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Flexibility and Productivity

How flexibility and productivity are related to each other

Is there a relationship between the two key performance variables of any enterprise, i.e. flexibility and productivity? If yes, what is its nature? Does it mean that greater flexibility implies lesser or higher productivity? These are some of the bubbling questions in the mind of any manager or management researcher.

A normal proposition is flexibility hampers productivity by reduced output and requirement of more input

Normally, it is argued that, as flexibility implies more options, change mechanisms and freedom of choice, it would be hampering the productivity both by way of reduced output and more inputs for more options. This proposition can be examined from two viewpoints: one from the output point of view and the other from the input.

Let us compare the output of a mass manufacturing system and a flexible manufacturing system

Less flexibility means more apparent productivity of undesired output, whereas more flexibility will facilitate more real productivity of the desired output

By considering the output, as the main variable, do we see that the output of a less flexible system is higher than a more flexible system. Let us consider two manufacturing systems: (i) a mass manufacturing dedicated assembly line; and (ii) a flexible manufacturing system able to handle many models/products. In which case, the output is expected to be higher in terms of number of products manufactured per day? Obviously, one would argue that in the case of a dedicated system the output would be higher as there are no changeover times required in between. But, in reality, we require many models to be produced as per the customer requirements and manufacturing more of only one model would not serve the purpose. If more than one model is to be produced on the dedicated assembly line, it would entail loss of set-up time as with every change of model a new set-up is to be created. Whereas, in case of a flexible manufacturing system many models can be processed simultaneously thereby having more desirable output and thus more productivity in real sense. Thus, with less flexibility apparently the productivity is high but more of undesired output, whereas more flexibility facilitates more real productivity of desired output.

Normal assumption is that a dedicated system requires less inputs and is more efficient

A flexible system may better cope with uncertainty of demand leading to less inputs per unit of output

Let us examine the same issue from the viewpoint of input required in a less flexible and more flexible system respectively. Normally, it is assumed that a dedicated mass manufacturing system with special purpose machines/assembly lines would be more efficient and would require less inputs of manpower and machines per unit product. In a dedicated system, dealing with one product, the production stages are well balanced and the skill levels of workers are quite high as the job is repetitive in nature. On the other hand, a flexible manufacturing system, dealing with multiple products at a time, would require higher inputs of technology and multiskilling on the part of the workers. Thus, on the face it appears that the productivity level of a less flexible system would be higher on account of lower inputs. However, in real terms it need not necessarily be so, because a dedicated system might be lying idle if the demand of that specific product is low, thereby having higher input costs per unit of output produced. Whereas, since a flexible system is dealing with variety, it may be able to better cope with uncertainty of demand, thereby having higher capacity utilization in real terms leading to higher productivity by way of less inputs per unit of output.

In an uncertain and dynamic environment, the real productivity of a more flexible system is expected to be higher than a less flexible system

Thus, from the above discussion it can be concluded that though the apparent productivity of a less flexible system may be higher than a more flexible system in a stable environment, in real terms the situation would be reverse in an uncertain and dynamic environment, i.e. the real productivity of a more flexible system is expected to be higher than a less flexible system from both the points of the view of the output and the input.

Sushil
Editor in Chief

Global Journal of Flexible Systems Management

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Guidelines for Authors

Aim

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

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

Scope

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

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

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

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Text: The main text should be more readable and mathematical models, if any, should be provided in Appendix. The ideas proposed should preferably be supported by real life case examples from business situations.

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For journals: surname, initials, (year) title, *journal*, volume (number), pages.

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A Decision Support System for Flexibility in Manufacturing

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Abstract

Performance modeling and evaluation of manufacturing systems help decision makers at higher levels to conduct an economic feasibility analysis for expansion/diversification of the system. Manufacturing system design, with flexibility and related issues, is a complex phenomenon, which is concerned with the selection from a wide variety of available system configurations and control strategy alternatives in the light of several criteria (flexibility, quality, productivity, costs etc.), many of which are difficult to quantify. For evaluation and selection of manufacturing systems here an attempt has been made through a decision support system by developing and combining models such as integrated manufacturing performance measurement, multi-criteria evaluation and ranking, and a knowledge based expert system approaches. The usefulness of the proposed decision support system for flexibility in manufacturing is demonstrated through a sample session.

Keywords : flexibility, FMDSS, productivity, quality

Introduction

Performance modelling and evaluation of flexible manufacturing systems (FMS) helps decision makers at higher levels to conduct an economic feasibility analysis for expansion/diversification of the system. Also, this could help in installing a new manufacturing system with a substantial reduction in the number of machines, floor space, inventory level, throughput and lead time and also high quality products, with a greater flexibility to respond to the market needs (Kakati and Dhar, 1991). Flexible manufacturing systems design is a complex phenomenon, which is concerned with the selection from a wide variety of available system configurations and control strategy alternatives in the light of several criteria (flexibility, quality, productivity, costs etc.), many of which are difficult to quantify (Borenstein et al., 1999).

Justification and implementation of advanced manufacturing technology (AMT) involve decisions that are crucial for the practitioner regarding the survival of business in the present day uncertain manufacturing world. Since advanced systems require huge capital investments and offer large number of intangible benefits such as flexibility, quality, competitiveness, customer satisfaction etc., which are ill structured in nature and sometimes very difficult to quantify. Basically, the justification and implementation of AMT is a very difficult question to answer because:

- Profitability and survival of a manufacturing firm depends upon accommodating fluctuating product demands, day-to-day technological advancements, and competition from and among different firms. Flexibility plays a vital role for operation in such a scenario. To meet the objective, various manufacturing flexibilities need to be measured to evaluate and select a desired flexible manufacturing system.
- Organizations should act to improve performance in critical areas. To help in such decision-making, an integrated manufacturing performance measurement in terms of both well structured costs like productivity and ill-structured costs like quality and flexibility is essential. This would help in, planning of business strategy at the strategic level, decision-making regarding implementation of AMT projects, and competitive disposal of individual products at the global market.
- To evaluate different manufacturing alternatives under unpredictable market environments, changes in product design, demand, and mix, a system for different manufacturing scenarios under conflicting multi-objectives is required.
- Selection of flexible machining centres using a knowledge based expert system will ease the process of justification and implementation of advanced manufacturing systems.

Thus, it can be argued that such justification and implementation decisions are unstructured and calls for decision support systems (DSS) approach that assists management in translating information in to effective actions for the organization. Over the many years of research and application around the world, the benefits of DSS, have clearly manifested through huge tangible returns as profits or cost savings to the organization.

The organization of the paper is as follows. Section 2 gives a brief review of justification approaches. Section 3 describes developments of the FMDSS. Section 4 presents a sample session. In the last section it gives the discussion and conclusion.

A Review of Literature

Manufacturing system evaluation, design and selection issues, have developed considerably over the past 3 to 4 decades. On the modelling side, emphasis has shifted from modelling conventional manufacturing systems to modelling of automated systems due to uncertainty in product demand and day to day technological developments. The spirit of these attempts is to justify the installation of AMT either in phased manner or total.

Son and Park (1987) propose a procedure to quantify and combine three total performance measures into a single unified measure, i.e., integrated manufacturing measure (IMP) from productivity, quality and flexibility along with a hypothetical case example, which indicated that the adaption of a FMS improved the integral manufacturing performance, compared to a conventional system. Hutchinson and Sinha (1989) enumerated a decision theoretic approach to evaluate a manufacturing system to meet the demand both for cost and flexibility with an example. The study of Beach et al. (1998) highlights the importance of manufacturing flexibility, which states that "the desire to exploit new process technology and the need to reduce costs and throughput times, to accelerate new product introductions, and to insure against market uncertainties have contributed to the increased importance manufacturing enterprises attach to manufacturing flexibility".

Advanced systems require huge capital investments - gives intangible benefits which are difficult to quantify.

As shown in the studies of Son and Park (1987), the evaluation of manufacturing systems through an integrated manufacturing performance measure is one of the uniquely identified procedures. But the coverage of a number of flexibilities is limited. The number of flexibilities considered for evaluating a flexible manufacturing system or an automated factory of future may not be adequate. The role of performance modelling is to aid this decision-making in an effective way. During the design and planning stages, performance modelling can help in deciding the number and type of machines, number of material handling devices, number of buffers, number of fixtures, best possible layout, and part type selection (Stecke, 1985). Progress in the manufacturing sector has been triggered by timely introduction of new technologies. Hence the selection problem of appropriate manufacturing systems becomes a major design issue at a strategic level for system designers.

The selection of a manufacturing system to suit a particular production environment from among the larger number of available configurations has become a difficult task. Various considerations such as product design, choice of equipment, flexibility, and economics need to be considered before a suitable manufacturing system configuration or machining centre can be selected. In this aspect, the literature review exercise has been divided into two sub groups. (i) selection of user desired manufacturing system configuration and (ii) selection of advanced machining centre or facility and is presented below.

Selection under Multi-Criteria Decision Making Environment

A characteristic of most of the formal techniques that have been used for decision-making is the selection of the best alternative with respect to a certain figure of merit. Tabucanon (1988) proposed a conceptual model of decision-making in industrial systems suitable for social, technical, and economic objectives. He also listed several technological, economic, ethical, political, legal, and social factors that affect an organization. Multi-criteria decision-making (MCDM) refers to making decisions in the presence of multiple, usually conflicting criteria in complex and unstructured situations. MCDM can be defined as the process of decision-making in the selection of an act or courses of action from among alternative acts or courses of actions such that it will produce optimal results under some criteria of optimization. In precise terms criteria are considered to be 'strictly' conflicting if the increase in satisfaction of one results in a decrease in satisfaction of the other. A conflict may arise due to intrapersonal and interpersonal reasons. The process requires the decision makers to develop a hierarchical structure of the problem, identifying the relative importance of each of the criteria, specifying a preference for each decision alternative with respect to each criterion in the form of a prioritized ranking so as to arrive at overall preference for each of the decision alternatives.

Stam and Kuula (1991) developed a visual interactive decision support framework, to aid the decision maker in selecting the most appropriate technology and design when planning an FMS. Their work was divided into two phases. The first phase, namely, prescreening phase, used the qualitative and quantitative criteria and are used to narrow the set of alternative system configurations under consideration down to a small number of most attractive candidates. In the second phase, multi-objective programming was formulated for each of the remaining configurations to explore and evaluate the costs and benefits of various different scenarios for each configuration. Stam and Kuula (1985) developed equations to various multi-criteria like production, cost and flexibility with in the system-dependent machine time constraints under FMS design environment. Significant contributors in this MCDM field include Steuer (1985), Gupta, Evans and Gupta (1991); Stewart (1992); Mollaghasemi and Evans (1994); Kim, Chan

and Yoon (1997); Parkan and Wu (1998); Parkan and Wu (1999) and Chang and Yeh (2001). Inclusion of multi criteria in the framework of DSS can be seen in the studies of Korhonen, Moskowitz, and Wallenius (1992); and Rao and Deshmukh (1997).

Selection of Advanced Machining Centre through Artificial Intelligence Techniques

In developing countries, the right machine could be very different from the one suited for the developed countries. So decision-making in the area of advanced machining centre selection is affected by the ongoing development of new technology, practices and machines having enhanced capabilities and complex characteristics. Further it is understood that the specific problem of advanced machining centre selection is a knowledge-intensive and complicated task due to the presence of many feasible non-determined alternatives, and the need to satisfy multiple and possibly conflicting objectives. Machine selection influences its operational capabilities in terms of various part design features, various performance measures set by the customer and then cost. The elicited hierarchy (Wick, 1979, Verma and Kumar 1989) in selection of a machining centre is a suitable working length, working diameter, achievable tolerance, number of axes, number of tool stations, price, level of available power, speed, and automatic swarf disposal. Hence, machining centre selection procedure is a complex and unstructured, hence, special attention is required to meet the varying customer requirements in the market.

DSS provides tangible benefits as profits or cost savings.

The selection of machining centre is a typical design problem. It is frequently unstructured, characterized by extensive domain dependent knowledge, and requires substantial expertise, making it an ideal candidate for the application of expert systems. Apart from multi-attribute decision-making models discussed earlier, expert system is also a valid tool for dealing with the problem of selection of machining centres. A brief review of literature in this area is now presented.

Knowledge Based Expert Systems

Artificial intelligence (AI) gained popularity in the late 1960s. Since then it has experienced considerable momentum. Expert Systems, one application of AI, have achieved considerable success in recent years. Specialists in industrial and production engineering are beginning to take interest in expert systems as a means of solving problems in their domain. Several prototype systems are being built in the areas of manufacturing, facilities layout, maintenance and fault diagnosis. Malmborg (1989) described a microcomputer based, expert system for selection of industrial trucks. Rambabu and Murthy (1989) has worked on the problem of optimum design of the machine layout for an FMS using knowledge based expert systems (KBES) approach, whereas, Shivathaya and Fang (1993) developed an expert scheduling system for tool room operations (which can be used on-or-off-line) through if-then rules. The KBES concept had been applied to various areas such as materials selection (Ram et al., 1989), scheduling of FMS (Rambabu and Murthy, 1989) acceptance sampling (Reddy and Murthy, 1989), process planning (Ajmal, 1989) design of FMS (Borenstein, 1998, Borenstein et al 1999), design of material handling equipment selection system (Chan, 2002), and also for other areas related to AMS (Jain and Chandwani, 1989, Rambabu 1997, Rambold 1989). The use of expert systems for the selection of a flexible machining centre thus seems a promising area for research.

It is apparent from the literature that evaluation and selection of manufacturing systems is a problem specific, unstructured and involves large number of multiple attributes. Developing and combining modules such as integrated manufacturing performance evaluation, multi-criteria evaluation and ranking; and knowledge based machining centre selection approaches can deal with it. In this context, a decision support system for flexibility in manufacturing (FMDSS) for evaluation and selection of manufacturing system is developed and demonstrated here. A brief description of the heuristics used in the model base such as the models for evaluation of integrated manufacturing performance, multi-criteria evaluation of manufacturing configurations, and knowledge based expert system for the selection of a flexible machining centre is given in Table 1. The proposed FMDSS and its capabilities through a sample session are provided in the following sections.

Development of the Decision Support System for Flexibility in Manufacturing (FMDSS)

Decision support system is an aid that assists management in translating information in to effective actions for the organization. It may be said that the deployment of a DSS represents the engineering of managerial decision-making process to meet the challenges posed by demanding constraints and objectives in a complex environment. Over the many years of research and application around the world, the benefits of DSS, have clearly manifested through huge tangible returns as profits or cost savings to the organization.

A decision support system for handling of flexibility and related issues in manufacturing should possess the characteristics like simple to use, with an ability to evaluate the system in terms of both quantitative and qualitative key performance measures, such as flexibility, productivity, and quality. It should also have the ability to integrate various performance and operational aspects in a modular fashion so that evaluation and selection of manufacturing systems becomes easy. Also, the DSS should have the ability to account for individual preferences, and permit the use of system by any user. Some of the developments in the area of DSS are now explained.

Table 1: Description of Heuristics used in Model Base of FMDSS

Heuristic Used	Description
1. For Evaluation of System Performance	
i) Total productivity (TP) measure	Total productivity measure is computed primarily from various partial measures of productivity such as labour, capital, equipment, material, and overhead
ii) Total quality (TQ) measure	Computed from product failure, process failure, and appraisal costs of quality
iii) Total flexibility (TF) measure	Computed based on various partial flexibilities such as product, process, demand, and equipment.
iv) Integrated manufacturing performance measures (IMP, RIMP)	Integrated measure of TP, TQ, and TF for existing and proposed approaches
2. Multi-criteria Evaluation and Ranking	
i) Simple additive weighting method (SAW)	To compute weighted alternatives for ranking of manufacturing system configurations using simple additive weighting method
ii) Hierarchical weighting method (HAW)	To compute composite vector of manufacturing system configurations for ranking using hierarchical additive weighting method
iii) Elimination et Choice Translating Reality Method (ELECTRE)	Pair-wise comparison of alternatives based on the degree to which evaluation of alternatives and preference weights confirm or contradict the pair-wise dominance relationships among the alternatives
iv) Technique For Order Preference By Similarity To Ideal Solution Method (TOPSIS)	Ranking of manufacturing system alternatives based on the concept of shortest distance from the ideal solution and the farthest from the negative ideal solution
3. Knowledge based expert system	for selection of a machining centre (KBFMS) Intelligent selection of a machining centre based on user specified features like shape, size, investment, and control system. Through data base, knowledge base, and inference engine (adapted from Chowdary, 1997).

