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e-mail : giftjournal@giftsociety.org

Tel : 91-11-26591167

Fax : 91-11-26862620

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## The 'Myth – Reality – Myth' Syndrome

Around 1600 AD, Giordano Bruno was burnt alive on stakes on the charges of heresy because he had the 'temerity' to profess the ideas based on Copernicus's view of the Universe, which at that point of time, appeared to be a 'myth'; the 'reality' of those times being that the Earth was the centre of the Universe and, therefore, stationary! And the Church of this time took upon itself the role of a prolocutor for any and every matter, including the astronomical and the scientific knowledge.

But gradually, the 'myths' propounded by Copernicus and Galileo, advocating the existence of an open Universe, of which the Earth was but a small part, shattered the then prevalent 'truth' of a closed Universe created and maintained in motion by God! This is one classical example of a 'myth' shattering an established 'truth' and becoming a reality in due course of time.

However, a closer look at history of mankind and technological advancements (both are closely intertwined anyway) reveals that the two are mutually sustaining and that the growth trajectory of both is a cycle of myth–reality–myth. For example, it wasn't long that the myths of telephone, radio, and television (mostly originating in science fictions) metamorphosed into realities, but the latest advancements in the information technology are stark landmarks epitomising this never ending itinerary.

Many of us (and this includes the author too) may be recollecting the TV serial Startrack aired some 25 years ago wherein the characters carried 'phones' they could use anytime and anywhere. Although it appeared as a fictional myth at that time but what we witness today in abundance is almost similar looking instruments called cellphones being used on a scale never observed before, thus annihilating both: the time and space. And the human mind is the precursor and the ultimate impeller of this cycle of progress.

But this is not to suggest that the human body has been a recluse in this journey. On the contrary, the human body is precious and it has the highest evolutionary value because of unique brain and spinal nerves; no other living form is so equipped. The mind is the wielder of muscles. As the force of a hammer depends on the energy applied, the power expressed by the human's bodily instrument depends upon his will and courage because the body is literally manufactured and sustained by mind and it is through this synergetic arrangement that the man has been able to conceive, design, and operate space and time annihilators.

But the duo of human mind and the instrument of body is the ultimate primogenitor of all that is stated above. And it does not need much sagacity to appreciate that flexibility is the vehicle carrying all these, since the human body is the most flexible machine in existence on the Earth till now. All other shades of flexibility we witness in the management of systems, machines, organisations, practices, and technologies etc. are concomitant with the inherent flexibility in the human thoughts and actions.

But would this myth–reality–myth syndrome continue forever? Would there be a time when the human and technological evolution have conquered the highest peak? We have no answers.

**O. P. Sharma**  
Deputy Editor

*The trajectory of technological growth is cycle of myth–reality–myth.*

*It wasn't long ago that the myths of telephone, radio, and television (originating mostly in science fictions) metamorphosed into realities.*

*What we witness today in abundance is almost similar looking instruments called cellphones being used on a scale never observed before, thus annihilating time and space.*

*Human body is precious and it has the highest evolutionary value because of unique brain and spinal nerves.*

*Human body is the most flexible machine in existence on the earth till now*



# Understanding Flexibility in Supply Chains: A Conceptual Framework and Models

**K. S. Rao**

Research Scholar  
Indian Institute of Technology Delhi  
Hauz Khas, New Delhi, India

**S. Wadhwa**

Professor  
Indian Institute of Technology Delhi  
Hauz Khas, New Delhi, India

## Abstract

*This paper presents the results of a conceptual study and literature review aimed at understanding flexibility in the context of supply chains. The study indicated that several types of feasible in supply chains. Identification and exploitation of flexibilities of these flexibility types is important for enhancing the competitive performance of supply chains. Practicing managers would benefit from understanding the nature of flexibility in supply chains and how it can be exploited to meet the customer requirements. Towards this, the paper proposes a conceptual framework and conceptual models that could help researchers and practitioners to understand supply chain flexibility in a more intuitive manner. The approach adopted is to systematically explore the underlying concepts of flexibility in the internal chains (manufacturing systems) and to extend them into the domain of external chains (supply chains). The proposed conceptual framework is based on resource-transformation-process-product interdependencies and, using this, various types of flexibility possible in supply chains have been identified. These flexibility types are discussed in relation to the manufacturing systems and the ideas are extended to the domain of supply chains. The paper is motivated by the view of Wadhwa and Browne (1989) where flexibility is seen as a means to provide alternative options for the flow of entities (material, resources, information etc) through various interacting processes in any system.*

**Keywords :** flexibility, manufacturing systems, supply chains, conceptual framework

## Introduction

The concept of supply chain was introduced in early 1980s and ever since it has been receiving increasing attention from both practitioners as well as researchers (Ulrika Persson, 1997). The dictionary meaning of a chain represents a series of connected things. In the case of a supply chain, the term chain is used as a metaphor to represent a series of connected business entities. This view has been widely supported in the literature. For instance, Svenssion (2002) views the supply chain as a network of organizations that are involved, through upstream and downstream linkages, in different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer. Similarly, Jan van Dorp (2002) views a supply chain as a network consisting of two or more enterprises which are each for itself and not a constituent of one or more of other enterprises, or which are separated by market forces. Nigel (1998) observes that the supply chain consists of the links between a firm and its suppliers, through to its distribution organization and on to its customers. Similar views are expressed by number of other authors. One question that follows this observation would be what is it that chains the entities in a supply chain. In our view, it is the materials, product(s)/family of products/services, and the information that flow through these entities which chains them as a supply chain. This view is also widely supported in the literature. For instance, Milgate (2001) observes that supply chains include all activities

associated to the flow and transformation of goods from the raw material through the end customer. Towill (1996) and Gunasekaran et al. (2001) cite a definition of supply chain as a system whose constituent parts include material suppliers, production facilities, distribution services, and customers linked together via the feedforward flow of materials and the feedback flow of information.

Similarly, Perry and Sohal (1999) cite a definition of supply chain management as the integration of business processes from end user through original suppliers that provide products, services and information that add value for customers. Cox (1999) describes the current orthodoxy in supply chain management thinking as a way of thinking that is devoted to discovering tools and techniques that provide for increased operational effectiveness and efficiency throughout the delivery channels that must be created internally and externally to support and supply existing corporate product and service offerings to customers. Walters and Lancaster (2000) view supply chain management as the management of the interface relationships among key stakeholders and enterprise functions that occur in the maximization of value creation which is driven by customer needs satisfaction and facilitated by efficient logistics management. Lau and Lee (2000) observe that the supply chain concept is based on the formation of a value chain network consisting of individual functional entities committed to provide resources and information to achieve the objectives of efficient management of suppliers as well as the flow of parts. Chandra and Kumar (2000) define

supply chain as a network (group) of entities (members) formed to solve a common logistics problem. Alshawi (2001) observes that the supply chain takes an integrated approach to logistics management. It covers the flow of goods from the suppliers through manufacturing and distribution chains to end consumer.

The above observations indicate that a supply chain is a way of looking at a group of entities from materials, services, logistics and information flow perspective. Therefore, the concept of supply chain is generic in nature and can be applied in several contexts. Two such contexts are the case of internal and external chains. When the entities of a supply chain are inside the organizational boundary, it is called an internal chain and when the entities are owned by multiple organizations, it is called an external chain. From this perspective, a manufacturing system can be viewed as a kind of internal supply chain and the commonly used word 'supply chain' can be viewed as an external supply chain. The conceptual framework proposed in this paper is based on certain underlying commonalities between the internal and external chains. It may be noted that internal and external supply chains we are looking at are the elements at different levels of aggregation. In both chains, a set of products that flow through are the supply chain, chains these entities to form the supply chain and each of the products that flows through the supply chain is associated with a process comprising of a sequence of process steps. In some cases, it may be possible to interchange the sequence of performing these process steps without affecting the process (for example, sequencing flexibility as in the case of manufacturing systems). Each of the process steps may require one or more resources to complete the process step and in this process they consume certain time and cost and add certain value. In both the internal as well as the external chains, each of the resource may be characterized in terms of their ability to perform different process steps, also called the process capabilities. Some of the resources may have overlapped process capabilities. Under such circumstances, certain process steps can be performed using alternative resources (for example, routing flexibility as in the case of manufacturing systems). Finally, in both types of chains, the existence of flexibility (sequencing flexibility, routing flexibility) increases the control complexity and the associated information/decision flows. Thus the functioning of both types of chains and the underlying flexibility concepts remains the same. One such commonality explored in this paper is the product-transformation-process-resource interactions, as discussed in the next section. Based on this we have proposed the conceptual framework and models for understanding flexibility in supply chains.

It is interesting to note that the notion of a chain reflects two aspects: first, it comprises of a certain number of links connected to each other and second, the relationship

between these links is inherently flexible, i.e. flexibility is an inherent property of a chain. Probably the chain is the best possible combination of connectivity and flexibility. This idea motivated our study on the supply chain flexibility. While the concept of flexibility is well developed in the manufacturing domain (internal chains), in the domain of supply chains (external chains), this concept needs to be enriched both at conceptual as well as operational levels. This paper is a step in the former direction as it proposes a conceptual framework and conceptual models that could help researchers and practitioners to understand supply chain flexibility in a more intuitive manner. The approach adopted is to systematically explore the underlying concepts of flexibility in the internal chains (manufacturing systems) and to extend them to the domain of external chains (supply chains). Accordingly, the paper is organized into three parts: Part-1 presents the key notions underlying the proposed conceptual framework in the form of a series of propositions; Part-2 presents multiple views of the proposed conceptual model to emphasize its generic nature and its applicability in several contexts; and part-3 presents various conceptual models to represent some possible types of flexibility in the supply chains.

### Part-1: The Conceptual Framework and the Underlying Key Notions

As discussed above, the proposed conceptual framework of supply chain flexibility is based on the interdependencies between products, transformations, processes, and resources flowing in a supply chain. This idea is depicted in Figure-1. The key notions of the proposed framework, viz. products, transformations, processes, and resources are well known in the domain of internal chains (manufacturing systems). However, to provide greater clarity, we discuss these underlying notions in this part of the paper with the help of a series of propositions. The propositions are very generic in nature and commonly known. The objective is to discuss the key notions in a known domain (internal chains) and clarify their intended meaning in the new domain (external chains). The discussions will be leading towards identification of flexibility.

#### **Why do Manufacturing Systems and Supply Chains Exist?**

*Proposition-1:* Manufacturing systems and supply chains exist to meet the perceived market demand for products.

Manufacturing systems and supply chains are a set of interdependent entities that exist to meet the perceived market demand for products. Boubekri (2001) observes that supply chain management involves operations that deal with how the customer orders are processed through the system and ultimately filled. The purpose of a manufacturing system is to manufacture products in the required quantity and quality at a minimum cost. The purpose of a supply chains

*Towill (1996) and Gunasekaran et al. (2001) cite a definition of supply chain as a system whose constituent parts include material suppliers, production facilities, distribution services, and customers linked together via the feedforward flow of materials and the feedback flow of information.*

is to ensure that these products are distributed in time and space so that the right products are available at the right place, at the right time and at the lowest possible cost. Thus, the realization of products and their distribution to meet the market demands is the main purpose of manufacturing systems and supply chains. Then the next question would be to examine how products are realized.

**How are Products Realized?**

*Preposition-2:* Products are realized from materials through a series of transformations in their states, brought about by performing certain processes on them, with the help of certain resources, and in this process, certain time, cost and effort are consumed.

*The concept of supply chain is generic in nature and can be applied in several contexts.*

This is the core idea depicted in the conceptual framework shown in Figure-1. In the context of this framework, the key notions of product, transformation, process, and resource may be interpreted as follows.

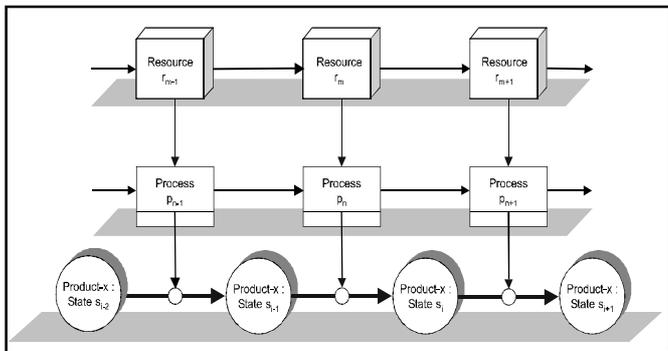


Figure 1 : A Conceptual Framework of a Supply Chain

**What is a Product?**

*Lemma 2.1:* A product is anything that can be sold to a market and that might satisfy a want or need. It is a bundle of physical, service, and symbolic attributes designed to enhance buyers' want satisfaction.

*Lemma-2.2:* Products include goods (the tangible components of a product) and services (the intangible components of a product). All the real life products can be placed on a goods-services continuum, as shown in Figure-2.

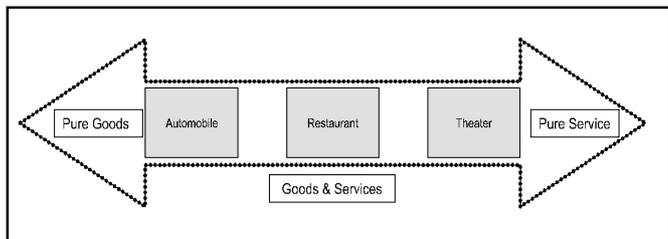


Figure 2: Goods-Services Continuum

In this paper, we are mainly concerned with the tangible components of a product, i.e. goods flowing through the supply chain. The next important notion is the transformation.

**What is a Transformation?**

*Lemma 2.3:* A transformation is something that happens to the product when it undergoes a process.

The idea of transformation refers to something that happens to a product, as it passes through a manufacturing system or a supply chain. In the case of manufacturing systems, transformations involve changing the form and dimensions of the materials as they pass through various manufacturing processes. In the case of a supply chain, some examples of transformations may include: (a) after a

conventional manufacturing process a raw material gets transformed into a semi-finished or a finished product, (b) after assembly, two or more products join to form one or more new products, (c) after disassembly, one product may get separated into two or more products, (d) after packaging, a product may get transformed into a form that is more suitable for distribution, (e) after storage, there will be a change in the temporal position (the product moves in time) of the product, (f) after transportation, there will be change in the spatial position (the product moves in space) of the product, (g) after aggregation, the product will move from a smaller lot to a bigger lot, (h) after disaggregating, the product will move from a bigger lot to a smaller lot.

*Lemma 2.4 :* Transformation of materials into products require a set of partially ordered transformations

Transformation of materials into products requires a set of partially ordered transformations to be carried out on the materials. This set of transformations is something that guides the development of process plans or process maps discussed subsequently. The size of the transformation set may vary, depending upon the kind of process and transformation. For instance, in the case of operations such as punching, stamping etc., the transformation set may include only one transformation. On the other hand, the transformation set for a complex machined component may include several transformations. These transformations will have to be performed in a particular order or sequence, which may be interchangeable under some circumstances. This will give rise to an important type of flexibility called sequencing flexibility which is discussed below.

*Lemma 2.5:* Under some circumstances it is possible to alter the order/sequence in which the transformations are to be performed to transform materials into products.

The idea of an order or sequence is important to understand a type of flexibility called the sequencing flexibility in manufacturing systems. Sequencing Flexibility refers to the possibility of interchanging the order in which the required transformations are performed on a product. This sequence is generally represented through the process plan, which is an abstract form of transformation sequence in the process plane. In general, each type of product can be associated with many sequences of transformations as determined by the technological constraints in realizing the

product type. However, in most of the cases, a single process plan is followed as a matter of convenience or due to an established practice. Depending upon the design of the product, it is possible to alter the sequence of transformations to be performed. This gives rise to the sequencing flexibility. The importance of the sequencing flexibility lies in the fact that this can be built into the product design, thereby avoiding much costlier option of building flexibility into the manufacturing systems.

The potential of sequencing flexibility in enhancing the manufacturing system performance has been recognized by the researchers and efforts have been made to understand the underlying mechanisms with a view to exploit this type of flexibility. For instance, Rachamadugu et al. (1990) studied the effects of sequencing flexibility on the performance of various scheduling rules in environments such as job shops and flexible manufacturing systems. They have found that relative differences in performance of various scheduling rules diminish and the relative rankings change as sequencing flexibility increases. They have noted that since sequencing flexibility is product specific, it exists in conventional manufacturing systems as well as in flexible manufacturing systems. In the past, organizational control issues and the high cost of information systems precluded the exploitation of sequencing flexibility even when it was available in the product structure. However, recent advances in information technology and the declining cost of information systems make it possible to use sequencing flexibility at the operational level. They further noted that if the benefits of sequencing flexibility in terms of reduced flow times and inventories are sufficiently great, this has implications for designing products in such a way as to maximize the potential sequencing flexibility in manufacturing the products. Rachamadugu and Schriber (1991) proposed an approach for modeling of perfect sequencing flexibility in a scheduling environment. Benjaafar and Ramakrishna (1996) introduced several representation and measurement schemes for sequencing flexibility and studied the relationship between sequencing flexibility and system performance under a variety of design assumptions and operating conditions. Wadhwa and Rao (2000) discussed about the determinants for process sequence in the context of Process Concurrency. They observed that, two processes 'A' & 'B' are carried out sequentially due to any of the following reasons: (a) done as a matter of established practice, habit or for convenience, (b) due to functional boundaries, (c) 'B' requires certain information from 'A', (d) 'B' requires certain decision from 'A', (e) 'B' requires certain materials from 'A', (f) 'B' requires certain resource(s) which are currently being used by 'A', or (g) there is a need for synchronization of certain event(s) of 'A' & 'B', which may result in certain lead-lag precedence relationships between 'A' & 'B'

***Manufacturing systems and supply chains are a set of interdependent entities that exist to meet the perceived market demand for products.***

In the case of a supply chains, the process sequence may be mainly as a result of information and material dependencies. The information in the form of customer orders flows upstream through the chain and materials in the form of products flows downstream through the chain. Under some circumstances, it may be possible to alter the sequence in which the information and materials flow. This will give rise to certain types of flexibility in supply chains. Whatever may be sequence, every transformation requires one or more processes to be performed. Hence, the next question to be addresses would be to understand what a process is.

#### ***What is a Process?***

*Lemma 2.6:* A process is any operation through which a set of inputs go through one or more steps resulting in a more valuable set of outputs.

A process can be viewed as a series of interrelated operations, which add value to its inputs resulting in outputs that are more valuable. A process comprises of a set of partially ordered steps intended to achieve the desired output. These steps may be called operations. Sometimes these steps are also referred to as processes themselves, and a process is viewed as a set of partially ordered processes. It is important to note that alternative processes can substitute processes.

*Lemma 2.7:* Under some circumstances a process can be substituted by an alternative process with or without some kind of penalty in terms of time, cost and effort.

This idea is important to understand certain types of flexibility. For instance, Benjaafar and Ramakrishna (1996) used this idea to describe certain types of flexibility originating from the product designs. They observed that the mechanisms that enable flexibility can be traced to specific physical and logical characteristics of a manufacturing system and suggested that flexibility in a manufacturing system can be classified as being either product related or process related. They further observed that, in general, three types of flexibility could be associated with the manufacturing of a product. The first, operation flexibility, relates to the possibility of performing an operation on more than one machine. The second, sequencing flexibility, refers to the possibility of interchanging the sequence in which required manufacturing operations are performed. The third, processing flexibility, which is determined by the possibility of producing the same manufacturing feature with alternative operations, or sequences of operations. Lemma 2.5 proposed above refers to the above-mentioned sequencing flexibility.

Whatever may be the type of process, every process requires one or more resources to perform it. Hence the next important question is to understand what a resource is.

**What is a Resource?**

*Lemma 2.8:* A resource is a means to perform a process on a product.

In the context of this paper, we propose to view a resource as a means to perform a process on a product. Each resource will have certain capabilities to perform these processes. These capabilities are sometimes referred to as process capability. The term process capability is often used in a statistical sense to represent the relationship between the allowed and actual spread of a controlled process. In the context of this paper, we use the term process capability to represent the ability of a resource to perform operations required for one or more processes. Process capability is a key idea behind resource related flexibility.

A process requires one or more resources to perform the required operations. The converse also may be true. A resource may be able to perform operations required for one or more processes. It follows from this that resources with overlapped/identical process capabilities will be able to substitute for each other.

Under some circumstances it is possible to substitute a resource with one or more alternative resources, to perform a given process.

This idea is key to understand resource related flexibility. In general, when there are two or more resources with their process capabilities overlapped, they give rise to a type of flexibility called the routing flexibility in manufacturing systems. Routing flexibility of a manufacturing system is its ability to produce a part by alternative routes through the system. In the case of supply chain an analogous situation can be found with multiple suppliers, multiple manufacturers, multiple modes of transportation, etc. This gives rise to a type of flexibility where the materials will flow through alternative channels. Several such ideas from manufacturing domain can be extended into the domain of supply chains. Some directions for this could be found in literature. For instance Milgate (2001) observed that each supplier in a supply chain is similar to a machine processing in a production system. This paper intends it is useful to extend the idea of flexibility from a manufacturing domain (internal chains) to the supply chain domain (external chains). Wadhwa and Rao (2002) have suggested this important insight along with the need to explicitly model simultaneously the chain elements of the supply chain along with those of the manufacturing system (internal chain). The proposed conceptual framework is a step in this direction.

*It is useful to extend the idea of flexibility from a manufacturing domain (internal chains) to the supply chain domain (external chains).*

**Part-2: Multiple Views of the Conceptual Framework**

The conceptual framework proposed above can be viewed from multiple perspectives to understand different aspects of the manufacturing systems and supply chains. Three important views are: the Resource the View, the Process View and the Transformation View. These three views further

emphasize the applicability of the framework to a wide variety of contexts.

**The Resource View**

Figure-3 presents the resource view of the framework. In the resource view, any system is visualized as a set of interconnected resources through which the products flow. Typical examples of resource view are various types of manufacturing systems such as, flow shop, batch shop, job shop, and flexible manufacturing system, and the conventional supply chain also is a kind of resource view. The resource view is more useful to represent situations where same the processes are repeatedly performed by the the same resources. Hence, it is commonly used in manufacturing and supply chain environments.

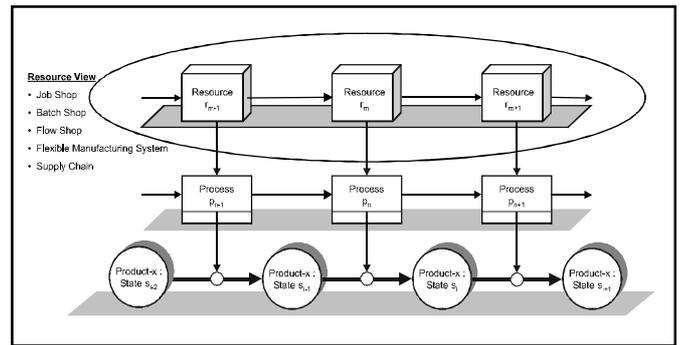


Figure 3: Resource View of the Conceptual Framework

**The Process View**

Figure-4 presents the process view of the framework. In the process view, any system is visualized as a set of interconnected processes through which the products flow. Typical examples of process view are process plan, project plan and process map. The process view is more useful in process-focused systems. For instance, in the case of project management, each project has a unique start and a unique end and all the intermediate process are mapped with the help of a project plan. The case of one-of-a-kind manufacturing is also similar with a unique process plan. Recently there has been considerable focus on process mapping and process improvement. The business process re-engineering, the continuous process improvement, are some of the initiatives in this direction. In a supply chain environment, process

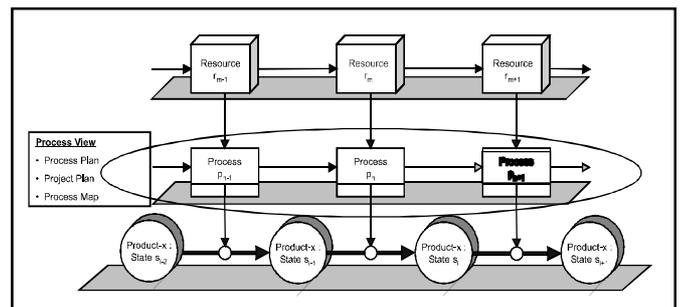


Figure 4: The Process View of the Conceptual Framework

view is useful for the overall improvement of the supply chain efficiency and effectiveness. In the context of this paper, we have used process view to identify various flexibility types originating from the process improvement.

