): Here both the chains operate as one system. However the chains are retained in the original form, that is no element is dismantled.

**Simulation Parameters:** Lead time, mean demand and standard deviation of the demand under normal distribution for both chains are given in Table 2. Reorder levels have been calculated as explained under Reorder Point model above. Both chains operate under similar parameters.

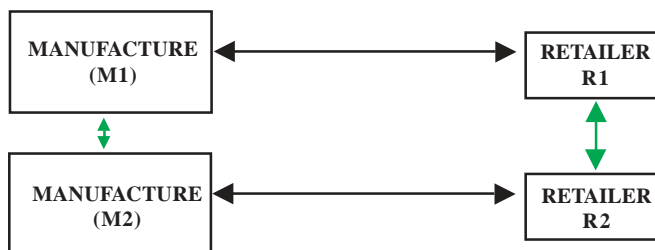


Figure 2: Supply Chains in a Formal Collaboration Mode

The simulator is run for 200 days on daily demand generated through normal distribution with mean 50, sigma 20 and ROP as above. Each simulation run of 200 days is for one fixed lead time. Thus, simulation is carried out 10

times on progressively increasing lead time. The simulator is first run on independent mode and then on horizontal collaborative mode as explained below.

Table 2: Simulation Parameters

Lead Time(days)	Mean Demand	Standard Deviation	Reorder Point
2	50	20	129
4	50	20	242
6	50	20	351
8	50	20	459
10	50	20	566
12	50	20	672
14	50	20	778
16	50	20	883
18	50	20	988
20	50	20	1093

### Logic in Brief

#### (a) Independent Mode

**1. Retailer End.** The retailer starts with ROP level. The retailer meets the daily demand. After meeting the demand if the stock falls below reorder level, an order is electronically placed on the manufacturer keeping the lead time in view. Demand is calculated on past demand averages. After the lead-time is over, retailer's stock is replenished, provided there is no delay at the manufacturer's end. If there is delay, day of delivery is postponed. He incurs holding cost on the balance stock at the end of each day. If he cannot meet any demand up to full requirement, shortage is noted and is counted for the purpose of fill rate. Shortages however, lapse.

**2. Manufacturer End.** The manufacturer starts with stock equal to capacity. He constantly revises his production targets in relation to the average demand on him. If he finds that the order is more than the stock plus average production on any particular day, he is able to produce to full capacity. One order must be supplied in one lot. If sufficient stock (including production) is not available, the whole order is delayed by one day and he incurs deficiency in service (fill rate). His holding costs are calculated on the balance stock held at the end of each day.

#### 3. Both chains operate similarly.

#### (b) Horizontal Collaboration Mode

**1. Retailer End.** Same logic except that if the demand cannot be met, he checks up with the other retailer. The other retailer checks if there will be surplus stock left after he has met his demand, which is known by now. Whatever

he can spare is passed on to the other retailer.

**2. Manufacturer End.** The two chains take joint production decisions based on one consolidated demand from both retailers. Thus manufacturing facility becomes one, although physically they may continue to work from two locations. The total manufacturing capacity is considered to be doubled. In essence there is now one manufacturer and two retailers

**Results**

**Impact of Horizontal Collaboration on Working Capital in the form of Inventory Holding - Supplier/Manufacturer End**

While the build up of Inventory with lead time in both cases is apparent, there is a distinct reduction in inventory with collaboration. This is both due to pooling of demand and pooling of resources. In percent terms, however, the reduction is not uniform as depicted in Figure 3. It varies from a high of 28% to a low of 14%. It tends to reduce with longer lead time. We feel this is happening because of aggregation in demand occurring at longer lead times.

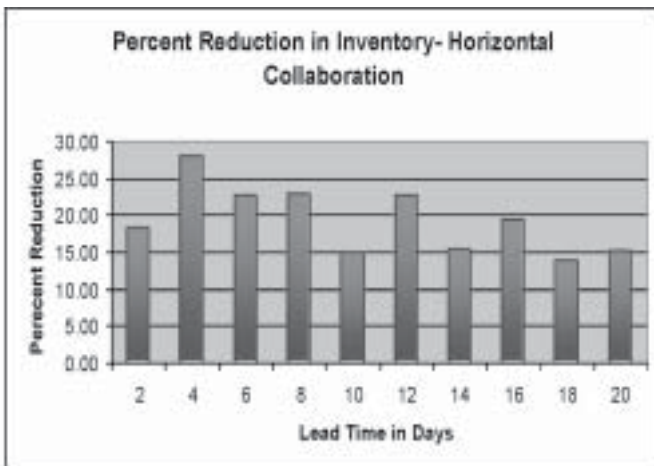


Figure 3: Per cent Reduction in Inventory under Horizontal Collaboration

**Impact of Horizontal Collaboration on Working Capital in the form of Inventory Holding - Retailer/Dealer End**

Refer Figure 4 and Figure 5. We find that not only is working capital saving occurring at manufacturer end, the retailer is also benefited. It has often been propagated that collaboration helps only the manufacturer in reducing inventories. This is sited as one of the reason why collaboration has not taken off in a big way despite apparent benefits. Moreover, additional benefit to manufacturers in vertical collaboration is possible because of so called arm twisting by them. Logical models apportion benefits on both, especially in horizontal collaboration where, each of them work as equals. Thus, this model is more likely to be a win-win situation.



Figure 4: Per cent Reduction in Inventory at the Manufacturer End



Figure 5: Per cent Reduction in Inventory at the Retailer End

**Impact of Horizontal Collaboration on the Supply Chain System – Working Capital**

Since both chains have gained, it is obvious that there is overall working capital reduction on account of inventory holding cost.

**Impact of Horizontal Collaboration on Fill Rates- Supplier/Manufacturer**

Refer Figure 6 below. The manufacturers are able to maintain 100% fill rates even when not collaborating because the demand pattern is stable (we will see the impact of perturbation later). However, this is possible till the lead time

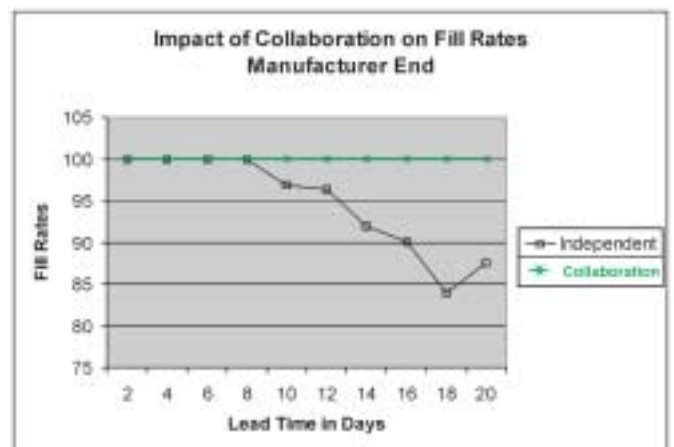


Figure 6: Fill Rates at the Manufacturer End

is short. As the lead time increases, fill rates drop drastically, despite the fact that inventory holding goes up. This is because, demand comes in larger batches and full batch satisfaction is postponed by a day or two. However, in the collaboration mode, the demand pattern of the two retailers tend to smoothen out (orders do not land up on the same day) thus ensuring 100% fill rates even for longer lead times. This outcomes appears to be interesting in the global context. If two manufacturers export to two retailers/ companies in another country with inherent long lead times, it would be prudent for them to enter into horizontal collaboration, thus ensuring better fill rates.

**Impact of Horizontal Collaboration on Fill Rates- Retailer/ Dealer**

This is a counter-intuitive result. While the fill rates were very good for shorter lead times in the case of manufacturer, the picture at the retailer end is reversed (See Figure 7). As the lead time gets longer, fill rates become better even when no collaboration is taking place. This is occurring because inability at retailer end arises only at the fag end of the lead time period. On other days, demand is fully met. In the model, aggregation of demand is already incorporated in the form of aggregated standard deviation (). Therefore, that cannot be sited as the reason for higher fill rate for longer lead times. Coming to the impact of horizontal collaboration per-se, it appears to improve fill rates significantly. For example, fill rate for two days of lead time improve from 91% to 96%.

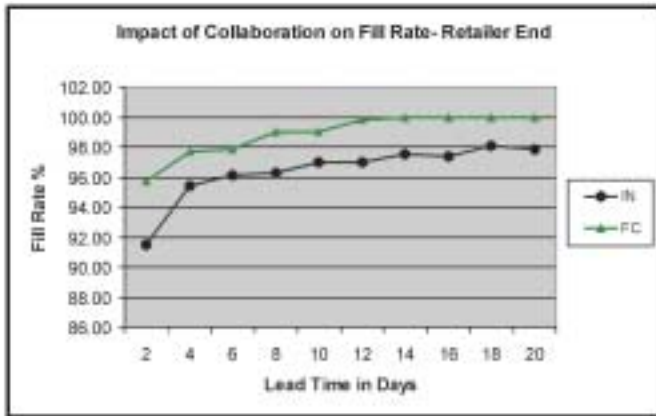


Figure 7: Fill Rates at the Retailer End

**Impact of Lead time on Horizontal Collaboration**

From the simulation output generated so far, lead time impact appears to have ambiguous nature as discussed below:

- (a) Horizontal collaboration reduces inventories marginally as the lead time increases. The impact is not very significant. In fact in percent reduction, there is a degradation although in absolute terms there is a gain
- (b) Service levels at both ends of supply chain become significantly better with longer lead time (refer Figure 8 and 9). In the case of manufacturer, impact at very long lead time is significant as service level was seen to

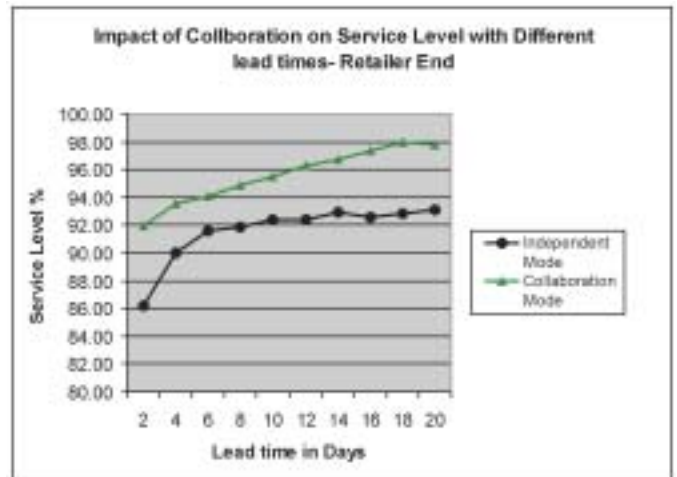


Figure 8: Service Level with Different Lead Times at the Retailer End

improve from 85% to 100% on horizontal collaboration. This is a useful deduction for low cost items. It means we can accept longer lead times in such cases as service levels will actually improve with lead time.

**Collaboration Response to Unexpected Surges in Demand**

So far our demand, although varying, was stable with constant mean. With sufficient reserves, predicable and constant lead times and aggregation of demand over longer time periods, fill rates tend to be very good. We therefore wanted to investigate the impact of lumpy demand on certain days. Accordingly, the demand data generated by the normal distribution was perturbed to include demand for 250 items against mean of 50 on 50<sup>th</sup>, 100<sup>th</sup> and 150<sup>th</sup> day of simulation. The results on service level at the retailer end with lumpy demand are presented in Figure 9.

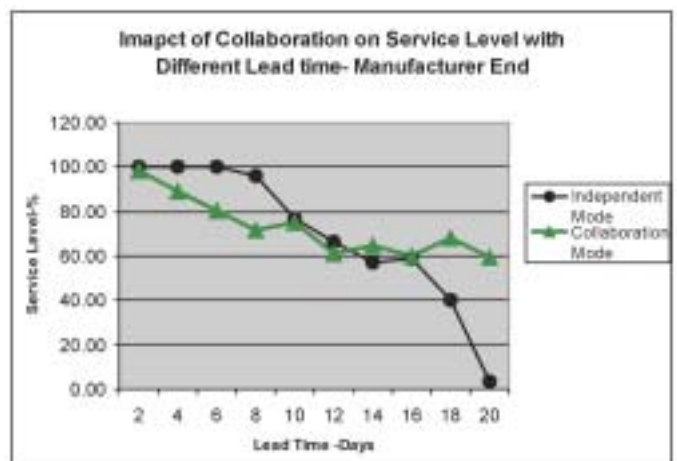


Figure 9: Service Level with Different Lead Times at the Manufacturer End

We find that horizontal collaboration response to fill rates at retailer end appears to be too good to be ignored. While in the independent mode, fill rates ranged from low of 86% to high of 93%, these tend to improve to 92% to 98% in the collaborative mode. Thus collaboration response



to fill rates appears to be even better under lumpy demand case. However, phenomena of fill rates improving with lead time is again observed. Reasons for this have been explained earlier under steady demand case.

The situation is vastly different at the manufacturer's end. There seems to be a complete chaos. Independent mode appears to be a full-scale disaster as fill rates plummet to 3.5 on 20 days lead time. In collaboration mode, fill rates come out lower than even independent mode for shorter lead times. But they never seem to drop below 60%. Therefore, horizontal collaboration continues to present a robust picture on fill rates under the simulated conditions earlier specified.

On a more practical note, it can be noted that it is the retailer who is facing the customer and he offers better service under horizontal collaboration. In the case of manufacturer, lower fill rates only imply postponement of shipment, with no denial to the end user. Therefore, horizontal collaboration is a superior model at the system level.

This also brings out another important deduction; it is not possible for all components of a complex supply chain system to benefit from collaboration. It could be a win some-lose some situation at individual component level, which needs to be underscored before embarking on any collaboration model.

### Leveraging Horizontal Collaboration

It is widely agreed that a vertically and horizontally integrated multi-channel business model will become standard in the retail industry. Yet, there are a lot of apprehensions. While the strategies, business models, soft integration issues are dominating all collaboration discussions, there is less back up quantitative data to support the horizontal collaborative model. Our investigation through simulation appears to suggest that there is a distinct reduction in working capital with improved service levels in horizontal collaboration. This is depicted in Figure 10.