Legend:
IMP - Integrated manufacturing performance
RIMP - Revised integrated manufacturing performance

Justification and implementation advanced manufacturing technologies involve decisions that are crucial for the practitioner regarding the survival of business in the present market environment. Since advanced systems require huge capital investments and offer large number of intangible benefits such as flexibility, quality, productivity, customer satisfaction etc., which are ill structured in nature and hence complex to quantify. But traditional justification approaches are insufficient to justify advanced technologies (Rao and Deshmukh, 1997).

Son (1991) developed an integrated decision support framework for economic justification of factory automation project and demonstrated it through a real application. Rao and Deshmukh (1997) developed a decision support system (DSS) for selection and justification of advanced manufacturing technologies. Also, this study says that selection and justification of AMT are unstructured and should consider other issues such as economic, analytical and risk factors in a decision support environment. A summary of literature in the area of DSS applied to manufacturing is presented in Table 2. The listed literature (in Table 2) shows that decision support systems have been applied for different applications such as production planning, production control, production management, project analysis and for justification of advanced technologies. These studies lead to develop a new DSS framework for evaluation and selection of manufacturing systems in this paper.

Table 2 : Literature on DSS Application to Manufacturing Problems

Author(s), Year	DSS Application
Janos and Temesi (1988)	Production control under multiple criteria decision-making
Wu and Tabucanon (1988)	Production management
Qingwen and Yingchu (1988)	Multi-objective project analysis
Chidambaram and Rambabu (1989)	Production planning
Ravichandran and Chakravarty (1989)	Design of FMS
Son (1991)	Factory automation
Stam and Kuula (1991)	Design of FMS
Ashfaq (1991)	Selection of process parameters in milling
Aly and Subramaniam (1993)	Design of FMS
Rao and Deshmukh (1997)	Selection and justification of automation technologies
Ozdamar, Bozyel, and Birbil (1998)	Production planning

From the literature it is clear that design and selection of manufacturing systems is a complex process involving a large number of key system performance measures because of which the evaluation of a manufacturing system problem is tend to unstructured. By combining economic and subjective attributes, a decision maker will have greater opportunity to evaluate and rank the flexible manufacturing system under a multi-criteria environment. In addition to this a knowledge based expert system will further strengthen the decision process in selection of a flexible machining centre for design of flexible manufacturing systems. By incorporating all these features a decision support system for flexibility in manufacturing (FMDSS) is proposed in this paper.

Architecture of the Proposed System

The development of the FMDSS has been taken up in a modular manner. The major components of the proposed system are: data base, knowledge base, and model base. The architecture of the proposed FMDSS is presented in Figure 1 and each module dealt in detailed in the following sections.

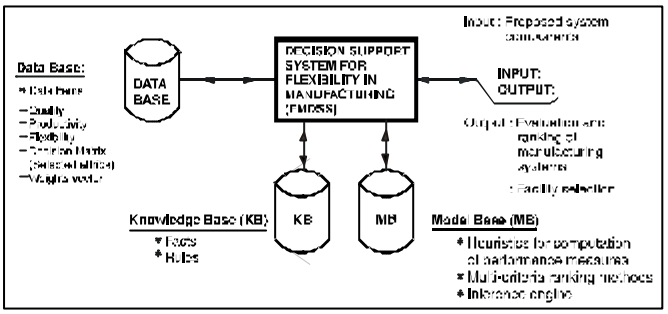

Figure 1 : Proposed Decision Support System for Flexibility in Manufacturing (FMDSS)

Data Base

The data base will contain the data items such as flexibility, quality, productivity, decision matrix for selected attributes, weights vector (to reflect the customer's preferences), and knowledge base. Data regarding a machining centre features needs to be referenced in the operation of the expert system. This sub module is created using linked list structure with the details of machining centre type, job size, weight, and price. A user interface probes the data base files whenever required during the consultation session.

Role of performance modeling is to make decision-making effective.

Knowledge Base

The technical knowledge about the manufacturing system and the logic used by successful practitioners in selecting the appropriate machining centre must be captured into the system. This becomes a knowledge base. The knowledge, which a system designer uses in selecting a flexible machining centre, is vast and complex. Knowledge about the selection of a flexible machining centre can be obtained from literature (Wick, 1979, Verma and Kumar 1989), by interviewing experts in that specific domain, and by observing the experts at work.

In the present study, the knowledge representation has been carried out through a combination of declarative knowledge, which includes the machine tool facts and procedural knowledge, which consists of the rules for machining centre selection. The rules are expressed in the standard if -then format and are used to represent relationship between facts and the kind of inference used in forward chaining. The rule based expert system is selected in the present machining centre selection system because of its merits like built in hierarchy, dynamic representation and ease of implementation. A generic rule may, therefore, be stated as

IF
premise(s)
THEN
conclusion(s)

For example a rule for selection of a machining centre based on job shape is:

IF
(The Job Shape is Plate Type) AND
(The Operations to be Performed are of Boring Operations)
THEN
(Select Vertical Type Machining Centre)

Model Base

The model base contains the models, namely, heuristics for measurement of partial and total measures of productivity, quality, flexibility, and integrated performance measure. It also comprises of various multi-criteria evaluation models for selection of manufacturing configurations apart from a knowledge based expert system for selection of a flexible machining centre.

The flexibility measure of each type is computed to arrive at the resultant total flexibility measure. Each flexibility type under each level is connected with the performance measures namely total productivity and total quality to contribute towards the total system performance measure. The total productivity (TP), total quality (TQ), and total flexibility (TF) measures are used to derive the RIMP measure. The partial flexibility measures are computed in terms of cost factors. The procedure for arriving at RIMP is presented in Appendix A.

Based on the structure of the problem and the information available, we consider four well known and commonly used multi-attribute value theory-based MADM methods (Hwang and Yoon, 1981) suitable for obtaining an overall cardinal ranking of manufacturing configurations. These methods are (a) the simple additive weighting (SAW) method, (b) the hierarchical weighting (HAW) method, (c) the elimination et choice translating reality (ELECTRE) method and (d) the technique for order preference by similarity to ideal solution (TOPSIS) method. The basic logic of SAW is to obtain a weighted sum of the performance ratings of each alternative over all attributes. In HAW, composite vector for ranking of manufacturing configurations is computed based on hierarchical additive weighting method. ELECTRE logic uses the degree to which evaluation of alternatives and preference weights confirm or contradict the pair-wise dominance relationships. TOPSIS is based on the concept that the most preferred alternative should not only have the shortest distance from the positive ideal solution, but also have the longest distance from the negative ideal solution. For more details

on these methods, the reader has been referred Hwang and Yoon (1981).

Inference Engine : The dialogue base facilitates the user interface to traverse through the decision-making environment. The capability to apply the machine tool knowledge and planning logic contained in the knowledge base is the problem solving procedure known as inference engine (IE). The IE manages the sequence of reasoning, interpreting the machining centre facts and selection rules and determining the sequence of rules activation. In the present expert system model, the inference process is carried through a forward chaining rule. The format of forward chaining rule used in the process is

IF
Premise(s)
THEN
Conclusion

The KBFMS contains three principal inference modules (i) classification of machining centres, (ii) an exact/close machining centre selection module, and (iii) advising module. Based on the dependent rules created in the knowledge base, the first module will classify the machining centres by extracting the centre node information from the data base i.e. it will group all the machining centres which fall or satisfy all the dependent rules. This forms the basis for selecting a close machining centre through the next module. The exact/close machining centre selection module will try to match the centres information that is grouped in the above module with the information taken from the user. If there is exact matching it will suggest the corresponding best centre. If exact matching fails then this module will suggest a close machining centre as per the requirements of the user within permissible limits, which can be specified for each node while building the data base. An advising module provides the message by interacting with the user and the system. The message is in the form of suggested exact/close machining centre along with machine features if there is matching of user information with the classified centres either exactly or closely. Otherwise it will direct the user to try again for another centre.

The knowledge based expert system has an interface with the user where the expert system seeks certain information about the problem. Based on the information the expert system tries to match the information available in the knowledge base and fact base. The analysis will be carried out depending on the closeness of the match.

This module in FMDSS gathers all the user specified information both in qualitative and quantitative form. This information is provided as new facts to the system and helps the inference engine in computing system performance, multi-criteria evaluation and ranking of manufacturing configurations, and selecting a close machining centre. The salient features of data base and model base of the proposed FMDSS are depicted in Table 3. FMDSS requires the following information at the data base level:

- details of productivity cost elements (C_L, C_R, C_{OH}, C_C)
- details of quality cost elements (O_T, C_P, C_F, C_A)
- details of flexibility elements (C_L, Ci_R, C_{OH}, C_C, C_P, C_F, C_A, C_{IC}, C_{OB}, C_{CF}, C_{TP}, C_W, C_S, C_R, C_{ID}, C_{MH}, C_{CF}, C_{IPC}, C_{PR}, C_{IN})
- details of alternative system configurations and attributes (decision matrix and weights vector)
- preferences/weightage vector to reflect the attitude of the user
- facts and rules relating with flexible machining centre (data base, knowledge base)

DSS assists management in translating information into effective actions.

The underlying logic of the modular FMDSS and the functional details of various models are presented in Figure 2. All the models (refer Table 1) used in developing the FMDSS are integrated using interactive menus. The main menu of FMDSS is as given in Appendix B1.

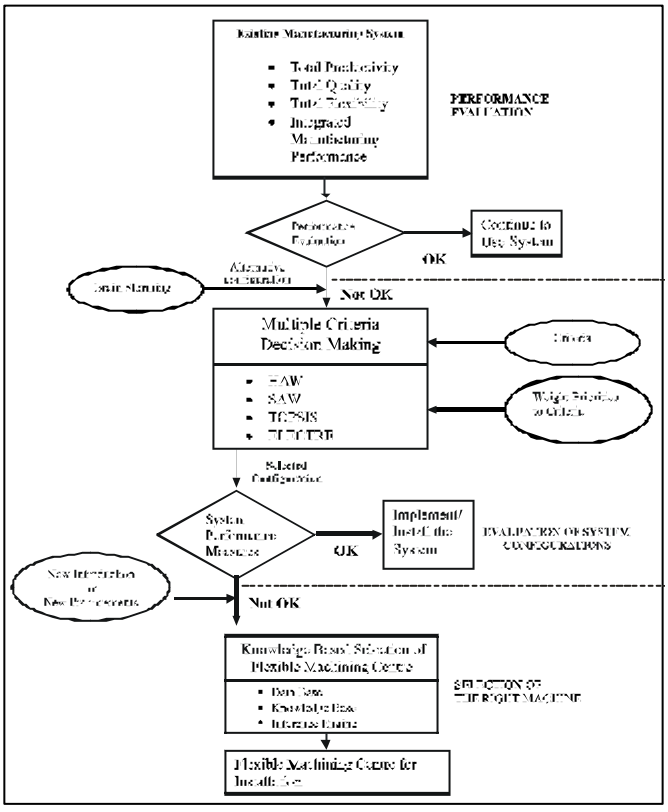

Figure 2 : Decision Support System for Flexibility in Manufacturing (FMDSS)

The sub-levels (such as total productivity, total quality, total flexibility, and integrated performance evaluation) of module 1 are as shown in Appendix B2. All these levels take inputs from the existing manufacturing system such as output of the system, cost elements relating with various

system performance measures like productivity, quality and flexibility. This module computes various total performance measures such as total productivity (TP), total quality (TQ) and total flexibility (TF) and revised integrated manufacturing performance measure (RIMP).

Module 2 evaluates the identified alternative configurations under multi-criteria environment. This module has four sub modules (SAW, HAW, ELECTRE and TOPSIS) as shown in Appendix B3. Each sub-module will evaluate and rank the alternative configurations as per the user's preference.

The selection process of a machining centre is a complex problem as it is influenced by many parameters such as job shape, design features, accuracy required, tool requirements, cost etc. In this study, the machining centre selection problem is based on the criteria such as (i) flexibility, (ii) quality, (iii) productivity, and (iv) cost. The rationale in selecting these criteria is based on the opinions of researchers, and information from machine tool brochures, and technical reports. The constituent elements of the knowledge base and the selected criteria for selection of a flexible machining centre are presented in Table 3.

DSS should be simple to use, able to evaluate the system both qualitatively and quantitatively.

Table 3 : Data Base and Model Base Details of FMDSS

	Data Base	Model Base
011	O_T, C_L, C_R, C_{OH}, C_C	P_1, P_2, P_3, P_4; TP
0121	O_T, C_P, C_F	Q_P, Q_F; TQ
0122	O_T, C_P, C_F, C_A	Q_P, Q_F, Q_A; TQ
0131	O_T, C_I, C_{SU}, C_W, C_I	F_E, F_P, F_S, F_D; TF
0132	O_T, C_{IC}, C_{OB}, C_I, C_{CU}, C_{SU}, C_A, C_W, C_S, C_R, C_{ID}, C_{MH}, C_{CF}, C_{IPC}, C_{PR}, C_{IN}	F_D, F_M, F_V, F_C, F_P, F_{EX}, F_S, F_M, FR, F_E, F_{MU}, F_{PR}, F_{ID}, F_C, F_{PD}; T_F
0141	O_T, C_L, C_R, C_{OH}, C_C, C_P, C_F, C_I, C_{SU}, C_W, C_{INV}	TP, TQ, TF, RIMP
0142	O_T, C_L, C_R, C_{OH}, C_C, C_P, C_F, C_A, C_{IC}, C_{OB}, C_{CF}, C_{TP}	TP, TQ, TF, RIMP
021 (for selected attributes)	* Decision Matrix * Weights Vector	* Comparable Numerical Matrix * Weighted Alternatives
022 (for selected attributes)	* Decision Matrix * Weights Vector	* Consistency Matrix * Composite Vector
03	Machining Centres Information * Data Base * Knowledge Base	Inference Engine

Legend

O_T = System Output
C_L = Labour Cost
C_R = Raw Material Cost
C_P = Prevention Cost
C_A = Appraisal Cost
C_{OB} = Cost of Obsolete Products
C_{CU} = Cost of Additional Tooling for Capacity Utilization
C_A = Additional Cost of Infrastructure for Expansion
C_W = Parts Waiting Cost
C_S = Cost of Additional Setup
C_{IE} = Idle Cost of Equipment
C_{PR} = Cost Incurred Due to Frequent Changes in Production Programs
C_{TPC} = Total Production Cost
C_{IN} = Investment Cost for Information Processing
C_R = Additional Cost Incurred due to Rerouting
C_{NH} = Additional Material Handling Cost
C_{CF} = Cost of Controlling
C_C = The Service Cost of using Invested Capital
C_{OH} = Overhead Cost
C_F = Failure Cost
C_{SU} = Cost of Setup
C_{IC} = Investory Costs of Finished Products and Raw Material
C_I = Infrastructure Cost Incurred to Produce Break-even Volume
TP = Total Productivity
TQ = Total Quality
TF = Total Flexibility
RIMP = Revised Integrated Manufacturing Performance

Flexibility Criterion: Under the flexibility criterion, machine, control and program flexibilities are considered as options, which are created in the knowledge base. Each flexibility option follows with rules/facts, which influence the selection process. For example, machine flexibility depends upon the capability of handling of various job shapes and number or nature of operations it can perform. An example rule in this regard is

IF (Job Shape is Multi Sided) AND
(Operations to be performed are of ALL type) AND
(Type of Control System required is CNC)
THEN (Select Centre = Horizontal Type)

The remaining flexibility options and the associated rules identified are presented in Table 3.