### The Transformation View

Figure-5 presents the transformation view of the framework. In transformation view the focus will be on the state transition of the materials from one state to another as they pass through different processes at different resources. The transformation view is the most fundamental view based on which the process view is developed. In the domain of discrete part manufacturing, this is called methods engineering, where specialized manufacturing engineers study the product designs and develop a transformation view and the corresponding resource view for manufacturing of the products. Understanding the transformation view is useful in identifying the opportunities for improvement in the process.

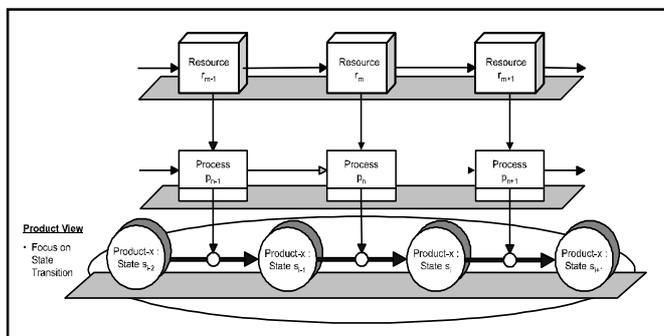


Figure 5: The Transformation View of Conceptual Framework

Thus we talk about the same system with different names and notation in different views. Whatever may be the view, the underlying structure and mechanisms may remain the same. This idea motivated us to develop the proposed conceptual framework for flexibility in supply chains, as discussed below:

### Part-3: Understanding Flexibility in the Supply Chains

With the growing turbulence in the business environment and competition shifting to the supply chain level, the supply chain flexibility is emerging as one of the key competitive priorities for the future. Developing a core competence in this area is expected to have a long-term impact on the supply chain competitiveness and business performance. Realizing this fact, recently a number of authors have started discussing flexibility from a supply chain perspective. For example, Koste and Malhotra (1999), while presenting a perspective on research opportunities in manufacturing flexibility, emphasized that the presence or absence of flexibility in supply chains and its relationship with performance should be explored and the effect of supply chain integration on the development of flexibility

in supply chains should be examined. They observed that, the competitive priorities of the supply chain might impact flexibility, as efficient supply chains may emphasize certain flexibility dimensions, while responsive supply chains focus on the other. An understanding of these differences, if any, would enhance the management of supply chains. Vickery et al. (1999) view supply chain flexibility to encompass those flexibilities that directly impact a firm's customers (i.e., flexibilities that add value in the customer's eyes) and are the shared responsibilities of two or more functions along the supply chain, whether internal (e.g., marketing, manufacturing) or external (e.g., suppliers, channel members) to the firm. They defined five supply chain flexibilities viz., production flexibility (customization), volume flexibility, new product introduction (launch flexibility), widespread distribution (access flexibility) and responsiveness to target markets. Adrian (2001) views supply-chain flexibility as the ability to restructure the system quickly and inexpensively. He observes that after the Sept. 11 terrorist attacks on the USA, many businesses were forced to wonder just how vulnerable their supply chains are to unforeseen disruptions. These unforeseen events can all have devastating effects on manufacturing and distribution operations and result in millions of lost dollars. He argues that the business must bulletproof their operations by building in supply-chain flexibility. Duclos et al. (2001) propose a conceptual model of supply chain flexibility and identified six components of the supply chain flexibility, viz., production flexibility, market flexibility, logistics flexibility, supply flexibility, organizational flexibility, and information systems flexibility. They observe that as the basis of competition is extending to supply chains and time becoming increasingly important, supply chain flexibility will be a

***With the growing turbulence in the business environment and competition shifting to the supply chain level, the supply chain flexibility is emerging as one of the key competitive priorities for the future.***

critical issue for competitiveness. They argue that if manufacturing flexibility improves performance, supply chain flexibility, which would include the manufacturing flexibility of firms within the supply chain, should further improve performance when measured across the entire supply chain. Another closely related work to supply chain flexibility is in the domain of lean and agile supply chains (Naylor et al. 1999, Mason et al. 2000, Christopher and Towill 2000).

The supply chain flexibility will manifest in the nature and type of supply chains. Hence there is a close relationship between the supply chain flexibility and its typology. For instance, Belussi and Arcangeli (1998) propose a typology of networks for flexible and evolutionary firms based on two dimensions: on one axis the operational flexibility (retractility and reversibility) is measured; on the other, static and dynamic (capability-building) forms of learning are bared. Based on this, they proposed three types of networks: those where static learning occurs, those with adaptive learning, and those characterized by creative learning. They observed that these emerging new organizational forms allow for more coordination among quasi-independent actors, and, at the same time, more flexibility and autonomy in planning, production, and

distribution, may represent the evolutionary genotype of a new phase of development induced by the application of new technologies. Similarly, Pfohl and Buse (2000) propose a typology of production networks. They identified four types of networks viz., strategic network, virtual enterprise, regional network and operative network. The strategic networks are guided by a large core firm, whereas the virtual enterprise is a temporary project to exploit a particular business opportunity. Regional networks are formed by small highly specialized firms situated in spatial proximity and the operative networks use pooled resources they can access quickly at a short notice. They defined inter-firm network as a complex arrangement of reciprocal, cooperative rather than competitive, relationships between legally independent but economically interdependent firms, with potential to achieve both efficiency and flexibility at the same time due to loose coupling. They observed that the supply chain concept in its traditional form does not sufficiently address all relevant aspects of the organization of logistics in production networks, and the potential for improvements which can result from (a) horizontal relationships (two suppliers cooperate in fulfilling logistics requirements e.g they bundle their delivery volume or one of the suppliers acts as logistical service provider for the other supplier) (b) lateral relationships (a supplier supplies to one customer and at the same time supplies to another supplier of that customer) (c) circular relationships (in which the customer at the same time acts as a supplier to his supplier) or (d) general reciprocal dependencies (the performance of a supplier depends directly on the activities of other suppliers: the customer might change his production plan because of delivery problems of one supplier which in turn can result in problems for other suppliers). Some of the flexibility types proposed in this paper address the above issues.

*Under some circumstances, it may be possible to alter the sequence in which the information and materials flow, towards supply chain benefits.*

The first two parts of the paper presented the conceptual framework and the key notions of products, transformations, processes and resources. Flexibility originates from the interdependencies of these four elements. Several examples can be found from the domain of manufacturing. For example, the ability to interchange the sequence of transformations will give raise to sequencing flexibility, the ability to perform a given transformation using more than one type of process, or the ability to perform a given process type using more than one type of resource, or having multiple resources of the same type, will give raise to routing flexibility. In a similar way, the supply chain flexibility may be considered as having originated from the interdependencies among products, transformations, processes and resources. Based on this idea, we identify several possible models for supply chain flexibility as described below.

The transformations that happen to materials as they pass through a supply chain may include 'being procured as a raw material', 'being transformed into a finished product', 'being moved in space', 'being moved in time', 'being

distributed to an intermediary' and 'being delivered to the end customer'. The corresponding process types are called as 'raw material supply', 'manufacturing', 'transportation', 'storage', 'distribution' and 'retailing', respectively. The resource types that perform these processes are called 'raw material suppliers', 'manufacturers', 'transporters', 'warehouses', 'distributors' and 'retailers'. In general, a given type of transformation requires a particular type of process to be performed by a particular type of resource. Having alternatives in these interdependencies will give raise to flexibility. Some such scenarios are discussed below.

**Case-1 Traditional Supply Chain**

Figure-6 depicts the representation of a traditional supply chain using the proposed conceptual framework. It can be seen that each state transition of the material is associated with one process and one resource. In the case of manufacturing systems, this kind of a chain represents the flow shops and transfer lines. This structure also represents many of the traditional supply chains based on single products. These types of chains may have limited or no flexibility.

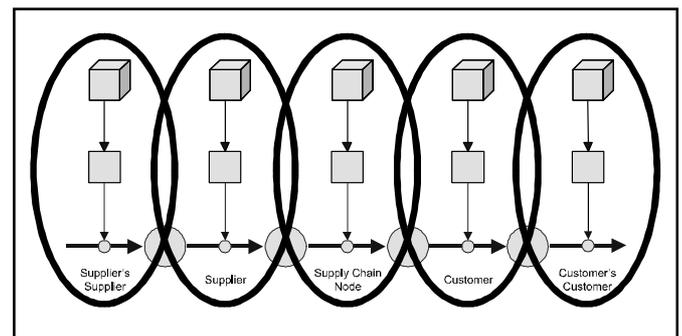


Figure 6: Traditional Supply Chain with Limited Flexibility

**Case-2 Supply Chain with Process Based Flexibility**

Figure-7 depicts the representation of supply chain with process based flexibility using the proposed conceptual framework. It can be seen that each state transition of the material is associated with more than one process and thus with more than one resource. In the case of manufacturing systems, this kind of chain represents the flow shop with

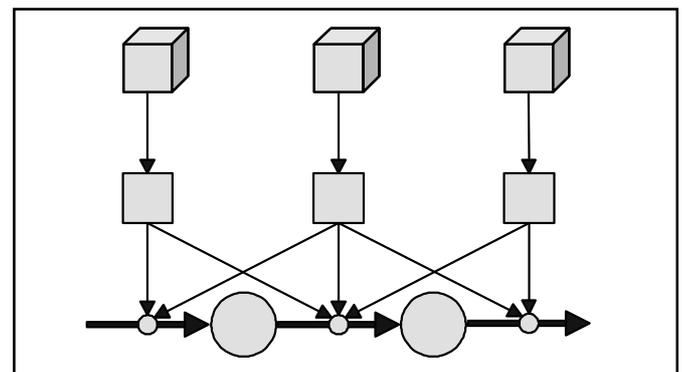


Figure 7: Supply Chain with Process based Flexibility

flexible operations and flexible processing as defined by Benjafaar and Ramakrishnan (1996). This structure also represents some situations of the traditional supply chains based on single products. For instance, this may represent a situation where a product is delivered to the end customer by both the retailer as well as distributor.

**Case-3 Supply Chain with Resource Based Flexibility**

Figure-8 depicts the representation of supply chain with resource based flexibility using the above defined conceptual framework. It can be seen that each state transition of the material is associated with one process but with more than one resource. In the case of manufacturing systems, this kind of chain represents the idea of machine flexibility as defined by Browne et.al. (1984). This structure also represents some of the traditional supply chains based on single products. For instance, this may represent a situation where a manufacturer performs both manufacturing as well as distribution, or a warehousing company handles both the storage as well as transportation.

*Whatever may be the type of process, every process requires one or more resources to perform it. Thus routing flexibility concept can be applied to supply chain processes*

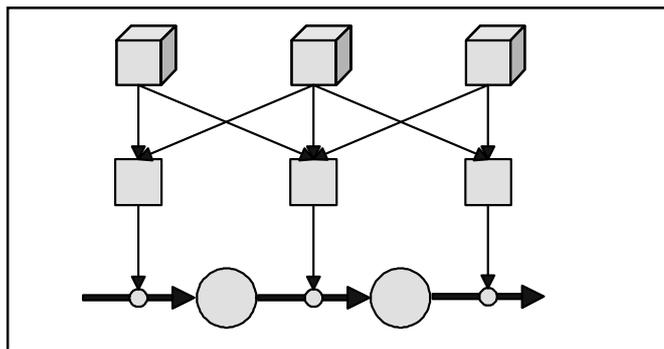


Figure 8 : Supply Chain with Resource Based Flexibility

**Case-4 Supply Chain with Process as well as Resource Based Flexibility**

Figure-9 depicts the representation of Supply Chain with both process as well as resource based flexibility, using the above defined conceptual framework. It can be seen that each state transition of the material is associated with more than one type of process as well as more than one type of resource. This kind of flexibility will be a combination of Case-2 and Case-3, mentioned above.

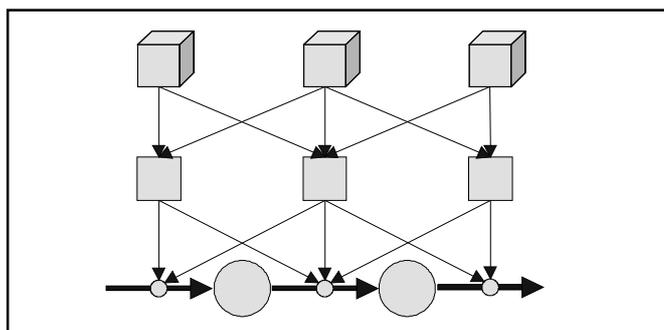


Figure 9 : Supply Chain with Process as well as Resource based Flexibility

**Case-5 Supply Chain with Process as well as Product Based Flexibility**

In the area of supply chain flexibility, one of the important concepts found to be useful is the concept of chaining. This concept is concerned with the ability of a plant to manufacture more than one product at the same time. The concept of 'chaining' has been introduced by Jordan and Graves (1995) as an effective flexibility strategy. They define a chain as a group of products or plants which are all connected, directly or indirectly by product assignment decisions. In terms of graph theory, a chain is a connected graph. Within a chain, a path can be traced from any product or plant to any other product or plant via the product assignment links. No product in a chain is built by a plant from outside the chain; no plant in a chain builds a product outside that chain. Figure.10 shows three different configuration for 6-product, 6-plant chain, as discussed by Tomlin (2000).

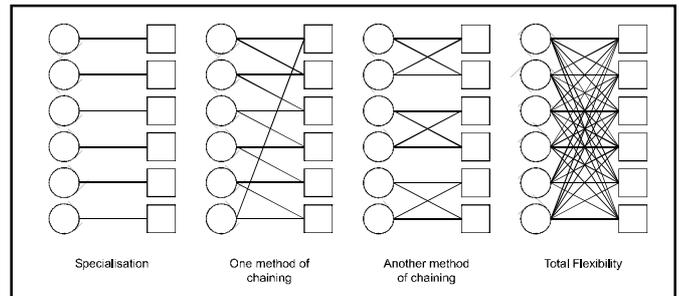


Figure 10 : The Concept of Chaining

In Figure-10, the circles represent products and the squares represent plants/machines. The graph indicates the allocation of products to the plants. In the case of specialisation, each plant manufactures only one type of product and hence there is no flexibility. The condition of chaining introduces certain amount of flexibility without much investment, but still captures most of the benefits of the total flexibility. Sheikhzadeh et al. (1998) extended the idea of chaining to study the operational performance of machine sharing configurations involving flexibility and chaining. They observed that chaining captures most of the benefits of total flexibility. In our opinion, this idea can be extended to the supply chains and this will give rise to certain product-based flexibility.

Figure-11 depicts the representation of supply chain with product based flexibility at process level, using the above defined conceptual framework. It can be seen that the state transitions of two products may share common processes and thus the common resources. This kind of a supply chain represents the job shop environment in a manufacturing system where multiple products share common processes and resources. It is also common in supply chains dealing with multiple products. For instance, a wholesaler or a retailer dealing with more than one type of product will perform the same type of processes on all the product types.

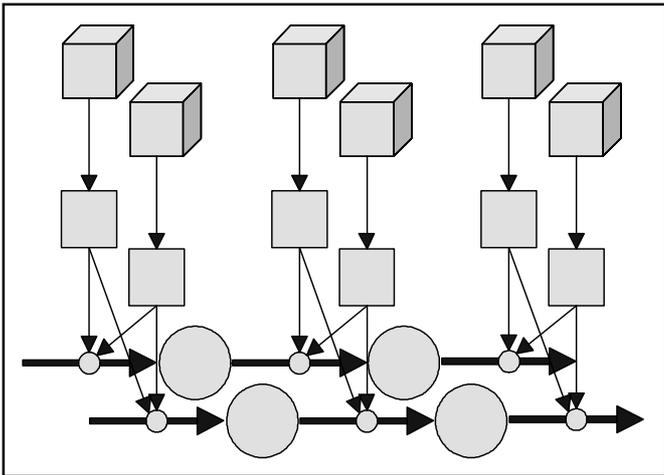


Figure 11 : Supply Chain with Product Based Flexibility at Process Level

**Case-6 Supply Chain with Product Based Flexibility at Resource Level**

Figure-12 depicts the representation of supply chain with product based flexibility at resource level, using the above defined conceptual framework. It can be seen that the state transitions of two products may share common resources through respective processes. This kind of a supply chain represents the job shop environment in a manufacturing system where multiple products share common resources. It is also common in supply chains dealing with multiple products.

For instance, a transporter may be dealing with several types of products and will perform the required processes on all the product types using same resources.

*Different types of flexibility can be mapped to the supply chain domain.*

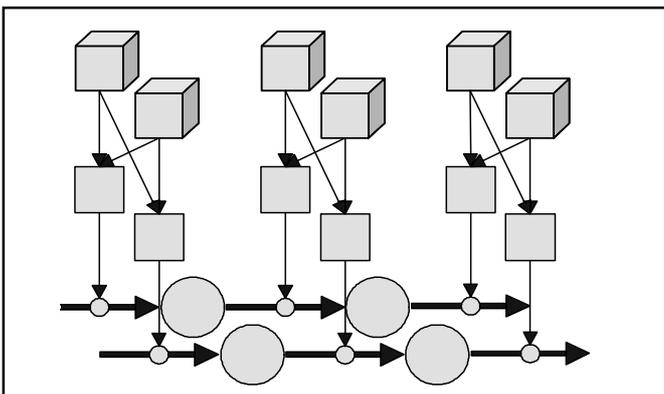


Figure 12: Supply Chain with Product Based Flexibility at Resource Level

**Case-7 Supply Chain with Product Based Flexibility at Process as well as Resource Level**

Fig-13 depicts the representation of supply chain with product based flexibility at both process as well as resource level, using the above defined conceptual framework. It can be seen that the state transitions of two products may share common processes as well as resources. This kind of a supply chain once again represents the job shop

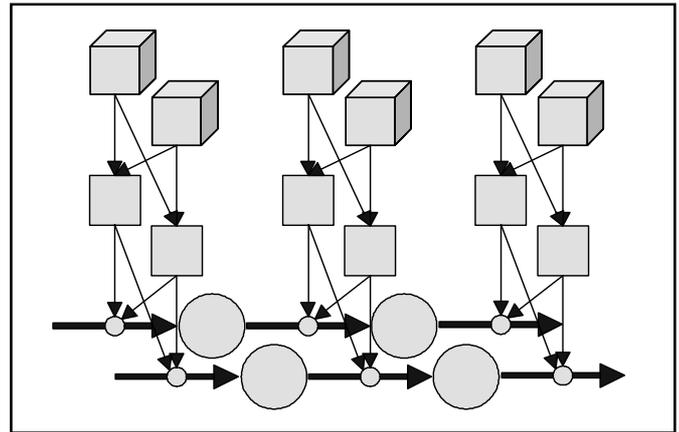


Figure-13: Supply Chain with Product Based Flexibility at Process as well as Resource Level

environment in a manufacturing system where multiple products share common resources. It is also common in supply chains dealing with multiple products. This may be considered as a combination of flexibility types mentioned at Case-5 and Case-6 above.

**Case-8 - Supply Chain with Total Flexibility**

Fig-14 depicts the representation of supply chain with total flexibility at product, process as well as resource level, using the above defined conceptual framework. It can be seen that the state transitions of two products may share common processes as well as resources in several combinations. This kind of a supply chain represents the flexible manufacturing system environment where multiple products share common processes and resources. This motivated us to evolve the

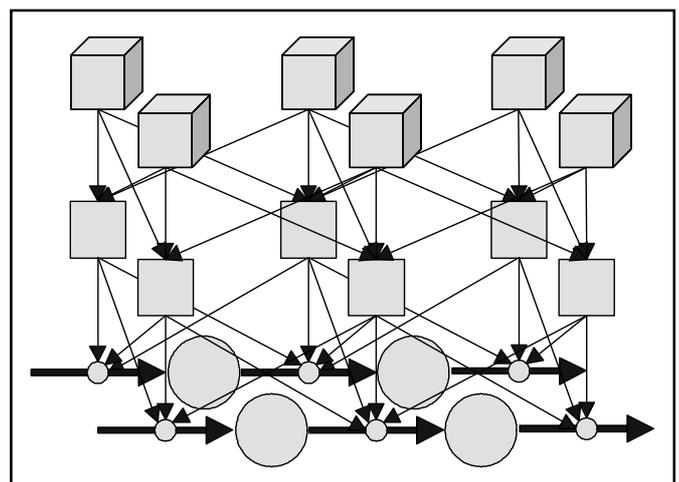


Figure-14 : Supply Chain with Total Flexibility

idea of a flexible supply chain system with similar interdependencies among products, processes and resources. This would be an extension of the concept of flexible manufacturing system into the supply chain domain as shown in Figure-15.

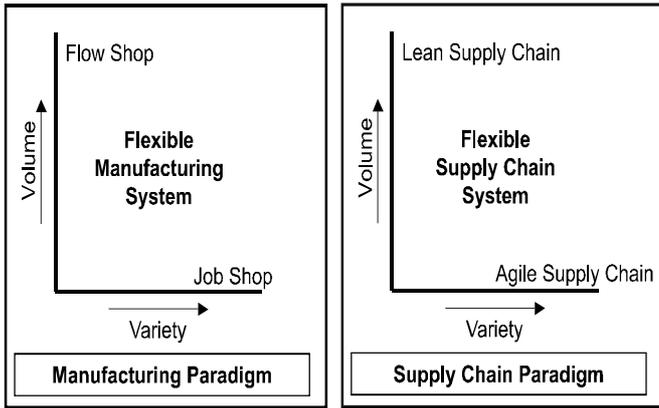


Figure 15: Towards the Flexible Supply Chain System (Wadhwa & Rao 2002)

Based on the above discussions it may be possible to identify certain types of flexibility in supply chains, based on process and resource flexibility as shown in Figure-16.

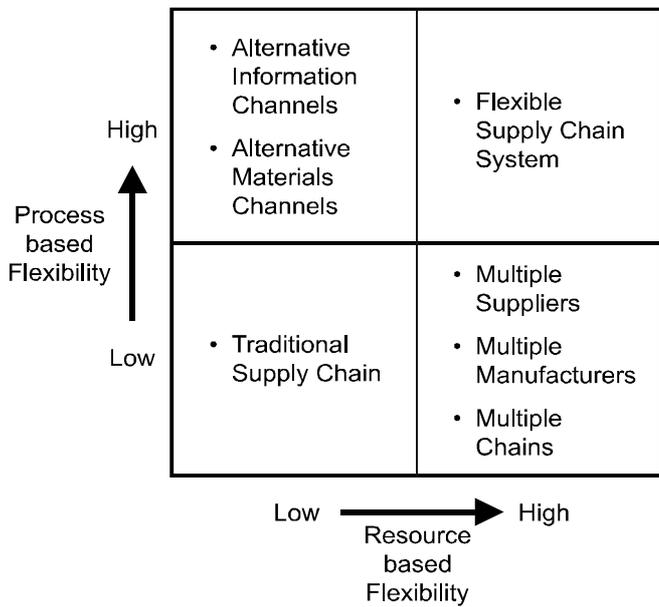


Figure 16: Some Possible Types of Supply Chain Flexibility

Figure-16 shows some possible types of supply chain flexibility. It can be seen that in a traditional supply chain both the resource based flexibility as well as the process based flexibility are low. As we increase the resource based flexibility, new supply chain configurations will emerge involving multiple suppliers, multiple manufacturers and multiple supply chains. Similarly, when we increase the process based flexibility, new supply chain processes will emerge resulting in alternative information channels and alternative channels for materials flow.

The information and the materials flow through the members of the chain for the reasons of geographical locations, business conveniences, logistic reasons or as a

**The transformation view is the most fundamental view based on which the process view is developed to appreciate supply chain flexibility.**

matter of established practice. With the advent of information technology, it is possible to alter these processes towards greater flexibility. One such possibility is already operational in the form of e-commerce where the orders are directly received by different echelons of the supply chain directly using internet. Similar developments are taking place in the domain of logistics through concepts such as cross-docking. With the help of these developments it would be possible to develop alternative channels for materials flow among various echelons of the supply chain. These ideas are shown in Fig.17.