Figure 10: Reduction in Working Capital with Improved Service Levels in Horizontal Collaboration

### Implication for Indian Retail Industry

According to a survey by AT Kearney, an overwhelming proportion of the Rs 400,000 crore retail market in India is unorganized. In fact, only a Rs 20,000 crore segment of the market is organized (Ganguly (2004)). This is expected to increase by 20% (yoy). Thus there is a Rs 5,00,000 crore plus business opportunity in horizontal and vertical collaboration. As per our findings, there is 7% to 17% reduction in inventory at retailer end and 14% to 28% at manufacturer end as a result of horizontal collaboration, under stable demand pattern. In the case of lumpy demand, the savings could be in the region of 12% to 27% at retailer end and 29% to 57% at the manufacturer end. Let us assume that 50% of the sector gets organized through horizontal collaborations. Further assuming optimistic inventory turns of 20 per year and modest 20% reduction in inventory through collaboration, there would be working capital saving of 2500 crore for the retail industry alone. It is useful to point out that collaboration in evolving dynamic environment needs greater decision flexibility amongst various chain members. The chain members may be manufacturers, wholesalers, retailers and so on. This gives rise to both internal chains as well as external chains. Collaboration is useful for both these chains with suitable decision flexibility with different chain nodes. Wadhwa and Rao (2004) proposed a unified framework to understand role of flexibility in manufacturing (can be seen as internal chains and supply chains) can be seen as external chains. It is useful to use the proposed framework to apply the key flexibility concepts towards improving collaboration between external supply chains. The area offers a lot of decision flexibility that may be employed to ensure good benefits. Horizontal collaboration may also help to reduce the level of flexibility required in each chain to deal with dynamic demand. Since flexibility is costly, horizontal collaboration will help decision makers to deploy judicious level of flexibility in each collaborating chain. Our research is ongoing in this direction.

### Limitations of the Research

Our simulation model has been constructed with many assumptions like deterministic lead times, normal demand distribution, IT enabled supply chain and others. Therefore, our findings will get impacted to a certain extent, as more realistic situations are factored in. However, we feel the horizontal collaboration model will generate more, not less benefits as the demand and supply uncertainties will only increase with more variables.

### Summary and Conclusions

Horizontal collaboration offers enormous opportunity in the form of reduced working capital coupled with increased service levels, often considered at the opposite ends of working capital requirement (higher service levels demand more in stock inventory). Since the model operates under IT enabled network, the chances of human interaction causing untold harm to the collaboration are far less. If these supply chains are allowed to operate under defined rules of



forecasts, demand planning, supply management and manufacturing, cash flows are inherent in the model. However, there is a caution; the benefits may not accrue equally. In horizontal collaboration, the retailers appear to be a more satisfied lot. Therefore, there is a need to evolve a profit sharing model acceptable to all parties. Indian businesses must start looking beyond the company centric supply chains towards a more collaborative approach to pave the way for groundbreaking multi-channel opportunities and new revenue streams. This is the only mantra for survival and growth in the increasingly competitive global economy.

The horizontal collaboration will help decision makers to deploy judicious level of flexibility in each collaborating chain. This will help to reduce flexibility costs for the individual supply chains. Thus, horizontal collaboration offers many opportunities towards effective use of supply chain flexibility.

### References

Brynjolfsson, E., and Hitt, L.M.(1996). Paradox Lost: Firm-Level Evidence on the Returns to Information Systems Spending, *Management Science* (42:4), April, pp 541-558.

Cachon, G. P. (2003). Supply Chain Coordination with Contracts, S. Graves, T. de Kok, eds., *Supply Chain Management-Handbook in OR/MS* (forthcoming). North-Holland, Amsterdam.

Cachon, G. P. and Zipkin, P. H. (1999). Competitive and Cooperative Inventory policies in a Two-Stage Supply Chain. *Management Science*, 45, 936-953.

Carbone, J. (2001). Strategic Purchasing Cuts Costs 25% at Siemens. *Purchasing*, September 20, 29-34.

Charles C. Poirier, Francis J. Quinn (2004) A Survey of Supply Chain Progress , *Supply Chain Management Review*, November 1 <http://www.manufacturing.net/scm/article/CA481094.html>

Chopra Sunil, Gilles Reinhardt, Maqbool Dada (2004). The Effect of Lead Time Uncertainty on Safety Stocks, *Decision Sciences* Volume 35 Number 1 Winter

Competitiveness and Order Fulfillment Cycle Time Within Supply Chains, *Academy of Management Journal* (45:3), June , pp 577-586.

Eyal Biyalogorsky, Oded Koenigsberg (2004) Lead Time, Uncertainty, and Channel Decision Making, UCD-GSM Working Paper

Friedman Thomas L. (2005). A Brief History of the Twenty-First Century

Ganguly, Saby (2004). Retail Industry in India, <http://www.indiaonestop.com/retailing.htm>

Griffin, P. M., P. Keskinocak, and S. Savasanelil (2004): Improving supply chain performance through buyer collaboration,” in *Applications of Supply Chain Management and E-Commerce Research in Industry*, edited by E. Akcali, J. Geunes, P. Pardalos, H. Romeijn, and Z. Shen, chap. 3, 2, Kluwer Academic Publishers, pp. 87–118.

Gurnani, H. (2001). A Study of Quantity discount Pricing Models with

Different Ordering Structures: Order Coordination, Order Consolidation, and Multi-Tier Ordering Hierarchy. *International Journal of Production Economics*, 72, pp 203-225.

Hayes, R.H., and Clark, K.B. (1986). Why some factories are more productive than others, *Harvard Business Review*, September-October, pp 66-73.

<http://www.washingtonpost.com/wp-dyn/articles/A17314-2005Mar31.html>

Jin, M. and Wu, D. (2001). Supply Chain Contracting in Electronic Markets: Auction and Contracting Mechanisms. Working Paper, Lehigh University, Bethlehem, PA.

Keenan, F. and Ante, S. E. (2002). The New Teamwork. *Business Week e.biz* , February 18, pp 12-16.

Ledyard, J. O., Banks, J. S. and Porter, D. P. (1989). Allocation of Unresponsive and Uncertain Resources. *RAND Journal of Economics*, pp 1-25.

Li, J.Q., Shaw, M.J., and Tan, G.W. (2000). Evaluating Information Sharing Strategies in Supply Chains, In *8th ECIS, Vol. 1*, 2000, Vienna, pp. 437-444.

Mentzer, J.T. , Foggin, J.H., & Golicic, S. L. (2000), Collaboration: The enablers, impediments and benefits. *Supply Chain Management Review*, 4 (September/October), 52-58.

Michelle L.F. Cheong, Rohit Bhatnagar, and Stephen C. Graves, (2005) “Logistics Network Design with Differentiated Delivery Lead-Time: Benefits and Insights” *Proceedings of 2005 SMA Conference*, Singapore, pp 20

Reilly, C. (2002). Specialists Leverage Surfactants, Plastics, Indirect and Other Products. *Purchasing*, January 15.

Stalk, G., and Hout, T.M. (1990) “Competing Against Time,” *Research Technology Management* (33:2), March-April , pp 19-25.

Strozniak, P. (2001). Sharing the Load. *Industry Week*, September 1, pp 47-51.

Wadhwa S., John J., Gandhi A., (2002). “Managing Innovation in e-Business Based SC Structures: Role of Demo Models”, *Studies in Informatics and Control*; Vol.11, No. 3, pp. 217-231.

Wadhwa, S, Rao, K.S., (2003). “Enterprise Modeling of Supply Chains with Multiple Entity Flows: Role of Flexibility in Enhancing Lead Time Performance”, *SIC Journal*, 4 Dec. Vol. 7, No. 4, pp. 329-342.

Wadhwa, S., Browne, J., (1989). “Modelling FMS with Decision Petri Nets”, *The International Journal of Flexible Manufacturing Systems*, Kluwer Academic Publishers, 1, 1989, pp. 255-280. (25 pages).

Wadhwa, S., Rao, K.S., (2004). “A Unified Framework for Manufacturing and Supply chain Flexibility,” *Global Journal of Flexible Systems Management*, Vol.5, No.1, pp.15-22.

Wadhwa, S., Rao, K.S., Chan, F.T.S. (2005). “Flexibility enabled lead time reduction in flexible systems”, *International Journal of Production Research*, Vol.43, No. 15, 1 August 2005, pp 3131-3162.

Weng, Z. K. (1995). Channel Coordination and Quantity Discounts. *Management Science*, 41, pp 1509-1522.

Yan. L (1999). Impact of Lead-time Distribution on the Bullwhip Effect and Supply Chain Performance”, *Journal of Logistics Management*, 10(2): pp55-70







# Role of Organizational Flexibility for Corporate Entrepreneurship: Case Study of FedEx Corporation

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## Abstract

*In order to remain competitive in global markets, an organization needs to focus on corporate entrepreneurship. This requires an organizational structure that allows organizational flexibility. A study on logistics and transportation organization, FedEx Corporation has been conducted to analyze the practice of strategy formulation and implementation based on corporate entrepreneurship. The case has been developed to find out the organizational flexibility issues in much greater depth. The study is based on Flexible Systems Methodology and was conducted through interviews. The synthesis of the learning reveals that there is a need for proper understanding of corporate entrepreneurship and flexible approach of organization to make the concept more effective.*

**Keywords:** corporate entrepreneurship, flexibility, learning issues

## Introduction

The study has been conducted to analyze the corporate practices concerning the use of corporate entrepreneurship (CE) as a strategy for competitiveness. In this paper, the case study of a service organization has been developed. The case study approach allows linking theory and practice by analyzing the strategic issues of select organizations in much greater depth. A case study can never capture fully the richness and complexity of real life management situations, but it has proven effective in the area of strategic management. It complements and enhances the information by focusing attention on what a firm has done or should do in a business situation. The successful organizations have been practicing the system flexibility in some way or the other in their management approach. The study aims at exploring the concept of corporate entrepreneurship for strategy formulation and implementation. The main objective was to get answers to the following questions:

- i) What do organizations understand from corporate entrepreneurship?
- ii) Is strategy formulation and implementation based on CE required for organizations?

During the course of the study, the following issues were addressed:

- i) The managerial actions that can improve the odds of success with the flexible practices and link them with the company's CE strategy?
- ii) The CE process that translates a technique or the method into some form of utilization.
- iii) The relationship with the flexibility and CE on strategy formulation and implementation w.r.t to individual flexibility and organizational flexibility.
- iv) The financial performances of the organization linked with CE.

## Methodology

The methodology has been derived from Flexible Systems Methodology as proposed by Sushil (1994). The study has been planned through interviewing, observation and case method. The interviewing method consisted of an interview schedule (Appendix 1) with senior management level in the select organizations. These personal interviews were conducted through prior appointments. The case method consisted of data relating to some phase of life history of the organizations under study. The complex situations and combinations of all the factors involved in the behavior were examined to determine the existing status and to identify the causal factors. The study mainly revolved around the following queries:



- i) How are different companies formulating their strategies for CE?
- ii) What are the problems faced by them?
- iii) What are the various linkages?
- iv) Are the companies able to define their CE strategies?
- v) How is this concept helpful to them?

*Corporate entrepreneurship refers not only to creation of new business ventures, but also to other innovative activities such as development of new products, services, technologies, administrative techniques, strategies and competitive postures.*

In this study a purposive sample of 40 respondents from logistics and transportation organization, FedEx Corporation has been taken. A brief past history of the organization was obtained and cases were prepared based on interviews and observations. The cases were analyzed applying the Situation-Actor-Process (SAP) framework to bring out the finer issues. The paper adopts single case study approach where unit of analysis are (a) firm level (its internal environment components) (b) product / service level (as number of products developed and number of ideas generated (Yin, 1994). Questionnaire explored the extent of management support, flexible organizational boundaries, intelligence generation and dissemination; work discretion is practiced within FedEx. Remaining questions were aimed at understanding CE initiative in terms of the number of products and services developed, markets developed, entrepreneurial ideas and products improved. "24-hours rule" was followed in interviews. According to this rule, detailed interview notes, impressions and various facts were cross-checked within one day of the interview.

The S-A-P analysis (Sushil, 1997) has been used to learn about the handling of the CE strategy in the organizations constituting the sample for the study. The three basic components that define the dynamic interplay in flexible management paradigm are situation, actor and process as shown in Figure 1. The actor forms the part of the situation as well as the process. The internal flexibility refers to the capabilities of the actor and making him open-minded; the actor could be an individual or a group of persons. The external flexibility provided by the situation, which enables

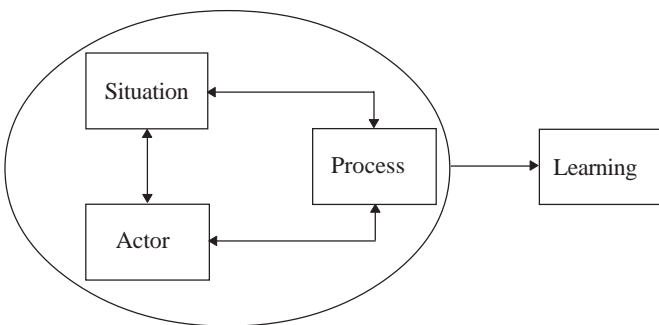


Figure 1: SAP Interaction for Learning (Sushil, 1994, 1997, 2000)

a manager to exercise his freedom of choice. The internal and external flexibilities should resonate with each other.

The case has been synthesized with respect to context, situational factors; roles played by various actors and CE strategies. Interviews were being conducted in the selected organization with people in top, middle and operation level.

The objective was to understand the top-level commitment and vision for CE, middle manager's implementation strategies, and operating level's perception of these strategies. This is important for better coordination and success of CE strategies.

In this case, the context of the situation and the roles played by various people has been described. The process part deals with the strategies and practices being carried out by the organization. In order to get deep insight and for effective action, Figure 2 shows a SAP-LAP model of inquiry (Sushil, 2000) has been developed by identifying critical questions in each element of situation, actor, process, and learning.

**Framework of Guiding Questions for SAP-LAP Inquiry**

**Situation**

- What are the major opportunities?
- What are the major threats?
- What are the major change agents?

**Actor**

- What are the main corporate entrepreneurship strategies?
- Does management support corporate entrepreneurship initiatives?
- Does it provide work discretion?
- Does it practice organizational flexibility?

**Process**

- How the corporate entrepreneurship processes are determined?
- What are the processes dominating towards CE?
- What are the potentials to change the process?

**Learning**

- What is our understanding about corporate entrepreneurship?
- What is the role of organizational flexibility in formulating corporate entrepreneurship strategy?