Quality Criterion: The quality level of a product has been divided into three categories: very high, high, and average. Classification of the quality as 'very high' depends upon the characteristics such as minimum accuracy that can be achieved from the machine, and flexibility to modify the control functions (if it is a CNC Machine). These two rules, which are important in the selection of advanced machining centre based on the quality criterion, can be explained further with respect to their dependent rules (alternatives) presented in Table 4. For example,

Table 4 : Summary of Selected Criteria and their Details

Criterion	Options	Rules	Dependent Rules	Action Value	Match Type	
					Parameter*	Node*
Flexibility	Machine	Shape	Plate Type or Multi-sided	Vertical or Horizontal Machining Centre		Machining centre type
	Operation	Tool effort	ATC	Possible	Fexpan	Toolmaz
	Program	Control System	CNC	Advanced	Control System Type	Control System Type
Quality	Very High (0.0008-0.001)	Control System	CNC	Advanced	Control System Type	Control System Type
	High (0.00030- 0.00079)	Control System	CNC	Advanced	Control System Type	Control System Type
	Average (0.0001-0.00029)	Control System	CNC	Advanced	Control System Type	Control System Type
Productivity	High (151-200%)	Tool Effort	ATC	Possible	Future expansion	Tool Magazine
	Medium (101-150%)	Tool Effort	ATC	Possible	Future expansion	Tool Magazine
	Average (90-100%)	Tool Effort	ATC	Possible	Future expansion	Tool Magazine

Note: The numerals with in the parenthesis represent the option value fixed in the sample session
* Notation followed while developing the FMDSS

IF (Control System Type = Advanced) AND
(Tool Monitoring System required is of Expert System) AND
(Positional Accuracy = 0.0015)
THEN (Select Centre = CNC Type Centre)

Productivity Criterion: Each machining centre possesses its significance depending on the functional features. A machining centre could have different benefits such as reduction in set-up for job and tool, and reduction in material handling efforts. This criterion should be able to discriminate between alternative machining centres based on the presence of such features. This criterion incorporates these rules and likewise one can develop several dependent rules. For example, a rule under this criterion is

DSS should have ability to account individual preferences.

IF (Setting Effort = Automatic Pallet Changer) AND
(Tool Changing Time = 6 seconds) AND
(Number of Tools = 48)
THEN (Select Centre = Centre having two Pallets)

The sub-menus of this module are depicted in Appendix B4. The structure used for creation of the knowledge base is very flexible so that the user can add more criteria to it. The robustness of the proposed knowledge base structure is tested through a 'cost' based criterion and is demonstrated in the sample session.

Salient Features of the FMDSS

The user is provided with wide scope to evaluate the manufacturing system performance, multi-criteria ranking of manufacturing configurations and selection of a flexible machining centre. The salient features of the proposed FMDSS include:

- The developed FMDSS is easy to understand since most of the input is in the form of monetary values.
- Greater emphasis on manufacturing flexibility
- Evaluation of system in terms of both well structured and ill-structured costs such as flexibility, productivity and quality
- Evaluation and ranking of manufacturing configurations under multi-criteria environment
- Intelligent selection of flexible machining centre through user defined criteria such as flexibility, productivity and quality.

A Sample Session with FMDSS

Usefulness of the present FMDSS is demonstrated through a case situation. The case situation is taken from Chowdary (2001) as illustrated in Table 5. Input cost elements are the important data items (as explained in module 1) in computing the integrated manufacturing performance. Identification of alternative configurations and formation of decision matrix (D) is an important task in evaluating and ranking of manufacturing systems under multi-criteria environment. Finally, building of data base (facts) relating with the latest machining centres and creation of production rules in consultation with the experts are the two independent and crucial inputs under flexible machining

Table 5 : Case Situation (Chowdary, 2001)

Company	Precision machine tool manufacturing
Products	CNC lathe and machining centres
Distribution network	Global as well as local markets
Existing machinery type	Combination of NC, CNC and conventional
System's capability	Cable of producing 6 and 3 models of first and second product types respectively
Company goals	Maintain competitive edge by introducing new products

centre selection module. The procedure explained in Chowdary (1997) is followed for preparation of data base and knowledge base. A sample test run for the proposed FMDSS under selected case situation is presented in Appendix C.

Usefulness of the FMDSS

Decision support system for flexibility in manufacturing (FMDSS) may serve the needs of modern industry in terms of providing guidelines for evaluation and selection of manufacturing systems. The robustness of the individual modules is tested through different case studies and results are available with the corresponding author. The results show that the performance evaluation module can be used as a decision tool to assess the performance of variety of manufacturing situations. First, the impact of addition of a new facility on a manufacturing system was investigated. Secondly, current and past performance of a manufacturing system was compared. Finally, evaluation of system performance had carried out when there are fluctuations in the product design.

Traditional approaches are insufficient to justify advanced technologies.

The second module aims at evaluation of a manufacturing system under multi-criteria environment, which supports the user in selection of a desired manufacturing alternative in terms of various costs and benefits. This module also has been tested for quantification of costs of quality, productivity and flexibility through different real manufacturing situations, where conventional facilities are in use and the managements are looking forward for conversion of existing systems into flexible systems. Some of the highlights of the results that are obtained from the module-2 of FMDSS are:

- Various production costs and operational benefits due to relocation of an existing facility
- Multi-criteria ranking of manufacturing alternatives with options for routing and machine flexibilities

The third and final module deals the selection of a machining centre through a knowledge based expert system. Building of data base (facts) relating with the machining centres and creation of production rules in consultation with the experts are the two independent and crucial inputs under the flexible machining centre selection module. The utility of this module is demonstrated by assisting the practitioner for introduction of flexible advanced machines. This has been tested through a set of key performance criteria such as productivity, quality, flexibility, and cost.

Discussion and Conclusions

Decision support systems assist management in translating information in to effective actions for the organization. In any manufacturing system design and selection process, quantitative as well as qualitative factors should be taken into account since it is a complex process and which involves a number of system performance measures such as flexibility, productivity, quality, system utilization, implementation risk, and WIP inventory. For evaluation and selection of manufacturing systems here an attempt has been made through a decision support system by developing and combining models such as integrated manufacturing performance, multi-criteria evaluation and ranking, and a knowledge based expert system approaches.

The major components of the decision support system for flexibility in manufacturing (FMDSS) are data, model, and dialogue bases. The data base contains items such as flexibility, productivity, quality, decision matrix for selected attributes, and weights vector. The model base contains models such as integrated manufacturing performance measurement, multi-criteria evaluation and ranking heuristics, and an inference engine relating to selection of flexible machining centres. The dialogue base facilitates the user when traversing through the decision-making environment. The usefulness of the proposed FMDSS is demonstrated through a sample session. The developed FMDSS is expected

- to judge whether the system is capable to accommodate any changes in product design or not (Module-1 i.e. Compute System Performance).
- to evaluate a manufacturing system under a multi-criteria decision-making environment for ranking of various manufacturing configurations (Module-2 i.e. Multi-criteria Evaluation and Ranking).
- to assist the practitioner for introduction of automation in a phased manner, by replacing the conventional system with advanced machining centres and to help in design a full-fledged flexible manufacturing system with growing adoption of AMT in developing countries (Module-3 i.e. Machining Centre Selection).

The type of exercise carried through the FMDSS here is sought before investing huge amounts on automation projects. The present study is also useful to organizations working with conventional systems and considering conversion to FMC, FMS, or CIM. Some of the additional features of the developed FMDSS include:

i) It is user-friendly software and can embed the knowledge obtained from the experts.

ii) It can handle qualitative as well as quantitative data.

iii) It has minimal user interaction.

Limitations

Some of the limitations presented here, if rectified by future researchers, will further provide guidelines for introduction of flexible manufacturing systems for improvement in production operations, where still conventional manufacturing practices are in existence. Some of the limitations associated with the proposed FMDSS are:

i. The case studies selected for testing the robustness of the FMDSS are combination of traditional and semi-automated, because of which only a selective number of flexibilities are computed.

ii. While creating the data base under the machining centre selection module the following assumptions are made due to the non-availability of the data:

- Accuracy parameter of a machining centre is taken as the deciding factor for selection of a machining centre under quality criterion
- Number of pallets available within a machining centre is chosen as the selection criteria of a machining centre under productivity criterion.

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Appendix A

Development of the Revised Integrated Manufacturing Performance Measure

1. Total productivity (TP) measure

Total productivity (Son and Park, 1987) for a given period is the integrated measure of partial measures like labour productivity, capital productivity, material productivity and overhead productivity.

Let

O_T = System output (usually expressed in physical volume, such as pieces, tons and other measurable units).
C_L = Labour cost
C_C = The service cost of using invested capital
C_R = Raw material cost
C_{OH} = Overhead cost

Now TP is given by

$$TP = O_T / (C_L + C_C + C_R + C_{OH}) \ldots (1)$$

2. Total quality (TQ) measure

Total quality measure (Son and Park, 1987) for a given period is the integrated measure of partial measures like prevention and failure costs. But based on the literature and the opinion of the experts in the field it is decided to include the appraisal quality in the definition of the total quality measure (TQ).

Let

C_P = Prevention cost
C_F = Failure cost
C_A = Appraisal cost

Now TQ is given by

$$TQ = O_T / (C_P + C_F + C_A) \ldots (2)$$

3. Total flexibility (TF) measure

In addition to the partial flexibilities such as demand, volume, equipment, and process defined earlier (Son and Park, 1987), some more partial measures of flexibilities in terms of monetary values are considered in this research. These measures are presented as below:

Let

C_{IC} = Inventory costs of finished products and raw materials
C_{OB} = Cost of obsolete products
C_I = Infra-structural cost incurred to produce break-even volume
C_{CU} = Cost of additional tooling for capacity utilisation
C_{SU} = Cost of setup
C_A = Additional cost of infrastructure for expansion
C_W = Parts waiting cost
C_S = Cost of additional setup
C_R = Additional cost incurred due to rerouting
C_{IE} = Idle cost of equipment
C_{MH} = Additional material handling cost
C_{PR} = Cost incurred due to frequent changes in production programs
C_{IN} = Investment cost for information processing
C_{CF} = Cost of controlling
C_{TPC} = Total production cost

The various partial measures of flexibilities can be given by

a) Demand flexibility (F_D) = O_T / C_{IC}
b) Market flexibility (F_M) = O_T / C_{OB}
c) Volume flexibility (F_V) = O_T / C_I
d) Capacity flexibility (F_C) = O_T / C_{CU}
e) Product flexibility (F_P) = O_T / C_{SU}
f) Expansion flexibility (F_{EX}) = O_T / C_A
g) Process flexibility (F_S) = O_T / C_W
h) Machine flexibility (F_M) = O_T / C_S
i) Routing flexibility (F_R) = O_T / C_R
j) Equipment flexibility (F_E) = O_T / C_{IE}
k) Material handling flexibility (F_{MH}) = O_T / C_{MH}
l) Program flexibility (F_{PR}) = O_T / C_{PR}
m) Information and Data handling flexibility (F_{ID}) = O_T / C_{IN}
n) Control flexibility (F_C) = O_T / C_{CCF}
o) Production flexibility (F_{PD}) = O_T / C_{TPC}

The TF during a given period is given by

$$TF = O_T / (C_{IC} + C_{OB} + \ldots + C_{TPC}) \quad \ldots (3)$$

4. Revised integrated manufacturing performance measure

The revised integrated manufacturing performance (RIMP) measure in terms of TP, TQ and TF is given by

$$\frac{1}{RIMP} \quad \frac{1}{TP} \quad \frac{1}{TQ} \quad \frac{1}{TF}$$

or

$$RIMP = (TP*TQ*TF) / (TP*TQ) + (TQ*TF) + (TF*TP) \ldots (5)$$

Appendix B1

Main Menu of FMDSS
1. Compute System Performance
2. Multi-Criteria Evaluation and Ranking
3. Machinning Centre Selection
4. Exit
Enter Your Selection:

Appendix B2

Sub Menu for System Performance of FMDSS	
1. Compute Total Productivity (TP)	
2. Compute Total Quality (TQ)	
3. Compute Total flexibility (TF)	31. Existing 32. Proposed
4. Perform 1, 2 and 3	
5. Integrated Performance Measure	51. Existing 52. Proposed
Enter Your Choice :	

Appendix B3

Sub Menu for Multi-Criteria Evaluation and Ranking	
1. SAW	2. HAW
3. ELECTRE	4. TOPSIS
Enter Your Choice :	

Appendix B4

Sub-Menu for Machining Centre Selection of FMDSS	
1. Data Base	2. Knowledge Base
3. User Interface	4. Quit
Enter Your Choice :	

Appendix C

Sample Test Run for Demonstration of FMDSS Decision Support System for Flexibility in Manufacturing

Main Menu of FMDSS
1. Compute System Performance
2. Multi-Criteria Evaluation and Ranking
3. Machining Centre Selection
4. Exit

Enter Your Choice: **1**

Sub-menu for system performance
1. Compute Total Productivity
2. Compute Total Quality
3. Compute Total Flexibility
4. Perform 1, 2, and 3
5. Integrated Performance Measure

Enter Your Choice: **5**

1. Use Existing (IMP) Measure
2. Use Proposed (RIMP) Measure

Enter Your Choice: **2**

Input from the User

System output(millions of Rs.) =? **570.74**
Labour cost(millions of Rs.) =? **323.36**
Overhead Cost(millions of Rs.)=? **50.82**
Capital Cost(millions of Rs.) =? **57.07**
Equipment Cost(millions of Rs.) =? **--**
Raw Material Cost((millions of Rs.) =? **49.22**
Cost of Prevention(millions of Rs.) =? **47.52**
Cost of Failure(millions of Rs.) =? **--**
Cost of Appraisal(millions of Rs.) =? **--**
Idle Cost of Equipment(millions of Rs.) =? **80.72**
Setup Cost(millions of Rs.) =? **33.26**
Part Waiting Cost(millions of Rs.) =? **27.72**
Work-in-process inventory(millions of Rs.) =? **370.98**

FMDSS Output

Total Productivity(TP)= **1.18**
Total Quality(TQ)= **12.01**
Total Flexibility(TF)= **1.11**
Revised Integrated Manufacturing Performance (RIMP) Measure = **0.548**

Are You Satisfied with the Output (Yes/No): **no**
You want to design a new manufacturing system (Yes/No): **yes**

Main Menu of FMDSS
1. Compute System Performance
2. Multi-Criteria Evaluation and Ranking
3. Machining Centre Selection
4. Exit

Enter Your Choice: **2**

Sub-menu for system performance
1. HAW
2. SAW
3. ELECTRE
4. TOPSIS

Enter Your Choice: **2**

Input from User

How many Criteria ? **9**
Number of Manufacturing Alternatives to Evaluate? **3**
Preference/Weights Vector: (give in row wise, also ensure that sum = 1.0)
0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.05 0.05
Type of Criteria ?
1. Benefit type
2. Cost type
Enter Your Choice: **1**
Criteria #1: Elemental values in Criteria #1: **8.93 7.80 7.78**
Type of Criteria ?
1. Benefit type
2. Cost type
Enter Your Choice: **2**
Criteria #2: Elements in Criteria #2: **0.0330 0.0296 0.0299**
Type of Criteria ?
1. Benefit type
2. Cost type
Enter Your Choice: **2**
Criteria #3: Elements in Criteria #3: **0.737 0.719 0.587**
Type of Criteria ?
1. Benefit type
2. Cost type
Enter Your Choice: **2**
Criteria #4: Elements in Criteria #4: **0.707 0.698 0.563**
Type of Criteria ?
1. Benefit type
2. Cost type
Enter Your Choice: **2**
Criteria #5: Elements in Criteria #5: **1253.00 1222.97 0997.90**
Type of Criteria?
1. Benefit type
2. Cost type
Enter Your Choice: **1**
Criteria #6: Elements in Criteria #6: **1.23 1.27 1.38**
Type of Criteria?
1. Benefit type
2. Cost type
Enter Your Choice: **1**
Criteria #7: Elements in Criteria #7: **1.72 3.99 3.99**
Type of Criteria?
1. Benefit type
2. Cost type
Enter Your Choice: 2
Criteria #8: Elements in Criteria #8: **1 7 7**
Type of Criteria?
1. Benefit type
2. Cost type
Enter Your Choice: **2**
Criteria #9: Elements in Criteria #9: **1 7 7**

FMDSS Output

Manufacturing Alternatives Ranking

Alternative#	Rank
I	2
II	3
III	1

Are You Satisfied with the Output (Yes/No): **yes**
You want to select flexible/advanced machining centre (Yes/No): **yes**

Main Menu of FMDSS
1. Compute System Performance
2. Multi-Criteria Evaluation and Ranking
3. Machining Centre Selection
4. Exit

Enter Your Choice: **3**

Sub-menu for Machining Centre Selection
1. Data Base
2. Knowledge Base
3. User Interface
4. Quit

Enter Your Choice:

Q: Which criteria would you like to base upon?
1. Flexibility
2. Quality
3. Productivity
4. Cost

Enter Your Choice: **4**

Type of Investment
1. Large Scale Investment: (0.45 -0.500)
2. Medium Scale Investment: (0.30 -0.449)
3. Small Scale Investment: (0.01 -0.229)