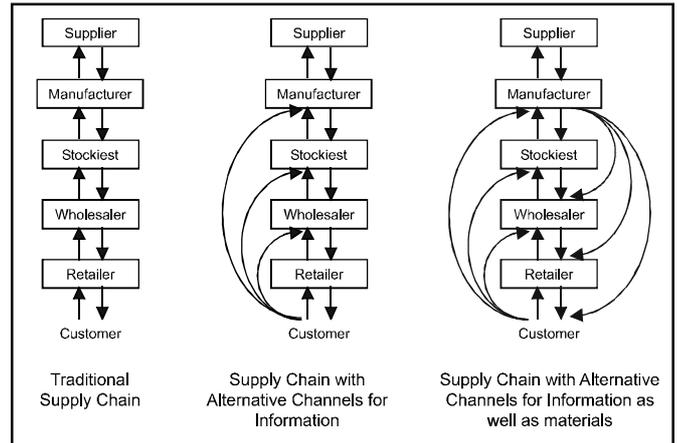


Figure 17: Supply Chain Flexibility Types Based on Alternative Processes

Use of alternative resources will result in new supply chain configurations such as the 'chain of chains'. Another important concept in this direction is the possibility of cross-flow between various entities in the same echelon. In our opinion this would further enhance flexibility of the supply chain system. Fig.18 depicts these ideas.

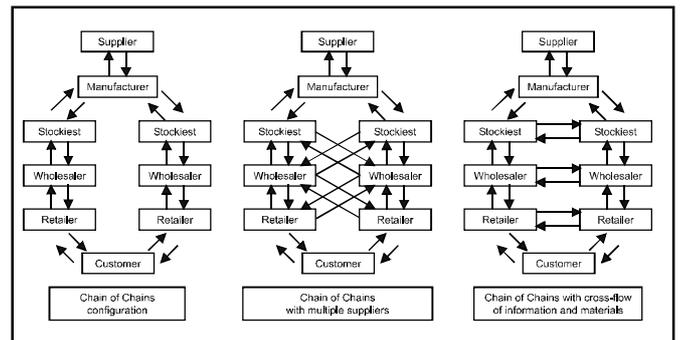


Figure 18 : Supply Chain Flexibility Types Based on Resource Flexibility

When both the process based as well as the resource based flexibility types are combined in a multi product environment, the flexible supply chain system will emerge. It is our research endeavor to develop an understanding of such an environment. This paper is a step in this direction.

## Conclusions

This paper presented the results of a conceptual study and literature review aimed at understanding the concept of flexibility in the context of supply chains. The study indicated that several types of supply chain flexibility are feasible and identification and exploitation of these flexibility types would be useful in enhancing the competitive performance of supply chains. Keeping this in view, this paper proposes a conceptual framework for supply chains based on the interdependencies between products, transformations, processes and resources. Based on this, framework number of conceptual, models have been presented to represent the process, resource and product based flexibility in supply chains. As on all-embracing conclusion, this paper endeavors to help practitioners to understand the concept of flexibility in the context of supply chains in a more intuitive manner. Wadhwa and Rao (2002) have proposed a flexibility maturity model, that can equally important for both the manufacturing systems and the supply chains.

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### Flexibility Mapping : Practitioner's Perspective

- Which variants of flexibility do you envision in a practical situation of a Flexible Supply Chain 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 to facilitate enhanced flexibility in supply chains relevant to your organization. On which planes, the flexibility needs to be enhanced ?
- Attempt the flexibility in supply chains in your organization on the following continua.  
(Please tick mark in the appropriate box(es)).

	Supply Chain with Resource Based Flexibility		
Completely Rigid	<input type="checkbox"/>	<input type="checkbox"/>	Completely Flexible
	Supply Chain with Process Based Flexibility		
Completely Rigid	<input type="checkbox"/>	<input type="checkbox"/>	Completely Flexible
	Supply Chain with Product Based Flexibility		
Completely Rigid	<input type="checkbox"/>	<input type="checkbox"/>	Completely Flexible
	Supply Chain with Total Flexibility		
Completely Rigid	<input type="checkbox"/>	<input type="checkbox"/>	Completely Flexible

- Develop a SAP-LAP (Situation Actor Process-Learning Action Performance) model of *"Flexibility in Supply Chains"* appropriate to your organization competitiveness.

### Reflecting Applicability in Real Life

- Implement the methodology of understanding and developing models for enhancing the flexibility in supply chains in your organization.
- Out of the seven cases of flexibility in supply chains discussed in this paper, select one which is the most beneficial to your organization.



# Managing Change for Competitiveness

**Rajiv Kumar Garg**

Assistant Professor, Department of Industrial Engineering,  
Dr B R Ambedkar National Institute of Technology, Jalandhar

**T. P. Singh**

Professor, Department of Mechanical Engg.,  
TIET Patiala

## Abstract

*Multinational companies have freely entered into many sector's of the Indian economy as a result of liberalization. This has made the Indian industry compete in global markets and has subjected it to unprecedented level of competition. Changing customer needs and awareness, technological developments and environmental issues have compelled the existing Indian industry to change their working practices and culture to face the new challenges. It is expected that change in an organization would increase the working capacity of its employees, resulting in higher productivity and continuous improvement. A successful change process, however, involves structural change, systemic change, cultural change, technological change, employees' involvement, and application of the philosophy of Total Quality Management (TQM) in an organization. In this paper, it is emphasized that we do need to understand the factors that have undergone a change and how could we manage them better. A procedure has been suggested to adopt TQM by providing education and training to the employees introducing change in the organization by changing existing structure, system, technology, and employees attitude. The prerequisites for achieving desired change, however, are sincere efforts using a participative approach by top management and all employees of the organization.*

**Keywords :** need of change, competitiveness, structural change, systemic change, technological change, cultural change, TQM.

## Introduction

Unprecedented level of competition brought about by globalization, liberalization and free entry of MNCs in the Indian market has forced the industry to change its age-old practices and become competitive. Changing customer needs, rapid technological developments and environmental issues have contributed to the present situation that demands the industry to be run with utmost professionalism, encompassing both short term and long term goals and actions. MNCs have a dominance of concepts and capabilities like innovation, risk taking, team spirit, commitment and stability amongst their employees leading to a "strong culture", whereas traditional Indian organizations are short of this type of dominance, or there prevails a "weak culture". Culture has a great impact on employee behaviour and attitudes, and is directly related to achieving organizational goals and competitiveness. The need of the time is, thus, to change from a conventional type of working to an environment of competitiveness, efficiency, teamwork and higher level of achievement.

The greater the forces for change, greater is the competitive pressure, and consequently a greater demand for change. Thus, the process of change becomes a vicious circle if new ways to compete in such an environment are not discovered. The ability of an organization to conceptualize and manage change is the true way to compete in the changing scenario. The universally accepted challenge of change is to learn how organization and employees can change faster than changing conditions, i.e. to change from inside of the organization than outside.

Organizations evolve through a life cycle, with each evolving stage introducing change challenges. Understanding and managing change is salient, especially for matured organizations where stability and security may be replaced by customer-service, self-confidence and empowered work force. The purpose of this paper is to explore how change can be managed in an organization. To do this, we will study the organization life cycle, agile manufacturing, detailed principles to guide change, and accomplish change.

## Change in Organizational Life Cycle

An organizational life cycle may comprise the following stages:

- Entrepreneurial stage
- Business proliferation stage
- Organization maturity stage
- Business renewal stage
- Declining stage

All of these stages are depicted in Figure 1.

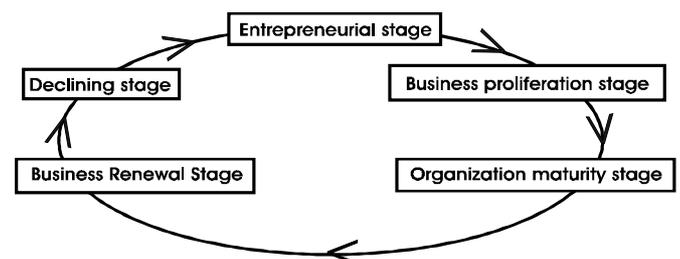


Figure 1 : Organizational Life Cycle

### **Entrepreneurial Stage**

During this stage, the focus is on the definition and development of new products and marketing avenues. This requires extensive market research through customer interactions. Basic idea is to make a note of needs of society (by customers) and translate them into values thus overcoming the challenges of market (Beatty and Ulrich, 1996).

### **Business Proliferation Stage**

After entrepreneurial stage, the business is expected to proliferate, i.e. spread. Many more competitors enter in the market making similar products with varying features. Survival of the organization is the major problem during this stage (Brown and Karagonoglu, 1989). As a strategy, small firms frequently join hands to form a large firm to sustain in the competitive market. The result is that the business organizations shrink down to a few business houses.

### **Organizational Maturity Stage**

After proliferation stage, organization maturity is expected with time. The business practices are systematized and also streamlined. Also the organization gains its individual identity in the market. The organization and its employees acquire a reputed position in the society (Barlett and Ghoshal, 1995).

### **Business Renewal Stage**

Business norms responsible for success of matured organizations lead to complacency. These existing norms become irrevocable patterns of behaviour, which lead to an avoidance of challenges in the organization. During the maturity phase, product and technology parity is likely to emerge (Grover, 1999). Competitors offer customers similar products at competitive prices. In the renewal phase, manager identifies additional capability to meet customer needs, reduced profit margins, market share, reduction of scrap and waste, etc. and tries to be competitive. The emphasis is on to develop the ability to compete from inside out - to build internal organizational processes that meet external customer requirements. For building such internal organizational processes, concepts like self-direction, self-management and self-control need to be strengthened in place of traditional control. This may require a lot of changes to be made in an organization, such as technological change, structural change and systemic changes. Proper management of change can convert these changes to the culture of an organization leading to enhanced competitiveness.

### **Declining Stage**

In the renewal stage, managers must learn to compete through competencies. They must learn and develop the ability to know and meet customer expectations through reactive and proactive improvements. Otherwise the

organization ceases to compete in the market and the declining stage starts. During this stage, market share, profit margins, turnover, reputation etc. of an organization starts going down if no measures to be competitive are taken (Grover 1999)).

The challenge of change throughout the organizational life cycle consists of the following aspects:

- i) Identification of market and learning how to enter/capture the market share during entrepreneurial stage?
- ii) Survival of organization during the growth stage.
- iii) Business renewal and be competitive.

Thus, change through the life cycle converges to business renewal tactics and competitiveness.

### **Agile Manufacturing**

The Indian industry has witnessed the emergence of a number of manufacturing philosophies and technologies in the last two decades. Customers are demanding varieties at less price with good quality and services in a short period of time. In this situation, agile manufacturing concept is very suitable as a new approach. Agility of a company can be characterised as the ability of the company to bring

*The ability of an organization to conceptualize and manage change is the true way to compete in the changing scenario.*

variety of models in short period of time. This trend is quite established in consumer durable industry and automobile sector as well. The term agile manufacturing can be defined (Ramesh et al., 2002) as

- Ability to closely align the enterprise system to changing business trend.
- Capability of the enterprise to quickly respond to the market requirements.
- Agile manufacturing is the science of a business system that integrates management, technology and workforce making the system flexible enough for a manufacturing organization to switch over from one component that is being produced to another component that is desired to be produced in cost effective manner, in a short time.

Thus, this manufacturing approach calls for changes in manufacturing, planning and setups in traditional manufacturing environment. The challenge is to build modular, flexible and reactive system, which can be easily reconfigured and which can provide capabilities for managing change and innovation.

### **Organizational Culture and Life Cycle**

The greatest effort in meeting the renewal challenge is to change the culture of the organization, i.e. method of thinking and working of employees of all levels. Culture represents a shared way of thinking” and behaving” within an organization. Culture includes behaviours and attitudes also. Culture is often formalized in vision, values and mission.

Policy of an organization affects the culture a lot. As the organization becomes matured, the vision, value and mission

become fixed/get freezed. The employees are paid/ rewarded and compensated as per the established norms of the organization. Organizational culture also becomes a means of encouraging unity, viz. teamwork, and enhanced job responsibility. In an old/matured organization, the fixed norms of culture become a liability and act as resistance to change because of fear amongst its employees. Another obstacle to change is mindset of employees at all levels (Robbins et al., 2001). "Mindset" represents a system of shared meaning held by members that distinguishes an organization from others. Organizational change is concerned with how employees perceive the characteristics of a culture, not with whether or not they like them. It takes time for mindsets to be instilled. By the time an organization becomes matured, it is likely to have established a relatively fixed mindset. They are rewarded by promotions, salary increases, and enhanced job responsibilities, when they embody the mindset. In old organizations, mindset can become a liability and its intensity may hinder the ability to change. To counteract, this traditional control-measures should be replaced with an empowered workforce that is more self-controlled and self-directed. This also results in need of less number of decision makers, i.e. managers. Change is a challenge that looks like a bottleneck, which, after energizing transforms the declining stage of organization into a revived state of activity, refer to Figure 2 (Garg et al., 2002).

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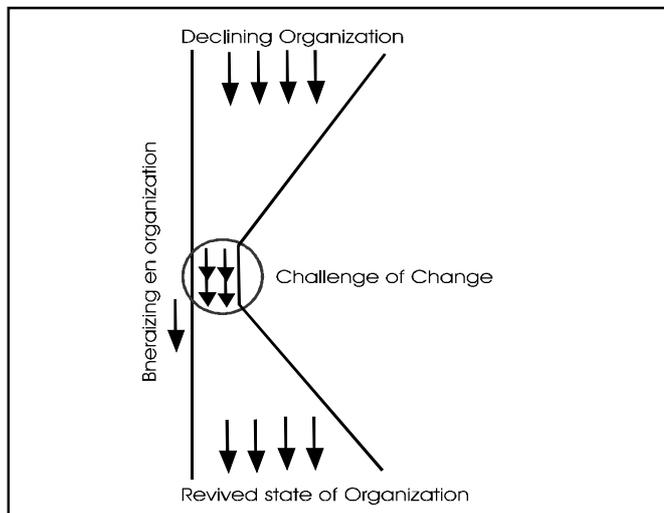


Figure 2 : Challenge of Change

### Organizational Competitiveness and Change

Competitiveness accounts for a number of parameters like reduction of hidden costs, quality conformance and improvement, reduction of services time and delivery time, maximization of profits and profitability, enhanced market reputation, and assured markets in future by innovations, learning and strategies in an organization (Szamosi et al., 2002). Accordingly, achieving any of these parameters leads the organization to achieve an increased competitiveness.

As has been explained earlier, with the traditional ways of working and fixed mindsets, it is nearly impossible to achieve enhancement of any above parameters. This needs a change of culture, system, structure and technology hitherto being prevalent in the organization. Each of these parameters of change complements one another. A well thought of change process built on scientific and logical basis using these strategies sequentially can only be successful.

### Change Process in an Organization

Having identified the need for change of an organization, work activities can be identified for the same. Synthesizing the results of various studies reported in literature from time to time, the process of change can be described to follow the following stages (Beatty et al., 1996), although all the organizations may not stick to the same sequence as some of the stages may occur simultaneously. However, a justification of the sequence proposed below is given subsequently.

#### Stage-1: Introducing Structural Change

Organization change begins with the concept of structural changes. Generally it denotes the change of hierarchical structure (vertical) to new structure (flat). Downsizing and delayering are the possible methods for the same that ultimately result in reducing the manpower. In the changed structure, teams are formed and team management is applied, so the organizational layers are reduced. Strong communication network is to be formed between teams and members of the teams so that the physical hurdles can be eliminated. With this reduction, the organization becomes lean at all levels. Measures of an organization per employee improve as a result. Task of organizational structures has to be handled with sensitivity - revolutionary in thought, and evolutionary in implementation (Business India, Sept. 22, 1999). Reduction of manpower in public sectors, banks, corporations etc. has been introduced as premature retirements, voluntary retirements, plant closings/shutdowns, consolidations and re-employment schemes, as a restructuring policy. Such reduction results in huge savings of organizational recurring expenditure and initiate renewal process. It is noted that at HMT Pinjore, a public sector organization, around 1800 employees were reduced by VRS. Such structural changes require a bold leadership. The leaders of structural changes must implement a process that ensures equity and due consideration to employees. Such changes are possible when leaders regularly turn around the organizations. The secret of the organization has as much to do with vision, values and culture, as it does with vertical reporting structures (Ghoshal et al., 1995).

After Godrej Soaps Limited and Proctor and Gamble (P&G) parted ways in 1996, P&G walked away with Godrej's distribution setup. The company had to go for a major

organizational restructuring. Earlier the company had three departments: the consumer product division, the chemical division and the product supply organization, which looked after the purchase of raw materials etc. After the partition, Godrej Soaps divided along its business lines—Consumer product division and Chemical division. Two business heads were appointed separately for these divisions. To improve sales and distribution, Godrej Soaps had to setup its separate distribution system to build trade confidence (*Business India*, Sept. 20,1999).

Recession in automobile industry resulted in restructuring of supply chain. Globally, automobile manufacturers are moving towards vendors who supply complete subassemblies rather than components, to support a lean manufacturing structure in vehicle industry. Also there is a global trend to reduce the number of vendors. The TATA Engineering and Locomotive Company (TELCO) had only 130 vendors for Indica compared to its truck division, which has over 1000. Bajaj Autos also restructured its supply chain to considerably cut down the number of its vendors (*Business India*, Sept 20,1999). The result was the transformation of auto component industry into tier-1, tier-2 and tier-3 suppliers. Tier-1 suppliers are large component manufacturers who will supply entire subassemblies. Tier-2 and tier-3 are medium and small manufacturers supplying components to tier-1 manufacturers.

In 1989, split of Usha Shriram led to two major group companies—Siel and Usha International. Shriram Industrial Enterprises Ltd. (Siel) was primarily an industrial manufacturing company, whereas Usha International is the largest consumer durables marketing company. With Usha International churning profits out of the group, it was the ailing Siel that needed comprehensive restructuring—creating new factories and tie-ups, e.g. Daikin Shriram Airconditioning Private Limited, Siel-TIZIT, a joint venture (JV) with Plansee of Austria, manufacturing tungsten carbide tips and tools, Siel South Africa (Pvt.) Ltd, Crisp Air (Pvt.) Ltd, Siel Industrial Estate etc. For the success of each and every business/factory, outsourcing professionals restructured it by making various studies of the group (*Business India*, June 26, 2000).

The above case studies show that the purpose of restructuring of an organization is to make it cost effective and competitive. However, results of structural changes in banking sector by introducing VRS are not exactly on the expected lines. It is noticed that maximum number of persons who opted for VRS were hardworking and capable. Their vacancies have led the banks to an unmanageable situation. As a result, the banks are contemplating to lift the ban on further recruitment for their replacements. However, services like Automated Telling Machines (ATMs), increased business hours, electronic clearances etc., as well as the

promise to provide customer satisfaction make these structural changes successful.

#### *Stage-II: Introducing Systemic Changes*

A system pertains to the existing practices in an organization. In systemic changes, the attempt is to eliminate the unnecessary procedures, reports, approvals, meetings, policies, or other 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 role is not judged individually. To achieve this, proper training needs to be given to the team members so that they can become self managed gradually. Simulation based guidance add more value to it (Jick, 1992).

Systemic changes should follow structural changes in an organization. In structural changes, employees who are afraid of challenges and are in favour of job security only, get annoyed. Most of such changes are being seen as contractual appointments than life long appointments. As a result employees feel their contract as short-term contract and psychologically react accordingly. Managers in such cases should be able to sustain employees' commitment by replacing loyalty with other means of employee considerations like opportunity. Opportunity can be provided to the employees to develop talents, participation in key decision-making and belongingness to the organization. It is possible by systemic changes. After the reduction in manpower in any organization, workload remains the same and adjustments have to be made to meet the work volume requirements with less manpower. Unnecessary, non-value added activities must be removed to gain parity between employees and their workload (Beatty, 1996). Introduction of ATM, electronic clearance etc. in the banking sector are examples of systemic changes along with structural changes.

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New incentive scheme for the workers linked with performance was the major systematic change at Maruti Udyog Limited (MUL). MUL was going for base year 1998-99 for labor productivity, whereas MUL employees union wanted it to be 1988-89. The result was a tool-down strikes, demonstrations inside the factory, suspensions etc. If the incentives are calculated based on 1998-99 as base year, average package of an employee was to be increased from 22,000/- to 33,000/- per month; however, the package was to shoot up to 43,000/- as per the union demand (*India Today*, Nov. 2000). Also two new systemic features in the incentive package linked to external environment incensed the union. The first is an incentive related to company's ratio of sales volume to its installed capacity, i.e. telling a worker that he should be ready to accept a drop in income when times are bad, with a part of production capacity lying idle. Another feature of package relates the incentive to the

turnover of the spares produced in the factory. MUL makes spares worth Rs 350 crores in which profit margin is as high as 15%, making up the dropping margins in the car business. The union says that both are unrelated to the jobs, but management says that it is a part of worker's burden as stakeholders in the business. Underlying the incentive war is an effort of the MUL management to make the workers accept the Japanese production philosophy of Kaizen or constant improvement of existing ability. Inspired by this, vendors are also inspired to unload their trucks on the conveyor belts which drives accessories directly to the assembly areas, rather than unloading them at central stores. The result is saving of power, time, labor and cost.

Leaders must demonstrate flexibility and listen to all reasonable requests as long as they add value to the customers and fall within legal and ethical boundaries. Also leaders need to encourage and reinforce risk taking among employees who initiate bureaucracy-busting activities (Keller et al., 1996). For this, committed employees are to be selected and leaders have the responsibility of reducing the fear of failure.

From the above discussion it can be concluded that systemic changes result in saving of power, time, cost and effort, leading to increased competitiveness. Any success because of systemic changes in an organization is the result of, bold leadership.

#### *Stage-III : Employee Involvement and Empowerment*

Instead of empowering only top management, involvement of employees is very important. If openness between employers/ managers and employees is increased, this will result in change of nature of the organization. No doubt, by bureaucracy, the employees' involvement results in productivity enhancement, cost reduction, waste reduction etc. but their effects on the organization are not long-lasting. Employees' empowerment is a very wide term. In one sense, it allows the employees to take their decisions, plan their activities and remove the barrier between them and managers. In the long run, this results in increased belongingness of the employees with the organization and also changes in the nature of organization. A simple technique for employee involvement and empowerment is to encourage the participation of employees in organizational strategies (Kotter, 1995). In big Indian companies, as a policy, some important projects are primarily assigned to fresh officers and they are supposed to handle independently. This practice not only gives them an opportunity but also makes them learn more about their organizational business and goals, feel empowered to have an impact on the business and build relationships with their colleagues and seniors. The technique is in practice at Punjab Tractors Limited (PTL) Mohali, Swaraj Combines Ltd Mohali, and many more industries. Another technique in practice in many organizations is to invite new officers in the business-

meetings and give them sufficient opportunities to express themselves. These examples of employee involvement mark a fundamental change from the traditional work culture of hierarchical matured organizations to a more fluid, flexible, mutual work environment. Empowerment is a movement away from leader and expert problem-solving system to a system where everyone is continuously involved in improving the organization in order to leverage its competitive advantage through speed and service. Leaders must learn that delegation/sharing authorities builds a capacity to change and increases the sense of commitment and competitiveness. After some years of the start of HMT at Pinjore, employees were invited to start the ancillaries for the same unit with the assurance that if failed, they will be reabsorbed in the same cadre. Necessary training and education for the same was rendered by Hindustan Machine Tools (HMT) to them. Many of these employees ended up as successful entrepreneurs afterwards.

***Leaders must demonstrate flexibility and listen to all reasonable requests as long as they add value to the customers and fall within legal and ethical boundaries.***

At MUL, it is more or less mandatory for all the officers to suggest innovations in the process/parts every year. They are free to think and act as per their ideas. Suitable rewards and recognition is given to the valuable suggestions. Thus, employee involvement and empowerment helps an organization in trying innovations, better services, less service and maintenance time, and enhanced reputation. All these parameters are indicators of enhanced competitiveness.

#### *Stage- IV: Cultural Changes*

Cultural changes relate the mindset, i.e. the way the employees think about their work. Employees, in general, feel the enthusiasm and commitment of trying new approaches to work and bring more desirable changes in the organizations. From literature (Saleh 1993) it is found that it takes roughly double the time to introduce a technological change in a matured organization as compared to a new organization. Cultural changes implementation is a difficult task that is generally done by an agent called change agent. Every change agent is judged by his ability to preserve, and how strong an advocate he is, of the new culture. He should exhibit tolerance since cultural changes requires time to take effect.

According to the Chairman of Suzuki motors, "Workers come to factories to work, not to walk". At MUL, there is no idle hand at the shoopfloor" (India Today, Nov. 2000). By giving proper perks, workplace and environment, the working culture becomes very strong. Strong belongingness of the employees towards company is also established.