Figure 2: SAP-LAP Inquiry Schedule for the Study

### Definition of New Business

New business is defined as entry into an entirely new market or introduction of an entirely new product or service as new business. The logic for calling such business is that entry into an entirely new market requires much new learning about logistics, distribution channels, advertising, and so on; and the development of an entirely new product requires similar new learning about design, development and manufacturing (Dougherty and Hardy, 1996). Corporate entrepreneurship refers not only to creation of new business ventures, but also to other innovative activities such as development of new products, services, technologies, administrative techniques, strategies and competitive postures. Previous views of corporate entrepreneurship can be classified on four dimensions: (a) new business venturing, (b) innovativeness, (c) self-renewal, and (d) proactiveness. New business venturing is the most salient characteristic of corporate entrepreneurship since it can result in new business creation within an existing organization (Stopford & Baden-Fuller, 1994) by redefining the company’s products or services and/or by developing new markets. In large corporations, it could also include formation of more formally autonomous or semi-autonomous units or firms. In contrast, the innovativeness dimension refers to product and service innovation with emphasis on development and innovation in technology (Covin and Slevin, 1991). The third dimension, self-renewal, reflects the transformation of organizations through the renewal of key ideas on which they are built. The innovativeness dimension refers to product and service innovation with emphasis on development and innovation in technology (Baden-Fuller, 1995). Proactiveness is related to aggressive posturing and leadership relative to competitors (Covin and Slevin 1991), risk-taking (Stopford & Baden-Fuller, 1994), initiative taking (Lumpkin & Dess, 1996) and boldness and aggressiveness in pursuing opportunities (Covin & Slevin, 1991). This paper has adopted corporate entrepreneurship as new business venture creation through product, service, process or market development.

*An entrepreneurial firm nurtures innovation by practicing flexibility and responsiveness.*

### Organizational Flexibility and Corporate Entrepreneurship

Flexibility is defined as the degree to which a business unit is adaptable in administrative relations and the authority is vested in situational expertise. A firm exhibiting low flexibility has rigid administrative relations and strictly adheres to bureaucratic practices. An entrepreneurial firm nurtures innovation by practicing flexibility and responsiveness (Guth and Ginsberg, 1990). Flexibility in organization structure contributes positively towards product success (Saleh and Wang, 1993). Entrepreneurial management style and a flexible structure facilitate communication across the functional boundaries (Graham, 1995). The learning organization requires flexibility and internal communication to achieve effective market

orientation.

It has become important for the firms to operate in highly dynamic market environment to have a high degree of flexibility in the product development activities. Some firms develop links with customers to co-develop the product in the iterative process.

### Case Study of FedEx

FedEx began as a pioneering venture providing full range of transportation, information, and supply chain services. FedEx consists of four operating companies. FedEx Corporation has grown and diversified into a multi-business enterprise, rapidly building a formidable presence in ten major areas. The details of these business areas have been shown in Figure 3.

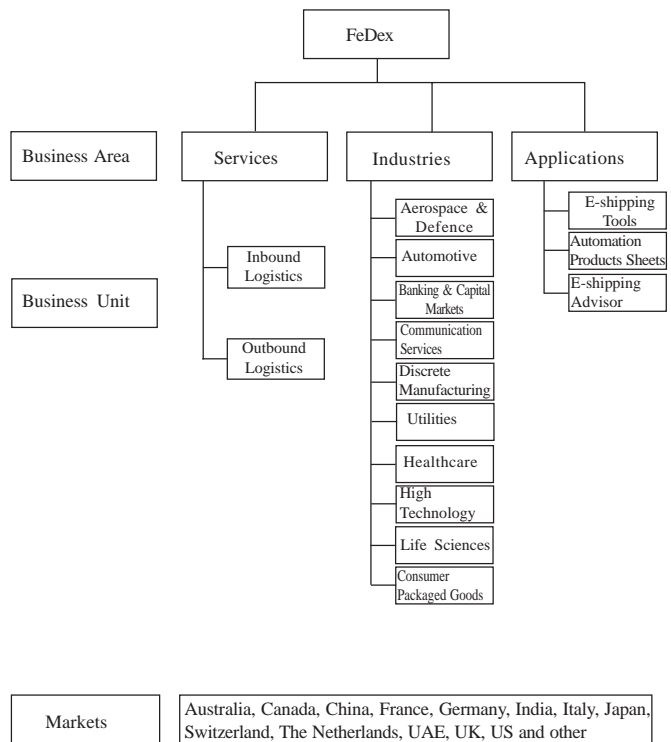


Figure3: CE Initiatives at FedEx

FedEx has adopted several business initiatives within the firm. To remove the obsolescence of computers and squeeze delivery time that reduced the cost of inventory carrying cost, FedEx developed customized business solutions for Hewlett-Packard (HP). Fred Smith, the founder of FedEx, developed and proposed the hub-and-spoke system to the Federal Reserve System for overnight delivery of checks between their 36 locations around the country. FedEx created a business by providing the system of home picking and solely dedicated fleet for reaching various destinations on time. FedEx developed the first Express Shipping Company to own and operate aircrafts, package-sorting facilities, and delivery vans in 1973. The other business initiatives include:

- It launched COSMOS (Customers, Operations, and Service Master Online Systems, 1979) that are agents to answer customer queries about the status of their package and was the first Express company to install electronic communication system in Delivery Vans (DADS, Digitally Assisted Dispatch System, 1980).
- FedEx offered 10:30 am delivery service (1982), where competitors were offering noon or later deliveries. It introduced a PC-based automated shipping system, a super tracker, a hand-held bar code scanner system (1986), developed an integrated, seamless international and domestic network (1989).
- It offered online tracking (1994) which helped customers better manage their business processes.
- FedEx Express, FedEx Grand, FedEx Freight, FedEx Kinko's were developed to offer comprehensive and complete logistics solutions.
- In 2000, FedEx teamed with Mazon.com to design and deliver a customized solution for 'Harry Potter' and 'Goblet of Fire'.

The challenge of successfully managing diversified businesses has been met by decentralization into focused profit centers in each business area. Each profit centre is fully equipped and manned to handle its own marketing, distribution, and service development. FedEx has captured a share of market by recognizing the importance of listening to the customers and then responding quickly to meet their needs. Customer care has become an acknowledged success factor for each business. Innovation and experimentation to create competitive edge are actively pursued, not just in product and process development, but also in all aspects of life. The group as lean corporate team coordinates a whole that manages strategy, performance and culture. The internal environment of FedEx is open and supportive which allows employees to be entrepreneurial at all levels. FedEx has PSP (People, Service, Profit) culture and its "people first" philosophy, which are the key success factor for CE.

A deep commitment to a decentralized organizational structure brings decision-making as close to customers as possible. The ability to listen to customers, to innovate product, process and service in response, the ability to build strong international presence, a commitment to quality, and managerial credibility based on high degree of knowledge and awareness, and an ethical approach, are the critical success factors that gave FedEx a competitive edge. The future strategy of the company is determined by the collective thinking of a group of managers gifted with imagination, courage and intelligence. The internal culture respects individuals, enhances professional awareness and credibility, and emphasizes that total quality lead to continuous improvement in all aspects of company life.

FedEx's revenue was \$ 8 billion in 2005 that was 9% increase over previous year's revenue of \$7.34 billion (Annual Report 2005). Its net operating income has been over \$713 million, up by 29% from \$552 million. Its net income was \$428 million, up by 35% from \$317 million. FedEx has been recognized as one of the 100 best companies to work for in America (Fortune, 1998-2004) and also as one of America's Most Admired Companies (2001-2004).

## SAP Analysis

### Prevailing Situation

#### Opportunities

- The demand for courier services was constantly increasing.
- The customer demand changed over a period of time. There was a demand for more customized solutions.

#### Threats

- There is presence of global logistics and supply chain management serve providers backed up by their hi-tech products and services.

#### Change Agents

- The changing environment in the business atmosphere of the globe, particularly liberalization, is opening up the overseas market for high quality customized solutions,

thus ensuring growth in this category.

## Main Actors

### Main Corporate Entrepreneurship Strategies

- The key actors of the CE activities include the employees who implement the ideas and managers who supported these ideas.
- Service personnel and station dispatch personnel are important for CE activities, since they informed the bottlenecks in the service deliveries.
- 'Large' number of service is developed. For example it introduced super tracker, a hand-held bar code scanner system (1986) that was used for scanning the package status on real-time basis. It also developed an integrated, seamless international and domestic network (1989) that helped to obtain these valuable landing rights. It helped to establish higher standard of service in the international arena.
- 'Newer' markets are being identified. For example, it launched COSMOS (Customers, Operations, and Service Master Online Systems, 1979). These were agents to answer customer queries about the status of their package.

- ‘Large’ number of process applications are adopted including TQM, Six sigma etc. For example, it was the first Express company to install electronic communication system in Delivery Vans (DADS, Digitally Assisted Dispatch System, 1980). It allowed carriers to receive on-call pick-up requests on a display monitor in their vans.

*Management Support for Corporate Entrepreneurship*

- Recognition and publicity is given to improve the group efforts.
- The internal leadership provides direct access and guidance to executive management. Organizational support system is also provided for entrepreneurial activities.
- Company’s value proposition is used as a common language across all departments and divisions.
- Work group, departmental and divisional goals are all aligned and directly related to improving customer service and customer experience.
- A percentage of company’s profits are shared with employees to encourage them and make them understand their efforts’ contribution to the company’s competitive edge.

*Encouraging inter-departmental cooperation and coordination is an important aspect of corporate entrepreneurship.*

*Providing Work Discretion for Corporate Entrepreneurship*

- The employees are empowered for executing work.
- They have the autonomy to take their own decisions about following their ideas but had to update the top management with their decisions.
- Employees’ suggestions and recommendations are always included.
- FedEx involves everybody in decision-making.

*Practicing Organizational Flexibility for Corporate Entrepreneurship*

- FedEx provides freedom to explore options to meet the customer requirements. For example, almost 25yrs ago, FedEx adopted bar code system when it was not available widely. FedEx employees worked with Mead, 3M and Standard Register for developing the bar code printing technology. The goal was to implement station-to-station positive tracking initially and then to drive the technology to expand door to door tracking. Team breakfast meetings were scheduled during which everyone had a chance to voice their opinion and ask questions.
- FedEx focuses on alignment between departments-between design and marketing, design and logistics, and so on. This pollination of disciplines has helped to breed innovation. People from different backgrounds

worked together to solve common problems.

- FedEx focuses on building mutually trusting relationships with the management of the transportation company and customs. For example there was a goal of reducing the time for clearance through customers by 50%. Three organizations- FedEx, the local transportation company (contracted by LOL), and the Indian customers department involved in the customs clearance process worked in tandem to reach this goal. This led to the development of a model for future collaboration.
- FedEx encourages inter-departmental cooperation and coordination. To facilitate interdepartmental collaboration, it regularly organized interdepartmental picnic and BBQ picnic contest, softball, basketball, golf leagues, and community volunteer programs. Officers and directors organized recreational activities day and lunches with peers to facilitate creative environment. FedEx recognized and celebrated teamwork in developing ideas.
- The employees know about the risk tolerant behavior of the organization, which motivates them to take risks with innovative ideas.

*Change Agents*

- FedEx is a company of young professionals, unafraid of change, who feel responsible for the work they are entrusted to perform, each ensuring that his work carries his personal stamp of quality.
- The speed of response, open and honest communication, and a positive determined attitude are evident all over the group. The universal values inspire a humane and vibrant work environment where all strive constantly to improve the level of customer care.

*Processes*

*Strategic Processes*

- The processes are to be evolved by the management by using flexibility for managing the situation. The strategic processes were determined by the collective thinking of group of managers. For example, to ensure this, manager-level meeting LRPC (Long Range Planning Committee) were conducted regularly. Group meetings were dedicated each quarter to discuss the competitive environment, the company’s strategy, and the previous quarter performance.
- Encouraging inter-departmental cooperation and coordination is important aspect for corporate entrepreneurship.

A decentralized management structure, essential for quick, focused decision-making, and appropriate systems carefully



designed to support and optimize autonomous working are in place, supported by information technology and communication tools. FedEx created process and infrastructure for collaboration through networked computers. For example MBO program helped to align department objective with corporate strategies and goals. The directors met every month to get an update on the progress and asked them to help. To manage the ever-changing business needs, a team was formed consisting of representatives from Materials Planning, Procurement, the MIS group etc. Together, they came up with several creative solutions to address the lack of communication.

*Processes Dominating Towards Corporate Entrepreneurship*

The processes dominating towards corporate entrepreneurship that enable the company to achieve its competitive edge are:

- **Imparting training to the people.** FedEx encourages employees to undertake various training programmes to increase experience and knowledge base. For example Marco Chan, and Operations’ Director for FedEx, joined the Leadership Institute. During this time, LOL was having an increase in shipments of equipment and supplies coming into New Orleans.

*Unlimited ‘cross-mobility of persons’ among the various developmental centers is a critical success factor for corporate entrepreneurship.*

This large volume of inbound logistics on Fridays created bottleneck for operations. To meet the delivery target, Marco, who was Managing Director of district operations, along with his operations manager and sales executives, along with the team thought to separate conventional packages from the rest of the New Orleans packages in different containers so that these containers can simply bypass the station completely. The operations group in the hub accepted the idea and worked together to implement it. Implementation required collaboration among five departments sales (identifying the convention customers), engineering (working out the logistics), hub operations (training the package sorters), New Orleans airport (loading the containers on the trucks), and station operations (meeting the truck at the convention centre). That solution significantly improved the service levels and reduced costs at the same time.

- **Increasing the communication level between the management and workers.** FedEx uses all available communication media, such as newsletter, closed circuits television, and email broadcasts. A close collaborative relationship was among the staff and the key players in legal, finance, and marketing was done. Work group, departmental, and divisional goals were aligned and directly related to improving customer service and customer experience. Sales and marketing department circulated non-confidential and non-

proprietary information pertaining to customer value. Project adoption Just-in-Time (JIT) inventory management practices adopted in the manufacturing sector reduced the delivery time from eight weeks to two weeks.

- **Making people feel more responsible towards their work.** By sharing the information about profits and financial data, FedEx makes the employees understand the difference they were making. Based on the company’ profitability, all employees receive cheque before Christmas as part of the current profit-sharing plan. At the end of the fiscal year, another distribution was made as part of the deferred profit-sharing accounts.

*Learning Issues*

The data collected has been analyzed and interpreted in the light of flexibility. The corporate entrepreneurship happens to be one of the qualitative aspects of business environment; therefore, a qualitative analysis is being carried out using different heads as the basis of analysis.

*Understanding Corporate Entrepreneurship*

The corporate entrepreneurship at FedEx Corporation is an integrated teamwork so as to have quality products and services. The concept of CE as such has not been formally introduced in the company. There is no social emphasis on CE at present but if some formal system is available to management which exposes this concept with formal methodologies it would certainly like to have such teams in the organization for constant training programs followed by implementation programs thereafter.

Table 1: Learning Issues in Case of FedEx Corporation

CE	Team spirit, interdepartmental collaboration.
Processes	Impart training to people, increasing communication levels, making people feel responsible towards their work.
Corporate performance	Achieve objectives and execute strategies efficiently with the help of collective thinking of intellectual people, group turnover is increasing (\$6 - \$8 Bn in seven years).
Strategy formulation and CE	Collective thinking of intellectual people formulates strategies.
Flexibility in strategy formulation	Strategies are formulated as per needs.