Enter Your Choice: **3**

Input from User

Criteria: Cost
Enter '-' If you do not know the precise value

Centre type (ct)	value: --
Job shape (shape)	value: **plate**
Operational capability (opc)	value: **boring group of operations**
Future expansion for MH (expansion)	value: --
Accuracy required (acc)	value: **0.0011**
Control system required (cs)	value: **Numerical Control**
Type of control system	value: --
Number of pallets required	value: --
You want automatic tool changer	value: --
Tool magazine	
no. of tools	value: --
future expansion	value: **not required**
Tool capacity	
maximum diameter of tool	value: --
maximum length of tool	value: --
maximum tool weight	value: --
tool change time	value: **9**
Work size	
length	value: **15**
width	value: **20**
height	value: **15**
weight	value: --
Travel range	
x-direction	value: --
y-direction	value: --
z-direction	value: --
Spindle	
speed range (rpm)	value: **2000**
drive motor (hp)	value: --

FMDSS Output
Details of the Centre Selection are:
Machining centre close to Requirements: Centre (V2)
Complete Features of the selected Centre:

Centre type (ct)	: Vertical
Suitable to	: Plate Type Jobs
Capable to perform	: Boring operations
Future expansion for MH (expansion)	: not possible
Minimum budget required	:0.0594 million US dollars
Accuracy possible	: 0.001 inch
Control System attached	: Numerical Control Type
Type of Control system	: Non advanced
Number of pallets attached	: nil
Automatic tool changer setup	: Not available
Tool magazine	
number of tools attached	: 40
future expansion for tools	: Not possible
Tool Capacity	
maximum diameter of tool	: 4.0
maximum length of tool	: 12
maximum tool weight	: 12
tool change time	: 10 seconds
Work size	
length	: 12
width	: 24
height	: 18
weight	: 300
Travel range	
x-direction	: 24
y-direction	: 12
z-direction	: 5
Spindle	
possible speed range	: (60-2000) rpm
motor power	: 2 hp

Flexibility Mapping : Practitioner's Perspective

1. What types of flexibilities you see in "DSS for flexibility in manufacturing" 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 DSS for flexibilities in manufacturing that are relevant for your own organizational context?
3. Try to map your own organization on following continua
   (Please tick mark in the appropriate box(es))

DSS
User Friendly ☐☐☐☐☐ Non-User Friendly

Performance Measure Flexibility
Evaluation Quantitatively ☐☐☐☐☐ Evaluation Qualitatively

Performance Measure Productivity
Evaluation Quantitatively ☐☐☐☐☐ Evaluation Qualitatively

4. Develop a SAP-LAP (Situation Actor Process-Learning Action Performance) model of "DSS for flexibility in manufacturing" relevant to your organization.

Reflecting Applicability in Real Life

1. Is your organization using any decision support system for flexibility in manufacturing? How would your organization will benefit using the proposed system?

Call for Papers

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In the uncertain and turbulent business environment, assessment and management of risk is key for the better business performance and effectiveness of any enterprise. Many researchers over time have stressed the importance of incorporating flexibility in the formulation of business strategy as it may help to achieve better business success. Therefore, 'flexibility' assumes significance for enterprises dealing with uncertainty. In fact, both flexibility and risk are inter-linked with each other. In general, flexibility in the systems helps in managing the risk; for example, financial flexibility of options can be used as a hedging mechanism. However, it should be recognized that flexibility can also enhance the risk. For instance, flexibility in manufacturing and supply chain to cope with changing customer requirements may add unused capacity and thereby affect profitability and operating risk.

The purpose of this special issue is to group together high-quality research papers that lie at intersection of the issues of flexibility and risk management. Both the terms flexibility and risk are adapted in most generic sense and includes both the service and manufacturing enterprises. The flexibility in the context of an enterprise means more options, change mechanisms and freedom of choice. Some examples of the subject matter of the papers suitable for the special issue, inter-alia, are:

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- Financial Derivatives as Tool of Risk Management.
- Risk Management in Flexible Enterprises.
- Flexibility in Production System and its Impact On Operating Risk.
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All manuscripts should follow the standard guidelines and will be reviewed as per the standard practice of the *"International Journal of Risk Assessment & Management"*.

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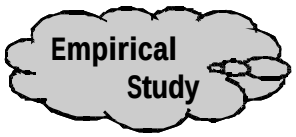

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Polarization of Perceptions of IT-enabled Privacy Violations at Workplace: Impact of Respondent Position, Peer Belief and Peer Pressure

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Abstract

Whereas Information Technology (IT) has given us freedom to do things in more easy and flexible ways on one hand, on the other, it also given us some ethical issues to look into. One such issue is that of privacy. People's perceptions on the issues of privacy and IT vary and it is important to assess how they vary. Perceived ethicality is not a normative fact, the perception varies from situation to situation and individual to individual. It is a function of how the individual constructs the social situation. There are many factors that influence how the individual constructs and perceives a situation. This paper empirically assesses the role of three such factors, respondent position (as a target or an actor), peer beliefs / perception of the situation, and the tendency of an individual to give in to peer pressure. Responses of 125, undergraduate and postgraduate students, on a structured questionnaire are analyzed. Results show a significant difference in the perception of respondents when they are target and when they are actors. Peer perception, is related to perceived ethicality and peer pressure moderates the relationship between peer perception and perceived ethicality though only for situation where the respondent is the actor.

Keywords : ethics, IT enabled, privacy, peer pressure

Introduction

Information Technology (IT) has given freedom to do things in easier, faster and flexible ways. The use of IT has given rise to many capabilities both immediate and derived. To begin with the data and information is now accessible to a much larger number of potential users than previously possible. It has made the capturing of until now intractable data possible at a much faster speed, with facilities for storage. Indeed these capabilities have helped tremendously in managing operations at a much larger scale in a much shorter time. As in any other managerial function, the study of Management Information systems raises question concerning "appropriate or responsible" managerial behavior. No doubt, IT has provided the capacity to do many things and make many decisions, but the ethical issue would be, does this capacity to do something justify the act itself? For example, if a manager can monitor employees behavior at all times of the working day, should he or she do so? The individual privacy in the workplace is becoming an important ethical issue in the present day context. The notion of privacy in recent times is undergoing change owing to the recent developments in the use of information technology. People's perceptions of what is ethical and what is not are under flux and get governed by many factors. Before we address the issues of privacy in this context, let us look at how the concept of privacy has been treated traditionally.

Privacy is a fundamental human right recognized in the UN Declaration of Human Rights, the International convict on civil and political rights and in many other international and regional treaties. Privacy underpins human dignity and other key values such as freedom of speech. It has become one of the most important human rights issues of the modern age. Of all the human rights in the international catalogue, privacy is perhaps the most difficult to define (Michael, 1994). Privacy has roots deep in history. The Bible has numerous references to privacy (Hixon, 1987). There was also a protection of privacy in early Hebrew culture, classical Greece and ancient China (STOA). These protections mostly focused on the right to solitude. Definitions of privacy vary widely according to the context and environment. In many countries the concept has been fused with data protection, which interpret privacy in term of management of personal information (Davies, 1996).

The law of privacy can be traced as far back as 1316, when the justice of the Peace Act in England provided for the arrest of peeping toms and eavesdroppers. In 1888, Cooley planted the seed of privacy for the legal profession's interest in the soil of the United States of America according to him the right to respect for private life is the right to be left lone. A couple of years later in (1890), Warren and Brandies (1890) cultivated the notion with the initial analysis of the concept of privacy. Interest in the right of privacy increased in the 1960s and 1970 with advent of IT.

The surveillance potential of powerful computer systems prompted demands for specific rules governing the collection and handling of personal information.

Different authors have defined privacy in different ways. Alan Westin (1967) defined privacy, "as the desire of people to choose freely that under what circumstance and to what extent individuals will expose themselves". According to Henderson and Snyder (1999), privacy is a right of individual to control the collection and use of personal information about themselves.

As mentioned earlier, over the past decade IT has become an important tool for communication and research. The technology is growing at an exponential rate with millions of new users. IT is also used increasingly as a tool for commercial transactions. The capacity, capability, speed and reliability of IT are constantly improving, resulting in constant development of new uses for the medium. IT has changed the public's perception of privacy. Organizations are faced with completely new policy decisions in term of which actions can be deemed damaging to individual's privacy and which are merely inconvenient (Agranoff, 1991). Information gathered via computer monitoring is likely to be increasingly used to coach employees. Currently many organizations use the information so gathered as a basis for criticism (De Tienne, 1993). The increasing sophistication of information technology with its capacity to collect, analyze and disseminate information has introduced a sense of urgency to the demand for legislation (Davies, 1996). Two forces threaten our privacy. One is the growth of information technology, with its enhanced capacity for surveillance, communication, computation, storage and retrieval. A second and more insidious threat is the increased value of information in decision-making. Information is increasingly valuable to policy makers; they convert it even if acquiring it invades another's privacy (Mason, 1986). For some privacy is a psychological state, a condition of being apart from others closely related to alienation (Weinstein, 1971).

The individual privacy in the workplace is becoming an important ethical issue in the present day context.

As mentioned earlier concept of privacy has been flexible, largely determined and decided by the individual. However, the current presence of information technology has made it even more unclear and ambiguous. In the wake of newer situations and newer issues relating to privacy, there is a need to assess how individuals perceive these newer situations. The perceived ethicality or otherwise of different issues related to privacy will involve a study of individual decision-making process and the factors that affect this process. Ethical issues by definition, involve a social construction by the individual, this process becomes more complex and important where is situational norms are also in a flux. Thus, the perceived ethicality of issues related to privacy depends upon the factors that affect this individual decision-making process. One important factor being considered in this work is the respondent position as an actor or target of violation of privacy. Using the ego defense bias, the rationalization processes are at work when the individual is the actor of situation involving violation of privacy, using the mechanism of neutralization (McDonald and Pak, 1996) and denial of an unethical act. It is also possible that the individual uses rationalization process to justify his or her act. Given the human tendency to diminish the negative acts of the self, it is likely that the individual will not perceive a violation of privacy as unethical. On the other hand, if the individual is the target of an unethical act of violation of privacy, it is likely that perceived unethicality is exaggerated.

Thus, our first objective is to study the perceived ethicality of a situation as a function of respondent position. On first hypothesis, hence is given below

H1: Situations where individuals are targets are likely to be perceived as more unethical as compared to the situation where individual are actors

There are many other factors that affect the perception of individual while making any ethical/unethical decision regarding privacy issues, peer belief is one such variable we are studying, the impact of this variable on perceived ethicality.

Peer Beliefs / Perception

Sutherland and Cressey's (1970) theory of differential association assumes that ethical/unethical behavior is learned in the process of interacting with persons who are part of intimate personal groups or role set. Research by Ferrell and Gresham (1985) research, show that differential associations with peers are better predictors of ethical/unethical behavior as compared to one's own ethical belief system. The findings support a model, which assumes that individual could become engaged in unethical behavior with a supporting belief system. This research further determines that the referent other group predicting ethical/unethical behavior of these employees is peers rather than top management.

Ferrell and Ferrell (1982), in another study on advertisement agency executives found that peers, the referents group closest to the focal person, is the strongest predictor of their ethical/unethical behavior. Watson and Pitt (1993) in their study investigated the personal computer user's attitudes towards ethical issues in personal computing. The findings of this study indicate that behavior of personal computer users when faced with an ethical/unethical issues is determined by their impression of how their peers behave in that situation. Thus, our second objective is to study the impact of peer beliefs about ethicality of privacy on the perceived ethicality.

However, we further believe that this relationship might vary for situations where the respondent is either the actor or the target. Our second hypothesis is as follows:

H2: Peer beliefs about ethicality of privacy will influence the perceived ethicality for situations where the respondent is the actor and not when the respondent is the target.

Though peer belief is an important predictor, it is likely that individuals vary on the extent to which they get influenced by peer perception. One factor that affects this relationship is the tendency of an individual to give in to peer pressure. Hence peer perception is the next issue that we explore.

Peer Pressure

Peer pressure occurs when the individual experiences implicit or explicit persuasions to adopt similar values, beliefs and goals or to participate in the same activities as those in the peer group. Ideally, the individual should make a decision based on a combination of value internalized from the family (as socialization process), values derived from thinking independently and values derived from friends and peers. Individuals vary in the extent to which they use these factors in decision-making. Thus, peer pressure is high for those who get influenced by the values of the relevant peer group. Though, peer perception is an important determinant but individuals vary in terms of the extent to which they get influenced by the peers. Peer pressure is the perceived pressure on the person from the peers. Thus peer pressure is likely to affect the above mentioned relationship between peer perception and perceived ethicality. Thus, our third hypothesis is as follows:

H3: Peer pressure will moderate the relationship between peer belief and perceived ethicality such that the perceived ethicality would be more like that of the peers for those respondents who show high peer pressure.

Methodology

Respondents

The present study collected data using questionnaire from 125 respondents. There were 56 undergraduates' students and 69 MBA student of IIT Delhi, India. The average age of undergraduate respondents was around 20 years, and the average age of MBA students was around 30 years. Of these 91 were male and 34 were female respondents.

Two forces threaten our privacy, one is the enhanced capacity for surveillance, communication, computation, storage and retrieval with the growth of information technology and second is the increased value of information in decision-making.

Procedure and Questionnaire

Data was collected through a structured questionnaire, which was divided into two sections. The details of the questionnaire are given below:

Section 1

This section contains two situations regarding privacy. First situation is where an individual is a target and the second situation is where the individual is the actor. Both the situations are followed by a question of perceived ethicality and peers perception of ethicality. (Please see Appendix for the situations)

Section 2

This section of the questionnaire assessed the peer pressure, i.e., the extent to which an individual gets influence by peer's beliefs. The four-item scale is taken from Taylor and Peter (1995) and modified for the present study to assess peer pressure only.

Results

Our first objective was to assess whether there is a significant difference in the perceived ethicality of situations where the respondent is either the target or the actor. To test this t- test was conducted between the perceived ethicality means for the two situations. Results are reported in Table 1.

Table 1 : t–Test for Perceived Ethicality for Two Situations: Actor and Target

	Situation 1 (Actor)	Situation 2 (Target)	T
Mean	3.5200	3.1680	
SD	1.13	1.10	3.927**
N	125	125	

Note. ** = p<. 01

It can be seen from Table 1 that the perceived ethicality of the first situation where the individual is the actor is significantly higher than that of the second situation where the individual is the target. Thus our first hypothesis finds full support.

To assess the relationship of peer belief, and peer pressure with perceived ethicality, correlations were computed. The results (see Table 2) showed that for both the situations, the correlations were highly significant, there by indicating that peer belief strongly affects perceived ethicality of the individuals both as targets as well as actors. Thus our second hypothesis receives only partial support as, we expected the relationship to be significant only for the first situation where the individual is the actor.

To assess the moderating role of peer pressure, a hierarchical regression analysis was conducted for perceived ethicality as dependent valuable (DV), and Peer Belief, Peer Pressure and the interaction between the two (in that order) as independent variables. For each interaction term the variables were first converted into Z- scores to give the scores equivalence. The interaction term was taken as the product of the Z – scores. The regression method used

Table 2 : Inter Correlations amongst Perceived Ethicality, Peer Belief and Peer Pressure

	Situation 1 (Actor)			Situation 2 (Target)		
	PE (Perceived Ethicality	PB (Peer Belief)	PP (Peer Pressure)	PE (Perceived Ethicality	PB (Peer Belief)	PP (Peer Pressure)
PE (Perceived Ethicality)	1	0.430**	-0.127	1	0.474**	0.033
PB (Peer Belief)	0.4300**	1	-0.001	0.474**	1	0.019
PP (Peer Pressure)	-0.1227	-0.001	1	0.033	0.019	1

** Correlation is Significant at 0.01 level.

requires the researcher to specify the order of independent variables. In this research, the independent effects of the two variables are included first and the interaction term was included last. Thus, by taking the interaction at the third step the compounding effects of the first two were removed. For the interaction hypothesis to be significant, the beta weights of the product term had to be significant.

Ethical/unethical behavior is learned in the process of interacting with persons who are part of intimate personal groups or role set.