Under the leadership of Dr. R.A. Mashekar, 40 odd laboratories of Council of Scientific and Industrial Research (CSIR) have undergone a cultural change. He adds that "change is always a product of proactive leadership and in India, where personalities matter so much, leadership is more crucial". He replaced the old adage in science "publish and

perish” with a new slogan “patent, publish and prosper” (Business India, 1999). In the last five years, CSIR has filed about 350 international patents and The National Chemical Laboratory (NCL) is the leader in US patent applications from India.

The conclusion of the above discussion is that cultural changes create a sense of competitiveness in an organization through social recognition, better salaries and high standard of living of its employees.

#### *Stage - V: Technological Changes*

Technological change is an ongoing process. Technology is the environment within which an organization functions. Technological innovations introduce changes in our social lives in addition to changing the ways of working. Technological changes lead to changed social customs as an irreversible effect. If the organizations are redesigned/modified suitably to absorb the changed technology, the organization will benefit from the synergy of Man-Machine system. Availability of technologically superior tool, and enhancing the workplace productivity, is giving rise to one-man-multiple-job concept, like for example, in an office, it is possible for one person to write letters in his PC, receive and transmit faxes, and also gather data from internet. A single person with multiple skills will add effectiveness to the changing structure of an organization. With the availability of technologically superior system, the time required to complete various activities has drastically reduced. The changing technology needs to be handled carefully, nurtured and gainfully adopted in the organization to derive optimum benefits and results in addition of competitiveness.

According to Sanjay Nayak, CEO of Tejas Networks “The technology business is totally people centric. If you have a world class team, then you can compete in the global market” (Business India, August 7, 2000). As a result of liberalization in economy, a large number of Indian industries have technical collaborations with MNCs to compete in the market. MUL in technical collaboration with Suzuki Motors of Japan, was the first landmark in this direction. Indian software industry is a sterling example of technological changes adaptation.

This is clear from the earlier discussions that every stage of change management results in an increase of competitiveness in some direction. The success of change programme is very much dependent upon the abilities of change agents. The mission and vision of the founders of an organization also have a major impact on the organizational culture. For keeping a culture alive, top management and change agents have to continuously strive for quality, cost reduction and morale upliftment of employees that ultimately results in increased competitiveness of an organization.

#### ***Justification of the Proposed Sequence of Stages for Competitiveness***

The discussions on various phases of change management demonstrate that every stage of change management contributes to one or more parameters and indicators of competitiveness of the organizations. However, depending upon the situations, different stage-sequences from the one suggested above, can be possible in various organizations. After interacting with a number of Indian automobile industrial units, it is found that the proposed sequence of change, in general, is applicable to most situations.

By advocating the use of the proposed sequence of phases of change management, it is not attempted to show that there are clear boundaries between these stages, and the next stage will start only when the previous one is complete. Rather, it is again emphasized that these stages are highly interwoven and overlapping. The main point being emphasized here, however, is that unless and until structural change, however small, is implemented, changes in systems, technology and culture are

not expected to be effective. Any change initiative must have the elements of ‘optional change’ and ‘compulsory change’ in it. Beginning with change process with structural change makes the changes in subsequent areas of system, technology and culture absolutely necessary for survival and competitiveness. Rather, the employees in post structural change scenario start demanding for systemic, cultural and technological changes. On the other hand, starting the change process with technological, cultural and systemic changes does not bring in seriousness and lack desired results. As an example, in the very beginning computers were procured by many offices for typing and other works without any simultaneous change in organizational structure and this did not result in their optimal use. They continued to use expensive typewriters for years till computer data-entry operators were recruited and trainings were imparted to the existing staff. These initiatives, however, are definitely required to be introduced before a major structural change.

Thus, structural change is the first stage in an organization adding to its competitiveness. This change includes alterations in authority relationships, coordination mechanisms, degree of centralization, job design, delayering and downsizing (Robbins, 2002). Structural change can be introduced in two ways:

- i. First order change
- ii. Second order change

First order change is linear and continuous. It implies no fundamental shifts in the assumptions that organizational members hold about the world and how the organization can improve its functioning, i.e. by motivation and education. In contrast, second order change is a multidimensional, multilevel, discontinuous, radical change involving refraining of assumptions about the organization and the

***Cultural changes create a sense of competitiveness in an organization through social recognition, better salaries and high standard of living of its employees.***

world in which it operates i.e. by force (Robbins 2002). First order change is very slow, taking into account, the mind set of the people. Therefore, enforcement of structural change by second order concept forms the first stage in the direction of achieving competitiveness. This change has some of the systemic changes introduced into it like redesigning of the process of approvals, procedures, authority and responsibilities of individuals. Also some of the employees may be involved at various levels by getting their authorities and responsibilities changed. Just at the introduction, this stage results in wide criticism and resistance, but slowly persons starts adapting to it. This stage is followed by second stage of systemic changes. In this stage, policies and procedures can be redesigned as per the goals and objectives of die organization. Sometimes, some of these policies and procedures are identified to be impractical after taking the employees views/experiences into account which call for introducing third stage of change, i.e. employees involvement and empowerment. After this stage, organization keeps on adapting to new style of working without any problem and here is the introduction of fourth stage i.e. cultural change. Employees start getting a feeling of belongingness with the organization. Their salaries, positions and benefits start increasing in time, forming a rich culture in the organization. After getting rich culturally, fifth stage of technological change is introduced. In this stage, new techniques of working, machines, equipments and processes are introduced, which account for some of the structural change for its accomplishment making the change process as a continuous process.

**Relationship of Change Initiatives with Competitiveness**

The relation between change initiatives and competitiveness has be summarized in Table-1 given below:

From the above discussion, this is evident that attitude of people carry a remarkable change in an organization. Structural change, systemic change, technological change, cultural change and employees’ involvement can bring a change in the attitude of people. However, all of these aspects are followed in total quality management (TQM) approach as well.

TQM involves everyone of the organization in decision-making. TQM also stands for continuous improvement. Structural changes, systemic changes and technological changes empower employees towards cultural changes. Employee’s empowerment builds employee’s commitment. Their initial commitment is translated into long-term processes so that individualism gets converted to a systemic version. Continuous improvement efforts begin in companies by focusing on error detection and then error prevention by using statistical and graphical tools. Continuous improvement is changing not only the technical tools of management, but also the fundamental approaches to

*For keeping a culture alive, top management and change agents have to continuously strive for quality, cost reduction and morale upliftment of employees that ultimately results in increased competitiveness of an organization.*

Table 1 : Change Initiatives and Competitiveness

Sr. No.	Organization	Change initiative	Result of initiative	Effect on competitiveness
1.	Public sector industrial units, banks, corporations	Introduction of VRS, pre-mature retirements, re-employments	Reduction of recurring liabilities and incompetent persons, new avenues for capable persons	Increase
2.	Godrej Soaps Ltd.	Set up a separate distribution system to improve sales and distribution system	Improvement in sales and distribution, increased trade confidence	Increase
3.	TELCO	Reduction of number of vendors	Reduced coste and lead time, more profits	Increase
4.	Baja Auto Ltd.	Reduction of number of vendors	Reduced costs and lead time. more profits	Increase
5.	Sie International (Usha Group)	Creating new factories and tie-ups, involvement of outsourcing professionals	Increase of product mix, profits and market share	Increase
6.	Maruti Udyog Ltd.	Introducing new incentive policy and new vendor policy	Saving of power, time, labor and cost	Increase
7.	Punjab Tractors Ltd.	Involvement of young officers in decision making and also policy making.	Upliftment of morale, increased belongingness to organization	Increase
8.	CSIR	Adopting new slogan as “patent, publish and prosper”	Better recognition, more no. of patents registered	Increase
9.	Maruti Udyog Limited	Technical collaboration from Suzuki Japan	Better quality, more profits, product mix and market share	Increase

management. Focus on continuous improvement must be upon the “right” work that was identified through structural and systemic changes (Saeed, et al., 1993). The work has to be linked to technological advancements through speed and simplicity in work process. When this philosophy is understood in the organization, it ensures an ongoing commitment to improve work processes. By instilling this philosophy, leaders are able to set a direction, motivate and steer a company through renewal. The continual change cycle is shown in Figure 3 (Garg et al., 2002).

Continual change in an organization is possible by keeping in touch with its customers and its competitive environment, rather than achieving by a functional department or part of a hierarchy. This is about every

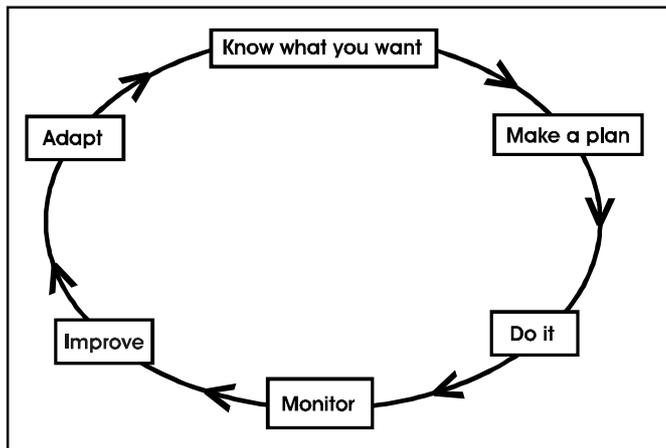


Figure 3 : Continual Change Cycle

individual being empowered to act in a controlled way to encourage and make the changes as the organization needs. The continual change cycle involving reactive improvement is based on Plan, Do, Check and Act (PDCA) cycle. While applying the continual change cycle to an organization, it is felt that after sometime, changes are absorbed in the organizational work-culture and once again, the need for further improvement is felt and planned with respect to this new level. Efforts are needed by the change agents to educate the employees of the organization for the possible benefits of the planned change. This procedure of carrying change in the organization by making efforts in levels pertains to the process of change by tinkering. "Tinkering denotes introduction of mainly small changes in an organization to introduce new product, model etc. with existing setup, facilities, expertise etc. but with a definite strategy" (Abrahamson, 2000). Every higher level achieved out of tinkering results in better state of adapted change in the organization, and this process keeps on repeating till the organization fully adapts to total quality management as its ultimate goal, as shown in Figure 4. This stage can only be achieved by imparting necessary education, training and skill to the employees as followed in the process of "kludging" (Which denotes tinkering for big changes in an organization with the help of formal education and training of its employees (Seth, 2000)."

From Figure 4 it is evident that structure, system and technological changes, together are responsible for introducing change in an organization for which culture of the organization should be favorable from the very starting till, the end, otherwise cultural reforms are needed. Combination of changes of structure, system, technology, and culture, results in permanent cultural changes of an organization (Garg et al., 2002). With setting of new goals/objectives and motivation of employees along with proper education and training and feedback, the organization can be energized for total change to achieve TQM.

***Task of organizational structures has to be handled with sensitivity - revolutionary in thought, and evolutionary in implementation.***

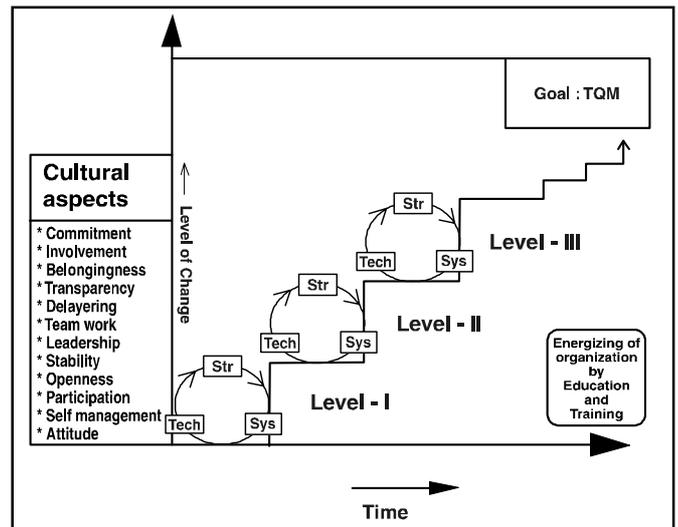


Figure 4 : Achieving Change as Continuous Improvement

## Conclusion

Any well established organization must change. They should redefine their work and recreate work culture consistent with changing customer demands. The changes are inevitable because organizations and leaders at all levels have developed a new vision of strategy and culture. Organizations are becoming far more strategic, purposeful and customer-oriented. The organizations will have to find ways to change their culture. Their vision will have to be translated into specific actions and managers should be helpful to employees to observe their progress and also to consider their feedbacks. Employees must strive for continuous improvement and change the organizational culture by making each effort adding value to its customers- strategically and continuously.

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### Flexibility Mapping : Practitioner's Perspective

1. What types of flexibilities you see in the practical situation of "Change Management" 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 in change management 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))

	Culture					
Weak	<input type="checkbox"/>	Strong				
	Change					
Inside	<input type="checkbox"/>	Outside				
	Structural Change					
Vertical	<input type="checkbox"/>	Flat				
	Employees Involvement					
Limited	<input type="checkbox"/>	Full				

4. Develop a SAP-LAP (Situation Actor Process-Learning Action Performance) model of "Change Management" relevant to your organization.

### Reflecting Applicability in Real Life

1. Is your organization going through a change? How will you use the findings of this study to manage change?
2. How will you manage change for competitiveness? Generate ideas to manage change using the process proposed in this paper.



# Sustainable Competitive Advantage with Core Competence : A Review

**Anjana Kak**

Regional Engineering College  
Srinagar, India

**Sushil**

Department of Management Studies  
Indian Institute of Technology Delhi  
Hauz Khas, New Delhi, India

## Abstract

*The potential of an organization's sustainable competitive advantage depends on the rareness and imitability of its resources and capabilities. The less imitable a competitive advantage is, the more cost disadvantage is faced by the competitor in imitating these competencies. Thus, core competence is an important source of sustained competitive advantage for corporate success and greater is its economic return. The literature has been reviewed for the sources of core competence, role of core competence for competitive advantage, and formulation of strategy with core competence and flexibility in a more focussed manner. The organizational learning, strategic flexibility, effective technology management, and people provide the important sources of core competence.*

**Keywords :** core competence, organizational learning, strategic flexibility, sustainable competitive advantage, technology management.

## Introduction

The idea that complex internal capabilities are critical to an organization's success is not new. Phillip Selznick in his book 'Leadership in Administration' (1957), acknowledged that factors internal to an organization, e.g. its personnel and its past experiences, are important to its success in implementing a formulated strategy. He defined the art of good management as the ability to make a practical assessment of an organization's suitability to its strategy. Selznick called the strange characteristics of an organization its 'distinctive competence'. In the year 1960, Learned, Christensen, Andrews and Guth, academicians of the Harvard Business School, suggested that the goals of corporate strategy have to match an organization's distinctive competencies with available opportunities and thereby gain competitive advantage. The thinking on competencies and corporate strategy remained dormant during the 1970s and early 1980s, the reason being that the consultants and the academicians paid more attention to other approaches of strategy. Porter (1980) developed five-force framework of competitiveness, which helped managers to understand external opportunities and competitive threats, and enable them to formulate a strategy, based on these analyses. It is simultaneously important to know if the organization has the requisite skills to implement the chosen strategy or can it acquire those skills at a reasonable cost. Hayes (1985) stressed the thinking on an organization's internal competencies wherein he advised managers to build capabilities first and then encourage the development of plans for exploiting them. Itami and Roehl in their influential book, 'Mobilizing Invisible Assets' (1987), also pointed out the importance of building on organization's strengths, or what

they called its invisible assets. This thinking gathered momentum with the emergence of the resource-based concept during the late 1980s. Successful corporate strategy depends on accumulating competencies and exploiting them by matching these competencies to the market opportunities, thereby achieving a sustainable competitive advantage. The identification of core competence of an organization is to be based on a corporation's complete history rather than selected parts of it.

The effective technology management, organizational processes and flexibility direct the attention to organizational capabilities, instead of focusing on specific technologies to build and refine core competencies. The less imitable the core competencies are, the more they become the factors for corporate success and greater is their economic return. This paper reviews the literature on the role of core competence for competitive advantage, sources of competitive advantage, and role of strategy with core competence and flexibility in a more focused manner.

## Role of Core Competence for Competitive Advantage

Hamel and Prahalad (1994) define core competence as a bundle of skills and technologies that enable a company to provide a particular benefit to customers. Core competencies are not product specific; they contribute to the competitiveness of a range of products or services. They are the roots of competitiveness and individual products and services are the fruit. A core competence is a tapestry woven from the threads of distinct skills and technologies. A skill must meet three tests to be considered as a core competence,

i.e., customer value, competitor differentiation, and extendibility.

Competitive advantage is at the heart of firm's performance. It is concerned with the interplay between the types of competitive advantage, i.e., cost, and differentiation, and the scope of the firm's activities. The value chain plays an important role in order to diagnose and enhance the competitive advantage. A sustainable competitive advantage creates some barriers that make imitation difficult. Without a sustainable competitive advantage, above average performance is usually a sign of harvesting (Porter, 1985).

The secret of a sustainable competitive advantage lies in performing every step in the value chain in an appropriate way. A competitive advantage essentially has to be one that not only merely represents better performance than that of its competitors, but also delivers genuine value to the customer, thus ensuring a dominant position in the market. The internal resources and capabilities of an organization play a very important role in building competitive advantage. The organizations that want to build competitive advantages, which cannot be eroded (no matter how much change is there in the environment), must make linkages between the advantage and the capabilities underlying it as impenetrable and as confusing as possible. Also the most important part of the competitive advantage stems from a capability that is impossible to replicate (Sinha, 1998).

To acquire competitive advantage in any market, a firm needs to be able to deliver a given set of customer benefits at lower costs than competitors, or provide customers with a bundle of benefits its rivals cannot match. To realize the potential that core competencies create, a company must also have the imagination to envision markets that do not yet exist and the ability to stake them out ahead of competition. A company will strive to create new competitive space only if it possesses an opportunity-horizon that stretches far beyond the boundaries of its current businesses. This horizon identifies, in broad terms, the market territory the management hopes to stake out over the next decade, a terrain that is unlikely to be captured in anything as precise as a business plan (Hamel and Prahalad 1991; Porter 1980).

The enhancement of core capabilities needs a longer run focus, which includes identifying what they are and how they are applied and synthesized in new products. Strong capabilities lead to strong product families because these are embedded in the people and assets applied to build an organization's new products. The organization, rather than releasing a single new product, can simultaneously introduce many products, each aimed at a specific market niche. The winning organizations retire their own products rather than let competitors do it for them. Initiative provides wide latitude to choose its own growth path in the fast changing

environment. The core capabilities will become the basis of future industry and technology initiatives. It refers to an organization's ability to direct resources that build and redefine core competencies, skills, and capabilities in a way that creates competitive advantage. The core capabilities of an organization must not be easily transferable by merely hiring a key employee employed by a competitor. The less imitable the core capabilities are, the more they become the factors for business success, and the greater is their economic return. If an organization's core capabilities are scarce, durable, defensible, or hard to imitate, they can form the basis for competitive advantage and surplus profit. The capabilities based companies outperform the competition along five dimensions: speed, consistency, acuity, agility, and innovativeness. One dimension reshapes the company in terms of its underlying capabilities, the capabilities can be used to define the growth path for the corporation, (Meyer and Utterback 1993; Lei and Slocum 1992; Schoemaker 1992, Stalk, Evans and Shulman 1992).

A company can clearly define organizational boundaries and focus resources for maximum competitive advantage by recognizing its core competencies. Some actions are performed much better than the competitors and are so crucial to end products or services that they can be described as core competencies. When a series of activities are organized into a system that works better than the sum of its parts, this business process can also create competitive advantage, even if component activities by themselves do not. An approach for identifying those competencies that can provide a company with the

***The thinking on competencies and corporate strategy remained dormant during the 1970s and early 1980s, the reason being that the consultants and the academicians paid more attention to other approaches of strategy.***

best chance to achieve long term competitive advantage could be framed in a set of four imperatives of core competencies, viz., avoid laundry lists, achieve senior management consensus on core competencies, leverage core competencies inside the organization, and share core competencies outside the corporation as well. Any company that wishes to capture a disproportionate share of profits from tomorrow's markets must build the competencies that will make a disproportionate contribution to future customer value. The growth and strengthening of core competencies depend to a great extent on the people who are involved in the organization. The skilled and expert individuals in the organization are identified and are given the authority to translate their functional expertise into useful products. The important actors who have to carry out the task of building and nurturing core competencies are the people in the top management (Snyder and Ebeling 1992, Hamel and Prahalad 1990).

Building core competence becomes essential to competitive advantage building, because advantages emanating from the product-price-performance-tradeoffs are almost short term. Especially in an era where technologies are altering the existing boundaries of business; advantage

can last only through competence enjoyed at the very roots of products. And only through expertise over several technologies and a complete command on their infinite variety of users, a company can occupy a highly advantageous position. An organization's management needs to consolidate corporate-wide technologies and production skills into competencies that empower individual businesses to adopt quickly to changing opportunities. The corporation is like a tree that grows from its roots, core products are nourished by competencies and engender business units, whose fruit are products. Three tests are proposed to identify core competencies

***Core competencies are not product specific; they contribute to the competitiveness of a range of products or services.***

in an organization: a core competence provides potential access to a wide variety of markets, it should make a significant contribution to the perceived customer benefits of the end product, and finally a core competence should be difficult for competitors to imitate. The core products provide a tangible link between identified core competencies and the end products. The real competitive advantage lies in integrating operations for the sake of hitting demand quality targets or meeting specialized customer needs. Every organization is a victim of its own success, so there is a need of diversification, which creates a different mix of talents and capabilities. It must learn how to utilize strategic alliances as a mode of learning new technologies and skills from their alliance partners. Also, in order to sustain competitive advantage it should protect itself from being despoiled and assimilate new sources of technologies, skills and core competencies. (Ramaswamy and Namakumari 1996, Bannergy and Krishnamoorty 1995, Hamel and Prahalad 1990, Fisher 1989).

Companies need to learn to manage tomorrow's opportunities as competently as they manage today's businesses. The discovery of new competitive space is helped when a company has a class of technology generalists that can move from one discipline to another. The new market development can be geared up by developing the capability to redeploy the human resources quickly from one business opportunity to another. It is the top management's responsibility to inspire the organization with a view of distinct goals and help them to achieve and reach the set target (Hamel and Prahalad, 1991).

The basis for competitive advantage is the ability to create knowledge and move it from one part of the organization to another. The creation of knowledge is a dynamic and continuous process involving interactions at various organizational levels. Organizations must learn from their environment how to survive and produce competitive condition that shapes the character of success. Time is an important factor, and it eventually renders nearly all advantages obsolete. Learning is the only sustainable source of advantage, so managers must link their core competence to different types of strategies across time. The real competitive advantage lies in integrating operations for the sake of demanding quality targets or meeting specialized

customer needs. An organization should provide a differentiating edge to be competitive to serve customers better, which is a newer method by which a company can turn more profitable. Due to fierce global competition, senior management must understand not only the technologies but also the competencies and motives of competitors. Building successful alliances requires identifying the core competencies of both the partners and developing the strong interpersonal skills and values needed to manage them. If an organization's capabilities are scarce, defensible, or hard to imitate, these can form the basis for sustainable competitive advantage and

surplus profits. The select key issues on role of core competence for competitive advantage are listed down in Table 1.

Table 1: Select Key Issues on Role of Core Competencies for Competitive Advantage

Author(s)	Year	Key Issues
Sinha	1998	Secret of a sustainable competitive advantage lies in the core competence that is impossible to replicate.
Ramaswamy & Namakumari	1996	Technologies change very fast, so advantage can last only through competence enjoyed at the very roots of products.
Meyer & Utterback	1993	A longer run focus is needed on enhancing core capabilities, which include its identification, application and synthesis in new areas.
Schoemaker	1992	Core competence form the discriminating factors for business success and greater is their economic return.
Stalk, Evans & Shulman	1992	Competitive success depends on transforming a company's key processes into strategic capabilities that consistently provide superior value to the customer.
Hamel & Prahalad	1991	Core competencies enable the organization to envision the markets that do not yet exist.
Hamel & Prahalad	1990	Core products form a tangible link between core competencies and end products.
Porter	1985	A sustainable competitive advantage creates barriers for competitors and makes imitation difficult.