The inhibitor of CE is the comprehensive level of executing team.



### Use of Organizational Flexibility in Formulating Corporate Entrepreneurship Strategy

The existing system is flexible as it absorbs new technologies and offers no resistance to innovation. While comparing the amount of flexibility as an individual or as a system, it is more flexible as a system but within a given framework only. The top management practices decentralization of powers, which help in reduction in decision-making levels. It also provides unlimited ‘cross-mobility of persons’ among the various developmental centers. FedEx has cross-functional teams. The organization focuses on creating sustaining corporate culture and values. The employees had faith in the corporate leadership. The organization has an employee-orientated environment including opportunities for varied work experience and accelerated employee development.

### Conclusions

The case has been discussed in the Indian context and synthesis of learning issues presented. There is need for proper understanding of CE and flexible approach of the organization in order to make the concept more effective. In a nutshell, it can be concluded that a key factor in competing for the future is to practice CE that helps in achieving sustainable competitive advantage. The CE and flexibility provide gateways for new business development and should constitute the focus for strategy formulation and implementation.

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### References

Baden-Fuller, C. (1995) Strategic Innovation, Corporate Entrepreneurship and Matching Outside-in to Inside –out Approaches to Strategy Research, *Br. J. Manage. Rev.*, 23, 305-324.

Covin, J.G., & Slevin, D.P. (1991) A Conceptual Model of Entrepreneurship as Firm Behavior, *Entrepreneurship Theory and Practice*, 16(1), 7-25.

Dougherty, D., & Hardy, C. (1996) Sustained Product Innovation in Large, Mature Organizations: Overcoming Innovation-to-Organization Problems. *Academy of Management Journal*, 39, 200-218.

Graham, P., (Ed.) (1995) *Mary Parker Follet - Prophet of Management*, Boston: Harvard Business School Press.

Guth, W.D., Ginsberg, A. (1990) Corporate Entrepreneurship, *Strategic Manage. J.*, 11, 5–15 (special issue).

Lumpkin, G. T. & Dess, G. G. (1996) Clarifying the Entrepreneurial Orientation Construct and Linking it to Performance, *Academy of Management Review*, 12(1), 135-172.

Saleh, S.D. & Wang, C.K. (1993) The Management of Innovation: Strategy, Structure and Organizational Climate, *IEEE Transactions on Engineering Management*, 40(1), 14-20.

Stopford, J.M., Baden-Fuller, C.W.F. (1994) Creating Corporate Entrepreneurship, *Strategic Manage. J.*, 15, 521–536.

Sushil (1994) Flexible System Methodology, *System Practice*, 7(6), 633-652.

Sushil (1997) Flexible System Management: An Evolving Paradigm, *System Research & Behavioral Science*, 14(4), 259-275.

Sushil (2000) Concept of Systemic Flexibility, *Global Journal of Flexible Systems Management*, 1(1), 77-80.

Yin, R. K. (1994) Discovering the Future of the Case Study Method in Evaluation Research, *Evaluation Practice*, 15, 283-290.

## Appendix 1: Interview Schedule

1. What is your understanding about CE?
2. Since how long the concept of CE has been introduced in your organization?
3. What are the tools and techniques being used to enhance the CE within the organization?
4. What are the inhibitors of CE?
5. What are your future plans for CE?
6. What role does your organizational environment play in facilitating CE process?
7. How would you define existing flexibility in the organization?
8. While comparing the amount of flexibility, is it more flexible as an individual or as a system?
9. How is flexibility and CE related to strategy formulation?
10. How does CE provide a cutting edge for competing in the market?
11. In what way is your organizational performance linked to CE?

### Flexibility Mapping : Practitioner's Perspective

- Which variants of flexibility do you envision in a practical situation of identifying "Strategy based on Corporate Entrepreneurship and Flexibility" on the following planes:
  - Flexibility in terms of "options"
  - Flexibility in terms of "change mechanisms"
  - Flexibility in terms of "freedom of choice" to participating actors.
- Identify and delineate the types of flexibility pertinent to establishing a regime for competitive strategies based on corporate entrepreneurship and flexibility appropriate to your organization. On which planes, the flexibility needs to be enhanced?
- Attempt mapping the socio-technical system of your organization on the following continua. (Please tick mark in the appropriate box (es)).

Strategy Formulation		
Completely Rigid	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Completely Flexible
Strategy Implementation		
Completely Rigid	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Completely Flexible
New Business Creation		
Completely Rigid	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Completely Flexible
Innovativeness		
Completely Rigid	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Completely Flexible

- Develop a SAP-LAP (Situation Actor process –Learning Action Performance) model of "Corporate Entrepreneurship and Flexibility based strategy" appropriate to your organization's competitiveness.

### Reflecting Applicability in Real Life:

- Implement the methodology of identifying the "issues" for enhancing the corporate entrepreneurship of your organization.
- Identify the change agents and processes appropriate to enhancing the overall competitive edge of your organization.



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## Management of Change – A Comprehensive Review

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### Abstract

*Globalization and liberalization of Indian economy has brought with it an unprecedented level of competition in the industry. To respond to the situation, the industry has to successfully change from the old ways of working to be more productive, cost efficient and competitive. Managing change is posing a big challenge to many Indian firms, as there is a great inertia and resistance to change and also lack of knowledge of globalization and liberalization. It is realized that managing change successfully in an organization requires change in various areas, i.e. technology, systems, structure, people and culture. All these areas are interwoven and interrelated. A successful change programme addresses all these areas and determines a sequence in which these are to be changed, with bigger changes intercepted by many small changes. Further, care has to be taken to use facilitators for change and minimize the effect of potential inhibitors to change. In this paper, an exhaustive review of literature concerning change management has been presented. Present status of change management and limitations of the present approaches are also discussed.*

**Keywords:** flexibility, management of change, organizational change

### Introduction

In recent years, researchers have been concerned with understanding why some organizations perform better than others. According to the resource-based perspective, successful organizations have unique capabilities or resources that give them an advantage over their competitors. Gersick (1994) has found that these resources are valuable when they are rare, inimitable and non-substitutable. Consistent with resource-based view, the author maintains that the development of social capital within an organization is the source of competitive advantage for a firm. Winning in business today demands innovative culture. According to Kanter (1999), the need of the companies is to serve the social sector and gain competitive advantage. For the success of a business, social acceptance of innovations especially technological changes is a must. He further states that companies should view community needs as opportunities to develop ideas, serve new markets, and solve long-standing business problems. The best way to ensure full commitment is to make parity between corporate and the community.

There are three types of competitiveness in an organization (Canada, 2002): competitiveness in short-term, competitiveness in long-term and dynamic competitiveness. In the long-term, competitiveness depends on the ability to develop the factors that sustain productivity growth. A dynamic process of creation of new resources, technological innovations, development of new markets, new skills and competences leads to long-term competitiveness.

Competitiveness in short-term depends on the development of factors that give more profits without new resources. Dynamic competitiveness involves the continuous improvements and innovations for the growth of organization.

Fink and Schlake (2001) have studied competitiveness of an organization and stated that enterprises must identify upcoming opportunities and threats very early and integrate them into strategic planning on time. The authors have given the concept of scenario management, which is based on systems thinking, future open thinking and strategic thinking, and result in organization success.

Nohria (2002) has concentrated on leadership, human performance, and corporate renewal for competitive advantage in Indian context. He has emphasized on three things for staying ahead than others, i.e. shareholder value, consolidation, and fast pace of change. Corporate education programme can help the people in reducing resistance to change. Through these techniques, an organization can achieve success as per expectation.

### Change Management

The content or subject matter of change management has been drawn from psychology, sociology, business administration, economics, industrial engineering, systems engineering, strategy, structure, and the study of human and organizational behavior. For many practitioners, these component bodies of knowledge are linked and integrated



by concepts and principles. The literature on change has been characterized as “a few theoretical propositions, repeated without additional data or development; a few bits of advice reiterated without proof or disproof; and a few sturdy empirical observations quoted with reverence but without refinement or explication” (Macy, 1993).

The study of change and its development has been one of the greatest themes in the social sciences. Many social science disciplines have developed theoretical literature and empirical findings about the birth, development, transformation, decay and decline of human and natural systems. A recent tradition of research in various fields of organizational science has grappled with organizational change and developments (Woodman, 1989; Van, 1995; Quinn, 1995). The development theories of change in the organization studies have been faced with the hurdle of scholarly quality and practical relevance (Pettigrew, 1987). It has not been possible to define the term change accurately owing to the broad spectrum of change and its heterogeneous character. Change management is viewed from two perspectives: implementing change and adapting change. Process of change has been found to vary dramatically if one executive demands the change (implementing) versus front line operators (adapting) who may be unsure about the need/adaptation of change (Robbinson, 1995).

*Process of change has been found to vary dramatically if one executive demands the change (i.e. implementing) versus front line operators (adapting) who may be unsure about the need/ adaptation of change.*

Mainly two perspectives of change have been studied: organizational change and individual change (Robbinson, 1996). Organizational change has been associated with the visible changes in the organization. Efforts are made in various areas like technology, structure, system, strategy, culture, etc. On the other hand, individual change represents the change in attitude, vision and target of an individual in the organization. Change management is defined as the effective management of a business-change. Executive leaders, managers and front line employees have to work in a team to successfully implement the needed processes and require technology for the organizational change. According to Scott (1997), it is possible for individuals to manage change and develop a greater sense of career focus in the midst of dynamic environment by examining three principles, i.e. firstly, “principle of centeredness” which means that as a centered person, you have a strong mission or purpose in life, values to help you in your decision-making efforts, and a vision to steer your future; secondly, “principle of limits” that means that you can’t do everything but must focus on what is important versus what is urgent. Create a greater sense of balance to the physical, mental, social, and spiritual aspects of your life; thirdly, “principle of fun” which means keeping life in its proper perspective by having fun. These principles have been helpful in implementing change in various areas in an organization. Pettigrew (1997) has critiqued the literature on

organizational change as being largely acontextual, ahistorical, and aprocessual. Since considerable advancement has been made in these areas, some writers have acknowledged that context and action are inseparable and that time must be an essential part of investigations of change if processes are to be uncovered (Greenwood, 1996; Weick, 1999).

From the literature, three basic definitions of change management have been obtained (Nickolas, 2002). The first and most obvious definition of “change management” is that it refers to the task of managing change. ‘Managing change’ has two meanings. One meaning refers to making changes in a planned and systematic fashion. The aim is to effectively implement new methods and systems internally in an organization. These (internal) changes have to be triggered by events originating outside the organization, what is usually termed “the environment.” Second meaning of managing change refers to the response of the change over which the organization has to exercise little or no control (e.g. legislation, social and political upheaval, the actions of competitors, shifting economic tides and currents and so on). The second definition of change management refers to an area of professional practice. There are a large number of independent consultants around the world who are engaged in planning change for their clients. Stemming from the view of change management as an area of professional practice, there is a third definition of change management. This definition consists of the models, methods and techniques, tools, skills, and other forms of knowledge that goes into making up any practice a body of change.

Another important definition is given by Prosci (2002). He states, “change management represents the processes, tools and techniques to manage the people-side of business change to achieve the required business outcomes and also to realize that business changes can be met effectively within the social infrastructure of the workplace”. This definition has been commonly used among practitioners and end-users.

### Categorization of Literature

The review of literature has been divided into the following categories:

- Organizational change
- Facilitators for change management
- Inhibitors to change
- Change strategies
- Major focus areas of change

All these categories are described in the following sections.

## Organizational Change

Descriptive research by Tichy et al (1990) suggests that transformation of an organization follows a process, which includes a sequence of phases: recognizing the need for change, creating a new vision, and then institutionalizing change. Saeed et al (1993) have recommended a “focused manufacturing knowledge” in manufacturing area than making many engineering changes. The engineering changes have been the primary means for most mid- to high-volume product-oriented organizations to modify existing product designs in a controllable, coordinated, and methodical manner. In this way, the organization can save substantial amount of engineering time while simultaneously developing higher quality, reducing cost, and reducing product time. To accomplish change in an organization, traditional measures need to be controlled with an empowered workforce that is more self-directed, self-managed and self-controlled. Special considerations are needed for bringing changes in a matured organization like increasing their capacity, altering the hardware (strategy, structure and system) and software (employees’ behaviour and mindset) within the organization and by creating empowered employees who act as leaders at all levels of the organization (Beatty and Ulrich, 1996).

Areas of organizational change have been related to its dynamics and effects of time, process, discontinuity and context.

Change management cannot be merely limited to technological aspects like replacement of machines, equipments, instruments and practicing new manufacturing processes. However, it has been commonly aimed to make the processes and products more effective in an organization. Managing change has comprised of various interconnected and interdependent areas (Garg and Singh, 2002). Each of these areas need to be recognized both individually and also in terms of its multilateral linkages with other areas. These areas are described as under:

- i. Technology:** Technology is concerned with design and layout of production facilities, type and mix of machines and equipments, product mix, flow of data and sharing of information, inventing new materials, automation, using computer softwares and hardware, monitoring and control of production processes, maintenance and simulation of operations and facilities and others.
- ii. Organizational systems:** This area is concerned with working practices related to production, maintenance, marketing, sales, information technology, material procurement, inspection, quality, etc. on the one hand and their interconnection on the other. Both technology and systems can be made/changed simultaneously in “reengineering” to achieve success.
- iii. Organizational structure:** Structure is related to

organizational support system that facilitates change process in an organization. The area includes hierarchical levels, cadres, span of control, manpower utilization, administration, communication, integration, coordination, learning and so on.

- iv. People:** This area is related to management attitude, vision, objectives, resistance to change, motivation, developing skills, coordination, mindset of individual and impact of group dynamics on change process.
- v. Culture:** Culture includes flexibility, work environment, team spirit and behavior of individuals, group behavior, management commitment, belongingness, leadership and interpersonal relationship in an organization.

## Facilitators for Change Management

Facilitators for change management include suitable change agents, their capabilities, role of management, information technology and organizational targets. An individual in the organization who is familiar with the process of change is assigned the responsibility of change programme and is called as ‘change agent’. This person facilitates all the essential events and also intervenes whenever feels so. Skill and knowledge of the change agent decide the extent of organizational change. An important aspect of the change process is ‘change target’. Target includes vision, objectives, knowledge, values, beliefs, assumptions and emotions. .

Leadership plays an important role in the change process. Various facilitators for managing change in an organization are

discussed below.