Table 3 shows the results of perceived ethicality in privacy situation one, where individual is the actor. The results show that both peers belief and peer pressure has a major influence on individual perceived ethicality regarding privacy issue. Results also show that peer pressure interacts with peer belief to predict perceived ethicality. Before we test the direction of this moderator let us look at results for the second situation (target).

Table 3 : Perceived Ethicality in Situation 1 (where individual is the actor) of Privacy

	Beta	t	Sig
Peer Belief (PB)	1.723	3.073	0.003**
Peer Pressure (PP)	1.755	2.569	0.011*
Interaction (PBEPP)	-2.264	-2.58	0.011*

Table 4 shows the results of perceived ethicality in privacy situation two, where individual is a target in the situation. The result shows that the interaction of peer belief and peers pressure has no impact on perceived ethicality of individual decision regarding privacy.

The interaction effect is significant for situation one, i.e., where the respondent is the actor. To see the direction of the results means are identified. Significant interaction is further analyzed graphically scores with ± one standard deviation from the means were plotted (Hunt and Osbrun, 1975). It needs to be mentioned here that the graphical representation shows the direction of the interaction effect, which is not shown by the beta weights. For the graphical purpose data are grouped into qualitative categories (low and High) Table 5 lists the mean scores on perceived ethicality for different combinations low and high of peer pressure and peer beliefs. The same data is shown graphically in Figure 1. The results clearly indicate that for high peer pressure perceived ethicality is lowest when peer belief is low and it is highest when peer belief is high. Thus our third hypothesis too finds full support.

Table 4 : Perceived Ethicality in Situation 2 (where individual is a target) of Privacy

	Beta	t	Sig
Peer Belief (PB)	0.085	0.144	0.886
Peer Pressure (PP)	-0.066	-0.09	0.928
Interaction (PBEPP)	0.128	0.138	0.891

Table 5 : Mean Scores on Perceived Ethicality for Low and High Belief and Peer Pressure

		Peer Belief (PB)	
Peer Pressure (PP)	L	3.14 SD = 1.41 N = 14	3.44 SD = 1.05 N = 64
	H	2.33 SD = 1.12 N = 9	4.08 SD = .81 N = 38

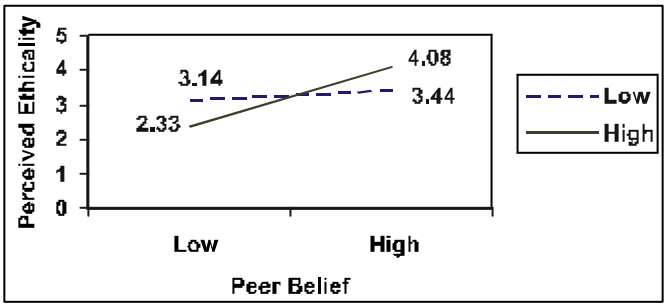

Figure 1: Perceived Ethicality as a Function of Interaction between Peer Belief and Peer Pressure for Situation 1 (Actor)

Discussion

In the present study we have taken ethical issues of privacy and tried to assess the impact of peers belief and peers perception on unethical/ethical decision-making regarding these issues, at the same time we are also trying to assess the difference in the opinions of individual in a situation where they are acting as an actor and in a

situation where they are a target themselves. At the first level, there is a significant difference in the perceived ethicality of the situation where the respondent is either an actor or the target. For the identical situation if one is the actor the situation is perceived as more ethical as compared to a situation where the actor is a target. Ego defensiveness biases are operating while making decisions of ethicality. Hence it is important to build this reason and logic into any assessment of individual's perceptions.

Our first result shows that a situation is perceived to be unethical if self is the target as compared to the situation when the self is the actor. It seems that at least in these situations self-interest is the guiding principle in deciding the ethicality of an issue and not a set of independent standards or values. This could be explained on the basis of changing situation and no clear social norms of right or wrong in the context of IT. The material worlds (IT) changes fast and the non-material world (values and beliefs) take a while to fall in place. In this time of flux, self-interest might govern ethical decision-making. At the individual level it looks like the psychological defense mechanism of neutralization is at work. Individuals, to lessen the impact of norm-violating behaviors upon their self-concept often use the neutralization framework as a technique. This is a rationalization process. The most common perceptual components of neutralization are (1) Denial of responsibility: where individuals might argue that they are not personally accountable for their actions because of circumstances beyond their control. (2) Denial of Injury: where the individuals contend that their action is not important and is an acceptable violation of normative behavior as probably no one suffers. (3) Denial of victim: where individuals condone their action by arguing that the violated party deserved whatever happened, i.e, a form of retributive justices is provoked. (4) Condensing the condemner: where individual points out that that they are not alone in the unethical action and that other are involved in similar disapproved behavior. Thus it seem in the case of a situation where ones own self acts as a violator of ethical norms the impact is significantly diminished. On the other hand, when one is the target the tendency is to enhance the negative impact. Thus, when the organizations design systems for control privacy issues this tendency to either inflate or deflate the impact needs to be accounted for.

Peers, the referents group closest to the focal person, is the strongest predictor of their ethical/unethical behavior.

The results of present study clearly show that individual decision-making gets influenced by what their peers think is right or wrong. Social belief of the referent group plays an important role in the perceptions of ethicality. Thus, it means that the collective norm or value operating in an organization will be a strong predictor of the pervasiveness of an unethical act. From the point of view of the organization, hence developing cultural belief through formal and informal mechanism are likely to yield positive results for controlling breach of privacy.

However, when the focus of attention is the individual, one important factor that predicts the perception is the tendency of an individual to get influenced by peer beliefs. However, it needs to be mentioned here that peer beliefs and peer perception are important predictors in our study because the sample of our study is the students who are more likely to get influenced by their peer groups. It is likely that the results (specially for hypothesis 2 and 3) are not all that strong for another sample of mature professionals.

Our study thus indicates that the individuals use ethical perception flexibly even for the same situation, as a function of their position. Thus the cognitive rationalization moves on a continuum of high ethicality to low ethicality depending upon their position. Also this perception is used flexibly as a function of peer belief and peer pressure. Thus, the design of system must respond to the issues flexibly (Bhal, 2000), keeping in mind the individual variations. The design of HR system, for privacy must keep in mind the position of the employees, as the perceptions of higher level employees (likely to be actors) will be different from that of the lower level employees (likely to be targets). The system must respond to the dynamic flexibility of level wise perceptions. The perception could be seen as moving on a continuum of ethical to unethical but it needs to integrated based on the situation and the actor involved, (Sushil, 2000 a, b). The flexibility has to be made operational at the level of diagnosis and analysis of the systems, keeping in mind the varying perceptions. At the next level the design of systems have to be flexible depending upon the situation and the position of the people.

Thus, the perceived ethicality of the same individual varies and there is a flexibility in the perception of ethicality specially by virtue of the position the respondent is in. A fact that must be addressed in the diagnosis and design of appropriate systems.

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Appendix I

Instruction

Following are two likely situations in the work place. Please read the situations respond to the questions that follow each situation.

Situation 1

You are HR manager, and you want to see that the employees are using phone and e – mail only for business purposes. You use a computer and other devices to randomly monitor compliance with this policy.

Q1. How correct is this activity in your view.
Very wrong….Wrong….Not sure….Correct….. Very correct….

Q2. What would your peers think about your action. Would they consider it.
Very wrong….Wrong….Not sure….Correct….. Very correct….

Situation 2

Suppose you are working for a company with a policy that phones conversation and e – mail use should be related only to business only. The company uses a computer to randomly monitor compliance with this policy.

Q1 How correct is this activity in your view.
Very wrong….Wrong….Not sure….Correct…..Very correct….

Q 2 What would your peers think about your action. Would they consider it Very wrong….Wrong….Not sure ….Correct….. Very correct….

Section 2

Following four items assess the pressure of your peers regarding the use of computer. Please mention on the scale given, how true they are for your peers and friends.

1. I get influenced by what my friends think that I should do.
   Very true…. True….Not sure ….Not true….. Not at all true….
2. Generally speaking, I want to do what my friends think I should do.
   Always…. Usually….Sometimes ….Rarely…..Never….
3. I would get influenced by what my classmates think that I should do.
   Always…. Usually….Sometimes ….Rarely…..Never….
4. Generally speaking, I want to do what my classmates think I should do.
   Always…. Usually….Sometimes ….Rarely…..Never….

Flexibility Mapping : Practitioner's Perspective

1. What types of flexibilities you see in the IT enabled environment regarding "Privacy at Workplace" 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 "Privacy at Workplace" 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))

Manager's Perspective (Actor)

High Important ☐☐☐☐☐ Low Important

Subordinates Perspective (Target)

High Important ☐☐☐☐☐ Low Important

Individual Personality (Peer Pressure)

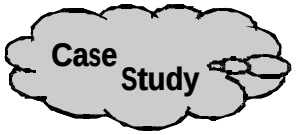
High Important ☐☐☐☐☐ Low Important

Peer Group Belief

High Important ☐☐☐☐☐ Low Important

Reflecting Applicability in Real Life

1. Is your organization going through IT enabled privacy violations at workplace? How will you use the findings of this study to manage them?



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Stakeholder Flexibility in E-Business Environment: A Case of an Automobile Company

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Abstract

Earlier, researchers talked about Stakeholder Theory, Stakeholder Responsibility, Stakeholder Partnerships, Stakeholder Management, Stakeholder Engagement, Stakeholder Relationships, Stakeholder Reporting, Stakeholder Mapping, Stakeholder Performance, Stakeholder Strategy, Stakeholder Dialogue, Stakeholder Networks etc. and various dimensions of stakeholder. E-Business is the concept to bring flexibility in the business. Researchers emphasized e-flexibility of online business in many ways such as CRM flexibility, SCM flexibility, marketing flexibility etc. This paper introduces a new concept of stakeholders and flexibility, i.e. stakeholder flexibility due to e-business environment. In the new economy, data, information, knowledge, interaction, technology, trust, and the relationship are the keys to success but flexibility is for sustaining in the dynamic and unpredicted present business environment. Flexibility is defined by three terms: more options, freedom of choice, and change mechanism. This paper is based on the strategic and flexibility aspects of E-Business transformation. This flexibility helps to produce a new, integrated approach of flexibility, which is dual in nature and sometimes it shows the multidimensional nature of flexibility. The paper examines the flexibility for stakeholders from business and from business to stakeholders in E-Business environment. There are mainly two groups of stakeholders: one is direct stakeholders and the other is an indirect stakeholder. This paper explains the direct stakeholder flexibility. The paper also addresses certain fundamental questions such as: Why flexibility? Why stakeholder flexibility? What is the nature of flexibility?

Keywords : e-business environment, flexibility, stakeholders, stakeholder flexibility

Introduction

E-Business is the new, evolving paradigm. Management has faced several transformations from the age of agriculture till information technology. Recent decades are the witness to rapid changes, which may be due to MIS or ERP. The focus of time-based paradigm has shifted from traditional brick and mortar centered setting to click and brick systems. In fact, competitive priorities in many firms have shifted from simply business speed to e-speed (Norris et al., 2001). The e-business revolution is impossible to ignore. It is transforming businesses in virtually every industry and reshaping the global economy. The traditional organizational structure and operational processes are suddenly changed due to information technology revolution. The e-business transformation is an evolving transformation since last five years and need lot of research in context of strategic management.

Gartner Research (1999) developed an e-business strategy framework that can help business leaders to get better results from strategic plans. This strategic framework consists five phases: e-vision, e-management, e-competition, e-plans and e-review. These are the basic components of strategic management. Those e-business strategies maximize opportunities and minimize the risks.

E-Business is not one-man effort; it needs various stakeholders such as technology providers, application service providers, supplier, distributor, retailer, shareholder, customer, and financial service providers. The key stakeholder involved gain lower cost of the product, better services, and ultimately more profits.

The recent advances in IT and telecom are changing business processes and structures, they are reshaping relationships with business partners and competitors, and in some cases they even cause the transformation of an entire industry. The Internet has brought about a dramatic change in the way business is done in today's world. And building an E-Business strategy is perhaps the single most important issue faced by corporate strategists. E-Business, of course, is not about technology itself – it's about how to use the technology to transform business processes. It's about new models of commerce, marketing and distribution. In fact, one of the key parameters companies are being evaluated on today is how well, and how fast, they can adapt themselves to the Internet.

Within next two years nearly two-third business transactions will be conducted through e-business in India. Business-to-business (B2B) e-commerce will continue its rapid pace of growth, generating $7.29 trillion in sales transactions worldwide in 2004. The revenue generation in the year 2001 was $953 billion, $2.18 trillion in 2002, and $3.95 trillion in 2003. The report estimates that such activity will make up 37 percent of the B2B e-commerce market,

worth $2.71 trillion by the year 2004. Business-to-business (B2B) e-commerce will continue its rapid pace of growth, generating $7.29 trillion in sales transactions worldwide in 2004, according to a report published by the research firm GartnerGroup (2002). The Internet business in India is worth about INR 120,00 billion per annum.

This paper presents an approach which provides tractability from strategy to process through the critical link of the business stakeholders: all those who have a 'stake' or interest in the success of the company whether they are customers, suppliers, owners, staff, or community-based. Stakeholder flexibility is very important to successfully run a business in competition. The stakeholder flexibility is more strategic approach in e-business environment. The area of e-business strategy is emerging and needs a lot of attention in order to understand the stakeholder flexibility. The flexibility is the key to sustain in the dynamic and uncertain world. The e-business strategy is fundamental to transform a business from brick and mortar to brick and click. Therefore, it becomes important to study e-business transformation, which brings stakeholder flexibility to sustain in competitive world.

E-Business (New Economy) Change Mechanism

The changes in technology and economy are creating a new set of business rules and practices what is being called "The New Economy" or "E-Economy". Some of major business beliefs in the old economy and how these beliefs are shifting in the new economy (e-business environment) are shown in Tables 1 and 2.

The change comes often when the previous phase faces the saturation of S shape growth curve. Previous change was MIS. The failure of e-commerce brought e-business to create new opportunities for business, especially for B2B. E-Business, is to exploit the opportunities created by the Internet and information technology for business to create virtual marketplace. E-Business is concerned specially about B2B segment because the failure the B2C segment (e-commerce). The transaction of money is much more in B2B as compared to B2C e-business.

For Whom E-Business is?

E-Business is for the stakeholders of the business: customers, employees, and shareholders, every one. It gives flexibility and JIT services at one place. From business point of view, it's for big MNCs to exploit the resources and opportunities available globally. They can afford the cost infrastructure of e-business with the help of world-class technology partners. The e-business can be for small and medium sized enterprises to adopt and transform e-business step by step as the Sawhny & Zabin (2001) described the ladder from inform to transform.

E-Business is not one-man effort; it needs various stakeholders such as technology providers, application service providers, supplier, distributor, retailer, shareholder, customer, and financial service providers.

Table 1: Changes from Old Economy to New Economy

Change Areas	Old Economy	New Economy
Assets	Tangibles	Intangibles
Business	Change	Transformation
Communication	Physical Meetings	Telecommunication
Competition	Known	Unknown
Control	Centralized	Decentralized
Demand/Supply	Market Driven	Customer Driven
Future	Prediction	Uncertain
Integration	Vertical Integration	Virtual Integration
Knowledge	Utilization	Creation & Renewal
Management	Compliance	Self Control
Organization	Structure, Hierarchy	Edge of Chaos, Networked
Reach	Local	Global
Sharing	Information Sharing	Knowledge Sharing
Skills	Individual	Collective
Strategy	Prediction	Anticipation of surprise
Technology	Convergence	Divergence
Technology Resource	In-House Development, Innovation	Tech Outsourcing, Diffusion
Trade Rules	Government Driven	WTO Driven
Work	Office Work, Flexi Time	Flexi Work, Fixed Time

Table 2 : Business Focus from Old Economy to New Economy

Old Economy	New Economy
Advertisement based brand building	Performance based brand building
Cost	Value
Customer Acquisition	Customer Retention
Look primarily at financial scorecard	Look also at marketing scorecard
Marketing does the marketing	Everyone does the marketing
Organize by product units	Organize by customer segments
Over promise under deliver	Under promise, over deliver
Product Technology	Process Technology
Shareholder	Stakeholder

According to Tettech and Burn (2001), Web based business can be an extremely attractive option for most SMEs to extend their customer base into a global market without vast expenses, but there are many hurdles and hidden costs. SMEs can achieve the global competitiveness without necessity increasing their actual size, but rather by building on their virtual or soft assets in order to expand. These virtual assets include information skills, digital resources, and competencies for managing inter firm relation and collaborative engagements with other firms.