### Sources of Core Competence

The organizations pick up skills, abilities, and resources that are unique to them, reflecting their particular path through history. These resources and capabilities reflect the unique personalities, experiences, and relationship that exist only in a single organization. Such resources can be the sources of sustained competitive advantage, and those imitating these resources will be at a cost disadvantage building them. An organization's competitive advantage potential depends on the value, rareness, and imitability of its resources and

capabilities. However, to fully realize this potential, an organization must also be organized to exploit its resources and capabilities. If strategic assets are imperfectly imitable, imperfectly substitutable and imperfectly tradable assets necessary to underpin an SBU's cost or differentiation advantage in a particular market, then core competencies can be viewed as the pool of experience, knowledge and systems etc. that exist elsewhere in the same corporation which can be deployed to reduce the cost or time required either to create a new strategic asset or expand the stock of existing one. In a dynamic world, only organizations that are able to continually build new strategic assets faster and cheaper than those of their competitors will earn superior returns and create long term competitive advantage. In this process core competencies have a pivotal role to play (Barney 1995, Markides and Williamson 1994).

Craig and Douglas (1996) suggest how a firm should respond to the challenges of change, complexity, competition and conscience. The use of different tools such as information systems technology, creating new organizational forms providing administrative and organizational flexibility, and effective resource deployment at various stages of the value chain can help a firm to cope with them. The nature of challenges is dynamic and the form it will take in the years to come remains uncertain. The firm's information system and its use of technology helps in initial involvement in international markets and establishes the foundation for subsequent expansion. As the firm starts its operation in the international markets, the organizational structure must evolve to coordinate operations in diverse and far-flung markets. Finally, the way in which the firm deploys its resources is of great importance. Firms that are able to adapt to changing realities of market continuously can sustain and succeed in today's world of competition.

Any organization that wishes to hold its present customers and expand its customer base has to innovate more effectively than its competitors. This needs the creation of an innovative climate, i.e., each department and function of the organization must be concerned with innovation of an incremental kind. The company has to set aside human and financial resources also to produce radical innovations for the future. If an organization does not have the will and capability to innovate, it inevitably ends up with obsolete products and services which customers are never interested to buy. The whole company must constantly be in the search of incremental improvements for everything from systems to training, from quality to purchasing. The hardwork of incremental improvement is a continuous process with an annual special effort. Radical innovation calls for different methods and people. To be ahead of the competition The original driving force is the technology and the people rather than the market. Those who define international competitiveness as no more than low cost

manufacturing are aiming at wrong target. Executives must look beyond lower costs and product standardization to think in new ways about world competition. Those who fail to identify the strategic intentions of their global competitors cannot anticipate competitive moves and often shoot behind the target. In a world of forward thinking competitors, the historical patterns of competition provide little guidance. Top managers must develop the new analytic approaches and organizational arrangements on which our competitive future rests (Humble and Jones 1989, Hamel and Prahalad 1985).

Oliva, Day, and Macmillan (1988) present a generic model of competitive dynamics that allows for the integration of structural and process components of competitive dynamics found in market place. A simple way to develop an understanding of competitive dynamics is to examine competitive behavior from the point of view of single business entering a new market. The business is alone during the launch phase, but in time the potential competitors counterattack by entering the market, thereby reducing the competitive position of first business. If the business cannot respond by repositioning itself through some new competitive advantage, it may be forced to disengage and exit from the market. It is critical of managers

*The corporation is like a tree that grows from its roots, core products are nourished by competencies and engender business units, whose fruits are products.*

of lagging business to be creative in finding ways to reduce industry inertia. Managers whose businesses are at a competitive disadvantage must over respond if they are to regain that edge. The model implies that an accurate assessment of the competitive situation is a critical factor in changing or enhancing a given business position. An incorrect assessment by a business has two negative sides to it, i.e., under respond results in a deteriorating relative competitive position, over respond results in wasted resources with little gain in advantage. This supports the development of competitor intelligence systems to accurately assess competitive positions as well as the current and likely actions of competitors.

Various sources of core competence, based on the review of literature, are as under:

### **Organizational Learning and Strategic Flexibility**

A learning organization is an organization skilled at creating, acquiring, and transferring knowledge and at modifying its behavior to reflect new knowledge and insights. In the absence of learning organizations, three M's need to be addressed, i.e., Meaning, Management, and Measurement. For learning to become a meaningful corporate goal, it must first be understood the new ideas are essential if learning has to take place. Sometimes they are created through flashes of insight or creativity; at other times it may arrive from outside the organization, or are communicated by knowledgeable insiders. These ideas are the trigger for organizational improvements. Learning organizations are skilled at five main activities: systematic

problem solving, experimentation with new approaches, learning from their own experience and the best practices of others, and transferring knowledge quickly and efficiently throughout the organization. Learning organizations are not built overnight. Any company that wishes to become a learning organization can begin by taking a few simple steps, i.e., to foster an environment that is conducive to learning, and to open up boundaries to exchange the ideas. The ability to learn faster than your competitors may be the only sustainable competitive advantage. The organizations that have to cope with the rigid procedures and information systems are going to learn more slowly than those with flexible, open communication channels. The best learning takes place in terms that accept that the whole is larger than the sum of parts; thus synergy its has to be there in the learning organizations (Garvin 1993, Geus 1988).

The continuous improvement is a philosophy that states that production, engineering, and marketing excellence require ongoing attention and learning. The corporate worldwide is a set of beliefs about how to compete successfully in a given set of competitive conditions. These beliefs include how the product should be designed, produced and sold. The role of accounting is important here for the purpose of developing systems that reinforce the activities necessary for the success of the company. Managers must identify and marshal excess resources if they are to save costs associated with that capacity; profits would not improve unless these costs are recovered or absorbed elsewhere. Continuous improvement requires a focus on all aspects of manufacturing including cost, quality, and delivery; thus today's accounting is an essential ingredient in the achievement of continuous improvement (Turney and Anderson 1989).

The creation of new organizational knowledge is becoming a managerial priority as it provides the basis for organizational renewal and sustainable competitive advantage. Failure to create knowledge and manage it as a critical organizational asset may call in for the declining performance of many well established companies. The organizational effectiveness is improved by sharing the individual knowledge throughout the organization. The creation of knowledge is a dynamic and continuous process involving interactions at various organizational levels. One of the important sources of competitive advantage is the ability to move the new knowledge from one part of the organization to another. In order to create knowledge, organizations must learn from their environment how to survive and produce competitive conditions that shape the character of the success. Managers need to link their organization's unique resources, i.e., core competencies, to different types of strategies across time. As technology cannot be separated from strategy, so competing on science and technology implies competing on organization of information, machine being not at the center of the

competition. The hidden thread of knowledge that coordinates is the only lasting corporate asset. Since learning does not occur overnight and is not possessed by all the organizations, top management must hold the levers and mechanisms of change to determine the rate and direction of learning in an organization. Managers interested in the future of their organizations can learn from the four phases of corporate planning, i.e., basic financial planning, forecast based planning, externally oriented planning, and strategic planning phase. The strategic management, linking the vigor of formal planning to vigorous operational execution, proves to be fruitful. (Inkpen 1996, Williams 1992, Clark 1989, Gluck, Kaufman, and Wallack 1980).

The organizational learning is necessary to retain and improve competitiveness in uncertain technological and market circumstances. To design a learning organization, it is necessary to define it in terms of a system and the processes that help it create, acquire, codify and utilize new knowledge and learning. Thus, the focus of creating a learning organization needs to shift from developing a learning oriented culture to building learning capabilities. The principles and practices of organizational learning are already being introduced as organizations strive to transform the assumption about how to succeed. Competitive progress

***Companies need to learn to manage tomorrow's opportunities as competently as they manage today's businesses.***

is fast coming to be seen as a learning process whose cornerstone is the rate at which organizations can change the way they view things and their assumptions about what is the best way to do things. Organizations unable to sustain learning are in a great danger of obsolescence. The rate at which organizations learn increasingly determines their prospects for survival. Organizational learning is about creating a close interchange between what customer needs and the required configurations of organizational capabilities, and using that intimate interchange to fuel continuous transformation for achieving competitive advantage (Chattel 1995, Shukla 1995, and Dodgson 1993).

In the longer run, the only source of competitive advantage is the organization's ability to learn faster than its competition. The organizations have to draw their attention where people expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where people are continually learning how to learn together. There needs to be a discipline that features into a coherent body of theory and practice, making the whole of an organization more effective than the sum of its parts. Team learning is important because it is the teams and not individuals that are the fundamental learning units in modern organizations. Thus, unless teams can learn, the organizations cannot, learn. The discipline of team learning starts with the capacity of members of a team to enter into a genuine thinking together (Senge 1994).

The knowledge base of an effective learning organization allows for the development of competencies and incremental or transformational change. There is assimilation and

utilization of knowledge and some kind of learning system to support such 'actionable learning'. An organization's ability to survive and grow is based on advantages that stem from core competencies that represent collective learning. A learning process has identifiable three stages, viz., knowledge acquisition, knowledge sharing, and knowledge utilization. Knowledge acquisition is the development or creation of skills, insights and relationships. Knowledge sharing is the dissemination of what has been learned. Knowledge utilization is the integration of learning so it is broadly available and can be generalized to new situations. True knowledge is more than information: it includes the meaning or interpretation of the information, and a lot of tangibles such as the tacit knowledge of experienced people that is not well articulated but often determines collective organizational competence. It involves many levels of people and all of their functions. It requires creation and control of both external and internal knowledge for both current and future operations. Thus managers designing learning organizations need to adopt holistic systems thinking that makes such systems difficult to imitate, thus providing a competitive advantage (Nevis, DiBella and Gould 1995, Leonard and Burton 1992, Hamel and Prahalad 1990).

There was a time when the prime business of business was to make a product and profit, but now the scenario has changed which leads to conclude that the business of business is learning. The process involved in planning and execution of significant changes in organizations can provide rich insights on how management can modify their ways of managing organizations and develop capabilities to introduce major changes successfully. The organization grows in its capability as managers' design and implement appropriate interventions to facilitate learning. The significant source of organizational learning could be through mobilization of organizational members, technical collaborations, or joint ventures. The better utilization of strategic alliances acts as a vehicle for learning new technologies and skills from their alliance partners while simultaneously protecting themselves from being deskilled. In order to sustain competitive advantage, companies need to assimilate sources of manufacturing technologies, tacit skills and core competencies that will become basis of future industry and technology initiatives. Alliances provide a mechanism for effective learning of new technologies, core skills and capabilities from a partner. Successful alliances share some common elements that permit them to leverage their skills across multiple centers of competence (Ramnarayan and Bhatnagar 1993, Lei and Slocum 1992).

Nonaka and Takeuchi (1995) illustrate the process of knowledge creation within a Japanese company. The organization's ability is important to identify the type of knowledge required by the changing external environment, and to improve the enabling conditions continuously.

Organizations cannot become competent tomorrow with today's knowledge, as different and new knowledge will be required to meet the needs of the customers in competitive environmental changes. It is the ability to create new knowledge continuously that becomes the source of competitiveness. In order to make knowledge creation dynamic knowledge created at one level needs to be amplified across different levels of the organization. Only by cross leveling the true benefit of organizational knowledge creation can be obtained. It is a never-ending process that requires a continuous innovation. The implementation of successful organizational knowledge creation process can be done by: i. Leveraging the tacit knowledge base of an individual and making use of socialization to transfer it throughout the organization; ii. Amplifying the knowledge creation across different levels of organization; iii. Enhancing the enabling conditions; and iv. Continuing to create new knowledge constantly.

'The climate of openness' is a facilitating factor that expedites learning in the organization. There is a need of permeable boundaries around information flow so that people can make their own observations. The opportunity to meet with the other groups and see higher levels of management promotes learning. All the people in an organization have a primary responsibility for learning from customers, competitors, suppliers and other companies.

*The organizations pick up skills, abilities and resources that are unique to them, reflecting their particular path through history.*

Managers need to ensure that information is shared within the organization and in particular between groups, functions, and geographical locations. They need not always program their strategies formally; sometimes the strategies must be left flexible, as a broad vision to adopt to the changing environment. Thus flexibility plays an important role in the organizational learning. It is a multi-dimensional concept demanding agility and versatility, creativity and innovation, sustainable advantage and capabilities that may evolve overtime. The attributes of flexibility are closely related to the issues of continuum, dynamic interplay, and freedom of choice. The three basic components that define the dynamic interplay of reality in flexible systems management paradigm are Situation, Actor, and Process; the three are the parts of an inseparable whole. They interact flexibly on multiple planes in ambiguous reality and ultimately melt together into one at the enlightened stage (Sushil 1997, Chattel 1995, Nevis, DiBella and Gould 1995, Minzberg 1994).

To understand the nature of learning capabilities, it is necessary to look at how organizations normally solve problems and take decisions. Managers must be creative in designing and operating strategic management systems and flexible enough to tailor their use of such systems to the organizational circumstances that confront them. The notion of flexibility is highly relevant in strategic management, as it is important for surviving in the present day economic environment of globalization and liberalization. Flexibility

in strategic management offers ability to add capacity and capability in the original system in a modular approach. In any organization the problems range from unstructured to well structured situations. There are multiple ways of reaching the same end, and the suitability of the way will depend on the nature and attributes of the problem situation at hand. Flexibility advocates an approach out of the existing ones so as to match the requirements of the problem situation. It thus integrates all system approaches and techniques into a family in which everyone, either individually or collectively, contributes meaningfully. The process of selection and integration of techniques is to be adopted flexibly in the practical situations (Mittal 1995, Sushil 1994, Certo and Peter 1991).

The organizational learning and strategic flexibility provide a congenial environment for the development of core competence. Learning does not occur overnight, it requires an endless effort. Thus, senior management needs to pay due attention to determine rate and direction of learning in an organization. The significant source of organizational learning could be through mobilization of organizational members, technical collaborations or joint ventures. The greater attention and more flexibility to people may be the keys to successful leadership. In the longer run, an organization's ability to survive and grow depends on the sustainable competitive advantages, which have their roots in the organizational core competencies that represent the collective learning and flexibility. The select key issues on organizational learning and strategic flexibility as a source core competence are listed down in table 2.

### Management of Technology

Technology is an important parameter for corporate growth and performance. The process of successful technology acquisition requires special skills, knowledge, and experience. It is a managerial responsibility and should be done with tact, patience, will and efficiency, in the interest of better organizational performance. Technology addresses the application of science and engineering knowledge to the solution of problems. However, technology management has a broader charter of integrating technology throughout the organization as a source of competitive advantage. A sustainable competitive advantage comes from the organizational learning, i.e., how constantly an organization can improve its technology acquisition and deployment capabilities. The transaction of technical knowledge into useful things or processes involves knowledge that is non-technical. Such knowledge is used to deliver products and services, e.g., managing people and facilities, assuring that products or services are consistent with customer desires, etc. The successful management of technology requires the capacity to orchestrate and integrate functional and specialist groups for the implementation of innovations, continuous testing of appropriateness of existing markets and skills for the exploitation of technological opportunities.

***Firms that are able to adapt to changing realities of market continuously can sustain and succeed in today's world of competition.***

Table 2 : Select Key Issues on Organizational Learning and Flexibility as a Source of Core Competence

Author(s)	Year	Key Issues
Sushil	1997	Flexibility expedites learning in the organization.
Inkpen	1996	Ability to create knowledge and move it from one part of the organization to another is the basis for competitive advantage.
Chattel	1995	Organizations need to define processes that help it to create, acquire and utilize new knowledge and learning.
Nevis, DiBella & Gould	1995	The advantages that stem from core competencies represent flexibility and collective learning in the organizations.
Senge	1994	Organizational learning is coherent in nature, making the whole of the organization more effective than the sum of its parts.
Garvin	1993	Organizational learning can be traced through three overlapping stages, i.e., cognitive, behavioral and performance improvement.
Lei & Slocum	1992	Alliances provide a mechanism for learning new technologies and skills from their partners.
Hamel & Prahalad	1990	Learning organizations need to adopt holistic systems thinking
Clark	1989	Organizational learning is the only lasting corporate asset.
Geus	1988	Flexibility, open communication and team approach help organization to learn much faster than its competitors.

Failure to improve the internal systems and processes leaves an opportunity for competitors to move ahead with technology based strategies and create a foundation of competitive advantage. A strategy that stresses technology is not necessarily the best, but if a company decides to exploit technology as a competitive weapon, it had better to do more than merely investing in R&D. The successful pursuit of the technology based opportunities for competitive advantage are not the result of a single set of decisions or a single product being introduced at a single moment of time, but of numerous product releases and many decisions. There is a requirement for continuous learning in order to exhibit the strategic consistency. The technology management provides a means to use new technology to create competitive advantage (Kumar 1994, Werther, Berman, and Vasconcellos 1994, Aldridge 1990, Pavitt 1990, Morone 1989, Frohman 1982).

Technology is important for competition if it significantly affects an organization's competitive advantage. The basic tool for understanding the role of technology in competitive advantage is the value chain. An organization, as a collection of activities is a collection of technologies. Technology is embodied in every activity in an organization

and technology change can affect competition through its impact on virtually any activity. An organization that can discover a better technology for performing an activity than its competitors thus gains competitive advantage. The twenty first century will be pervasively technological. All nations will share the conviction that technology is the critical factor for economic growth, national security, and social stability. No single country will depend solely on world arena. As the generation, dissemination and the application of technology is to be accepted as predominantly global, all nations will adjust toward a more open world of technology exchange, alliances and research. It is important to note that today's successful organizations are not necessarily those that create new technologies but those that rapidly absorb them. Thus it requires an organizational capacity to identify promising new technologies worldwide and absorb them into new products and processes quickly and effectively. Organizations need to be constantly oriented towards improving their critical competencies or capabilities to absorb new technologies and improve and combine existing technologies (Rastogi 1995, Branscomb 1992, Ramo 1989, Porter 1985).

In a typical organization's technological portfolio there exist three broad classes of technologies, viz., the base technologies, the key technologies, and the pacing technologies. Base technologies are necessary, but not sufficient to achieve competitive advantage. These technologies are widely known and readily available. Key technologies provide competitive advantage and permit the producer to have differentiating features or functions in the product. Pacing technologies could become tomorrow's key technologies. It differentiates the leaders from the followers, as every organization cannot afford to invest in pacing technologies. Managing technologies effectively means setting and communicating strategic priorities, managing projects to get timely results and effectively using linkages inside and outside the organization. A good fit between a parent and its business can create value while a bad fit can destroy it. Parents often create value as they have people with unique capabilities. The organizations that are on a quest for patenting advantage can achieve the competitive advantage for corporate level strategy (Campbell, Goold and Alexander 1995, Ericson, Magee, Roussel and Sad 1990).

Technology transfer in itself will not lead to increased economic growth but the ability to maintain and fully utilize the appropriate technology may lead to long term economic growth. A successful transfer can occur only if the recipient is sufficiently capable of maintaining an introduced production system. Factors such as socio-political and cultural value systems affect technology transfer.

Technology transfer is not without its consequences; this may result in additional financial strain on the receiving country. Before a new technology is adopted, the scope and limitations of the existing technology have to be studied. It may suggest the need for improvement and the need to develop more capabilities before the right type of technology can be transferred. The factors that are important for the transfer of technology are needs and objectives; capabilities; education, training, research, and development. Adaptation of technology should not end the process of technology transfer. There is a need to develop a control system for evaluating the success or failure of the new technology continuously or periodically. The transfer of technology can take place also from university to industry. Again, this is not one single operation but contains a great variety of methods that can be applied depending on the local circumstances. The close co-operation between university and industry is a key requisite in technology transfer. The research results are transferred in general to society and in particular to industry. Thus R&D from universities can contribute to the economic and social progress of the country (Madu 1989, Kroonenberg 1989).

Zahra, Nash, and Bickfold (1994) examine the conditions under which the technological pioneering can be the source of a competitive advantage. A competitive advantage exists when a company can distinguish itself from rivals, thereby succeeding in making a profit. Technological pioneering is the creation and commercialization of new technology. It enables a company to create and maintain a technological gap, allowing it to produce at lower cost than its rivals, offer innovative products, and change product designs, or features. The pioneer's success in creating an advantage from its technology depends on its progress in building capabilities, overcoming inertia, and creating an organization that enhances technological development and commercialization.

The successful pursuit of technology based opportunities is not a result of a single set of decisions but is a process of continuous learning in order to exhibit the strategic consistency. Managing technologies effectively requires the capacity to integrate functional and specialists groups for the implementation of innovations and continuous testing of skills for the exploitation of technological opportunities. Technology is an important parameter for corporate growth and is embodied in each activity of an organization. The organizations need to develop competencies to identify promising new technologies and transfer and absorption of right type of technologies. The effective management of technology provides a means to create competitive advantage for corporate success and growth. The select key

*There was a time when the prime business of business was to make a product and profit, but now the scenario has changed which leads to conclude that the business of business is learning.*

issues on management of technology as a source of core competence are listed down in table 3.

Table 3 : Select Key Issues on Management of Technology as a Source of Core Competence

Author(s)	Year	Key Issues
Campbell, Alexander & Goold	1995	The organizations that are on a quest for parenting advantage can achieve the competitive advantage by creating value as they have people with unique capabilities.
Rastogi	1995	Core competence represents the nature and direction of company's continual efforts to enhance and maximize its technological strengths and organizational sustainability.
Kumar	1994	Technology is an important parameter for corporate growth and performance.
Werther, Berman & Vasconcellos	1994	Technology management focuses on organizational capabilities instead of specific technologies to gain a competitive advantage.
Zahra, Nash & Bickford	1994	Technological pioneering cannot succeed without skilled management that defines the company's core competencies.
Ericson, Magee, Roussel & Saad	1990	The management of technology ensures the organization's ability to command the technologies relevant to its purposes.
Pavit	1990	Successful technology management integrates functional and specialist groups for the exploitation of technological opportunities.
Kroonenbrg	1989	Close cooperation between university and industry is a key requisite in technology transfer so as to get quicker pay off from R&D.
Morone	1989	Successful pursuit of technology based opportunities for competitive advantage requires continuous organizational learning.

### The People

The successful organizations of the future will be the those which understand the link between their business results and the people. The people are the most important assets and are the source of competitive advantage. Competence at the level of people is an underlying characteristic of a person which enables him or her to deliver superior performance in the given job, role or situation. Those characteristics are present in superior performers but not average ones. Organizations can improve their overall productivity by shifting people from average to superior performance through development and by promoting right people. The less control, greater flexibility, and more attention to people in the organization and to the environment outside the organization may be the keys to successful leadership. The strategies for successful leadership in the changing times impinge on leaders to take responsibility for their own development and the

***Learning does not occur overnight, it requires an endless effort.***

development of their people and the organization. They need to learn more about people so as to know how they work in groups and organizations, talk with people about their careers and promote career development activities, hire broadly educated people with diverse interests, and keep a low profile. In the 21st century, humans will be to computers what pets are today to humans. In addition, humans will continue to hold a huge competitive advantage over computers by the fact that they are superb problem solvers, they can learn, and they can be creative. These talents must be cultivated as far as possible as they will become the critical skills of 21st century (Boulter, Dalziel and Hill 1996, Makridakis 1989, Bisesi 1983).

The creation of meaningful future of an organization depends on its human dimension. Tomorrow's organization is the one that uses technology to amplify human capabilities, both in products and services it offers to its customers, and in the essentially human means by which they are created. The organizations that are going to succeed will be those that make it possible for individuals to make the highest and most creative individual contribution and who see success as having its foundations in the abilities of confident people to make unique contributions. Only people can generate ideas and turn them into action, and future success is increasingly determined by the abilities of an organization to express the ideas of its people quickly enough. The individuals in the organization are valuable resources. Most organizational competencies start with the individual skills and knowledge, and can develop expertise. Competence develops partly as an individual action learning process and through reflective learning between practice and cognition to result in superior competitive positions (Chattel 1995, Schon 1983).

The competencies may be described, as the precious seeds of growth as it takes into account the individual characteristics, many of which are difficult to change. It provides a way of matching the individuals to organizations that is highly acceptable to global companies. Organizations arrive at competencies through different routes, the most important being to strike a balance between individual motivation and organizational needs. There is a growing recognition, especially among multinationals, that individuals who can contribute to the achievement of company goals in the future will be qualitatively different from the past, depending less on skills of today and more on their ability to perform in the face of change. The real sources of competitive advantage are to be found in the management's ability. There is a need for communication, involvement, and a deep commitment to working across organizational boundaries. It involves many levels of people and functions. The competence carriers should be regularly brought together from across the corporation to trade ideas. The goal is to build a strong feeling of community among these people (Wisher 1994, Hamel and Prahalad 1990).

The increasing global nature of competition requires that firms utilize all of their valuable resources in order to survive and succeed. This has resulted in an emphasis on the alignment of all functional activities of the firm (e.g., finance, marketing, operations, etc.) toward the achievement of strategic objectives. Core competencies deal with the internal resources or capabilities of an organization that are competitively unique and add value to the firm. The frequent innovations in product offerings require more human inputs, thus creating greater potential for value added from employees. These organizations obviously perceive that competitive advantage is created through people, and attempt to develop and exploit such advantages (Wright et al 1988).