**Change Agents:** Change agents influence employees’ readiness for adapting change. Readiness is described in terms of organizational members’ beliefs, attitudes and intentions (Kavanagh, 1999). A typology of readiness programme is offered taking urgency of change and employee readiness. Change agent can contribute a lot in achieving various aspects like increase of morale of employees of the organization, increase of retention (reduce attrition), instill high organizational commitment, allow for greater creativity and innovation through HR alignment, develop a culture that is proactive and receptive to change. All these aspects result in achieving success in an organization.

**Transition Management Teams:** Beckhard and Harris (1987) have recommended a transition management team (TMT) composed of leaders who are influential in the organization and have wisdom, objectivity and effective interpersonal skills. This team must also have the resources and clout to manage change process. Duck (1993) expanded on Beckhard and Harris approach, highlighting the dynamic nature of change and the importance of an effective transition management team (TMT) composed of people who report directly to the CEO and can commit all their time and effort

*Organizational change has been associated with the visible changes in various areas like technology, structure, system, strategy, culture, etc.*

to manage change process. From Duck's perspective, it is critical for TMT to manage the 'dynamic' aspects of change. The cornerstone of this process is effective communication throughout the organization. TMTs are also responsible for managing emotional connections so that are essential for successful completion of the transformation.

**Leadership:** Armenakis et al (1993) have defined the role of various persons in the organizations for change programme. The facilitation works between the social and mythic realities enable the emergence of new symbols as the success of change programme. According to Nohria and Berkley (1994), decision-leadership of managers in a company keeps them competitive. The authors have stated that effective managers play with the possibilities of change, tinker with systems and use all the resources to find workable solutions. By frequently changing, it becomes a tool that creates a balance of needs of organization and conflicting modes of organizational behavior, such as flexibility and consistency. When the leader takes as given his mythic reality, the facilitation gains acceptance in the community for the new symbol. The leader charms the members into the feeling of 'co-ownership' in the symbol's creation and propagation (Pawar and Eastman, 1997).

**External Agents:** Kronenberg (1989) has emphasized the close co-operation between universities and industry and considered it as the key requirement to intensify dialogue that can result in accomplishing change in the organizations. Spann et al (1995) have considered the role of sponsors, developers and adopters as external agents for the effective technology transfer in a change programme.

**Organizational Learning:** Kanter (1999) has recommended "learning in the organizations" for change successfully. He has stated that traditionally business viewed the social sector as a dumping ground for spare-cash, obsolete-equipment and fired-executives. But today, smart companies are approaching it as a learning laboratory where they can stretch their thinking, extend their capabilities, experimentation with new technology, get feedback from early users about product potentials, and gain experience working with underserved and emerging markets. He adds that a company has a better chance of making a change if it knows how its business agenda relates to specific social needs.

**Information System:** Role of information system has been found crucial in change process (Stenzel et al, 1997). After laying the foundation of strategic vision, constructing a robust set of measures, and ensuring a consistent leadership, an efficient and effective information system helps to facilitate communication, understanding, and organizational intelligence. An effective information system creates a sense of organizational community and facilitates in organizational change.

**Advisory Board:** An advisory board consisting of various

cadres has been proposed to allocate the duties and responsibilities (Lijnse, 2002). The amount of work for a change manager is staggering. He has to approve changes, record changes, manage meetings, control the process, improve the processes, and lots more. The best way to cope with this challenge is to introduce different cadres within change process like the 'process owner' owns the process and supporting documentation for the processes, oversees the process, and ensures that the process is followed by the organization. 'Change manager' is responsible for ensuring that all changes are reviewed. He can approve minor changes if found necessary. 'Change Coordinator' ensures that all changes are recorded, scheduled, and that all parties involved with the change have the information that is needed through the process. The role of the 'change owner' is to make a change through its life-cycle. The 'change sponsor' is the individual that approves the change from business perspective.

### Inhibitors to Change

It is a universal truth that people do not like/ favour change. Any change has been found to disturb the status quo, adds problems and fear into the daily lives and requires changes in 'overall behavior'. As a result, a poorly managed organization results in a 'force' that slows down or in some cases even stops the change process.

Ford and Ford (1994) have used logical models to provide different understandings of the hindrances to the change process. They have found that change has been dependent upon conflict or struggle. The conflict between the forces for or against change have been two opposing actions that work at each other until one dominates, and the resulting outcome has been a synthesis that is distinct but contains elements of the forces for and against change.

This model has been based upon the assumption that dissatisfaction with status quo has been necessary before change can occur. They have further added that changes do not result from "pushes" or pressure to move away from the present situation, but instead result from being "pulled" towards or attracted to different possibilities.

There are strong arguments as to why resistance to change occur (Kavanagh, 1999). Political arguments are connected with the interests of individuals/ groups against the changes of losing status or power. Emotional arguments relate to personal fear of individuals into account that result in reduced feeling of involvement in the change. Rational arguments are concerned with the role of specific organization for change (Kavanagh, 1999). Managing the resistance by human beings has been the major part of any change process. Chakravarty (2000) is of the opinion that change can be initiated, planned, directed and controlled. He adds, "Bureaucracy is generally regarded as biggest resistance to change". Management of change, therefore, involves identification of winners and losers and developing

*Individual change represents the change in attitude, vision and target of an individual in the organization.*





strategies for building and managing coalitions.

Dasgupta (2002) has studied the cultural change with respect to the revolution in information technology. She has found people itself as the biggest problems encountered in the global change. Employees are dealing with attitude, behavior and expectations that are extremely different from their routine. The revolution in telecommunication, banking, postal delivery and information technology has demanded a permanent cultural change.

### Change Strategies, Tools and Techniques

For making a successful change in an organization, various types of changes, e.g. incremental, episodic, discontinuous and continuous have been suggested by many researchers. According to Quinn (1985), incremental change should be preferred for making change. Successful managers in a company act logically and incrementally to improve the quality of the information used in key decisions to overcome the personal and political pressures giving resistance to build organizational awareness, understanding and psychological commitment essential to effective strategies to make the organizations successful. Episodic changes are organizational changes that tend to be infrequent, discontinuous and intentional changes. Episodic changes occur as organization moves away from equilibrium stage, or change as a result of misalignment or environmental encroachment (Miller, 1994). Continuous changes are those changes, which are ongoing, evolving, and cumulative in nature (Orlikowski, 1996). Any equilibrium of change emphasizes the discontinuous nature of changes (Greenwood and Hinings, 1996). Further, long periods of small incremental change need to be interrupted by brief periods of discontinuous and radical changes. Brown and Eisenhardt(1997) have found that organizational survival depends on the firm's ability to make rapid and continuous change in contrast to episodic change. The occasional dramatic revolutions or punctuations overcome organizational inertia that alters the organization frame (Beer and Nohria, 2000).

Kotter and Schlesinger (1989) have discussed several strategies to deal with resistance of individuals in the organizations, e.g. upgrading education and communication, boosting participation and involvement of individuals at all levels, facilitation and support by top management, negotiation and agreement between employees and management. According to Kronenberg (1989), continuous improvement helps an organization in doing better and gaining an edge. Continuous improvement requires a commitment to learning. In the absence of learning, companies and individuals may repeat old practices and change remains cosmetic only. It is further stated that

*Change management represents the processes, tools and techniques to manage the people-side of business change to achieve the required business outcomes, and also to realize that business changes can be met effectively within the social infrastructure of the workplace.*

learning organizations cultivate the art of open and attentive listening. A learning organization takes account of carefully cultivated attitudes, commitments and management processes that have accrued slowly and steadily over time.

A systematic method for promoting climate for innovation by designed interactions and preparing a summary of best ideas for innovations was suggested by Humble and Jones (1989). Their argument about the incremental innovation also seems quite plausible, since radical innovations or technological breakthroughs can be realized once in a while but incremental innovation in the existing products can go on almost on a regular basis. Many a times, it is not possible to realize radical innovations within the existing firm's setup. In such cases, contract research consultants and universities can be funded for specific research projects or long-term contract may be signed with any of the above or with any combination of the above organizations.

Hatch (1993) and Gersick (1994) have offered two distinct mechanisms – temporal pacing and event pacing that modulate the speed and course of organizational change. They further say that temporal pacing is well suited to the non-routine situations. In contrast, event based pacing is shown to be well suited to fostering incremental change.

Here the focus is on the specific events that signal when actions should be initiated or corrections made. Its focus is on keeping a given track and is motivated by the desire to achieve specific outcomes.

Some researchers have discussed 'readiness for change' as a strategy to change process. Beer and Walton (1987) and Armenakis et al (1993) have examined the influence of change agents on organizational members for change. The authors find that the primary mechanism for creating readiness in an organization is the message, which incorporates organizational needs and its ability to change. They add that management of information, internally and externally, is very important and needs to be controlled by top management.

Kotter (1995) after studying many successful as well as unsuccessful organizations concluded that change process goes through a series of phases that in total, require a considerable length of time. He adds that skipping steps creates only the illusion of speed and never produces a satisfying result. He has offered eight steps to transform an organization in a phased manner. These steps are: establishing a sense of urgency, forming a guiding coalition, creating a vision, communicating the vision, empowering others to act on the vision, planning for and creating short-term wins, consolidating improvements and producing still more changes and lastly institutionalizing new approaches. He further adds that transformation of an organization is





dependent upon a good leader who looks the need for a major change.

Porter (1996) has considered 'operational effectiveness' as a change strategy to get superior performance, which is the primary goal of any enterprise. Operational effectiveness means, "performing similar activities better than rivals perform them". He added that a company might have to change its strategy if there are dramatic changes desired in it.

Brynjolfsson et al (1997) introduced a new tool "the matrix of change" that can help managers anticipate the complex relationships surrounding change. It is found that the matrix can help managers determine how quickly change should proceed, in what order changes should take place, whether to start a new site, or whether the proposed systems are stable and coherent. Specifically, "the tool helps manage concerns about feasibility (stability of a new system of practices), sequence (which practices to change first), location (Greenfield or Brownfield sites), pace (slow or fast), and stakeholder interests (sources of value added)". The tool involves four steps. "First, managers determine which business practices matter most for their business objectives. Second, the matrix highlights interactions among these practices and possible transition difficulties from one set of practices to other. Third, it encourages various stakeholders to provide feedback on proposed changes. Finally, it reveals process interactions that can provide guidelines for the pace, sequence, feasibility, and location of change".

The need for flexibility in management has been emphasized by researchers as well as practitioners. A 'flexible managerial approach' has been reported by Baker (1985) with long-term financial planning having a full understanding of the dynamic nature of business environment. The concept of 'flexibility management' has been outlined by Armstrong (1993) as a flexible approach to organization management to ensure that the organization will be able to adapt to change, respond quickly to new threats and opportunities, and manage diverse and decentralized operations. Mintzberg (1994) has suggested that managers need not always program their strategies formally; sometimes strategies must remain flexible, as broad visions, to adapt to a changing environment. A flexible system methodology (SAP-LAP) has been developed by Sushil (1997). This methodology tries to resolve the end of continuum paradoxes, by treating all the system based methodologies, and techniques as lying on a continuum ranging from well structured to unstructured. The three basic components in flexible systems management paradigm are situation, actor and process. The situation is to be managed to an organic order by an actor through flexibly evolved self-organizing management process, which recreates the situation. The actor exercises the freedom of choice to

flexibly and systemically evolve a management process in an interactive and innovative manner.

Grover (1999) has developed "business process change management" for the success of the organization. According to him, reengineering focuses radical changes over broad core entities and is related to organizational processes whereas process change management involves the management of the multiple facets of process change. He adds that global economy has mandated greater operational effectiveness and efficiency, and imposed tremendous pressures for cost reduction. The conclusion is to go for strategic changes for the firm to survive and prosper for the success of reengineering phenomenon.

Eric (2000) has developed a theory for changing the organizations without 'pain'. The author states that to change successfully, companies should impress major change initiatives among carefully paced periods of smaller change, using "tinkering and kludging". He adds that company can manage change with an approach called dynamic stability. Dynamic stability is a process of continual small change efforts that involve the reconfiguration of existing practices and business models rather than the creation of the new

*To accomplish change in an organization, traditional measures need to be controlled with an empowered workforce that is more self-directed, self-managed and self-controlled.*

ones. Tinkering is concerned with the minor changes in the products, motivating the existing manpower of the organization. Kludging is tinkering but with a college (formal) education. It takes place on a large scale and involves many more parts. Organizations that have consistently avoided changes may need to undergo rapid, destructive change. He adds that the companies already changing rapidly face a different challenge, i.e. they must learn to shift down from highly destabilizing and disruptive change to tinkering and kludging. This thinking helps an organization to change without pain.

Pattanayak (2000) thinks that with the changing business environment, organizations must focus on their employees in order to ensure that they move ahead together. He states that focus today is on becoming learning organization where new concepts like BPR, TQM, Benchmarking etc. are practiced. He found that "reengineering of organization behaviour can be achieved by a thorough understanding of an organizational culture, its effect on organizational change, employee empowerment and by integrating HRM with corporate strategy".

The decades-old paradox of great software promise and its disappointing practice in organizations has been recently increased by the appearance of enterprise-wide systems often called "enterprise resource planning or ERP" (Taylor, 2002). Obtaining effective user involvement has been problematic in the past and it promises to become worse in the future with larger, more comprehensive software applications. Business process re-engineering (BPR) adds to this significant problem by exhorting managers to undertake

massive change - including new information systems - using autocratic methods whereas socio-technical systems (STS) design combines user-involvement in design with structural change and the effective use of technology. The author explores the successful application of STS with its local participation in organization design to a centralized and autocratic application of BPR and SAP enterprise-wide software.

### Major Focus Areas of Change

From the literature, it is found that managing change successfully in an organization requires changes in various interconnected areas. The important areas are technology, structure, systems, people and culture. In addition, impact of entrepreneurial abilities and flexibility has also been found on change management. All these areas are described below.

**Technological Change:** Need of technological change for organizational development was analyzed by Ramo (1989). He commented that the twenty first century would be totally dominated by technological change. Also, the global characteristics and fast changing nature of the world economy has demanded sophisticated and conscious technological changes (Greis, 1995). The factors affecting technology change have been availability of resources, availability of data, credibility of sources of data, similarity in present and future technologies, and variables affecting the development of new technology.

Managing a technological change pro-actively has always been a big challenge for any firm. Hayes (1991), Langowitz (1992) and Katz et al (1996) have studied the technology transfer in a multinational cooperative joint venture and concluded that technology change depends upon type of technologies, methods used to transfer them, their degree of success, and the organizational, national and cultural differences. Developing countries have been relying heavily on technology transfer from abroad. Indigenous technological innovations are based on local needs and availability of resources whereas the developed countries have been emphasizing exploitation of technology and introduction of new products and processes. They have given high priority to management of research and development and commercialization of new technologies.