Economic development is a goal of most governments. Globally it is recognized that approximately 80 per cent of economic growth comes from the SME sector. It is, therefore,

likely that government strategies aimed at facilitating SMEs adopting the Internet enabled business processes and practices to help increasing national GDP (Dawan, Bodorik and Dhaliwal, 2002).

Who Are Stakeholders?

The Webster Business Dictionary defines stakeholders as "Stakeholders include all individuals and groups who are affected by, or can affect the organization". The dictionary meaning of stakeholder is "one who holds a stake". The word *stake* is defined as "a personal interest or involvement" or " a monetary or commercial investment in something, as in hope of gain."

Stakeholders are those who have rights or interests in a system. For an organization, stakeholders are any group or individual, who can affect, or is affected by the achievement of the organization's purpose.

Corporate Stakeholders and e-Business

A company involved in e-business has a responsibility to protect its corporate stakeholders, because in any e-business model, corporate stakeholders may be harmed in number of ways. This may turn in financial loss, reputation loss, and loss of trust. Stakeholder groups (Fig.1) always include customers, vendors/suppliers, service providers, shareholders/ investors, corporate executives, board of directors and the general public.

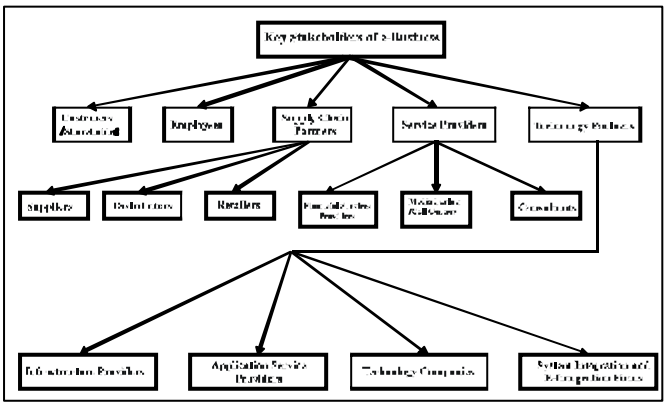

Figure 1 : Key Stakeholders of E-Business

Why are Stakeholders Important for E-Business Transformation?

A company can transform itself including value network (all the stakeholders). To do this, companies must divest non-core businesses to partners to cut cost and gain flexibility. In doing so, they'll create a value network of partners that will fulfill the same demand, but with a smaller asset and resource base. If businesses choose this route, a critical mass of capable business service providers emerges. This would result that the company benefits from its partner's growth and capabilities. Successful value networks excel largely through their technology and information sharing practices. To create an e-business transformation, companies should partner with or acquire a company with a proven e-business model and channel. For competitive advantage, firms going for this route must focus on areas that have challenged their industry, for example, e-channel fulfillment or establishing private marketplaces. The key advantage is the opportunity to get a jump-start with a proven e- business model. A main disadvantage is the lack of control of customer demand in a Web channel.

The Pressure for Flexibility

There are causes of pressure for flexibility demanded by stakeholders, shown in Table 3. All stakeholders want profit and money by long-term association with the business. On the other hand, business puts pressure on stakeholder for flexibility, shown in Table 4. E-Business environment has the potential to tolerate both pressures at the same time by conducting the business electronically and results in stakeholder flexibility.

Table 3 : Pressure for Flexibility by Stakeholders

Stakeholder	Cause
Customer	Want ever lower prices and more immediate delivery
Competitors	Want to strive to satisfy these same customers
Shareholders	They want higher profit on their investment
Government agencies	They are squeezing budgets and demanding better value for money in service delivery
Employee	Want high salary, services and flexi work
Suppliers	Want accurate order process system and more demand
Distributors	Want higher commission and fast order fulfillment and product delivery
Retailers	More commission and to satisfy customer demand
Technology Providers	Want long time association
Call Centers	Want profit by renewing tenure and assignment for more time
Consultants	Want to give the more solutions of problems for earning
IT Partners/comp	Want to upgrade new technologies and log term engagement
Financial Service providers/ banks/Insurance	Want to provide financial services to increase revenue
Media Partners	Want to promote product campaign to earn money

Dual Nature of Stakeholder Flexibility

Stakeholders are those who have rights or interests in a system. For an organization, stakeholders are any group or individual who can affect, or is affected by the achievement of the organization's purpose. Those, who has a 'stake', claim or vested interest, those who provide something of importance to the organization, and expect something in

Table 4 : Business Demand from Stakeholders

Stakeholder	Cause
Customer	Buying product and long term retention
Competitors	Information of competition and market demand
Shareholders	Investment
Government agencies	Facilities and flexible rules
Employee	High Productivity
Suppliers	Cheap materials and immediate delivery
Distributors	Fulfill the customer demand and better services to customers
Retailers	Fulfill the customer demand and better services to customers
Technology Providers	Innovative and new technology to gain competitive advantage
Call Centers	Customer care and providing information to stakeholders
Consultants	Accurate planning and better solution of the problem
IT Partners/comp	Better hardware, software and services with time to time updating
Financial Service providers/ banks/ Insurance	Easy financial processes with low interest rate
Media Partners	Better campaigning for brand building

return. Stakeholders can be individuals, communities, social groups, or organizations that has the ability to influence decision-making in an organization. Stakeholders are viewed as playing an important role in determining organizational direction by influencing the goals and strategies that organizations adopt.

E-Business can create new value propositions for every stakeholder. A value proposition describes the perceived value that each member of the value chain (buyer, seller, distributes, alliance partners, etc.) receives from participating in a business model. This creates flexibility for stakeholder as a word change in order to get information, transaction, and transformation of work culture.

A company involved in E-Business has a responsibility to protect its corporate stakeholders, because in any e-business model, corporate stakeholders may be harmed in a number of ways.

Flexibility of a business process is how easily a business process can be adjusted according to different stakeholder's needs. Moreover, flexibility means more options and more choices in change mechanism (Sushil, 2000). There are two types of flexibility: first to stakeholders and second to business from the stakeholders. We are taking both the ways of flexibility in the account. The dual nature of stakeholder flexibility is shown in Appendix I in detail.

Customers

Customers are the focus points of any business. E-Business created many options and choices for customers to save time and money and get better quality with better services. Now, the second phase of the coin, how e-business creates flexibility for business? This is helpful to establish one-to-one customer relationship. This also brings end-to-end business solutions to ensure long-term success in managing customer relationships based on ongoing learning with the help of information. The most important thing brought by e-business, is information gathering about market with in the time, helpful in learning about customers and marketing analysis. This will help to determine its place in the electronic marketplace of future. This will help to form better customer relationship.

Employees

Employees may be benefited in terms of flexible hours, flexible work, and flexible place to work. This could be beneficial in terms of less stress, more time with family and friends and easy to work at home. Employees may get knowledge not only of their own field but also other fields, which are essential and influences their work. On the other hand, business or company will get the benefit in terms of connectivity with employees. So the management can get information about their performance and may established better relationship with their employees. The business can also save their expenses from the facilities reduction. Job share and location independent among employees may enhance the flexibility and knowledge management perspectives. So they can share their knowledge with the help of e-business, and facilitate job rotation to enhance knowledge, not only their own job but also other jobs, if needed.

Shareholders

The flexibility to shareholders from e-business is to get update information about the stock exchange and their position (Trading Update) time-to-time by newsletter or daily news. They can also share their view and ideas with the company by providing the suggestions through online meeting and communities. New initiative about the business will be provided to all the shareholders to get their feedback. The second phase how business is getting flexibility from e-business in terms of shareholders. Business will get more investment from shareholders as well as new shareholders associated with the business. Now, shareholders will also care about the IT, because the failure of New York Stock Exchange. Business can give the information about new policies, initiative, and can also get feedback just in time so decision-making would be made easily for a business. Online traders, such as e-trade, and even exchanges, such as New York exchange, have experienced systems failure that has made them the unhappy centers of world attention. In June 1999, the Internet auction site e-buy was down for 22 hours. In the next two trading days, the e-buy's share price dropped by 25%. So definitely your shareholders will care about the IT.

Supply Chain Partners (Suppliers, Dealers, Retailers)

The information about all the products, reviewing products, review product specifications, check availability of raw material and production schedules, commit order, track order status, schedule delivery, will be easily available electronically due to e-business. The transaction gives freedom of space and time, and also avoid burden of hard files and manuals. There is difficulty of security and secrecy of information and money transaction. The seamless integration of all supply chain activities reduces cost of procurement, delivery cost of product, inventor information cost and production cost. The manufacturer benefits from increase in sales. The retailer gets benefits from having an adequate stock of the product and being able to offer it to the end consumer at a lower cost, thereby increasing sales volume. This will be helpful to increase profit margin for business and all supply chain partners (IBM e-biz resource).

Information Technology Companies

E-Business forms alliances with leading e-business software, hardware, networking, and service provider companies to develop and deliver the back-end integration capabilities they required to provide their customers and business with complete e-business portal and marketplace solutions. Company products help partners create an open, scalable framework that supports complex interactions among customers, buyers, suppliers, partners, and employees. Technology company alliances include IBM, Oracle, Microsoft, and so on.

Stakeholder flexibility in any business is very important to successfully run business in competition.

Call Centers

Call centers are helpful to communicate with dealers and consumers. When dealers communicate with their manufacturer online, and when consumers find the answers to the questions online, the cost comes down dramatically: through the dealer e-channel, manufacturers and dealers can keep their costs down. Consumer questions are answered online, and they can research the products and other information they seek online as well. For dealers, they can conduct business with consumers. They save the enormous cost-of-business expenses. Call centers will be benefited by long term engagement with the business for profit making.

Media Partner

The media partner provides promotion of business through different channels such as radio, TV, Web publishing, posters, hoardings, newspapers, magazines and so on. But, the booking and transaction of promotion could be electronic and payment could be made by electronic transaction between business and media partners. Media partners also provide consulting, business assurance services, ad delivery and privacy attestation and consultation, assistance to mergers and acquisitions, tax planning and compliance, capital structuring and employee benefits and executive compensation packages. Media partners will have long-term association in providing so.

Financial Services Providers

This includes bankers and insurance companies to provide financial services online into interest of business, and to make money from the business.

Consultants

E-consultancy is the way to get benefit of electronic medium for facilitating business customers and business online, results in reducing time, and cost from both ways. Internet also helps to provide information to consultants regarding business and search.

All Alliance Partners

The non-core process will be shifted to all alliance partners, so they may become a part of e-business. If the business gets profit then they will also be benefitted; if they grow the business also grows. E-Business includes all the alliance partners, IT partners and different channel partners. The e-business brings flexibility for alliance partners in terms of development of new thoughts, research and development, new learning opportunities, creating new forums and virtual meetings, information sharing and access, and finally recognition.

Case Study : Maruti Udyog Limited (MUL) is Thriving Stakeholder Flexibility in E-Business Environment

Maruti Udyog limited (MUL) is the largest car manufacturer of India. In the year 1982, the government signed a joint venture with Suzuki Motors Corporation of Japan and set up the first joint venture of Government of India in car manufacturing. Maruti has 2.8 million customers round the globe, an average of 30,000 to 40,000 cars coming out of assembly lines each month, and a network of 10 regional offices across the country. Maruti exports to 70 countries. Some of the key processes and their results are pointed in Table 5.

IT at MUL

Maruti, an INR 9,6720 million company is doing well to retain its market leadership, and seems to coming out on top. One of the biggest weapons in Maruti's is information technology. Currently, almost 75% percent of Maruti's yearly business transactions is conducted online; the company is poised to take it to 80 percent by 2003. On an average, Maruti invests between INR 150-200 million every year on IT.

B2B at MUL

As part of its Web initiative Maruti is also a part of a consortium of eight majors, which intends to set up an automotive e-marketplace for India. This kind of a market,

Table 5 : E-Business at Maruti

Processes

- End to end streamline procurement system, which integrates over 500 suppliers and around 300 dealers network.
- Use of Extranet and Intranet
- Offers JIT procurement
- Teleconferencing from Suzuki Motors Japan
- Oasis portal and Knowledge Bank
- Marutiudyog.com provides wide range of information for all

Results

- Reduce 50% cost of procurement processes.
- Cost reduction of inventory and other overhead costs
- 75% cost saving of paper and other stationary
- 72 Laks Rs by online reverse auction
- Helpful in maintaining Maruti's core competency to provide cheapest car
- Customer Information Management, customer support
- Online transaction of 75% of total revenue

which gives an opportunity for the company for supply chain optimization as well as helps in eliminating flab from operations at various tiers of the value chain. On the B2B front it includes putting its entire dealer and vendor network fully online by developing extranet-based systems, which integrate dealers and suppliers to Maruti's business systems. The first step was the linking of its 260 dealers in India into its Wide Area Network (WAN).

Being a transaction-heavy organization, Maruti's prime area of focus in installing its numerous systems and applications has been to cater to its various functions, thus helping it achieve the highest efficiency levels. Maruti has established collaborative systems with its business partners, e.g. dealers and suppliers besides enhancing/re-engineering its in-house systems and processes. With almost 99 percent of dealers using the extranet facility today, currently Maruti has implanted similar facilities for its vendors. Maruti boasts of a full-featured B2B marketplace for business partners, which is the Maruti extranet based on a Virtual Private Network (VPN). Maruti has implemented various modules and systems including production planning, scheduling and material scheduling in order to enhance its supply chain efficiencies. The company has implemented a Just in Time (JIT) materials procurement system. Vendors under this system are given specific delivery instructions for materials supply, which specify all details to the last degree the exact date and time of delivery, even the specific workstation inside Maruti and the exact quantity to be supplied to any of these. This allows the vendor adequate time to schedule his own production system and ensures smoothening at his end.

Business environment has the potential to tolerate both pressures at the same time by conducting the business electronically and results in stakeholder flexibility.

B2C at MUL

On B2C front Maruti is currently in the process of fine-tuning its purely informative product-specific website to a customer relationship oriented corporate website that will boast of a virtual showroom, using Microsoft's yet to be released portal development software Microsoft Share Point. The company is connecting the new site to about 260 dealer sites, all of which have been developed by Maruti itself and are hosted on VSNL. This will allow the customers privileged access to information catering to their specific needs and tastes and also allow customers to book cars online.

IT Infrastructure

IT at Maruti is a competitive weapon. IT infrastructure at Maurti is shown in Table 6 given below. Maruti develops some of the IT software and services in house and some are outsourced.

Table 6 : IT Infrastructure at Maruti

IT Department	• Separate IT department at Maruti, heads by Mr. Rajesh Uppal, General Manager IT
IT Staff	• Around 70 people IT staff at Maruti
IT Systems	• 12 Compaq Alpha servers, • 20 PC servers, • Around 850 PCs, • 300 VT100 terminals. Enterprise Storage Architecture (ESA12K), • Tape Library, • Enterprise backup facility of 17.9 TB, • A remote backup and disaster recovery site Network environment • 20 km of optical fibre cabling within plant location at Gurgaon (1,000-node LAN).
Network Environment	• Plant to corporate office connectivity 2 Mbps. • 10 regional offices connected through VSATs. • 64 Kbps leased line ISDN link to Suzuki, Japan
Softwares	• In House Development, MS Office, Windows, Oracle 9i
Website	• Self development with self maintenance

MUL Stakeholders

Maruti's stakeholders are listed down in Table 7 but Maruti also has those indirect stakeholders, who are getting flexibility from e-business such as Haryana Vidyut Board, Haryana Transport Corporation, society, hospitals (Batra, Escorts) etc. We are considering only direct stakeholders of Maruti's e-business. We are avoiding indirect stakeholders such government and society.