The competence at the level of people enables the organizations to generate innovative ideas and translate those ideas into actions. People are the source of competitive advantage as the frequent innovations in product development are the results of human capabilities. All organizations provide worthwhile goods and services through people working together. The identification of the people with specific competencies to do the specified jobs well is an important step. Training the people for delivering superior performance at their respective work places can develop the competencies. People with the right competencies in the right jobs means competitive advantage, producing better profitability, which serves the ultimate goals of a good business to maximize the satisfaction of the owners and customers. The select key issues on People as a source of Core competence are listed down in table 4.

*The successful management of technology requires the capacity to orchestrate and integrate functional and specialist groups for the implementation of innovations, continuous testing of appropriateness of existing markets and skills for the exploitation of technological opportunities.*

**Formulation of Strategy with Core Competence and Flexibility**

Strategy may be defined as the match that an organization makes between its internal resources and skills, and the opportunities and the risks created by its external environment. Top management’s role must go beyond the buying and selling of business to building integrity in the company’s operations and commitment among employees. However, the value of full strategy cannot be realized in practical terms, unless and until it is expanded to the real complexities of the organizations. The key to resource based approach to strategy formulation is understanding the relationships between the resources, capability and an in-depth knowledge of the mechanisms through which the competitive advantage can be sustained overtime. This requires the design of strategies that exploit to maximize the effect of organization’s unique characteristics. Mangers can leverage their firm’s skills and resources for increased competitiveness. When intelligently combined, core competence and extensive outsourcing strategies provide improved returns on capital, lowered risk, greater flexibility,

Table 4: Select Key Issues on People as a Source of Core Competence

Author(s)	Year	Key Issues
Boulter, Dalzier & Hill	1996	People enable the organizations to deliver superior performance to achieve competitive advantage.
Chattel	1995	Human capabilities need to be amplified for making the future meaningful.
Wisher	1994	Competencies are the precious seeds of growth as they take into account the individual characteristics.
Hamel & Prahalad	1990	Communication, involvement and deep commitment at all levels of people and functions is needed in the organizations.
Makridakis	1989	The superb problem solving, creativity and learning talents of people will become the critical skills of 21 <sup>st</sup> century.
Wright,et.al	1988	Core competence is created through people and deals with internal resources of an organization that helps in value addition.
Bisesi	1983	Flexibility and more attention to people lead the organization towards successful leadership.
Schon	1983	Individuals in the organization are valuable resources as they generate ideas and turn them into actions.

and better responsiveness to customer needs at lower costs. The concept of strategic intent comes into play here as its goal is to fold the future back into the present. It implies a sizeable stretch of an organization, where current capabilities and resources will not suffice. Achieving strategic intent requires enormous creativity; this forces an organization to be more inventive (Hamel and Prahalad 1994, Quinn and Hilmer 1994, Grant 1991, Hamermesh 1986, Chaffee 1985).

The selection of strategy and structure is to a great extent at the discretion of management. The culture is to be considered, as the deep-rooted beliefs are extremely difficult to change. The organization’s culture is related to the organization’s identity. Successful organizations having their own style and shared values tend to fit into one of the four basic identities: license giver, license taker, jobber and consultant. In case of license giver, the bulk of revenues come from license fee and only a minor part from own production. The license taker’s aim is to exploit the potential of a particular existing product in a limited regional market. The technology jobber offers a multi-functional manufacturing or servicing capacity to the local market. His aim is to get his capacity utilized to the full.

The consultant hires his knowledge capacity in a particular field. The use of technology as a corporate resource helps to sense if the organizational culture on the one hand and strategy and structure on the other hand is in harmony with each other. The most wrenching of the changes that

Indian business houses are experiencing involves acquiring a strategy to cope with liberalization. It demands a process of rigorous and analytical exploration of the environment, opportunities, and capabilities. There is a need for new strategic imperative that emphasizes on nurturing a core competence, which forms the foundation of a sustainable competitive advantage for an organization. A well-defined strategic direction is essential for surviving competition (Gunstren1987, BT 1998).

A company must first take an objective look at its existing businesses and the value added by the corporation in order to translate the principles of corporate strategy into successful diversification. The understanding of good corporate strategy should guide future diversification as well as the development of skills and activities with which to select further new businesses. A corporate strategy that truly enhances competitive advantage of each business unit is the defense against the corporate raider. The core competencies are the highest level and longest lasting units for strategy making; they must be the central subjects of corporate strategy. Top management must have a point of view on which new competencies should be built. A key challenge in competing for the future is to preemptively build the competencies that provide gateways to tomorrow's opportunities, as well as to find novel applications of current core competencies.

***Technology is embodied in every activity in an organization and technology change can affect competition through its impact on virtually any activity.***

The approach that provides a link between strategic vision and core capability focuses on a strategic vision that pulls together the insights obtained from examining the multiple scenarios, the industry's competitive structure, and the organization's distinct core capabilities. It enables the management to indicate which core capabilities the organization must develop further and how, so as to succeed in its chosen business segments. The approach emphasizes a resource-based view of the organization and aims at identifying core capabilities that are important in multiple segments. Since the strategic vision on core capabilities complements other capabilities, synergy is developed that results in surplus returns (Hamel and Prahalad 1994, Schoemaker 1992, Porter 1987).

In order to manage a multi-business organization, there has to be a good relationship between executives in the central office and those who run the business units or divisions. The best way to manage depends on the nature and the needs of the business in a company's portfolio, styles of the people in the corporate office, and the organization's strategy and goals. There is no one best way to make strategy; each is characterized by a particular way of organizing the relationships between headquarters and the business units. The secret to chose strategy is to find the style that suits the circumstances best. Strategy plays a vital role in diversified organizations. The process of diversification is an important method of providing a

company with protection from obsolescence in present products and with opportunities of future growth. The situation calls for tools that companies can use in assessing the suitability of various diversification routes. These tools need to be designed to help the organizations to formulate the strategies in more individualized directions for diversification so that they will not follow their close competitors. These tools should focus on the basic competencies of the company so as to diversify successfully (Goold and Campbell 1987, Conrad 1963).

Sugiura chairperson of Honda Motor Company, shares his practical experience to describe successful localization strategy which consists of four target concepts: localization of products, profits, production and management. The localization of products mean developing manufacturing and marketing the products best suited to the actual and potential needs of the customers and to the social and economic conditions of the market place. The localization of profits addresses the issue of reinvesting as much of the profits as possible in the local market. A company investing abroad must regard itself as a local company and endeavor to prosper together with the host country. There could be

two ways to make the localization of the production most effective: one is to increase the ratio of local content which gives added impetus to related industries, The other is to increase the value added in local production which not only depends upon employment opportunities, but also gives employees a greater sense of responsibility for, and pride in, manufacturing their own products. The localization of management modifies the corporate philosophy to suit local conditions. Managers should avoid forcing people to accept management know-how or corporate philosophy in its original form, which may be foreign to them. These efforts create a sense of unity that is essential for achievement of common goals. Good communication between management and labor, as well as delegation of authority, elevate the employees' sense of responsibility and motivation, which lead to improved productivity and maintenance of high quality standards. In short, corporate behavior must be such that the corporation itself and all of its activities are satisfactory to the community, society, and country.

At corporate level, a competency perspective provides insight into the kinds of businesses in which the firm can compete successfully. The competence approach to strategic management argue that it is the firm's capabilities which should guide the decisions on portfolio building, diversification, acquisitions, divestments, and resource allocation. The corporate strategy defines the business in which a company will compete, preferably in a way that focuses resources to convert distinctive competencies into competitive advantage. A sound understanding of internal capabilities is necessary because an organization may not

realize the full profitability potential or may even lose money unless it has the capabilities required for success in the new venture. The capabilities must be strategically important ones so that the competitors cannot easily imitate or acquire them. The basis of successful diversification is the transfer of underlying capabilities from existing businesses to new ones, thus the extendibility or the relatedness of core competence can be the source of competitive advantage (Makrides and William 1994, Andrews 1980, Ansoff 1965).

The process of strategy formulation involves matching of opportunities and corporate capabilities, which results in the generation of economically feasible strategic alternatives. The choices that satisfy the personal aspirations of top management and perceived social responsibility of the company, and which survive the organizational politics, are implemented. The proper understanding of environmental trends and corporate capabilities is of paramount importance in the process of diversification. In the new businesses, although being unrelated to the existing one, the issues like size of investment, timing of entry, sequencing of projects, organization design etc. are to be resolved. Thus the strategic analysis is necessary at every stage of diversification. The strategic competition has a profound impact on business productivity. Its basic elements are: the ability to understand competitive behavior as a system in which competitors, customers, money, people and resources continually interact; ability to use this understanding to predict how a strategic move can rebalance the competitive equilibrium; resources that can be permanently committed to new users even though the benefits will be deferred; ability to predict risk and return with enough accuracy and confidence to justify that commitment; and willingness to act. Success usually depends on the culture, perceptions, attitudes, and characteristic behavior of competitors and on their mutual awareness of each other (Chaudhary 1979, Henderson 1989).

Every organization, whether a business or not, has a theory of the business. The assumption on which the organization has been built and is being run has to fit the reality. These assumptions are about markets, identifying customers and competitors, their values and behavior. They are about technology and its dynamics, and about a company's strengths and weaknesses. The core competence of an organization also plays a pivotal role to accomplish the organization's mission, as it defines where an organization must excel in order to maintain leadership. The theory of business has to be tested constantly. When it shows the first signs of becoming obsolete, it is time to start thinking again and take effective action with the new realities of environment, with a new definition of its mission and with new core competencies to be developed and

acquired. The process of revival (in the case of sick organizations) cannot be initiated without a clear strategy, articulation of policies, isolation of problems, and sequencing of actions. Moreover strategy for revival is a result of series of negotiations with key interest groups such as trade, distributors, labor unions, financial institutions and the government. The formulation of strategy consists of matching the organization with its environment while its implementation includes the motivation and commitment of internal and external publics to the new strategy (Drucker 1994, Prahalad and Thomas 1977).

Minzberg (1987) defines managers as craftsmen and strategy as their clay. They bring their work an equally intimate knowledge of the materials at hand by sitting between a past of corporate capabilities and future of market opportunities. Strategies are both plans for the future and patterns from the past. Once the strategy is formulated, people take actions one by one and respond to them, so those patterns eventually form. Strategies take root in all kinds of places wherever people have the capacity to learn and the resources to support that capacity. To manage strategy is to craft thought and action, control and learning, stability and change. There is a need to create the climate within which a wide variety of strategies can grow. In more complex situations, this may mean building flexible structures, hiring creative people, defining broad umbrella strategies, and watching for the patterns that emerge. Like potters at the wheel, organizations must make sense of the past if they hope to manage the future. Like managing craft, crafting strategy requires a natural synthesis of the future, present, and past.

Strategy is given a serious thought in today's new manufacturing technologies. The notion of economies of scale implies greater production volumes at lower unit costs. There is a need to plan for economies of scope that brings in efficiencies by variety and not by volume. The new technical capabilities rest on economies of scope, where the same equipment can produce multiple products more cheaply in combination than separately. The major barrier to the effective use of this new technology is a lack of understanding of its impact on strategy. Managers must reinterpret its often considerable costs in the light of expanded options it makes available and of the costs of not adopting it. In short, managers will have to learn to accumulate a whole new set of strategic possibilities taking into account the structure, marketing, accounting and finance, and strategy. The long-range strategies should be formed from an integration of an understanding of the customer, competitor, and the company. Thus the long range strategies or strategic visions must address the present and future needs of the customers and the responses of competitors, while simultaneously it has to be consistent

***Pacing technologies could become tomorrow's key technologies. It differentiates the leaders from the followers, as every organization cannot afford to invest in pacing technologies.***

with the capabilities and the culture of the organization. The strategic visions, technological advances and R&D must be developed in concert with the corporation's core competencies, affording it the opportunity to leverage past success into future opportunities. An understanding of one's core competency helps organizations identify businesses which do not leverage the core capabilities of the organization and, therefore, are not a good fit with the company. One's core technology forms the basis for many of the company's core capabilities and thus provide the essence for developing sustainable competitive advantage in the market place. The vision development and core competencies management must be on-going business processes in any organization (Goldhar and Jelinck 1983, Kesler, Kolstad and Clarke 1993).

Goold and Alexander (1995) developed a further perspective on the link between core competencies and corporate strategy. The key to clear thinking in this area is to recognize the important role of the parent company in the corporate strategy. If the parent company is able to create skill pools, linkage mechanisms and knowledge sharing between business units that have similar competencies, in a way that raises these competencies such that they become a shared source of advantage, then there is a logic for competence based portfolio strategy. If the parent does not have the competence management skills, then there is no logic for competence based portfolio strategy. The concept of parenting skills, i.e., the core skills of the parent organization, has to be a key link between competence and corporate strategy. It is a long-term challenge that requires the parent to learn new skills. Companies without sound corporate level strategies generally lose strength and fall prey to hostile predators. On the other hand, the companies with sound corporate level strategies create value from a close fit between the parent's skills and the needs of the business.

Strategic thinking is about syntheses; it involves intuition and creativity. Planners should make their greatest contribution around the strategy making process by aiding and encouraging members to think strategically, and by supplying the formal analysis that strategic thinking requires. The outcome of strategic thinking is an integrated perspective of the enterprise. Strategies often cannot be developed on schedule; they must be free to appear at any time and at any place in the organization typically through processes of informal learning of people at various levels who are deeply involved with the specific issues at hand. Strategy making is not an isolated process, but an interwoven one with all that it takes to manage an organization. The core' competence and strategy of an organization are also managerially interlinked. The core competencies are the major resources of the organization.

In order to have a significant role in maintaining the competitiveness, the resources underlying the development and nurturing the core competencies must be the forces that drive the organization. The failure of managers to deal effectively with core competencies is the major cause of the strategic oversights. Effective organization-wide communication is necessary to assure coordination of effort and enhancing of core competencies (Constantin and Lusch 1994, Minzberg 1994).

Purpose of strategy is to exploit the unique advantages of the organization in facing the challenges of the environment. A strategy begins with a concern and a burden of how best to use the limited resources of the organization in realizing the objectives, and confronting successfully the environmental realities. The successful corporations make their strategic priority to build their core competencies and long term competitive advantages, so that they will serve the real back up for the business level strategies of the business units of the corporation. While competitive advantage serves as the back up to the strategy formulation,

***Managing technologies effectively requires the capacity to integrate functional and specialists groups for the implementation of innovations and continuous testing of skills for the exploitation of technological opportunities.***

strategy is needed for competitive advantage. The point is that while corporate level ground strategies take care of competitive advantage, the business/market level strategies of the organization use the corporation's competitive advantage as the foundation to work on. Competitive advantage building is thus a conscious and strategic activity of the corporate management (Ramaswamy and Namakumari 1996).

Strategies can be developed through the process of informal learning of people involved at different levels as strategy making is not an isolated process but an interwoven one with all that takes to manage an organization. In order to stay competitive in the changing environment, the organizations must design their strategies that exploit to maximize the effect of their core competencies. The top management needs think carefully which of the capabilities really create unique value and which activities can more effectively be bought from outside. In order to stay competitive in future markets, there has to be a competitive innovation rather than competitive imitation. Since core competencies are the well-spring of future product development, it provides improved returns on capital and better responsiveness to customer needs. They are the primary factors upon which an organization can establish its identity and create competitive advantage that can be sustained overtime. The resources, skills and capabilities of an organization should form the focus for strategy formulation. There is a need for flexible approach for strategy formulation so as to have a broad vision to adopt to the changing environment. The select key issues on Strategy with Core Competence and Flexibility are listed down in table 5.

Table 5: Select Key Issues on Strategy with Core Competence and Flexibility

Author(s)	Year	Key Issues
Ramaswamy & Namakumari	1996	Core competence building and long-term competitive advantages have to be strategic priority of successful corporations.
Drucker	1994	Core competencies define where an organization must excel in order to maintain leadership.
Makrides & William	1994	The competence-based approach to strategy provides insight into the kinds of businesses in which the organization can compete successfully.
Hamel & Prahalad	1994	Core competencies must be the central subject for strategy making.
Kesler, Kolstad & Clarke	1993	The vision development and core competence management must be on going business processes.
Schoemaker	1992	The strategic vision helps to indicate which core competencies the organization must develop further so as to succeed in its chosen business segment.
Grant	1991	Strategies must be designed to exploit to maximum effect each organization's unique capabilities.
Henderson	1989	Strategy calls on the commitment and dedication of the whole organization.
Minzberg	1987	In complex organizations, there is a need to build flexible structures, hiring creative people, and defining broad umbrella strategies.
Harmermesh	1986	Effective planning can improve both strategies and performance.
Chaffee	1985	The strategy definition in the literature cluster into three distinct groups, i.e., linear, adaptive and interpretive.
Prahalad & Thomas	1977	Strategy formulation consists of matching the organizational competencies with its environment while as implementation includes motivation and commitment of internal and external publics.

## Conclusion

A review of the literature makes it clear that recent trends in management have been towards the development of core competencies, The globalization of market and liberalization has enhanced competition A powerful way to prevail in global competition is invisible to many companies. The area of core competence is emerging and needs a lot of attention in order to describe the capabilities which may lead to leadership in a range of products or services.

Effective technology management and organizational processes direct attention to organizational capabilities instead of focusing on specific technologies, to build and refine core competencies, skills and integrate multiple streams of technologies. It is important to incorporate the multidimensional concept of flexibility that demands agility and versatility, creativity and innovation, responsiveness to change, non-rigidity, sustainable competitive advantage and

capabilities that may evolve over time. The less imitable the core competencies are, the more they become the factors for corporate success and greater is their economic return.

Strategies are broad statements of intent which show the types of action required to achieve the objectives. A pay-off for reaching those objectives is the corporate success and can be measured on the basis of profitability and growth. The top management has to think carefully which of its activities really create unique value and which activities can effectively be bought from outside. The core competence perspective must be the central subject of corporate strategy to be implemented with a perspective of strategic flexibility so as to effectively cope with the emerging challenges.

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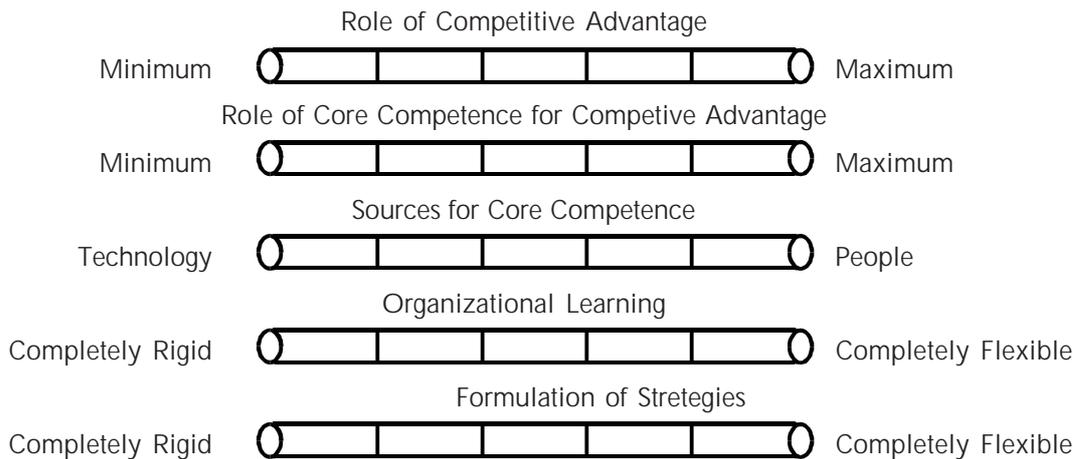
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**Flexibility Mapping : Practitioner's Perspective**

1. Which variants of flexibility do you envision in a practical situation of a "Sustainable Competitive Advantage with Core Competence" 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.
2. Identify and delineate the types of flexibility conducive to establishing a regime for sustainable competitive advantage in your organization. On which planes does the flexibility need to be enhanced ?
3. Attempt mapping the sustainable competitive advantage of your organization on the following continua. (Please tick mark in the appropriate box(es)).



4. Develop a SAP-LAP (Situation Actor Process-Learning Action Performance) model of "Sustainable Competitive Advantage with Core Competence" appropriate to your organization.

**Reflecting Applicability in Real Life**

1. Implement the methodology of formulation of strategy with core competence and flexibility discussed in the paper.
2. Identify at least five select key issues on people as a source of core competence relevant to your organization.

# Dispute Prone Contract Clauses - A Basis for Operational Flexibility in Contract Administration

**K. Chandrashekhara Iyer**

Associate Professor  
Department of Civil Engineering  
Indian Institute of Technology, Delhi – 110016 (India)

**Satyanarayana N. Kalidindi**

Associate Professor,  
Department of Civil Engineering,  
Indian Institute of Technology, Madras – 600036 (India)

**L. S. Ganesh**

Professor  
Industrial Engineering and Management Division  
Indian Institute of Technology, Madras – 600036 (India)

## Abstract

*Contract terms and conditions play a dominant role in preventing and resolving disputes in construction contracts. However, in most construction contracts, a few clauses are regarded as dispute-prone. This paper presents a methodology for systematic identification of dispute-prone clauses in construction contracts using three multivariate statistical analysis techniques, viz. factor analysis, two group discriminant analysis, and multiple regression. The paper also tries to identify possible remedy for a reduction in the frequency of occurrence of disputes. A preliminary questionnaire survey of 72 clauses featuring in Indian Government construction contracts led to the identification 17 potential dispute prone-clauses. A more detailed questionnaire survey was then conducted for studying the 17 clauses. A total of 150 professionals (106 owner representatives and 44 contractors) responded to the questionnaire. The study revealed that dispute-prone clauses can be grouped in one of the four factor dimensions: owners' powers, contractors' defaults, payment to contractors, and deviations and discrepancies. Clauses grouped in owners' powers were found to be the most dispute-prone from both owners and contractors points of view. Owner's decisions, governed by the power vested on him through these clauses and his fear of audit observations and objections, tend to be blind and rigid. If the owner's auditor had understood the operational difficulties of the project and been flexible in his attitude while raising the observations, the owner too would have the flexibility to mend his decision. This attitude can motivate contractors too to be reasonable in submitting the claim and this would, in turn, pave path of mutual confidence between them.*

**Keywords** : construction contracts, disputes, contract clauses, statistical analysis, factor analysis, discriminant analysis, multiple regression, questionnaire, legal cases.

## Introduction

Contract documents should play a dominant role in preventing and resolving disputes in the construction contracts by providing comprehensive coverage of all the items of work, duties and responsibilities of the contracting parties, and conflict resolution mechanisms related to all contingencies. However, in reality it is not so and a few contract clauses are regarded to be dispute-prone. Disputes may arise due to numerous reasons including unfair contract clauses allocating disproportionate risks on parties, ambiguity in contract clauses leading to varied interpretations and applications, discrepancies and inconsistencies among various documents, and conflicting interests of owners and contractors in the contracts.

Construction contract clauses predominantly represent owners' interests, to which the business hungry contractors agree, with a hope that enough ambiguity resides in the document to permit multiple interpretations (Ibbs and Ashley 1987). These clauses serve as proxy or pressure points while the parties assert their rights through claims.

Situations become critical when the owner is a government organization and the owner representatives (the government officials) take decisions based on the content of the agreement rather than the intent, generally fearing audit objections, which are generally blind and rigid. A more flexible attitude of auditors that gives due considerations to situation and facts on the ground, may be a step in the direction of reduction of occurrence of disputes.

## Literature Survey

Fox (1974) observed that owners prepared the contract documents with exculpatory clauses which dealt more with risks and uncertainties than with the specifications of the work. Thompson and Portis (1978), while discussing the history of evasive contract clauses from the pre-industrial revolution period, concluded that the use of exculpatory and evasive clauses by engineers to transfer all responsibilities to contractors was not a legally accepted method in contracting. Russel (1990) pointed out that competitive bidding systems were the main source of conflicts in contracts. Owners wanted the work to be completed at the

lowest price with high quality and least risk of performance while contractors wanted to maximize their profits. Steen (1994) observed that even the most careful planning could not prevent disputes and suggested five steps to resolve construction disputes without going for litigation.