Malthus (1978), Marx (1987), and Ricardo (1995) have expressed concern about the effects of innovation, especially in the form of new technology machinery, on the displacement of labor. According to them, new technology is concerned with labor saving and quality-enhancing innovations, such as computer-aided design/computer-aided manufacturing systems, computer numerically controlled machines, just-in-time inventory systems, flexible manufacturing systems and robotics. Technology change has been derived as a two-stage process. In the first stage, the

firm is found to make a decision to adopt a new advanced manufacturing technology. This is followed by adjustment of the labor force in the second stage. Much technical advancement has been found as labor-saving innovations enabling companies to eliminate less-skilled positions. This has led to a shift in labor composition in favor of more highly educated workers. Furthermore, technology change has increased the wage premium associated with additional investment in education or skill acquisition. Indeed, as noted by Berman et al (1998), numerous studies have attributed both the greater wage premium for skill and recent increases in unemployment in “Organization for Economic Cooperation and Development (OECD) countries” to skill-biased technological change. It is essential to see the needs of the organization before changing technology. This can be possible by establishing a meaningful dialogue, preferably with a group of three or four persons at different hierarchical levels (Misra, 2002).

**Structural Change:** Organizations have various structures based on the optimal coordination of interactions amongst various activities. Many structures are designed in the organizations based on number of levels, authorities and responsibilities of individuals. There are six elements of structures: work specialization, chain of command, span of control, authority and responsibility, centralization and decentralization, and departmentalization (Robbins, 2001). Based upon the elements, the organizational structure has been categorized into six types. An organization with ‘simple structure’ is low in specialization and formalization, but high in centralization. In ‘functional structure’, activities pertaining to a particular function are organized into various departments, e.g. departments dealing with distribution, styling, engineering, manufacturing, research, public relations, and personnel relations (Harris and Raviv, 2002). In divisional structure, all the activities pertaining to a single product, set of products, or types of customers are grouped into a division/ department/ section. An organization, in which specialists from functional departments are assigned to the work on one or more projects led by a project manager, represents a matrix structure. In a team-based structure, the entire organization consists of work groups or teams that perform the organization’s work. Such an organization is also termed as flat organization.

A process focused organization is usually characterized by a large central staff coordinating the plants throughout the functional areas, whereas a product focused organization is highly decentralized, flexible, and has a large number of staff functions in each plant. The later structure is needed when the firm’s strategy emphasizes product innovations rather than efficiency (Haynes and Schmenner, 1982). Kanter (1985) has studied the impact of organizational structure change on innovative abilities. The author has indicated that most of the best innovative ideas in an engineering

*Areas of organizational change have been related to its dynamics and effects of time, process, discontinuity, and context.*

organization are interdisciplinary and inter-functional. He has indicated that an innovative company needs to assemble a group of talented people who are eager to do new things and put them in an environment where innovation is expected.

Changing structure in a company includes alteration in any authority relationships, coordination mechanisms, degree of centralization, job design, or similar other structural variables. Process reengineering, restructuring, downsizing and empowering have resulted in more decentralization, wider spans of control, reduced work specialization, and cross functional teams. These structural components have given employees the authoritative flexibility and ease to implement process improvements (Robbins, 2001).

The need of structural change of a high technology firm is reflected directly from the environment of the firm and the characteristics of the technology (Moharman et al, 1990). New technology can have different levels of impact depending on their pervasiveness and the structure of the organization and society (Rao, 1990). The interpersonal behavior in an organization has been taken as the 'momentum' for change (Clarke, 1994; Dawson, 1994). Therefore, an appropriate organization structure can be an important lever for making the change. However, its effectiveness has been dependent upon the recognition of its informal as well as formal aspects. Bartlett and Ghoshal (1995) expressed that formal business structures create barriers between themselves and their customers, take initiative away from those who need to exercise it and promote the people who operate well in that environment. They emphasized for need of an organizational structure with the opposite characteristics. The changing scenario requires a new management philosophy on organizational structure that is based on purpose, process, and people. Calori et al (2000) gave a different meaning to the concept of structural change and its effect on competitiveness. The authors have shown that structure of a company is changed by changing manpower strength, layers and levels, and their skill.

Structural changes in global firms have been discussed by Birkinshaw (1988). He has expressed that the strategic and structural changes are being manifested in large multinational corporations (MNCs) to locate more and more value-added activities outside the home country. Further, 'subsidiary development' initiative is an important driver of the process of structural change - through which the subsidiaries expand their scope of activities and responsibilities within MNCs.

Drucker (1990) has stated, "Structure is a means for attaining the objectives and goals of an organization. Any change in structure must start with objectives and strategy".

Organizations are composed of informal structures, rules and norms as well as formal practices and procedures. These informal rules, patterns of behavior and communication norms and friendships are created by people to meet their own emotional needs. Because of this, they can have more influence on individual behavior and performance, and ultimately on overall organizational performance than the formal structure and control mechanisms laid down by management.

Mitchell and Mulherin(1996) and Mulherin and Boone (2000) have pointed out broad economic shocks in restructuring at industry level. Industries are affected by specific shocks (rapid changes) in terms of deregulation by government policies, technology transfer, foreign competition and energy price volatility. Shocks have been studied with respect to various factors like growth, opportunities, profitability, availability of cash and industry concentration (Jensen and Ruback, 1989; Jensen, 1993) and also technology, industry deregulation and foreign competition (Mitchell and Mulherin, 1996; Mulherin and Boone, 2000). Powell (1997) has studied the restructuring at the industry level for a sample of U.K. firms over a period of 10 years and concluded that deregulation is very much significant in explaining takeover activity for 1990s period. Pattnayak (2000) has advocated downsizing and delayering for reengineering in the companies. He has emphasized that successful reengineering requires a change in the company's whole structure.

*Change management cannot be merely limited to technological aspects like replacement of machines, equipments, instruments and practicing new manufacturing processes.*

Role of management style on structural change has been studied by Covin and Slevin (1998). They have offered that an entrepreneurial management style will have a positive effect on the performance of organically structured firms and negative effects on the performance of mechanistically structured firms. They further commented that an organic structure can facilitate innovation through its flexibility and ability to respond to a turbulent environment.

Michael (2001) popularized the concept of business process reengineering (BPR). According to him, BPR refers to fundamental rethinking and radical redesign of work processes so that the company becomes lean and develops quick response capabilities, to face competition and to exploit new opportunities. Abrahamson et al (1999) have given the steps for designing a new logistics structure: calculate the total cost and delivery service of the existing structure, making calculations for alternative structures, and make calculations on dimensions and size of facilities. First two steps directly deal with the organizational structure whereas the third one deals with operational part.

Kohn (2002) has described the changes in the logistical concept and studied its impact on the environment. In a model developed, he has illustrated the creation of opportunities and limitations on account of structural



changes in an organization. He has concluded that changes on a structural level surely influence time, cost and environment.

**Systemic Change:** Mumford (1983) and Pava (1983) developed socio-technical systems design approach for process redesign. They have stated that performance of the organizations is dependent upon technical and social dimensions. They further considered that technology dimension is concerned with its technology and procedures, and social dimension denotes people who work for the organization and focuses on their psychological needs for fulfilling and satisfying work. They have concluded that socio-technical systems involve the joint design of the technical subsystem (optimized for efficiency) and the social subsystem (optimized for job satisfaction and motivation) in such a way that they support each other.

Van (1992) have stated that process (system) has been used in three ways in literature: as a logic used to explain a casual relationship in a variance theory, as a category of concepts that refers to individuals or organizations, and as a sequence of events that describe how things change over time. Out of these three, only the third permits explicit and direct observation of the process in action, and thereby allows describing and accounting for how some entity or issue develops and changes over time. Thus, the definition of process used in change management should refer to the sequences of individual and collective events, actions, and activities. Wastell, White and Kawalek (1994) have been of the opinion that efficiency, effectiveness and adaptability of business processes (systems) improve the organizational performance. Also, processes are argued to be inherently vulnerable because they flow horizontally, cutting across vertical functions and are prone to atrophy due to departmental rivalries, bureaucracy, lack of coordination and loss of customer focus.

Ghoshal and Bartlett (1995) have classified the company's core organizational systemic processes into three parts: the entrepreneurial process, the competence building process, and the renewal process. An entrepreneurial process deals with the changes in organizational structures, relationships, and values to create an environment of innovation and risk taking. The competence building considers flexibility, responsiveness, learning, skill, information sharing, cost reduction, increasing overall equipment effectiveness, openness in decision-making, technological changes, and culture. The renewal process includes data processing, system support process, new strategies, motivation, and building core competencies. The authors have considered that systems help companies to decide strategies for their competitive strengths. Managers are expected to design systems, procedures, and policies that ensure all the employees conformed to the company way.

Hicks and McGovern (2000) have classified processes into three categories: nonphysical, physical and support processes. The first category relates to information and knowledge-based processes, second group involves the physical realization of the product through manufacturing, assembly, and construction, and the third category includes staff functions such as finance and human resource management. They have concluded that in addition to coordinating marketing and supply, systems related to procurement, product development, and manufacturing activities need to be changed for success in a business.

French (2000) has found the impact of the new processes on the survival of the organization. Further, he has demanded new processes to be developed for cost reduction through value engineering activities, also reduction in product-life cycle through research and development, and improving confidence of its vendors through revitalization of the company. Carr and Gabriel(2001) have considered the systemic change responsible for competitiveness of an organization. He has demanded a shift from crisis management to long-term process of stabilizing the organization, sustaining progress and ensuring the success of the company in a rapidly changing environment.

Adrian and Yiannis (2001) have considered three subsystems in a system namely technical, social and power. They found that no change could convert an entire system instantaneously. They

*Managing change has comprised of various interconnected and interdependent areas. Each of these areas need to be recognized both individually and also in terms of its multilateral linkages with other areas.*

portrayed reorganizations as beginning with a nucleus where the change must first become established firmly before it propagates to rest of the system. They also found that if communication mechanism gets more efficient, then nucleus becomes larger and stronger resulting in a systemic change, instead of being damped by its surroundings.

Pattanayak and Misra (2002) have considered reengineering responsible for a successful change in an organization. According to the authors, reengineering represents rapid and radical redesign of strategic, value added business processes and the systems, policies and organizational structure that support them. They have emphasized that dramatic changes and dramatic results are possible through systemic changes in an organization.

Chaudron (2002) studied the impact of various change efforts in various organizations. Based on this study, he determined several causes to organization's change efforts to stumble or stagnate. One of the important causes has been lack of systemic changes. He has stressed that management must focus on customer satisfaction, and should promote teamwork in the entire organization. Profit sharing may be introduced; individual performance appraisals may be radically changed or eliminated; organizational structure may be realigned away from functions (production, quality, engineering) to a customer-, process- or geographic-based; information may be disseminated to all the employees than



to reserve it for senior management. Significantly, more authority must also be extended to the line employees. If management does not align these systems, the effect will be like “Dr. Doolittle’s Pushme-Pullyou” animal (a horse with two heads, each pulling in the opposite direction).

Garg and Singh (2002) are of the opinion that system pertains to the existing practices in an organization. In making systemic changes, the efforts are needed to eliminate the unnecessary procedures, complicated reports, formal approvals, formal meetings, enforced policies, or other formal activities, which generally create backlogs/ bottlenecks. Red tapism and other bureaucratic procedures also need to be changed which cause frustration amongst employees as their capabilities and roles are not judged significantly. Proper training needs to be given to the organizational members as a team so that they can become self-managed. Simulation based guidance can add more value to it. The authors have stated that systemic changes result in saving of power, time, cost and effort leading to increased competitiveness. It is further added that systemic changes in an organization can be made through bold leadership and commitment from top authority.

Manfred and Elizabeth (2002) have emphasized upon the need of the employees to match the desired changes in the organizational systems. They have indicated that by soft process changes like training, transfers, teamwork and travel, hard results can be easily met out in an organization for global leadership. Role of change agents, cheerleaders, coaches, teachers, mentors, process consultants and integrators has been very important in selecting the new systems for motivating the manpower to reframe their mindset.

Lamb and Leisch (2002) have offered an approach to reframe the relationships between three constructs – market commitment, market knowledge and market involvement, in the process of internationalization of a small firm. They have added that as the firm grows, organizational resources become a great issue requiring increased management attention and coordination. This situation requires a change in its existing systems and structure. Kampas (2003) has found that it is the necessity of the present industry to orchestrate transition from product-innovation culture to process-innovation culture, which focuses on systems change like product development, procurement, manufacturing, sales, distribution and marketing.

**People Change:** Change in people refers to changes in employee attitudes, expectations, perceptions, or behavior. The human dimension of change requires a workplace committed to the organization’s objectives, targets and vision. This dimension has necessitated proper education and training for the manpower. It has also demanded a performance evaluation and reward system that supports and encourages continuous improvements.

Van (1986) has considered people for the development

and implementation of technological innovations at various stages. He has concentrated on four factors namely new ideas, people, transactions and organizational context, and problems related to them. According to Bardwick (1991), many organizations and their employees are mired in the mentality of entitlement. As a result, there is low performance, lack of commitment and accountability, little risk-taking and scant enthusiasm. The opposite of entitlement is fear. Duck (1993) has described the need to take people into confidence while introducing change in any area. The author has emphasized the change paradoxes and mentioned that trust is hardest to develop and achieve when you need it most. Hazen (1994) explains how to overcome both the lethargy of entitlement and the paralysis of fear and to move into the energy of earning in order to create a work environment of high confidence and high performance.

According to Beatty and Ulrich (1996), the greatest effort involved in making change in an organization is to change the mindset of employees at all levels. The mindset represents a shared way of thinking and behaving within an organization. Further, they added that mindset is institutionalized in vision, value and mission. As an organization becomes mature, it has a relatively fixed mindset, and becomes a liability. With time, its intensity may hinder the ability to change.

*Change agent facilitates all the essential events and also intervenes whenever feels so.*

In an interview with Jaques Naseer, CEO of Ford Motor Company, Wetlaufer (1999) has discovered that no company driven by rapid changing customer needs and tastes can survive without having competent leaders capable of fast decision making. It has been emphasized by CEO that need of the organization is to make quick changes in the fundamental approach. Employees should think like shareholders, and the company as a whole must be able to respond swiftly to customers needs. All this is possible through a change in the mindset of people. It is further added that change in mindset is possible by involvement and commitment of top management, sharing their views and vision with the people of the organization.

Carr and Gabriel (2001) have referred the notion of unconsciousness contextualized as psychodynamics relevant to managing people. According to the authors, the concepts of identity (individual, group and organizational), groups, culture, motivation, emotion, rationality, ethics, leadership, commitment, psychological contract, role, power, and conflict acquire a deeper meaning when enriched with psychoanalytic insights and help in getting success in an organization.