Customers

Customers are the focus point of Maruti as in any business. Maruti provides detailed information to the customers through their website (marutiudyog.com), that contains all possible information of customers' interest, such as dealers

Table 7 : Key Stakeholders of Maruti

Stakeholders	Description of Stakeholders
Customers	• All Customers of all segment (around 5 million vehicles are sold till 2002 and 3,50,000 are sold every year)
Employee	• Around 2000 employee are IT savvy out of around 5700 employee
Suppliers/vendors	• Around 500 supplier and all are connected through Extranet
Dealers/Retailers/ workshops/	• Around 260 dealers (show room) all are connected through WAN. • Around 277 dealers workshops • Around 1329 Maruti authorized service station
Technology Provider	• Suzuki Motors Japan with strong communication system
Call center	• GE Gurgaon for customer Information center • i2i enterprise across all 25 cities of India
Financial Service Providers (Bankers)	• ABN AMRO • American Express Bank Ltd • Bank Of Tokyo-Mitsubishi Ltd. • Banque Nationale De Paris • Citibank N A. • Citicorp Maruti finance ltd • Corporation Bank • Credit Lyonnais • HDFC Bank • ICICI • Kotak Mahindra • Maruti Countrywide Finance • Punjab National Bank • Sanwa Bank Ltd. • SBI Maruti car loans • Standard Chartered Grindlays Bank Ltd. [Merged] • State Bank of Indore • State bank of Mysore • State Bank Of Travancore • Sundaram Finance • Union Bank Of India
Insurance	• Maruti Insurance Distribution Services (MIDS), MIDS was set up to sell insurance as a corporate agent of Bajaj Allianz General Insurance • Maruti Insurance Brokers (MIBL). MIBL was constituted to sell insurance products of the state-owned National Insurance.
IT partners	• Compaq • HP • Oracle • Microsoft
Consultants	• PWC (Auditor of the Maruti) • AT Kearney for E-Business solution • MB Athreya for HR (employees performance system)
Shareholders	• Suzuki Japan • Government of India • Recently Issued Public Shares
Media Partners	• Yahoo India • FM Radio • Indiatimes.com • Business magazines, Newspapers • TV

information, workshop information, maintainace planner, broucher, online calculator for calculating financial scheme and insurance policy, price of the car, financial schemes, insurance, true value, N2N fleet management, quarry answer, It provides special information and order booking to the special buyers such as Handicapped (see Table 8). The special information for holidays around Maruti dealers in India also available on the website. Maruti is getting the benefit in order to retain old customer, acquiring new customer, gaining customer trust, and building customer loyalty.

Table 8: Dual Nature of Customer Flexibility at Maruti

Flexibility to Customers	Flexibility to Maruti
• Online information about finance or loan schemes • Online information about insurance • Maruti Gateway guide for Travel in India • True value dealer information • Product/price/ availability information • Information about service stations/workshops/Maruti road service. • Online brouchers • Customer want to sell the call for that online help • E-mail account on Maruti for services • E-newsletter • Online owner manual • Online feed back and quarry • Toll free customer information from GE gurgaon • Online answer and help • Trust • Transparency about availability with online status of booking	• Customer Loyalty • Long term associations and feedback from customers • Online True value information attracts new customer segment • Online information about dealers service stations provide better reach ability to customer and trust • Global customer interaction • Rich database of customers • Rich database of customer demand • Database of customer quarry • Market Information and analysis • Regional Demand analysis

Employees

Computerization benefitted Maruti for improving the quality of life for every employee, by simplifying procedures, reducing paper work and giving instant access to accurate information. Moreover the availability of all sorts of data like production of vehicles to medical claim of employees online has resulted in punctuality and accuracy of work. Intranet supports Maruti's organizational work electronically in order to reduce work of the employees and reduce paper-stationary cost by managing file transfer and storage electronically. All intra and extra organizational works are conducted either through intranet, extranet or Internet. Maruti has OASIS portal with in the organization to support its HR policies. Oasis provides individual ID and password to all employees for getting information related to employee's interest such as monthly incentives, his

Table 9 : Dual Nature of Employee Flexibility at Maruti

Flexibility to Employees	Flexibility to Maruti
• Oasis portal to provide HR information with in the organization to all employee • Less Work load using user friendly software's • Paperless work using centralized server with in organization • Maruti started knowledge Bank database for storage and retrieval of knowledge of organization • All Policies and Information through intranet on personal account • E-mail account @mul.co.in • Fast and flexible communication system • Teleconferencing between Suzuki and Maruti people from Japan to India and vise-versa	• Oasis helps in HR strategy of the Maruti • Annual 50,000 Suggestions from employees electronically • Saving paper and stationary cost • Just in time information among employees • Just in time information and interaction among employees for better decision-making • Information and interaction with regional offices of Maruti • Cut paper and mailing cost of documents with fast processing, saving time • Full detail of staff

performance score, guest entry, claim status of loan, pass of bill and payment, special policies and related information to individual, e-learning etc (Table 9). Maruti is having the online knowledge bank to manage knowledge in the organization. Through electronic system, Maruti got 50,000 feedbacks from their employees last year.

Shareholders

The public issue to Maruti shares was launched recently hence much information is not available to get shareholders feedback. But, Maruti's two shareholders, Suzuki and Government of India get online newsletter and all information electronically. This helps to Maruti for more investment and shareholder trust for investment (see Table 10).

Table 10 : Dual nature of Shareholder Flexibility at Maruti

Flexibility to Shareholders	Flexibility to Maruti
• E-newsletter • Share market information online to Maruti shareholders • Maruti share information on Maruti website • Online suggestions and interaction about companies policies	• Recently started but Maruti is looking for investment • Shareholder satisfaction • Shareholder will care about business

Dealers

Maruti has the presence of dealer network at each and every part of India and connecting through strong electronic networking. Maruti's dealers are using e-business (EDI) for booking online orders, order status, availability of choice of the car, true value information, Maruti Insurance, and customers query (see Table 12). The dealership application and rules are also available online. E-Business is helpful in Maruti's supply chain management and dealer satisfaction.

Suppliers

Around 500 Maruti's suppliers are connected through the extranet to conduct JIT procurement. The e-procurement saves the cost of procurement and inventory and processes fast. E-procurement helps Maruti's suppliers in order to provide information such as inventory information, bidding, auction information, online supplier order rejection and current position of supplier, online tendering, financial transactions, online order process and approval (see Table 11). This helps Maruti to reduce inventory cost from 2 days to 2 hours and helps to achieve significant reduction in procurement processes.

Table 11 : Dual Nature of Supplier Flexibility at Maruti

Flexibility to Suppliers	Flexibility to Maruti
• E-newsletter • Inventory information of Maruti • Online Bidding for Order • Online payment with Maruti • Online Order Processing • Online Order Tracking • Online vendor ranking • Online quality information and rejection rate • Online contract information for vendors • Auctions/reverse auction information	• Seamless Procurement using extranet with around 500 dealers • Online vendor rating help to reach almost zero defect in Maruti • Quality inspection rating • Cut procurement cost • Manage inventory from minimum 2 hours to maximum 2 days, saving inventory cost • Auctions/reverse auction information

Table 12 : Dual Nature of Dealer Flexibility at Maruti

Flexibility to Dealers	Flexibility to Maruti
• Online status of the order to provide accurate information to customer about availability of the car at place • Less time to book order • EDP • Online interaction with direct suppliers for parts delivery and payment • Online interaction with financial service providers and for insurance parties regarding loans and insurance schemes • Fast and easy follow-up processes to customers due database • Electronic billing and all databases of customer enquiry • Order tracking system • Online information about Maruti and newsletter and all other information electronically • Information about dealers location wise given on the Maruti website	• Wide Dealers network across country at small place • EDP with dealers • Satisfying dealers demand by supplying as soon as getting information • 70 countries globally export dealers for Maruti • Global reach • Global interaction with dealers via Internet and knowing their demand electronically • Better dealers communication system • Easy sharing and getting dealers view for Maruti's policies

IT Partners

To run such a successful integrated e-business system, Maruti needed an infrastructure. This infrastructure consisted of hardware, software, and networking provided by IT partners. These IT partners gaining advantage to be associated for long life because Maruti requires continuous technology updating and maintenance (see Table 13). They also get advantage to provide same solution for Maruti's suppliers. This is helpful to Maruti in order to gain latest technology and better streamlined e-business system for better and faster processes.

Table 13 : Dual Nature of IT Partner Flexibility at Maruti

Flexibility to IT Partners	Flexibility to Maruti
• Time to time updating software's cause longtime engagement • Always updating Maruti website • Always engagement to maintain such big IT system • Hardware maintenance and new hardware supply	• Centralized Serves for data storage and services • FIBER optics line in organization for better and fast data transfer • Save CPU cost by using link box • Self ID division to fulfill most of IT requirements apart from hardware

Call Centers

GE Gurgaon call center is the call center for Maruti. It is toll free on BSNL and MTNL from all metros and from Gurgaon. Its called Maruti's Customer Information System. E-business is helping GE call center for providing information to customers electronically, to solve query of customer electronically, to send information and to get back information from Maruti electronically. The i2i enterprise, who cares Maruti's customer in 25 cities in India. This is helpful to Maruti for gaining customer database, information, requirement, and feedbacks (see Table 14). It helps to improve customer care of Maruti.

Successful value networks excel largely through their technology and information sharing practices. To create an e-business transformation, companies should partner with or acquire a company with a proven e-business model and channel.

Table 14 : Dual Nature of Call Center Flexibility at Maruti

Flexibility to Call Centers	Flexibility to Maruti
• Communication with Maruti through Internet to communicate customer information • Can get the information about customer quarry from Maruti's people online • Long term association	• Properly managed customers information system • No bother ness about cars information

Technology Providers

Suzuki Motors Corporation is the technology provider to the Maruti. E-Business helps MUL to have teleconferencing from Gurgaon to Japan, online training to Maruti employees about technology and about e-learning from Japan (see Table 15). All information and document transactions are through the Internet from Suzuki to Maruti and from Maruti to Suzuki.

Table 15 : Dual Nature of Technology Provider Flexibility at Maruti

Flexibility to Suzuki Motors Japan	Flexibility to Maruti
• Suzuki Motor Japan has teleconferencing system to conduct meetings • All information and documents transaction through Internet	• E-learning for employees about new technologies • Teleconferencing to discuss issues with directors

Media Partners

Media partners take order for publicity and campaign from Maruti electronically. The new channels help for better campaigning of Maruti. Indiatimes promote Martui's product online. FM radio in Delhi broadcasts daily a Maruti program called" Delhi Traffic" electronically. E-Business supports Maruti's marketing strategy globally. This helps for campaigning worldwide with easy and cheaper and from more channels (see Table 16).

Financial Services Providers

Information about financial services and information about financial service providers are available of Maruti's website. Customers can calculate the financial scheme through online calculator and can choose accordingly. Again, Maruti is getting customer satisfaction in order to provide better information to the customers (see Table 17).

Table 16 : Dual Nature of Media Flexibility at Maruti

Flexibility to Media	Flexibility to Maruti
• Time to time ad campaign • Time to time marketing assignment • New channels for promotion	• New and cheaper ways for promotion for Maruti • Save marketing cost

Table 17 : Dual Nature of Financial Service Provider Flexibility at Maruti

Flexibility to Financial Service Providers	Flexibility to Maruti
• All financial services information available on Maruti website • All policies and Online calculator for getting details on Maruti website • Online documents transaction and financial processes	• Easy loan and financial services to Maruti's customers • 70 % of Maruti revenue comes online

Consultants

E-consultancy is the way to find a better solution to a problem. Maruti takes help of MB Athreya, and AT Kerney for performance and e-business respectively. Price Waterhouse Cooper takes the responsibility of auditing of the Maruti. This is helpful both ways, to reduce cost and time (see Table 18).

Table 18 : Consultant Flexibility

Flexibility to Consultants	Flexibility to Maruti
• E-consultancy can be given to Maruti as Maruti is IT savvy • Still A T Kerney group is engaged with Maruti regarding problems in E-Business system	• M B Athreya has developed a new performance measurement and development method system and using electronically • E-consultancy option is possible to save money

Conclusion, Implications and Limitations of the Study

Conclusion

Successful competitive strategy and corporate results are likely to focus on performance attributes including speed, flexibility, quality and scale. E-Business can bring such things for their stakeholders. Stakeholder flexibility provides systematic understanding of value chain partners and actors involved in e-business system. This understanding is 360 degree via considered options, freedom and choice and change mechanism of stakeholders of any business. The case study proves that the flexibility to stakeholders and from the stakeholders is the key to success of Maruti Udyog Limited in an e-business environment.

Implications

The managerial implication of the stakeholder flexibility is to enhance understanding of both side of business (business to partners, customers and vise-versa) in an electronic environment of business. The understanding reflects new stakeholder acquisition, old stakeholders retention, and ultimate long term association of stakeholders for competitiveness of the business via transparency, speed, cost saving, knowledge management, information, communication, better processes and operation, faster transaction, participation of stakeholders and so on.

Limitations

The paper considered only key stakeholders of the e-business (see Figure 1). Some other stakeholders may be affected due to e-business environment such as the government, society, and community. We have restricted our paper only up to key stakeholders. But, for further study, all the stakeholders may be considered.

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www.stakeholderpensionsdirect.co.uk/ stakeholder_for_companies.html

Appendix I : Dual Nature of Stakeholder Flexibility

Stakeholder	Flexibility to Stakeholder from Business	Flexibility to Business from Stakeholder
Customers	• Online Catalog • Online Shopping • Online after sales services • Online Enquiry/quarry • Order Tracking • Online Payment • Online Invoice • Online shopping globally • More options for same product • Online Feedback and Suggestions • Additional services • Time Saving, Money Saving • 24*7*365 days services • Flexi time	• Customer Acquisition and Retention • Database of customers • Customers feedback and inputs • Market Information • Market Analysis • Low cost of setting distribution centers • Online transaction • Lower cost of marketing • Time and money saving • Global customer reach • Telemarketing • Showroom Problems solve • Operation flexibility
Employee	• E-mail accounts • Online work • Paperless office & work • Fast information highway • Online file transfer • Online HR policies • Online performance status • Central Knowledge Bank • Online Communication • Online Training and E-Learning • Flexi Time • Flexi Work • Online Business Information • Online Company Information • Online market Information • Analysis softwares	• Better Productivity • Proper Document Management • Fast information and document delivery • Fast intra organization work • Less cost of paper and other materials • Less manpower • Teleconferences • Easy system for performance appraisal • Reduced workload • Fast decision-making • Knowledge management • Fast information sharing • Remote online communication

Cont... Appendix I

Stakeholder	Flexibility to Stakeholder from Business	Flexibility to Business from Stakeholder
Suppliers/ Vendors	• Online bidding • Online order • Online process fulfillment • Online order tracking • Online inventory information • Online auction • Online communication • Online status of order • Reduced paper work • Reduced process work • Time saving • Online payment • Global manufacturer reach • Information of market • Information of dealers	• Minimum inventory management • Online status of suppliers • Lower process cost • JIT procurement • Order tracking • Reduced paper work • Electronic communication • No follow-up • Global suppliers reach • Distributors suppliers information
Distributor Retailers Dealers	• Online Booking of order • Online status of order • Online availability of product • Electronic • Online insurance • Online finance • Online customer quarry and response • Online after sales service • Online payment • Electronic data interchange • Market Information, share information, price information etc. • Order tracking	• Electronic Data Interchange • Online order status • Online demand information • Online supply information • Online market information • Online market research • Order tracking • Reverse auctions • Customer demands
Financial Services providers	• Online Financial policies • Online enquiry/response • Online feedback/inputs • Online finance • Online billing & invoices • Online transaction • Online payment • Online insurance schemes • Online insurance • All financial information	• Financial flexibility to customers • Insurance flexibility to customers • Financial transaction • Financial policy and schemes sharing • Customer satisfaction • Electronic communication
Technology Partners/ IT Partners	• Technology consultancy • Technology project • Technology updating • Long term association • Brand building	• Less bother ness about technology • Latest and updated technology • Competitive move by better technology • Better processes
Call Centers	• Long term association • More project • More product assignment • Knowledge gaining	• Customer care • Customer quarry • Information to all information seekers • Services 24*7*365

Cont... Appendix I

Stakeholder	Flexibility to Stakeholder from Business	Flexibility to Business from Stakeholder
Shareholders	• Share information • Share market information • Company position and information • Company policies • News letters • Feed back/inputs • Participation in online meetings	• Shareholder value • More investment • Shareholder perception
Media	• More channels for marketing • Long time association • Lower cost of marketing • Online marketing • Web marketing • Different channels for promotion	• Different channels for brand building • Global Promotion • Information reach to all stakeholders
Consultants	• Time to time consultancy • Long term association • Online consultancy	• Less bother ness • Better solution • Online consultancy

Value proposition is described as perceived value by the interest group of business in participating in business model. Table shown below in the context of Maruti's e-business model, explains the value propositions from both ends.