Thomas et al. (1990 and 1991) suggested methods for resolving disputes pertaining to notice requirements and oral changes. Thomas et al. (1995a and 1995b) have studied disputes arising out of defective specifications of construction contracts and on issues of compensation arising out of varied interpretation of completion of work respectively. These studies are related to the legal aspects of contract administration.

Ibbs and Ashley (1987) carried out a study on the impacts of construction contract clauses on four measures of project performance: cost, schedule, quality, and safety. They defined and examined 18 different clause families from 96 construction contract clauses. They found only three families among the 18 families to be significant in causing disputes. These families were 'change clause family', 'work scope definition clauses family', and 'project control clause family'. While this study gave an indication that the clauses were grouped together to represent families, no methodology for evolving the 'clause families' was reported by them.

In India, Chandra (1984) has expressed the opinion that government contracts appeared to be totally one-sided and they are in favor of the government (the owner) allocating most of the risks to contractors. Due to this reason many of the clauses were not upheld by arbitrators or in courts of law. Moreover, a greater awareness on the part of contractors of their rights and remedies available through arbitration and also the growing tendency of playing safe on the part of owner representatives, have led to an increase in the number of disputes/arbitration cases (Agarwal 1991). Besides one-sidedness of the contracts, types of the contracts, documents forming the contract, interpretation of clauses, design changes and consequent effects, variation and extra items, risks and unforeseeable conditions, extension of time and escalation, had also been sources of disputes.

While these studies have provided useful information on particular clauses and the steps required to overcome disputes, no attempt has been made to study the nature of clauses in relation to the frequency of occurrence of disputes. This paper describes the use of three multivariate statistical analysis techniques for systematic identification of dispute prone clauses in construction contracts.

### Research Objective and Scope

The primary objective of this study was to identify dispute-prone contract clauses from a construction contract. In general, construction contract clauses cannot be taken as completely independent of each other. Most clauses have a bearing on each other and they are correlated among

themselves in some way or the other to form groups or families. So the first step to achieve the objective was to identify such groups of problematic clauses of a construction contract, which otherwise would seem quite unrelated to each other, and to identify their common underlying properties responsible for causing disputes. The next step was to identify the most dispute-prone clause(s) of a construction contract.

The Indian Government construction contracts used by Military Engineering Services (dealing with defence works) and Central Public Works Department (dealing with the public works), two quite old and large departments, were selected for study. The reasons for selecting these two departments are:

- These departments are almost a century old and have similar contract clauses with minor variations. The contract forms of these departments form the basis of many other contract forms followed by other the Central and the State Government Departments.
- These departments being large and pioneering departments of the Government of India, have experience in executing all types of construction projects, both in size and cost. Their establishments are spread all over the country.

Broadly, the methodology of the research study consisted of the following three steps.

- Data collection using a questionnaire survey approach,
- Analysis of data using appropriate multivariate statistical techniques, viz. factor analysis, two group discriminant analysis and multiple regression, and
- Legal case study.

### Data Collection

Several professionals were approached for data collection and for gaining information from their past experiences, in the construction contracts. A few Government representatives declined to give interviews stating that they were bound by the Official Secrets Act. However, they were ready to share their general views. Contractors, on the other hand, expressed their inability to respond stating that they retained records only for the current works and not for the completed works which were closed in all respects. Further, wherever data access was possible, it was found that organized information was not available for various contracts executed in the past.

Considering the above aspects, a mail questionnaire survey approach, where the respondents could be assured of the confidentiality of their responses, was used for data collection. This method also facilitated wider geographic coverage of the respondents. The questionnaire survey approach was adopted for data collection in two stages: (a) the preliminary stage, to identify the potentially problematic

***In general, construction contract clauses cannot be taken as completely independent of each other.***

clauses, and (b) the main stage, to gather detailed information on identified problematic clauses and related issues.

### **Preliminary Questionnaire**

The construction contracts considered for the study contain 72 clauses and many of them are not considered to be dispute prone. In order to identify only the potentially dispute-prone clauses for detailed study in the main questionnaire, a preliminary questionnaire was considered necessary. Since the questionnaire containing all the 72 clauses was quite lengthy and took more than two hours to complete, the survey was restricted to a smaller population. Of the 80 questionnaires sent, responses from 31 professionals (18 owner representatives and 13 contractors) were received and analyzed. Based on the rank order, indicating the decreasing order of contribution to disputes by various clauses, seventeen clauses falling in the top quartile were selected for further study.

### **Main Questionnaire**

The main questionnaire was intended for a larger study and was quite exhaustive. It sought information on the respondent's professional experience and organization; issues related to construction problems (such as delays) disputes due to contract clauses, and several reasons associated with disputes, ill effects of disputes, and cost overruns. Since the scope of this paper is limited to identification of dispute-prone clauses in the context of their common properties and the impacts, an extract of the relevant portions of questionnaire is presented in Appendix I.

### **Questionnaire Responses**

From the addresses available with the government offices, the Builders Association of India and through personal contacts, 380 professionals were identified and the questionnaires were sent to them in the first week of January 1995. All the professionals who were contacted had over 20 years of experience in the construction industry, and had direct association with defence/public works. The professionals included owner representatives (both active in service and retired) and contractors. A total of 150 responses were received which included responses from 95 owner representatives, 44 contractors and 11 retired government officials who were active as consultants with contractor organizations. The response rate was 39.5%.

The data from the responses were stored in a database and various analyses were performed using the SAS (1988) statistical software. Responses of consultants were not found to be significantly different, at 5% significance level using various statistical tests, either from that of owner representatives or of contractors. Also, since the sample size was small their responses were not considered for further analysis.

## **Identification of Underlying Properties of the Most Dispute-Prone Clauses**

As discussed earlier, most clauses have a bearing on each other and they are correlated among themselves in one way or other to form groups or families. One method for identifying like-natured clauses to form sets or groups could be on the basis of personal experience. There would be chances of bias in such studies as identification would be based on the individual's personal experience. To overcome this problem, this study used collective experience of professionals having immense experience in contract administration through a questionnaire survey and identified sets of like-natured clauses from the point of their dispute proneness using powerful statistical techniques that eliminated bias almost completely. For identification of underlying properties of dispute-prone clauses, three multivariate statistical techniques were used: factor analysis, two-group discriminant analysis and multiple regression.

Factor analysis provides a method for combining variables from among several variables considered in a study, into sets of variables, called a 'factor' or 'factor dimension' (both represent the same nomenclature and hence the word 'factor' will only be used later in the paper). The variables present in a set represent some common properties among them, which may not be expressed or otherwise obvious in the beginning of the study.

Factor analysis provides a method of combining the clauses into factors that are linear combinations of variables (the clauses) and independent of each other.

Two-group discriminant analysis was then performed to find out the relative importance of factors based on their discriminating powers between owner representatives and contractors. With the factors as defining characteristics and mean scores of the ill effects of disputes (Appendix II) as a criterion variable, multiple regression was then performed to find out the most problematic factor. The schematic diagram of the analysis along with the methodology for identification of dispute-prone factors is presented in Fig. 1. The various analyses are discussed in detail below.

### **Factor Analysis: Underlying Properties among the Clauses**

Factor analysis is a powerful method of statistical analysis that aims at providing greater insight of relationship among numerous correlated, but seemingly unrelated, variables in terms of a relatively few underlying factor variate (Overall and Klett 1972 and Dillon and Goldstein 1984). This technique is extensively used by psychologists as a variable reduction technique. Many researchers from other areas including politics, sociology, economics, human-machine systems, accident research, taxonomy, biology, medicine, and geology have also applied this technique (Child 1990). In construction management, Maloney and McFillen (1995)

*Factor analysis is a powerful method of statistical analysis that aims at providing greater insight of relationship among numerous correlated, but seemingly unrelated, variables in terms of a relatively few underlying factor variate*

have used this technique to identify various job characteristic differences between union and nonunion workers.

Factor analysis is usually employed for the following four purposes (Hair et al. 1990):

1. To identify a set of dimensions that are latent (not easily observable) in a large set of variables.
2. To devise a method of combining or condensing large number of people into distinctly different groups within a larger population.
3. To identify appropriate variables for subsequent regression, correlation or discriminant analysis from a much larger set of variables.
4. To create an entirely new set of a smaller number of variables to partially or completely replace the original set of variables for inclusion in the subsequent regression, correlation or discriminant analysis.

In the present study, factor analysis was employed for the applications 1 and 4 above. Important technical terms discussed to interpret the results of analysis are explained in Appendix III for greater clarity to readers. The terms, ‘variables’ and ‘observations’ referred below are the ‘seventeen clauses’ and the ‘responses of the individual respondents’ respectively.

*The five clauses together explain the powers of the owner representatives of factor-1 which they could exercise on the contractors in the event of necessity.*

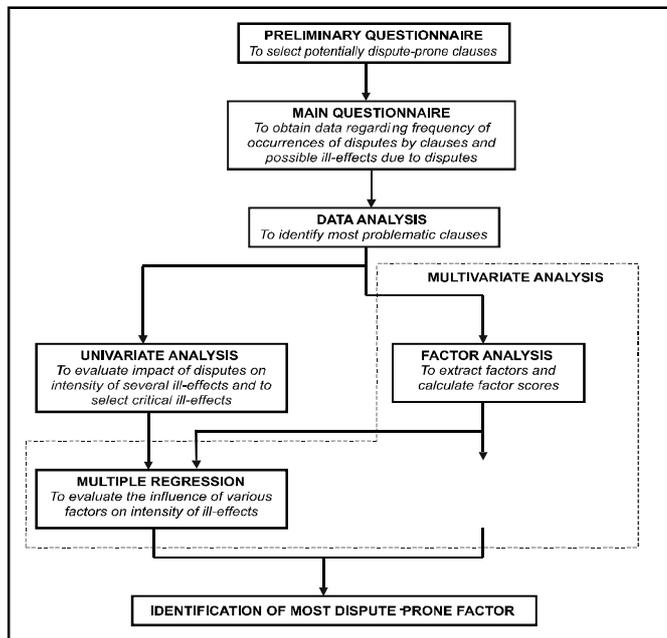


Figure 1: Schematic Diagram for Selection of the Most Dispute-Prone Factor

The total sample, i.e. responses from both owner representatives and contractors to all seventeen clauses for the question, ‘frequency of occurrence of disputes’, was subjected to factor analysis and four factors were extracted using the minimum proportion criterion. Initially, the extracted factors, which were all orthogonal to each other

in nature, were not amenable to interpretation. Therefore an oblique rotation of the reference axes, called varimax rotation, was performed. The derived factors and their corresponding loadings were then obtained. A summary of the rotated factor loadings matrix is presented in Table 1 under the column ‘All respondents’ responses.’ Factor loadings  $\geq 0.4$  are only shown in this Table. The four factors explained 57.3% of the total variance. Further, the communalities of all the variables were found to be much greater than 0.3, hence the factor model was reliable. Meanings assigned to these factors are given below.

**Factor-1**

The first factor, Factor-1 has high loadings for five clauses viz., ‘owner’s lien on withheld amount’, ‘post audit and technical examination’, ‘recovery of owner’s claim from any sum due to contractors’, ‘final and binding power’ and ‘where no specification exists’. The clause, ‘owner’s lien on withheld amount’ describes that whenever any claim arises out of the contract against the contractor, the owner has the authority to withhold a sum of money from any sum payable to contractor under the same contract or from the security deposit of the contract. Further, this clause also states that the owner will enjoy the lien on the withheld amount till the claim is settled through arbitration or in court of law, and the contractor shall not have any claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien.

The ‘post audit and technical examination’ clause explains that the owner (the Government) has the right to conduct audit and technical examination of the works and the final bills of the contractor even after payment of the final bill. In case any discrepancies are noticed during technical examination of the work, a recovery towards non-compliance of specification is recommended by the examiner and the contractor shall pay the same.

The ‘recovery of owner’s claim from any sum due to contractors’ clause describes that in case sufficient amount of the owner’s claim, including suggested recovery on account of defective work or overpayment, is not available in the contract, the claim can be recovered from the running bills of the same contract or bills of some other contracts (which may be with other organisation or employer), or from any other source. The source includes the banks or the financiers to the contractor.

The ‘final and binding power’ clause discusses the owner’s power to give decisions, which is an administrative authority of owner, which will be neither open to arbitration nor any court of law. Yet it is found that these decisions are being challenged both through arbitration and courts of law. This clause is applicable for : levying compensation on contractor in the event of delay in completion of the work, deciding the quantum of recovery while accepting

sub-standard work (but sound structurally), and in many other situations. Various situations which lead to disputes where this clause is the central point, will be discussed in the section on legal cases later in the paper.

The the where no specification exists clause describes that if there does not exist specification in the contract document for a particular work, the Engineer-in-Charge shall have the authority to decide the specification and get the work executed.

The common property through which the above five clauses are linked to each other is the 'owner's power'. However, if factor analysis had not been performed, the five clauses appear to be addressing different aspects of a contract on individual basis. For example, while 'owner's lien...' describes withholding of claim amounts, 'recovery from...' discusses the mode of realisation of the claim amounts from other sources, if sufficient money is not available in the current contract. As for underlying property causing disputes under these clauses, they appear to relate more with payment to contractor. 'Post audit and...' addresses the quality check of constructed facility or auditing of bills to check any overpayment. 'Final and binding...' and 'where no specification...' describe necessary administrative measures required to be taken by an owner representative to achieve the objectives of the contract. However, the five clauses together explain the powers of the owner representatives of factor-1 which they could exercise on the contractors in the event of necessity. Hence, the factor was named as 'Owners' powers'.

### **Factor-2**

In Factor-2, the clauses appearing are: 'suspension of work on default of contractor', 'time, delay and extension, and compensation for delay', 'completing unfinished work of contractor under risk and cost of original contractor due to defaults of contractor', 'rescission of contract on default of contractor' and 'foreclosure of work when it is no more required by owner'. All these clauses except the last one, explain various actions to be taken by the owner representative in case of contractors' defaults. Hence, the factor was named as 'Contractors' defaults'.

Looking at the descriptions of various clauses of the above two factors, all clauses appear to discuss owner's decisions or owner's powers in one way or the other. But there exists a distinct difference between the sets of clauses in the two factors which can be observed through a close scrutiny of the clauses. While the clauses of Factor-2 state various types of actions to be taken by the owners on the contractors' defaults, clauses of Factor-1 discuss mostly the owner's powers as a corrective measure of their own faults. For example, Factor-2 clauses state that: if the contractor delays..., or if the contractor fails to complete or rectify..., etc. Whereas from Factor-1 clauses it could be noticed that: if any overpayment is noticed at a later date..., or owner has

the right to audit and examine the work after final bill is paid (the work would have actually been approved and accepted by one of the owner representatives) and if any recovery is noticed..., etc. The distinction between the two types of owner's authorities discussed above is not obvious and can easily lead one to believe that all clauses possess the same property of owner's decisions, if no rigorous analysis had been carried out.

### **Factor-3**

The Factor-3 contains clauses: 'Foreclosure of work when it is no more required by owner, with due compensation for the work executed/material brought to site for execution of work, but without compensating for the loss of profit that the contractor might have earned from execution of full work', 'pricing of deviation/extra items.', 'compensation for price escalation using price indices' and 'preparation and payment of final bill' to contractor. All these clauses explain methods of pricing, interval of preparation of bills and various checks for payment to the contractor. Hence the name 'Payment

to contractors' was assigned to this factor. Incidentally, the clause, 'Foreclosure of...' appears to be associated more with Factor-1, the owner's power. This clause states that if at any time after commencement of the work, Government shall, for any reason whatsoever, not require the whole work as specified in the contract, the owner representative will give notice in writing and determine (i.e., foreclose) the work. This clause further states that the contractor shall not have any claim to payment of compensation on account of any profit or advantage that the contractor may have derived from the execution of entire work. However, the contractor would be paid for the items of work carried out by him at the tendered rates and for all materials brought to site for execution of work. Hence the appearance of this clause in Factor-3 gives an insight that the consequential effect of foreclosure, the loss of profit/payment to contractor is the main cause for disputes rather than the foreclosure by the owner. Similarly, 'pricing of deviation...' clause appears to be more associated with Factor-4 where other aspects of deviations have predominantly appeared. However, its appearance in Factor-3 indicates that the contentious issue behind this clause is 'payment to contractor' which is suspect to be subjective by both parties and finally leads to disputes.

### **Factor-4**

The clauses dominating in the last factor, Factor-4 are 'sub-soil data: owner does not take responsibility of correctness of data and contractor shall himself explore thoroughly at his own cost, before quoting', 'interpretation of contract in cases of ambiguity in various documents forming contract', 'deviation in foundation items' and 'deviation in super-structure'. All these clauses relate to deviations and discrepancies in a contract. Hence, the name 'Deviations and discrepancies' was assigned to this factor.

***Contractors' default, 'Payment to Contractor and 'Deviations and Discrepancies' represented other factors.***

From the above discussions, it is clear that if the clauses are to be grouped based on some common properties, and without any rigorous analysis like factor analysis, there may be many different combinations. Each property can subsequently be claimed to be responsible for disputes. Moreover, because of the interrelationship among various clauses, there are also possibilities of simultaneous appearance of the same clauses, in several groups, e.g., pricing of deviation can be cited in 'owner's power', or 'deviations and discrepancies', or 'payment to contractor'. Also it would be difficult to gauge the degree of predominance of individual clauses in defining the particular property. Whereas the factor analysis helped in evaluating the significance of individual clauses through their factor loadings in defining particular property-the factor. This analysis also helped in forming distinct groups with only one clause overlapping two factors.

Factor analysis was again performed on the seventeen variables for owner responses and contractor responses separately. Four factors were extracted in each case and then subjected to varimax rotation. Factor loading (loading  $\geq 0.4$ ) of various variables (i.e. clauses) obtained after varimax rotation, for both owner and contractor responses, are summarized in Table 1 under the columns 'Owner Responses' and 'Contractor Responses' respectively.

The dominant variables in Factor-1 in owner responses were found to appear in Factor-3 in contractor responses and the dominant variables in Factor-1 in contractor responses appear in Factor-2 in owner responses. This meant that the clauses, which were dominating in owner responses (Factor-1) and perceived to be contributing the most to common factors (i.e. explaining maximum variance among all extracted factors), were less dominating (Factor-3) in contractor responses. Similarly, the set of clauses (Factor-1) dominating in contractor responses were not so dominating (Factor-2) in owner responses. Although this implied that differences in perceptions existed between owner representatives and contractors about the extent of disputes caused by individual factors, this could not be conclusively stated without proper statistical tests.

Further, the factor analysis did not indicate which factor influenced the most in 'the occurrence of disputes'. It indicated only the grouping of like variables in a given factor, based on their concomitant variation among the variables. It was possible, therefore, that the first factor, in spite of explaining the maximum variance among the four factors, was the least dispute-prone and some other factor was the most dispute-prone.

Incidentally, each of the factors identified above has been discovered to be dispute prone by earlier researchers based on their professional experiences. For example, Chokshi (1978), Agarwal (1991) and Roy (1991) had pointed out that no finality in owners' decisions, or improper utilization of

owners' powers were great sources of disputes. While discussing various reasons for project overruns and disputes, Jergeas and Hartman (1994) and Saluja (1984) identified contractor's defaults as the primary cause for most overruns and disputes. Dennis (1991) maintained that if contractors' eventual payments were secure, then he was not prone to make the worst of any problem. Similarly, many other researchers have identified deviations and discrepancies as the root cause of most disputes (Fox 1974, Ibbs and Ashley 1987, Rau 1993).

Hence, in order to assess the dispute-proneness of individual factors, further tests were necessitated. Factor scores were then calculated from the factor loadings matrix of rotated factors and employed in performing discriminant analysis and multiple regression as discussed below.

### ***Discriminant Analysis: Differing Perceptions***

Discriminant analysis is a statistical technique for classifying individuals or objects into mutually exclusive groups on the basis of a set of independent variables.

Several applications of this technique have been reported by researchers in the areas of psychology, medicine, marketing

research and business (Dillon and Goldstein 1984; Overall and Klett 1972; Gau 1978). Hair, et al. (1990) have pointed out the following applications of discriminant analysis.

1. To determine if statistically significant differences exist between the average score profiles of the two (or more) a priori defined groups.
2. To establish a procedure for classifying statistical units (individuals or objects) into groups on the basis of their scores on several variables.
3. To determine which of the independent variables account for the differences in the average score profiles of two or more groups. In other words, this analysis reveals which of the specific variables in the profile account for the largest proportion of inter-group differences.

In the present study, two-group discriminant analysis was performed for the applications 1 and 3 above. Generally, the differences in opinions between two people about any matter can be regarded as sources of disputes. Accordingly, the objective of applying this technique in this study was to determine if there existed significant differences of opinion between owner representatives and contractors about the factors and if differences existed, which of the factors accounted for the differences?

Factor scores as obtained from the combined responses of owner representatives and contractors (i.e., corresponding to 'All Responses' in Table 1) were used to find the mean scores profiles of the owner and the contractor responses and to determine the pooled variance-covariance matrix. Results of the analysis are summarized in Table 2. The Z statistic (Overall and Klett 1972; Dillon and Goldstein 1984) as

***The differences in opinions between owners and contractors about any matter is regarded as sources of dispute and hence discriminant analysis performed***

Table 1 : Factor Loadings of Potentially Dispute-Prone Clauses on Various Factors

Clause Number (1)	Brief Description of Clauses(for detailed descriptions refer Appendix I) (2)	All Responses				Owner Responses				Contractor Responses			
		Factor-1 (3)	Factor-2 (4)	Factor-3 (5)	Factor-4 (6)	Factor-1 (7)	Factor-2 (8)	Factor-3 (9)	Factor-4 (10)	Factor-1 (11)	Factor-2 (12)	Factor-3 (13)	Factor-4 (14)
1	Sub-soil data: owner does not take any responsibility...				0.54			0.63					0.58
2	Interpretation of contract in case of ambiguity				0.42					0.53			
3	Deviation in foundation without deviation limit				0.73			0.66					0.78
4	Deviation in super structure				0.72			0.72					0.82
5	Suspension of work		0.61			0.61							
6	Time, delay & extn. and compensation for delay		0.53			0.46						0.76	
7	Completing unfinished work under risk and cost		0.86			0.83						0.85	
8	Rescission of work		0.87			0.87						0.86	
9	Foreclosure of work		0.58	0.46		0.73					0.59		
10	Pricing of deviation/extra items			0.74					0.61		0.83		
11	Price escalation			0.72					0.66		0.77		
12	Prep. and payment of final bill			0.64			0.48				0.76		
13	Owner's lien on amount	0.69					0.74			0.46	0.46		
14	Post audit and technical exam.	0.78					0.76			0.81			
15	Recovery of owner's claims	0.73					0.59			0.83			
16	Decisions under final powers: not referable to arbitration	0.63					0.50			0.77			
17	Where no specification exists	0.56				0.44				0.85			
Varimax rotation	Variance explained/Eigen value	2.918788	2.851366	2.024707	1.941375	3.174728	2.426722	1.938265	1.277902	3.880654	2.969112	2.589562	2.061842
	Proportion of total variance	0.171693	0.167727	0.119100	0.114199	0.186749	0.142748	0.114016	0.075171	0.228274	0.174654	0.152327	0.121285
	Cumul. Prop. of total variance	0.171693	0.339421	0.458521	0.57272	0.186749	0.329497	0.443513	0.518683	0.228274	0.402927	0.555255	0.676539

Note: Factor loading ≥ 0.40 are only shown in the table.

Table 2 : Summary Results of Two Group Discriminant Analysis Evaluating the Discriminating Powers of Factors

Factors (1)	Means in owner responses* (2)	Means in contractor response* (3)	Difference (Col 2-Col 3) (4)	Discriminant coefficient (5)	Product 1 (Col 2* Col 5) (6)	Product 2 (Col 3 * Col 5) (7)	Product 3 (Col 4 * Col 5) (8)	Percentage discriminated (Col 4 / D <sup>2</sup> ) *100 (9)	Rank on decreasing value of discrimination (10)
Factor-1	-0.040031	0.176428	-0.216459	-0.190489	0.007626	-0.033608	0.041233	4.24	4
Factor-2	0.171438	-0.346144	0.517582	0.712109	0.122083	-0.246492	0.368575	37.90	1
Factor-3	-0.202801	0.280433	-0.483234	-0.746708	0.151433	-0.209402	0.360834	37.10	2
Factor-4	-0.124612	0.268825	-0.393437	-0.513202	0.063951	-0.137962	0.201913	20.76	3
<b>Total</b>					<b>0.345093</b>	<b>-0.627462</b>			
Point of separation = {42*(-0.627462) + 91*0.345093} / (42+91) = 0.03796 Mahalanobis D <sup>2</sup> = 0.345093 - (-0.627462) = 0.972556 and Z = 6.827 (>2.44, the F value for d.o.f. 4, 129 at a=5%)									

\* Owner responses = 91 Contractor responses = 42

calculated from the formula given below, and was applied to determine whether between-group differences in mean scores profiles were significantly different. This, in turn, indicated significance of the discriminant model as a whole, given by

$$Z = \frac{n_1 \cdot n_2}{n_1 + n_2} \times \frac{n_1 - n_2 - p - 1}{(n_1 + n_2 - 2)p} \times D^2$$

where,

n<sub>1</sub> = number of contractor responses,

n<sub>2</sub> = number of owner responses,

p = number of variables (the 4 factors), and

d<sup>2</sup> = Mahalanobis's generalized distance (It is a distance between the centroids (means) of two object scores in

standardized form. Factor scores obtained earlier were used to compute this value.)