Friedman (2002) has studied the role of individual in organizational change. Organization learning occurs when individuals within an organization experience a problematic situation and enquire about it on organization’s behalf. Further, involvement of people results in change of individuals’ mindsets as well as organization culture. He has further stated that programmes like TQM and reengineering



transform people at all levels into agents of organizational change.

Bogley and Boyd (2003) have felt the importance of developing a global mindset requiring changes of organizational structure, process and systems. It requires a balanced formalization with flexibility through modular networks and communities of practice, balancing standardization with customerization through disruptive management, centers of excellence and corporate vision.

**Cultural Change:** Organizational culture denotes a system of shared meaning within an organization that determines to a large degree how employees behave. New systems or patterns of values, symbols, rituals, myths, and practices have evolved over time in the industry. Organizations around the world are experiencing changes in the culture, and the trend is towards even more changes as countries continue to undergo changes in the cultural composition of their general populations (Erez and Somech, 1996; Hambrick, et al, 1998; Wenting and Palma, 2000).

Cultural orientation can be assessed by collecting data on issues relating fear/ risk taking, communication/ feedback, flexibility/ structure, stress/ peer support, learning, continuous improvement, managing orientation and involvement, and operating norms. Dance (1991) has related total quality with the process of cultural change. He has stated that cultural change process is developed by a management style based on clear objectives, effective organization structure, clear and simple cultural values, and efficient management and procedures.

There are basically two types of approaches for cultural change in an organization, i.e. the team approach (Heavens, 1993) and the committee approach (Quinn and Brian, 1995). Participation on committees means to bring people together to share ideas on a particular project. The committee approach has been superseded by the concept of shared management. Teams have been encouraged in order to work collaboratively using team problem-solving techniques. Teams tend to have more responsibility, more authority, and the team approach tends to be more proactive than the committee approach. Impact of information technology on cultural change was studied by Davenport and Thomas (1994). According to the authors, by paying attention to how people share information, management can use all the resources to its fullest potential. The authors have spoken of integrating human behavior into information systems and at the same time, changing employee behavior to meet technology halfway.

Pascale et al (1997) and Meek (1998) have stressed on a fundamental change in the companies operations. Earlier the tendency was to improve functions and process to meet the objectives. With the accelerating pace of change, companies

are pouring executive energy for higher levels of quality, service and overall business agility. Companies achieve real agility only when every person makes efforts to rise to every challenge. This type of fundamental change is called “revitalization or transformation”.

Jick (1998) has stated that despite the entire corporate benchmarking and academic wisdom, companies are not happy with the prospect of 5-7 years time frame. He states that “the quicker a company adapts a new culture based on the competitive needs, the greater is the likelihood of its succeeding”. He has found people of the organization as the bottlenecks and tollgates in an organization to change. Thus, challenge involves changing the hearts called “Software of the company”. A cultural change is very much comparable to a product launch. A new product is launched based on what customers want now, not later. If it arrives too late, it may no longer serve its purpose, or customers may be lost to a competitor. A cultural change has the same sense of urgency. If it arrives too late, an enterprise business may be lost to a competitor (Jick, 1998).

*Change agent can contribute a lot in achieving various aspects like increase of morale of employees of the organization, increase of retention (reduce attrition), instill high organizational commitment, allow for greater creativity and innovation through HR alignment, develop a culture that is proactive and receptive to change.*

Morrison and Phelps (1999) have studied factors to motivate employees for cultural change. They have found an important factor called “taking

charge” which in turn effects organization functions. As reported by coworkers, taking charge is related to feel responsibility, self-efficacy and perceptions of top management. It entails voluntary and constructive efforts, by individual employees, to effect change with respect to how work is executed within the context of their jobs, work units, or organizations. They have concluded that employees can be motivated to go beyond the boundaries of their jobs for cultural change. Also, the employees are likely to be motivated when they perceive top management as open to employee.

Kozan (2002) goes beyond the current practice of treating cultures as uniform entities, and investigates the influence of sub-cultures on the styles used during conflicts. He has identified three distinct subculture clusters in addition to the main culture of an organization. The traditional culture preferred avoiding, while power seekers preferred competing, and egalitarians preferred accommodation in comparison to other subcultures. It has been emphasized that an organization practicing these subcultures can acquire success. Hopkins and Hopkins (2002) further emphasized that employees should be engaged as meaningful contributors to cultural change.

**Entrepreneurial Aspects:** Covin and Slevin (1988) have indicated that an entrepreneurial management style will have a positive effect on the performance of organically structured firms and a negative effect on the performance of mechanistically structured firms. An organic structure is



expected to facilitate innovations through its flexibility and ability to respond to a fast-changing and turbulent environment. It has been emphasized that the synthesis of skills and collaborative efforts for team building along horizontal and vertical levels would be effective.

Lee and Peterson (2000) have evolved a cultural model of entrepreneurship. They have proposed that a society's prosperity to generate autonomous, risk taking, innovative, competitively aggressive and proactive entrepreneurs depend on its cultured foundation. Role of economic, political/legal, and social factors are moderators in the relationship between culture and entrepreneurial orientation. Finally they have concluded that a strong entrepreneurial orientation will ultimately lead to increased competitiveness.

Michael et al (2001) have defined entrepreneurship as the process of storytelling that mediates between extant stocks of entrepreneurial resources and subsequent capital acquisition and wealth creation. The authors have proposed a framework that focuses on how entrepreneurial stories facilitate the crafting of a new venture identity that serves as a touchstone upon which legitimacy may be conferred by investors, competitors, and consumers, opening up access to new capital and market opportunities.

**Flexibility:** A flexible system is one that is able to respond to changes, and flexibility is the ability of the system to respond effectively to change. The ability of the organization to cope with the internal changes require a degree of redundancy in the system, whereas the ability to cope with the external change require that the systems be versatile and capable of producing wide variety of parts with minimal change over times and costs (Buzacott, 1982, Chung and Chen, 1990).

The concept of systemic flexibility was introduced by Sushil (1994). Systemic flexibility is the exercise of free will or freedom of choice on the continuum to synthesize the dynamic interplay of thesis and antithesis in an interactive and innovative manner, capturing the ambiguity in systems, and expanding the continuum with little penalty in time and effort. Such a systemic concept of flexibility will have major attributes of spectral, integrative, interactive, innovative and fuzziness character, and lead success to the organization.

Technology flexibility is the technology characteristics that allows or enables adjustments or other changes to the business process. Technology flexibility has two dimensions, structural and process flexibility. The flexibility of technology that supports business processes can greatly influence the organization's capacity for change. Existing technology can present opportunities for or barriers to business process flexibility through structural characteristics such as language, platform, and design. Technology can also indirectly affect flexibility through the relationship between the technology maintenance organization and the business

process owners and other response characteristics. These indirect effects reflect a more organizational perspective of flexibility (Nelson et al, 1997).

Dixon (1992) feels that there is a linkage between flexibility and competitiveness of an organization. With respect to avoiding product changes, the ultimate level of flexibility is achieved when the need for change itself has been eliminated. Three strategies have been evolved for improving flexibility- choosing flexible technologies, lower the cost of change, and product architectural choices that allow the product to easily accommodate change.

### Present Status and Limitations of Existing Approaches

There is a good amount of literature available on the issues related to socio-technical change management in context of technology, system and culture in developed countries. Authors in the areas have tried to capture different problems faced by technology based firms and have thrown light on various aspects of change management function. Today, technology change is a buzzword. A good deal of work has been reported to develop technologically advanced machines, CAD/CAM practices, CNC machines, robotics, FMS, new tools, dies and fixtures, etc. Emphasis has been given to enhance quality, minimize waste, customer delight and increasing productivity by replacing manpower by machines.

*'Change Coordinator' ensures that all changes are recorded, scheduled, and that all parties involved with the change have the information that is needed through the process.*

It is learnt that systemic changes have been adopted even by the companies, which are technologically poor. One or more amendments in systems like JIT inventory to reduce investment on inventory, 5S for better house-keeping, ISO9000 for international process standards, QS9000 for automobile industry, Kaizen teams, Quality Circles, TQM and TPM have been adopted by most of the companies and have added success to them.

Structural change has been crucial in recent times. With developed technology and multi-skilled manpower, most of the companies have extra manpower and are finding it difficult to reduce it. Many joint ventures and public sector units have offered voluntary retirement schemes (VRS) and early separation schemes to get rid of excessive manpower. A virtual ban on recruitments has been imposed in a number of organizations. For new systems and culture, delaying is desired in the Indian context. Efforts have been made to enlarge vendor base, suppliers and ancillaries for quality improvement and cost reduction. This aspect is also adequately covered in literature.

Mindset of people and cultural change is considered critical for a successful change management programme. At international level, various theories have been developed for group dynamics, teamwork, belongingness, ownership and rich work culture. Literature pertaining to these studies is





readily available.

Change management publications at national and international level mostly deal with technology, system, and culture. Publications dealing with highlighting technological change, systemic improvement, restructuring, and cultural modification of Indian industries are rare. A lot is said about motivation, labor unrest, time standards, labor laws, technology adaptation, market competition and similar aspects but, it is seen that each of these aspects is described in isolation. Studies aimed at finding out the interplay of all the factors and forces involved in the change process are scant.

Some of the major limitations of the existing approaches towards management of change are highlighted as follows:

- There is a heavy emphasis on technology management and systemic improvement. Organizational structure, mindsets of people, attitude and culture have not been addressed in an integrated manner along with technological and systemic changes.
- In technological change, emphasis is on technical collaboration or technology-acquisition from MNCs. Innovation and technology development aspects have not been fully addressed.
- The aspects of supporting change in the systems and structure required as a result of major technological change have not been adequately analyzed with regards to the extent of efforts required and the results thereof.
- In case of manpower utilization, various techniques have been developed for manpower-optimization, but no model or methodology has been devised which relates the manpower with organizational change.
- The research on change management is concentrated on quality improvement, increasing production rate, reducing scrap rate etc. Literature on interactions of various areas of change management is scant.
- Literature on Indian manufacturing sector, in general, deals with financial aspects, market share, profitability and launch of models/variants. Research on management of change has been inadequate in the Indian context.
- Research work taking individual aspects of change is available in abundance but it does not present a realistic solution for organizational change. Literature related to change management considering various aspects of change together and its impact on competitiveness is rare.

## Conclusion

Change management has attracted attention of researchers in the past about two decades. Substantial work has been reported on the topics related to the meaning of change, its facilitators and inhibitors. Further, each major area of technology, structure, system, people and culture has been adequately addressed. The optimal sequence in which these

major areas should be changed for a successful change programme based on the present status of the organization, has also been discussed. Further, the literature emphasizes on an approach of changing with stability, which demands that bigger changes are intercepted with small changes. Need of flexibility in the process of change management and adopting an entrepreneurial approach have also been brought out. Comprehensive studies for an organization's change programme involving all these aspects have not been evidenced. Such studies need to be undertaken for an organization or a class of industry.

## References

- Abrahamson, M. and Aronsson, H. (1999), "Measuring logistic structures", *International Journal of Logistics: Research and Applications*, 2(3), pp. 111-132.
- Adrian and Yiannis, (2001), The psychodynamics of organizational change management, *Journal of Organizational Change Management*, 14(5), 415-421.
- Armenakis A., Harris S. and Massholder K. W. (1993), Creating readiness for organizational change, *Human Relations*, 46(6), 681-703.
- Armstrong, G., and Kotler, P., (1993), "Marketing: An introduction", 3<sup>rd</sup> Edition, Prentice Hall NY.
- Baker, (1985), "The marketing handbook", 5<sup>th</sup> edition, Butterworth-Heinemann, An imprint of Elsevier Science, Linacre House, Jordan Hill, Oxford.
- Bardwick J. M. (1991), *Danger in the Comfort Zone*, New York: American Management Association.
- Bartlett and Ghoshal (1995), Changing the role of top management, *Harvard Business Review*, May-June 1995, 132-142.
- Beatty R. W. and Ulrich D. O. (1996), Re-engineering the mature organization, *IEEE Engineering Management Review*, Fall 1996, 60-69.
- Beckhard R. and Harris R. T., (1987), Managing complex change, *Harvard Business Review*, May-June 1987, 123-133.
- Beer M. and Walton A. (1987), Organizational change and development, *Annual Review of Psychology*, 38, 339-367.
- Beer M. and Nohria N. (2000), Cracking the code of change, *Harvard Business Review*, May-June 2000, 133-141.
- Berman, E.M., (1988), "Productivity in public and non-profit organizations: Strategies and Techniques", Sage Publications INC.
- Bogley and Boyd (2003), The Need for a Corporate Global Mindset, *MIT Sloan Management Review*, 44(2), 25-32.
- Brown S. L. and Eisenhardt K. M. (1997), The art of continuous change: Thinking complexity theory and time-paced evolution in relentlessly shifting organizations, *Administrative Science Quarterly*, 42(1), 1-34.
- Brynjolfsson E., Renshawamy A. and Marshall V. A. (1997), The matrix of change, *Sloan Management Review*, Winter 1997, 37-54.
- Buzacott J. A. (1982), The fundamental principles of flexibility in manufacturing systems, *Proceedings of the First International Conference on FMS*, Brighton, UK, 23-30.
- Calori R., Melin L., Atamer T. and Gustavsson P. (2000), Innovative international strategies, *Journal of World Business*, 35(4), 333-354.
- Canada (2002), Steps to competitiveness, <http://strategis.gc.ca>.
- Carr and Gabriel (2001), The psychodynamics of organizational change management, *Journal of Organizational Change Management*, 14(5), 415-421.
- Chakravarthy S. (2000), Management of change, *Productivity*, 41(1), 37-45.