The computed Z value for the model was 6.83. The Z follows an F distribution with p and n<sub>1</sub>+n<sub>2</sub>-p-1 degrees of freedom and its computed value was found to be greater than the theoretical F value (2.44), for the given degrees of freedom at 5% significance level. Hence, the model was statistically significant which indicated that the factors (the explanatory variables) used in the model adequately explained the group differences.

The results of the analysis (Table 2) indicated that Factor-2 discriminated the most, followed by Factor-3, in the responses of owners and contractors. These two factors

revealed about 75% discrimination exhibiting maximum differences of perceptions about these two factors, between owners and contractors. If differing perceptions were the criteria to select the most dispute causing property of the clauses, the obvious choice would be Factor-2 followed by Factor-3. On the other hand, the Factor-1, which dominated among all factors explaining maximum variance, was found to possess the least discriminating power explaining only 4.2% discrimination. This percentage exhibited least differences in perceptions between owner representatives and contractors (or in other words, the similarity of opinions) about Factor-1.

At the end of the factor analysis the question remaining was : whether Factor-1 explaining the maximum variance was the most dispute-prone or the least dispute-prone? The discriminant analysis indicated that the Factor-1, explaining the maximum variance was the least dispute-prone. Following the similar logic, Factor-4, which explains the minimum variance among the four factors, should have been the most dispute-prone followed by Factor-3 and Factor-2. However, the results of the discriminant analysis were different. Hence before concluding about the dispute-proneness of factors, further probing was required. Multiple regression was used for this purpose.

**Multiple Regression Analysis: Disputes Versus their Ill-Effects**

Regression analysis is primarily concerned with estimating and/or predicting the population mean values of a dependent variable on the basis of the known values of one or more explanatory variables. This technique has been used extensively by researchers in the area of sciences, social sciences, economics, management and engineering. In this study, multiple regression analysis was used for the limited purpose of identification of the factors most responsible for occurrence of disputes in construction contracts.

*In this study, multiple regression analysis was used for the limited purpose of identification of the factors most responsible for occurrence of disputes in construction contracts.*

Factors were considered as the explanatory variables and the effects of disputes (Appendix II) as the criterion variable in the multiple regression. Factor scores, obtained after varimax rotation, represented the values of factors, and the mean scores of all eight effects of individual responses were considered as the corresponding values of the criterion variable. The results are summarized in Table 3.

It was found from the parameter estimates (Table 3) of the regression equation that Factor-1 was the most significant among all the factors with coefficient of variable as 0.13142 and a p-value (Pr>|t|) = 0.0548. But since the F value was low (Pr>F = 0.1619), the regression as a whole could not be considered significant.

On further investigation, it was found that the criterion variable, which represented the ill effects of disputes through mean scores of responses to all the eight effects

Table 3 : Summary Results of Multiple Regression between Factors and Mean Scores of Extent of all Ill-effects Caused by Disputes

Factors considered	Parameter estimates	t for H <sub>0</sub> : Parameter=0	Pr >  t	R <sup>2</sup>	Pr > F for regression as a whole
(1)	(2)	(3)	(4)	(5)	(6)
	A=24.5868	49.95	0.0001		
Factor-1	1.0513	1.94	0.0548		
Factor-2	0.5495	1.04	0.3019	0.0473	0.1619
Factor-3	-0.0075	-0.01	0.9891		
Factor-4	0.5713	0.98	0.3287		

\* Intercept of regression equation.

listed in the questionnaire, did include a few effects which were not considered to be caused by the disputes. The individual mean values of effects numbered 3, 4, 5 and 6 (Appendix II) were either significantly less than 3.0 or significantly not different from 3.0. This indicated that respondents were not in agreement with the facts that these effects were caused by the disputes in construction contracts. Hence, discarding responses to effects numbered 3, 4, 5 and 6, another iteration of multiple regression was performed.

Several iterations of stepwise regression were carried out considering fewer factors at a time. The important results are summarized in Table 4 as cases I to IV. Elimination of scores of four effects (effects numbered 3, 4, 5 and 6) from the criterion variable scores did improve the regression with regard to both the R<sup>2</sup> value and the F value. However, the p-value (Pr>F) was observed to be greater than 0.05 in all the cases studied in the stepwise regression (Table 4). Hence, none of the regressions could be considered significant at a 5% significance level whereas a few were significant at a 10% level.

Table 4 : Summary Results of Multiple Regression between Factors and Mean Scores of Extent of Selected Ill-effects Caused by Disputes

Case no	Factors considered	Parameter estimates	t for H <sub>0</sub> : Parameter=0	Pr >  t	R <sup>2</sup>	Pr > F for regression as a whole
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I	Factor-1	A* = 13.4678 0.6826	54.85 2.51	0.0001 0.0132	0.0586	0.0843
	Factor-2	0.3153	1.21	0.2279		
	Factor-3	-0.1793	-0.65	0.516		
	Factor-4	0.0297	0.1	0.9189		
II	Factor-1	A* = 10.2392 0.3946	53.91 1.91	0.0001 0.0588	0.0338	0.0949
	Factor-2	0.199	0.99	0.3246		
III	Factor-1	A* = 10.2486 0.4354	54.02 2.09	0.0001 0.0384	0.0367	0.0775
	Factor-3	-0.2487	-1.18	0.2411		
IV	Factor-1	A* = 10.2422 0.4041	53.94 1.95	0.0001 0.0528	0.0269	0.0528

\* Intercept of regression equation.

Further,  $R^2$  values in all cases, including the case described in Table 3, were found to be quite low. Normally three reasons are attributed to low values of  $R^2$ : noise factor, sampling error and variable selection. Explanation of these reasons with reference to the present study could be as follows.

**Noise factor:** Since several iterations of stepwise regressions were performed, keeping a few variables at a time and the  $R^2$  value had been consistently low, the influence of noise factor was ruled out.

**Sampling error:** Possibility of this error could not be ruled out as responses from professionals having varied background, in terms of types and sizes of projects they had executed, were sought. However, since the sample size was large, the effect of this error may not be significant.

**Variable selection:** probably this reason was the most responsible factor for low  $R^2$  value. This may be due to certain key variables missing in the study. From the low  $R^2$  value it was concluded that the criterion variable, represented by 'ill effects', depended not only on the disputes due to contract clauses but also on other reasons (characteristic variables), including disputes, due to other causes than only the clauses, which were not included in the study. This could be considered as a limitation of this study.

Since this technique was used for limited application of identification of most significant dispute-prone factor from among the four factors and not for carrying out any advanced predictions, the results of analysis at 10% significance level, were-relied upon. Accordingly, based on the t-values and coefficients of variables of regression parameters, it was concluded that Factor-1 had the greatest potential to cause disputes among all factors.

It can be further seen from the summary results of multiple regression given in Table 4 (Case I) that Factor-2 and Factor-3, which explained the maximum differences between owner and contractor responses, are not so significant (Col 5) in causing disputes. It is Factor-1, which exhibited the least differences between owner and contractor responses, that is the significant factor in the regression (Col 5). The two analysis techniques, the two group discriminant analysis and the multiple regression, together lead to conclude that both owner representatives and contractors have collectively expressed that 'owner's power' is the most significant in causing contract dispute. Also based on coefficient of variables in Case I regression (Col 3 in Table 4), it can be concluded that the next important factor in the regression is Factor-2, followed by Factor-3 and Factor-4.

### Legal Case Study

Most construction contracts in India have arbitration agreements for settlement of disputes. Since the arbitration awards are not publicized due to ethical reasons, they are

not available for study. However, these awards can be challenged by the aggrieved parties on specific grounds in the courts of law (the parties here are not necessarily the contractors alone, but they can also be the owners). Again, the parties, if dissatisfied with the judgment of the court can file appeal in the next higher court with special leave from the lower court, up to the Supreme Court (the Apex court of the land). The law reporters publish only those cases which are heard and settled by the Supreme Court, or High Courts. Hence, the number of cases pertaining to construction contract disputes appearing in the law reporters is very few when compared to actual number of disputes arisen.

Moreover, these courts being appellate courts deal only with questions of 'law' (i.e. if any error of law has crept in the previous judgment for which it has been appealed) and they do not deal with questions of 'fact' or 'evidence'. Hence the cases are not easily comprehensible to engineers and many times the judgments appear confusing and very often it is difficult to trace the actual clause(s) dealt/

***The law reporters publish only those cases which are heard and settled by the Supreme Court, or High Courts. Hence, the number of cases pertaining to construction contract disputes appearing in the law reporters is very few when compared to actual number of disputes arisen.***

discussed in the specific cases. However, with the background of the survey analysis results, which helped in a great way to understand the court cases more clearly, 42 cases were studied. Though the scope

of the questionnaire survey was restricted to only two departments, CPWD and MES, case studies were not confined to disputes arising in the CPWD or MES contracts only. They included other Central and State Government organizations. Most of the cases studied were reported in the Arbitration Law Reporter (Arb L R) between 1983-93.

It was found from the case studies that disputes connected with decisions under 'final and binding power' were the most frequent (18 times) followed by 'time, delays and extension' (13 times), 'rescission of contract' (11 times: includes completing unfinished work of contractor under 'risk and cost' of contractor (5 times)), finalizing rates of 'deviation and extra items' by owner representatives (8 times) and definition of deviation limit/scope of work (4 times). It should be noted here that more than one clause were invoked simultaneously in some specific court cases and therefore, total count of invocation of clauses would not match with the number of cases studied. For example, when there were delays in completing work caused by the contractors, the owner representatives invoked one or more of the three clauses: 'levy compensation' for delay, 'rescission of contract', and 'risk and cost' for getting the remaining work completed through other contractors under the risk and cost of the original contractor.

The clauses 'time, delay and extension, and compensation', 'rescission of contract', and 'completing work under risk and cost', although actually dominate in Factor-2, as given in Table 2, the 'final powers' prerogative exercised by the owner representatives has governed decisions which have led to disputes regarding the three clauses. Similarly, on a few occasions, owner representatives

using their final powers, reduced rates of certain items that did not conform to contract specifications. Then contractors raised disputes claiming that since mutually accepted substituted items were used, the recoveries were irregular and illegal. Although such disputes are apparently related to Factor-3, 'payment to contractors', or Factor-4, 'deviations and discrepancies', their root cause has been traced to be the decisions taken by the owner representatives under their 'final powers'.

Interestingly most disputes, directly or indirectly, revolved around decisions taken by owner representatives under their final powers, which were neither acceptable to contractors nor referable to arbitrators or any court of law. It was confirmed from the court judgments where several appeals pertaining to disputes arising out of decisions of owner representatives under their final and binding power were rejected. This further indicates that although the dispute-prone clauses have appeared predominantly in Factor-2, Factor-3 or Factor-4 (based on the selection criterion of factor loading  $\geq 0.4$ ), they do possess some of the properties exhibited by Factor-1, i.e. 'Owners' powers', and contribute to factor score of Factor-1. Hence, the frequency of invoking certain clauses comprising a factor cannot be construed as being indicative of their being most dispute-prone. This fact is further strengthened from the results of the regression analysis, which showed that Factor-2 or Factor-3 or Factor-4 were not significant either in their coefficient values or t-values. However in case-I (Table 4), they collectively improved the characteristics of Factor-1, both in its coefficient value and t-value. Hence, it could be concluded that the latent property, 'Owners' powers' of the problematic clauses represented by Factor-1 is the main source of most disputes and the 'final and binding power clause' is the most dispute-prone clause.

The legal case study ruled that 'final and binding power' clause is not defective in its wording, but it is the subjective decisions of owner representatives due to 'their lack of knowledge regarding the legal implications of their decisions' or 'playing safe attitude to avoid criticism', which is the root cause of disputes in construction contracts.

### Operational Flexibility in Contract Administration

Subsequent to the legal case study, a few professionals having a large experience in construction industry were approached to know their reactions on the findings. They also accepted the conclusions to be right and they added that the owner's or the contractor's attitudes to distort the language of the contracts and interpret for their personal gain (commonly called as reading between the lines) and their adamant and rigid attitude in going by the 'content' of the contract rather than 'intent' of the contract was the main source of dispute. These disputes remain unresolved for decades. If a good contract administration guidelines were prepared and implemented and the parties tried to look beyond their personal gains and understood the 'intent' of the contract, then there would be drastic reduction in the

occurrence of disputes. Contract clauses should be regarded only as the tools at the hands of operators. It is the parties who are the operators and handle them. Having recognized that certain clauses are dispute-prone, these clauses should be invoked and used sparingly. One should adopt other possible methods of achieving project objectives and exercising of powers, vested in owner through these clauses, only as a last resort. This can be achieved only if flexibility in administration of contract is adopted. If this flexibility is adopted, it would also build confidence in the minds of contractors and motivate contractors to be reasonable while submitting their claims. Thus the operational flexibility brings the flexible attitude of parties and paves a path of win-win situation between the two parties of conflicting interests. Comments of the professionals matched with the findings of the authors in a paper (Iyer et al. 2001) where they have addressed problems arising out of unreasonable or rigid attitude of parties.

### Summary and Conclusions

The present study aims at developing a systematic and quantitative procedure for identifying dispute-prone clauses from a construction contract through recognizing the latent underlying properties among them. Under the

***It was found that most of the disputes were centered around the clause, 'final and binding powers'.***

Indian conditions of contract administration, it was found that organized data of completed projects were not available for the study, either with owner organizations or with contractors. A questionnaire survey approach was therefore, considered for data collection. Based on a preliminary questionnaire survey, 17 potentially problematic clauses were selected from among 72 clauses. A methodology, using three multivariate statistical analysis techniques, viz. factor analysis, two group discriminant analysis and multiple regression was developed to analyze responses pertaining to the 17 clauses in relation to their impacts on occurrence of disputes.

Through application of factor analysis 17 clauses were transformed into four independent factors: 'owner's powers', 'contractors' defaults', 'Payment to contractors' and 'Deviations and discrepancies.' These factors indicate the underlying properties of dispute prone clauses. To establish relative importance of factors as determinants of the occurrences of disputes, two-group discriminant analysis and multiple regression were performed using factor scores obtained from factor analysis. While discriminant analysis indicated that the two factors, 'contractors' defaults' and 'payment to contractor' exhibit maximum differences between owner and contractor responses, the multiple regression established that the factor, 'owner's power' was the most significant in causing disputes. Interestingly, both owners and contractors have expressed similar opinion about the factor, 'owner's power' which can be seen from the discriminant analysis results. Appearance of 'owner's power' as the most dispute-prone factor in lieu of Factor-2 or Factor-3 also demolished the general myth that differences in perceptions is the root of all disputes, at least in the context of the Indian contracts.

Moreover, the above results being the outcome of collective responses from 150 professionals having long and rich experiences, and application of multivariate statistical techniques significantly eliminated personal bias in the results. Following the survey and analysis, legal case study of 42 cases pertaining to construction contract disputes arising out of contract clauses and personal interviews with seasoned professional were undertaken. This gave greater insight to the findings of above stated methodology and established the reliability of analysis results. It was found that most of the disputes were centered around the clause, 'final and binding powers'. The decisions given under this clause are final, binding and conclusive on both parties and neither referable to arbitration nor to any court of law and, accordingly, appeals pertaining to disputes arising out of decisions under this power are rejected by courts.

Further probing into the cases revealed that the subjective decision of owner representatives due to their 'lack of legal knowledge regarding the implication of their decisions' or 'playing safe attitude to avoid criticism', and the rigid attitude of parties to contract are the root cause of disputes. The clause, 'final and binding powers' is not defective in its wording. Hence good contract administrative guidelines are required to be formed to bring in more operational flexibility in the contract administration and implementation. Owner representatives should be trained to take proper administrative measures to prevent/resolve dispute and both parties should be encouraged to be more flexible in their attitude and stand.

Finally, the results of this study also demonstrate that even if documented information of completed projects are not available for study, the methodology employed in this research could be incorporated in identifying dispute-prone clauses from any contract worldwide.

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Appendix I : Extract from the Main Questionnaire Addressing Question on Frequency of Occurrence of Disputes due to Potentially Dispute-Prone Clauses

Brief description of contract clauses	Frequency of occurrence of disputes due to the clauses				
	1	2	3	4	5
1. SUB-SOIL DATA: Owner does not take any responsibility regarding nature of soil/correctness of data furnished with the tender. Tenderer shall himself explore thoroughly at his own cost, before quoting.	1	2	3	4	5
2. INTERPRETATION of contract based ON GIVEN ORDER OF PRECEDENCE in case of ambiguity/discrepancies among various documents forming contract.	1	2	3	4	5
3. DEVIATION IN FOUNDATION (without specific deviation limit as given in the CPWD contract forms).	1	2	3	4	5
4. DEVIATION IN SUPER-STRUCTURE WORK.	1	2	3	4	5
5. SUSPENSION OF WORK on default of contractor	1	2	3	4	5
6. TIME, DELAY & EXTENSION and COMPENSATION FOR DELAY/LIQUIDATED DAMAGES.	1	2	3	4	5
7. Completing the unfinished work/rectification of defects, etc. under RISK AND COST of contractor after serving due notices.	1	2	3	4	5
8. RESCISSION/CANCELLATION OF WORK on default of contractor.	1	2	3	4	5
9. FORECLOSURE OF WORK when it is no more required by owner WITH due compensation for mobilization of resources, for materials procured, etc. BUT WITHOUT the profit that the contractor may have derived from execution of work in full.	1	2	3	4	5
10. PRICING OF DEVIATION/EXTRA ITEMS as per relevant clauses of contract.	1	2	3	4	5
11. Compensation for PRICE ESCALATION using price indices/wages.	1	2	3	4	5
12. Preparation and payment of FINAL BILL.	1	2	3	4	5
13. OWNER'S LIEN ON WITHHELD AMOUNT.	1	2	3	4	5
14. POST AUDIT and TECHNICAL EXAMINATION.	1	2	3	4	5
15. RECOVERY of owner's for payment of certain sum FROM ANY SUM DUE TO CONTRACTOR either from running bill or any other bill.	1	2	3	4	5
16. Decision under FINAL POWERS OF OWNER: not acceptable to contractor and not referable to arbitration.	1	2	3	4	5
17. Where no specification: LOCAL/DISTRICT SPECIFICATION to be followed/Engineer-in-Charge's decision is final.	1	2	3	4	5

LEGEND : 1. Always                      2. Very often                      3. Often  
 4. Sometimes                      5. Never

Note : Scale reversal was carried out during analysis stage to maintain consistency with other responses in the questionnaire.

Appendix II : Extract from the Main Questionnaire Pertaining to Effects of Disputes in a Project/ Work and their Analysis Results

Extract from the questionnaire						Summary statistics of responses		
Effects due to disputes on		Intensity				Mean value	t-value for H0: m = 3.0	Pr > t
(1)		(2)				(3)	(4)	(5)
1. Wastage of time, money and efforts during progress of work.	1	2	3	4	5	3.41*	4.34	0.0001
2. Wastage of time, money & efforts after progress of work.	1	2	3	4	5	3.49*	5.17	0.0001
3. Chances of abandoning the work by contractor	1	2	3	4	5	2.75	-2.60	0.0104
4. Chances of suspension/ rescission of work by owner.	1	2	3	4	5	2.54	-4.86	0.0001
5. Chances of adversarial relationship developing between contractor & owner.	1	2	3	4	5	3.12	1.17	0.2432
6. Decrease in motivation of owner in completing the work.	1	2	3	4	5	2.64	-3.68	0.0003
7. Decrease in motivation of contractor in completing the work.	1	2	3	4	5	3.36*	4.10	0.0001
8. Chances of mark up in bid amount by contractor in future works (with the particular owner).	1	2	3	4	5	3.24*	2.35	0.0202

Legend : 1 : Very low                      2 : Low                      3 : Neither low nor high  
 4 : High                      5 : Very high

\* Indicates significantly high intensity on effects listed in column (1) due to disputes in two tail t-test at a = 5%.

Appendix III : Definitions of Important Statistical Terms Used in the Text

**Factor loadings:** The factor loadings represent the correlation between original variables and the factors. They can be conceived as projections on orthogonal reference axes representing factors and the squared factor loadings indicate what percentage of variance in the original variable is explained by a factor. The factors are interpreted based on the various variables dominating in the factor and this dominance is represented by the factor loadings of individual variables. Thus factor loadings become key to understanding the nature of a particular factor.

**Common factor vectors:** "A useful analogy is a half-open umbrella where the radiating frame gives the directions of the test vectors and the handle is used as a reference vector. These lines of reference needed for resolution of test vectors are referred to as common factor vectors or simply factors" (Child 1990).

**Rotation of factors:** All the factors extracted are initially orthogonal to each other and are completely independent of one another. They are usually not amenable to interpretations. Therefore rotations of factor axes are performed. The object of rotation is to increase the magnitude of loadings for certain variables, while at the same time decreasing their cross-factor loadings. In general, variables that load highly on one factor should have minimum loadings on the other, insofar as possible (Overall and Klett 1972). Rotations of axes are mainly of two types, viz. if after rotations, orthogonality of various pairs of axes are retained as orthogonal they are called orthogonal rotation, or else they are called oblique. However, the rotation to be employed in any study is problem dependent. The rotation employed in the present study is varimax rotation.

**Communality:** It explains the amount of variance an original variable shares with all other variables included in the analysis. If the values of communalities of individual variables are too low, say in the region of 0.3, it could well mean that the test is unreliable and that variables exhibit more of unique properties, i.e. not common with other variables (Child 1990).

**Factor scores:** Factor scores are composite measures of factors that represent the status of each subject or observation on the factors. They are usually defined as weighted combinations of several original variables. For further analyses, say discriminant analysis, multiple regression, etc., where factors are taken as new representative variables, in lieu of original set of variables, these scores are used as data points in performing analyses.

**Flexibility Mapping : Practitioner's Perspective**

1. Which variants of flexibility do you envision in a practical situation of a "Dispute Prone Contract Clauses " 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.
2. Identify and delineate the types of flexibility appropriate for reducing dispute-prone contract clauses and increasing operational flexibility in your organization. On which planes does the flexibility needs to be enhanced ?
3. Attempt mapping the flexibility in contract administration in your organization on the following continua. (Please tick mark in the appropriate box(es)).

	The owner's Interest Clauses		
Completely Rigid		Completely Flexible	
	The Contractor's Interest Clauses		
Completely Rigid		Completely Flexible	
	Transparency in Information Available		
Completely Rigid		Completely Flexible	
	Operational Flexibility in Contract Administration		
Completely Rigid		Completely Flexible	

4. Develop a SAP-LAP (Situation Actor Process-Learning Action Performance) model of *Dispute-Prone contract clauses - A basis for operational flexibility in contract administration* of your organization.

**Reflecting Applicability in Real Life**

1. Implement the methodology for reducing the frequency of occurrence of disputes discussed in this paper in your organization.
2. Identify the underlying characteristics of the most dispute-prone clauses of the contract administration in your organization.

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**GIFT** (Global Institute of Flexible Systems Management) is a professional society to enhance “flexibility” in business and management.

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To evolve and enrich the flexible systems management paradigm for the new millennium.

### **Vision**

Evolving as a global forum for interaction of all interested professionals and organisations in a truly flexible mode so as to help them create more options, faster change mechanisms and greater freedom of choice in their own settings.

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#### **Correspondence :**

All correspondence and membership applications may be addressed to the Manager of the institute at the following address:

**Ashish Jain**  
Global Institute of Flexible Systems Management (GIFT)  
S-15, LSC, DDA Commercial Complex  
Mayur Vihar, Phase-I,  
Delhi - 110 091