- Chaudron (2002), Nine pitfalls of organizational change, *www.prosci.com*.
- Chung C. H. and Chen I. J. (1990), *Managing Flexibility of Flexible Manufacturing Systems for Competitive Edge*, Springer Verlag, Berlin.
- Clarke (1994), *The Essence of Change*, Prentice Hall, London.
- Covin J. G. and Slevin D. P. (1988), The influence of organization structure on the utility of an entrepreneurial top management style, *Journal of management studies*, 25(3), pp. 217-234.
- Dance D. (1991), Successful change management- the total quality route, *Mining technology*, 73(5), 78-88.
- Dasgupta (2002), Business process outsourcing, *Indian Management*, September 2002, 31-35.
- Davenport Thomas, H. (1994), Saving IT's soul: Human-centered Information management, *Harvard Business Review*, March-April 1994, pp.119-131.
- Dawson P. (1994), *Organizational change: A processual approach*, Paul Chapman Publishing, London.
- Dixon J. R. (1992), Measuring manufacturing flexibility: An empirical investigation, *European Journal of Operational Research*, Vol. 60, pp. 131-143.
- Drucker P. F. (1990), *Management: Tasks, Responsibilities, Practices*, New York: Harper and Row.
- Duck J. D. (1993), Managing change: The art of balancing, *Harvard Business Review*, 71(6), 109-118.
- Erez M. and Somech A. (1996), Effects of culture and group-based motivation, *Academy of Management Journal*, 39, 1513-1537.
- Eric A. (2000), Change without pain, *Harvard Business Review*, July-August 2000, 75-79.
- Fink A. and Schlake O. (2001), Scenario management- An approach for strategic foresight, *IEEE Engineering Management Review*, First Quarter 2001, 25-31.
- Ford J. D. and Ford L. W. (1994), Logics of identity, contradiction and attraction in change, *Academy of Management Review*, 19(4), 47-56.
- French (2000), Measuring systematic Unity in a learning organization, *Journal of Management in Engineering*, 16(4), 39-46.
- Friedman V. J. ( 2002 ), The Individual as agent of organizational learning, *California Management Review*, 44(2), 70-89.
- Garg R.K. and Singh T. P. (2002), Managing change for competitiveness, *Global Journal of Flexible Systems Management*, 3(4), 13-22.
- Gersick C. (1994), Pacing strategic change: The case of a new venture, *Academy of Management Review*, 37(3), 1-9.
- Ghoshal and Bartlett (1995), Changing the role of top management, *Harvard Business Review*, Jan-Feb1995, 86-96.
- Greenwood R. and Hinings C. (1996), Understanding radical change: Bringing together the old and new institutionalism, *Academy of Management Review*, 21,1022-1054.
- Greis N. P. (1995), Technology adoption, product design and process change: A case study in the machine tool industry, *IEEE Transactions on Engineering Management*, 42(3), 192-202.
- Grover V. (1999), From business reengineering to business process change management: A longitudinal study of trends and practices, *IEEE Transactions on Engineering Management Review*, 46(1), 36-46.
- Hambrick D. C., Canney D. S., Snell S. A., and Snow C. C. (1988) When groups consists of multiple nationalities: Towards a new understanding of the implications, *Organizational Studies*, 19, 181-205.
- Harris and Raviv (2002), "Organization design", *Management Science*, 48(7), pp. 852-865.
- Hatch M. J. (1993), The dynamics of organizational culture, *Academy of Management Review*, 18(4), 657-693.
- Haynes R. H. and Schmenner R. W. (1982), *How Should You Organize Manufacturing? - Readings in Management of Innovation*, Marshfield, MA: Pitman Publishing.
- Hayes R. H. (1991), Requirements for successful implementation of new manufacturing technologies, *Journal of Engineering and Technology Management*, 7, 169-175.
- Hazen (1994), Multiplicity and change in persons and organizations, *Journal of Organizational Change Management*, 7(6), 72-81.
- Heavens (1993), The change dazed manager, *Harvard Business Review*, Sept-Oct 1993, 22-37.
- Hicks Earl, and McGovern (2000), An analysis of company structure and business processes in the capital goods industry in UK, *IEEE Transactions on Engineering Management*, 47(4), 66-75.
- Hopkins and Hopkins (2002), Effects of cultural decomposition on group interaction processes, *Academy of Management Review*, 27(4), 541-553.
- Humble J. and Jones G. (1989), Creating a climate for innovation, *Long Range Planning*, 22(4), 46-51.
- Jensen and Ruback (1989), Eclipse of the public corporation, *Harvard Business Review*, (Sept-Oct, 1989), 60-74.
- Jensen M. C. (1993), The modern industrial revolution and the challenge to the internal control systems, *Journal of Finance*, 48, 831-880.
- Jick D. (1998), Accelerating change for competitive advantage, *Organizational Watch Editorial: Organizational Dynamics*, 77-82.
- Kampas P. J. (2003), Shifting cultural gears in technological driven industries, *MIT Sloan Management review*, Winter 2003, 44(2), 41-48.
- Kanter R. M. (1985), Supporting innovation and venture development in established companies, *Journal of Business Venturing*, 1, 47-60.
- Kanter R. M (1999), From spare change to real change, *Harvard Business Review*, May-June 1999, 123-132.
- Katz Ralph, Rebenisch E. S. and Thomas, J. Allen (1996), A study of technology transfer in a multinational cooperative joint venture, *IEEE Transactions on Engineering Management*, 43(1), 97-105.
- Kavanagh A. (1999), *Change management journey*, *www.kpmg.org*.
- Kohn (2002), *Structural changes and their effect on the environment*, Logistic Management Group, Linkoping University, Linkoping Sweden.
- Kotter J. and Schlesinger L. (1989), Choosing strategies for change, *Harvard Business Review*, 57(2), 106-114.
- Kotter J. P. (1995), Leading change: Why transformational efforts fail, *Harvard Business Review*, November-December 1995, 59-67.
- Kozan M. K. (2002), Subcultures and conflict management style, *Management International Review*, 42(1), 89-105.
- Kronenberg H. V. (1989), Getting a quicker payoff from R&D, *Long Range Planning*, 22(5), 51-58.
- Lamb and Liesch (2002), The internationalization process of the smaller firm: Reframing the relationships between market commitment, knowledge and involvement, *Management International Review*, 42(1), 7-26.
- Langowitz N.S. (1992), Managing a major technology change, *Long Range Planning*, 25(3), 79-85.
- Lee, S. and Peterson, S., (2000), "Culture, entrepreneurial orientation and the global competitiveness", *Journal of world business*, 35(4), pp. 401-16.
- Lijnse P. (2002), Above and beyond change management, *White Paper: Hewlett-Packard Company, Version 1.3- February 2002*, 1-15.
- Macy B. A. and Izumi H. (1993), Organizational change, design and work innovation: A meta-analysis of 131 North American field studies, *Research in Organizational Change and Development*, 7, 235-313.
- Malthus (1978), Skill-based technological change: Evidence from a Firm-

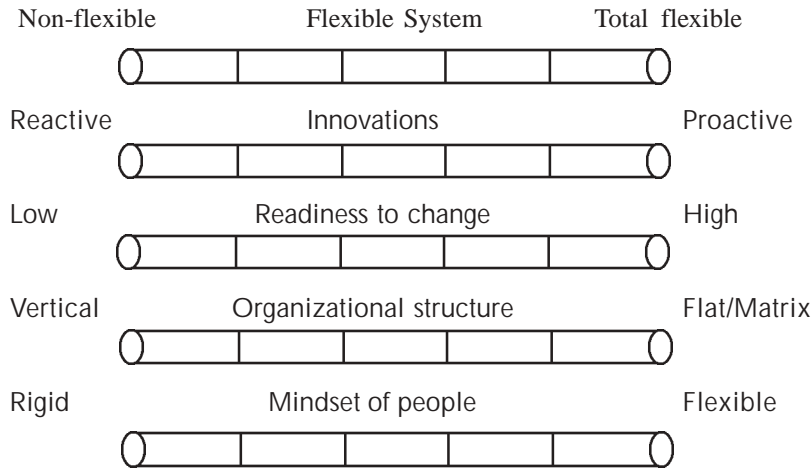


- level Survey, *Upjohn Institute for Employment Research*, 1-7.
- Manfred and Elizabeth (2002), Creating high commitment organizations, *Organizational Dynamics*, 30(4), 25-30.
- Marx (1987), Skill based technological change: Evidence from a firm level survey, *Upjohn Institute for Employment Research*, pp. 1-7.
- Meek V. L. (1988), Organizational culture: Origins and weaknesses, *Organizational Studies*, 9(4), 453-473.
- Michael (2001), Entrepreneurial Strategies for Wealth Creation, *Strategic Management Journal*, 22(6-7), pp. 545-564.
- Miller D. (1994), What happens after success: The perils of excellence, *Journal of Management Studies*, 31, 325-358.
- Misra P. (2002), Management of technological change, *pmisra@gisdev.net*
- Mitchell, and Mulherin (1996), "Corporate performance, corporate takeovers and management turnovers", *Journal of Financial Economics*, Vol. 41, pp. 193-229.
- Mitzi, H., (1994), "The rise and fall of strategic planning", Prentice hall, USA.
- Mohrman S. A., Glinow M. and Ann Von (1990), High technology organizations: context, organization and people, *Journal of Engineering and Technology Management*, 6, 261-280.
- Morrison E. W. and Phelps C. C. (1999), Taking charge at work: Extra role efforts to initiate workplace change, *Academy of Management Journal*, 42(4), 403-419.
- Mulherin J. H. and Boone A. L. (2000), Comparing acquisitions and divestitures, *Journal of Corporate Finance*, 6, 117-139.
- Mumford E. (1983), Designing participatively, *Manchester Business School Press*, Manchester.
- Nelson M., Nelson H. and Ghods M. (1997), Technology flexibility: conceptualization, validation and measurement, organizational systems and technology, *Proceedings of the Hawaii International Conferences on System Sciences*, 3, IEEE Comp Soc, Los Alamitos, CA, USA, 76-87.
- Nickolas (2002), *nickels@worldnet.att.net*
- Nohria and Berkley (1994), Whatever happened to the take-charge manager?, *Harvard Business Review*, Jan-Feb 1994, 128-139.
- Nohria (2002), India has to run faster to stay where it is, *Indian Management*, 41(9),62-66.
- Orlikowski W. J. (1996), Improvising organizational transformation overtime: A situated change perspective, *Information Systems Research*, 7, 63-92.
- Pascale, Millemann and Linda (1997), Changing the way we change, *Harvard Business Review*, November-December 1997, 127-139.
- Pattanayak P. (2000), Towards reengineering organizational behaviour, *Productivity*, 41(1), 71-75.
- Pattanayak B. and Misra R. K. (2002), Organizational development, *Productivity*, 43(1), 110-118.
- Pava C. (1983), *Managing New Office Technology: An Organizational Strategy*, Free Press, New York.
- Pawar, B. S., and Eastman, M. L. (1997), "The Nature and implications of contextual influences on transformational leadership: A conceptual examination", *Academy of Management Review*, Vol. 22, pp. 80-109.
- Pettigrew A. M (1987), Context and action in the transformation of the firm, *Journal of Management Studies*, 24, 649-670.
- Pettigrew A. M. (1997), The double hurdles for management research, *Advancement in Organizational Behaviour: Essays in the honour of D S Pugh*, London: Dartmouth press, 277-296.
- Porter M. E. (1996), What is strategy?, *Harvard Business Review*, November-December 1996, 61-78.
- Powell, R. G. (1997), "Modelling takeover likelihood", *Journal of Business Finance and Accounting*, 24(7), 1009-1030.
- Prosci (2002), *www.prosci.com*
- Quinn J. B. (1985), Managing innovation: controlled chaos, *Harvard Business Review*, 63, 73-84.
- Quinn, Brian (1995), Understanding the differences between committees and teams, *Library Administration & Management*, 9(2), pp.111-116.
- Ramo S. (1989), National security and technology edge, *Harvard Business Review*, Nov-Dec 89, pp. 115-120.
- Rao A. S. (1996), *Management of technology change*, Global Business Press, Delhi.
- Rao, R., (1990), "Compensating heterogeneous salesforces – some explicit solutions", *Marketing Science*, 9:4, 319-341.
- Ricardo (1995), Skill-based technological change: evidence from a firm-level survey, *Upjohn Institute for Employment Research*, 1-7.
- Robinson and Benett (1995), A typology of deviant workplace behaviours: A multi-dimensional scaling study, *Academy of management Journal*, April 1995, 556-572.
- Robbins S. P. (2001), *Organizational Behaviour*, Edition 9th, CD-ROM included, e-business updated edition, Pearson Education, Low Price edition, India.
- Saeed B., Bowen D. and Sohoni V. S. (1993), *IEEE Transactions on Engineering Management*, 40(1), 54-59.
- Scott M. P. (1997), Being centered, setting limits and having fun, *Association Management*, 49(3), 87-99.
- Spann, M., Adams, and Souder (1995), "Measures of technology transfer effectiveness: Key dimensions and differences in their use by sponsors, developers and adopters", *IEEE Transactions on Engineering Management*, 42(1), pp. 12-29.
- Stenzel Catherine and Joe Stenzel, Re-visioning the organization: Silence and song of her majesty, *Journal of Strategic Performance Measurement*, 1(6), 43-46.
- Sushil (1994), Flexible systems methodology, *Systems Practice*, 7(6), 633-651.
- Sushil (1997), Flexible systems management: An evolving paradigm, *Systems Research and Behaviour Science*, 14(4), 259-275.
- Taylor (2002) Participative design: Linking BPR and SAP with an STS approach, *Journal of Organizational Change Management*, 22(8), 178-199.
- Tichy N. M. and Devanna M A. (1990), *The Transformational Leader*, John Wiley, New York, NY.
- Van De Ven (1986), Central problems in the management of innovation, *Management Science*, 32(5), 590-607.
- Van De Ven (1992), Suggestions for studying strategy process: A research note, *Strategic Management Journal*, Vol.13, pp.169-188.
- Van de Ven and Poole (1995), Explaining development and change in organizations, *Academy of Management Review*, 20, 510-540.
- Wastell, White, and Kawalek (1994), A methodology for business process redesign: Experiences and issues, *Journal of Strategic Information Systems*, 3(1), 23-40.
- Weick K. E. and Quinn R. E. (1999), Organizational change and development, *Annual Review of Psychology*, 50, 361-386.
- Wenting and Palma (2000), Current status of diversity initiatives in selected multinational corporations, *Human Resource Development Quarterly*, 11(1), 35-60.
- Wetlaufer S. (1999), Driving change – An interview with ford motor company's Jaquees Nasser, *Harvard Business Review*, March-April 1999, 77-88.
- Woodman R. W. (1989), Organizational change and development: New arenas for inquiry and actions, *Journal of Management*, 15, 205-228.



### Flexibility Mapping : Practitioner's Perspective

1. What types of flexibilities you see in the practical situation of "Organizational Change" on the following points:
  - Flexibility in terms of "options"
  - Flexibility in terms of "change mechanisms"
  - Flexibility in terms of "freedom of choice" to participating actors.
2. Identify and describe the types of flexibilities that are relevant for your own organizational context? On which dimensions, flexibility should be enhanced?
3. Try to map your own organization on following continua (Please tick mark in the appropriate box(es))



4. Develop a SAP-LAP (Situation Actor Process-Learning Action performance) model for "change mechanism" relevant to your organization.

### Reflecting Applicability in Real Life

1. How do you find the study presented in this paper relevant to your organization? Critically examine and use the relevant findings.
2. Based on the parameters in this paper, is it possible to use it for benchmarking purposes?
3. To what extent the findings of this paper are relevant for managing change in your organization?



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