Appendix II : Value Proposition for Stakeholders of Maruti in E-Business

Stakeholder	Value Propositions of Stakeholders	Value Propositions to Maruti
Customers	• More interactive information channels • Increased information detail • Anywhere, any time service • Transparency in services	• Increased Retaining old customers and acquiring new customers • Increased global customer reach
Employee	• Reduced overall load on staff • Improved flexibility of analysis • Better matched with employee needs	• Cheaper channel for dissemination of information • Increased anywhere accessibility • Faster process
Suppliers	• Lower cost of transaction • Reduced transaction time • Faster access	• Easy supplier selection • Electronic linkage with suppliers
Dealers	• Increased transparency in order booking and tracking • Fast EDP	• Better probability to satisfying dealers • Availability of market information
Technology Providers	• Increased teleconferencing • Faster information available	• Increased technology learning

Cont... Appendix II

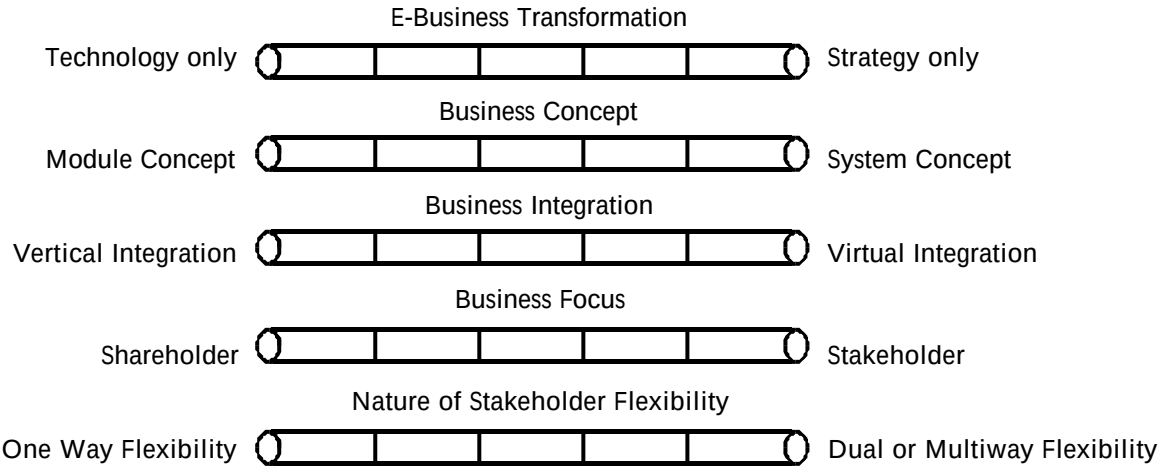
Stakeholder	Value Propositions of Stakeholders	Value Propositions to Maruti
Call Centers	• Increased long time association	• Enhanced customer care
Financial service providers	• Better security of transaction • Increased financial information and transactions online	• Increased online transactions • Reduced transaction time and cost
IT Companies Media Partners	• Increased long time association • New ways of marketing	• Better maintenance and better IT • Reduced cost of marketing • Easy Global reach
Consultants	• Increased E-consultancy	• Reduce cost of consultancy
Shareholder	• Increased online trading • Update information of share	• More investment

Acknowledgement

The authors are thankful to Mr. H. Srivastava of Maruti Udyog Limited for providing valuable information and their experiences for the case study.

Flexibility Mapping : Practitioner's Perspective

1. What types of flexibilities you see in the practical situation of "e-Business Environment" 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 "e-Business Environment" 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))



Reflecting Applicability in Real Life

1. How important is the stakeholder flexibility for the success of your organization particularly in e-business environment?
2. How would you enhance the stakeholder flexibility in your organization?

Short Communication

giftjourn@l
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Innovating Growth through "Six Sigma": A Strategic Approach for Combining Robustness with Flexibility

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Introduction

Six sigma so far applied to operations, design or manufacturing and processes

Six sigma framework has been traditionally used for enhancing operational performance by focusing on reduction of process variations and bringing it within predetermined limits based on specified requirements. The essence is to have an analytical approach with an outside-in view, keeping the end users or customer in focus. So far concepts of six sigma had been applied to areas related to operations, design or manufacturing either for improvement of existing processes or design of new products and processes. The core idea of Strategic Six Sigma is to analyze the likely risks/variations in any given system of initiatives comprising the strategy, identify the cause and effects, and apply "Define, Measure, Analyze, Innovate and Control (DMAIC)" philosophy based qualitative and quantitative tools for process improvement.

Recently six sigma have been adapted to strategy process

Unique combination in approach to strategy robustness with flexibility to deal with unique challenges

Recently, the six sigma concepts have been innovatively adapted to strategy process and applied uniquely in the Indian industry for making the strategy deployment process more robust, yet maintaining the flexibility of options. The liberalization and globalization process has strengthened the competitive environment which has thrown up unique set of challenges for Indian industry to be met through innovation. This calls for a unique combination in our approach to strategy - "*robustness* to minimize risks with *flexibility* to adapt to change" and enhancing organizational effectiveness towards strategy deployment.

The Potential to Unlock Value for the Organization

Six sigma is a performance target which reflects how effectively and efficiently we are working

The defining characteristics of six sigma is disciplined through an analytical approach. Six sigma in conventional terms is a performance target which reflects how effective and efficient we are in doing what we are supposed to do. Six sigma is a breakthrough strategy and is a methodology to achieve the six sigma target. If we are not doing things right at the first time, then such situation leads to some kind of waste and every such waste has cost or risks associated with it. Be it wastage of engineering man-hours, material, time or even cost of identifying a wrong opportunity in strategic sense.

Six sigma is asking questions differently and finding answers to these questions

Sigma is a measure of how consistent and hence predictable our actions are. At a high sigma level (say five sigma) our actions will lead to more consistent and predictable results than if we are at a low sigma (say one sigma).

Six sigma is about asking questions and finding answers. General logic and common sense can lead to general results. To achieve special and different results we need to think and act differently. For that, we must ask questions differently. Six sigma orients us to ask questions differently and provides a toolbox of various tools, which help find answers to those questions.

What cannot be measured cannot also be controlled and managed. We also measure what we value and sigma level is a measurement of performance for any process that produces any type of tangible value based output.

A Brief History and its Recognition as a World Class Benchmark

Motorola pioneered and successfully applied six sigma in early 80's

The concept of six sigma was pioneered and successfully applied at Motorola in early eighties and transmitted through Larry Bossidy at Allied Signal/Honeywell which was one of the first organizations to adopt six sigma to GE in mid nineties. This phase saw GE's dramatic turnaround strategy under the legendary Jack Welch. Every aspect and process in GE went the six sigma way and Jack Welch attributed this approach in bringing in the discipline that laid the foundation for the organizational success.

It is performance deployment, benchmarking and continuous improvement tool

Since then it has been recognized as the common language of disciplined approach to business across all organizations around the world that have reaped success. It is now acknowledged as the performance deployment, benchmarking & continuous improvement tool to be used in conjunction with any business excellence framework the organization may wish to adopt such as TBEM, Malcolm Baldridge or Deming.

Six sigma project progresses through five phases

A six sigma project progresses through five phases (Figure 1) : Define, Measure, Analyze, Innovate and Control. In Define phase the initiatives definition is completed and scope is finalized. In Measure phase "as is" situation is assessed. In Analyze phase what is going wrong or risks entailed is studied. In Innovate phase the recommendations are deployed and change is tested. In Control phase an operational plan is put in place along with necessary measurements for monitoring sustained gains. This model is known as DMAIC model. Various six sigma tools used in these different phases.

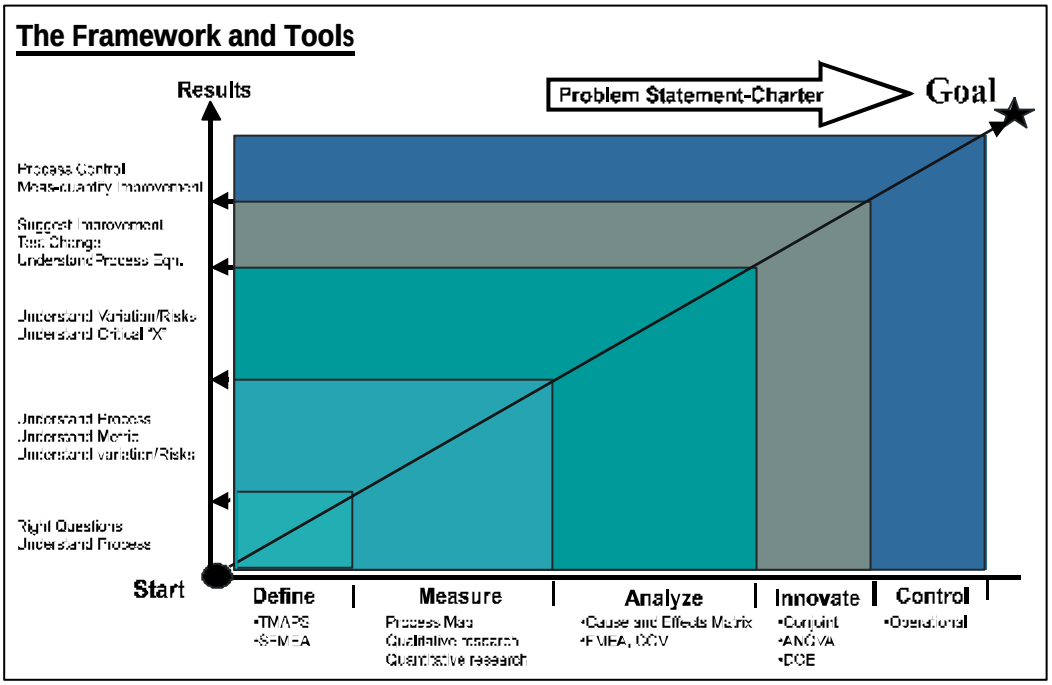
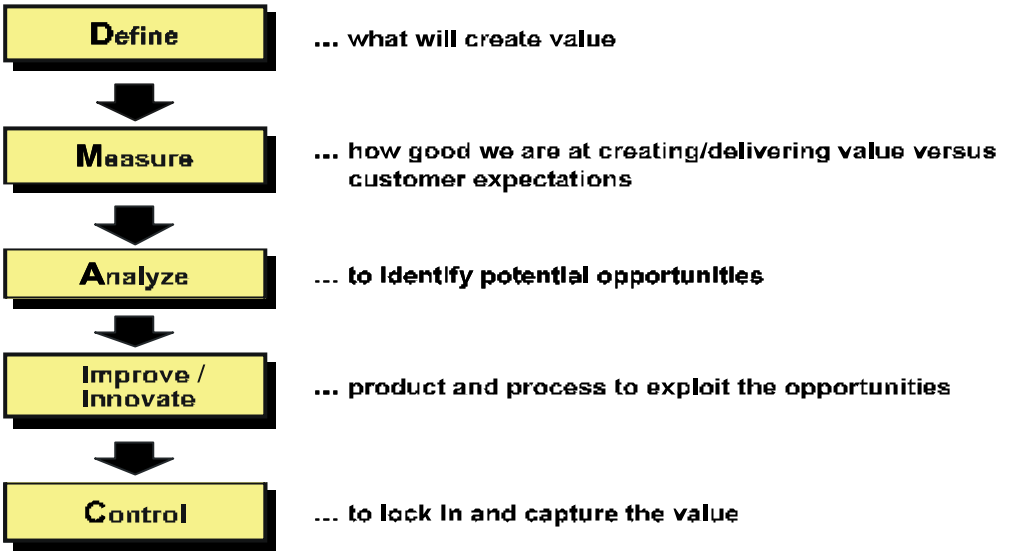


Figure 1 : Five Phases of Six Sigma Project

The approach links up all elements, starting from strategy to the final process that delivers the desired product or service. Figures 2 and 3 integrative approach that ties up all elements of the business value chain.

The process flow is as depicted in Figure 4 with extensive usage of tools in each stage of the process.

The inherent checks and balances using the stage gate mechanism shown in Figure 5 of the six sigma process ensures that investments are focused on the right opportunities and the risk are minimized. The profile above indicates how investments increase as ideas propagate through stage gate clearances after satisfying requirements of the process in each phase.



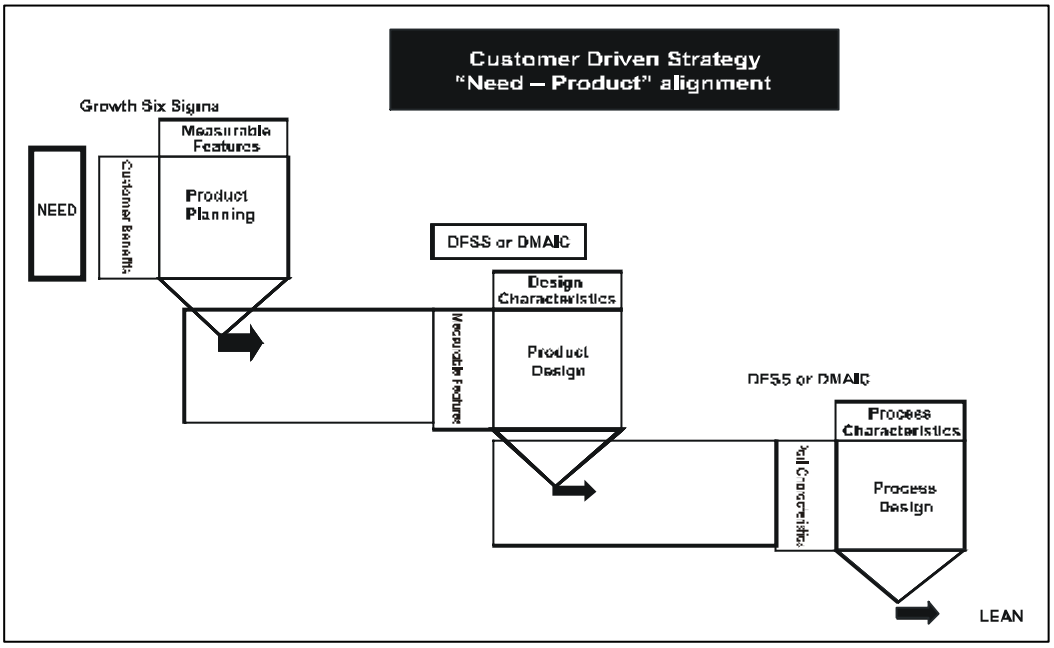


Figure 2 : Approach 1, Linking Various Elements

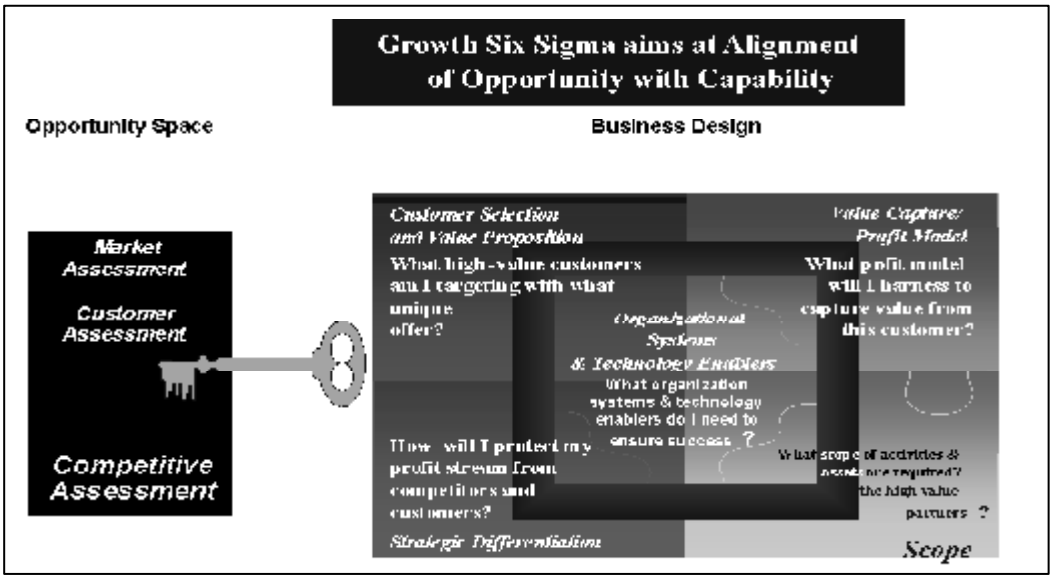


Figure 3 : Approach 2, Linking Various Elements

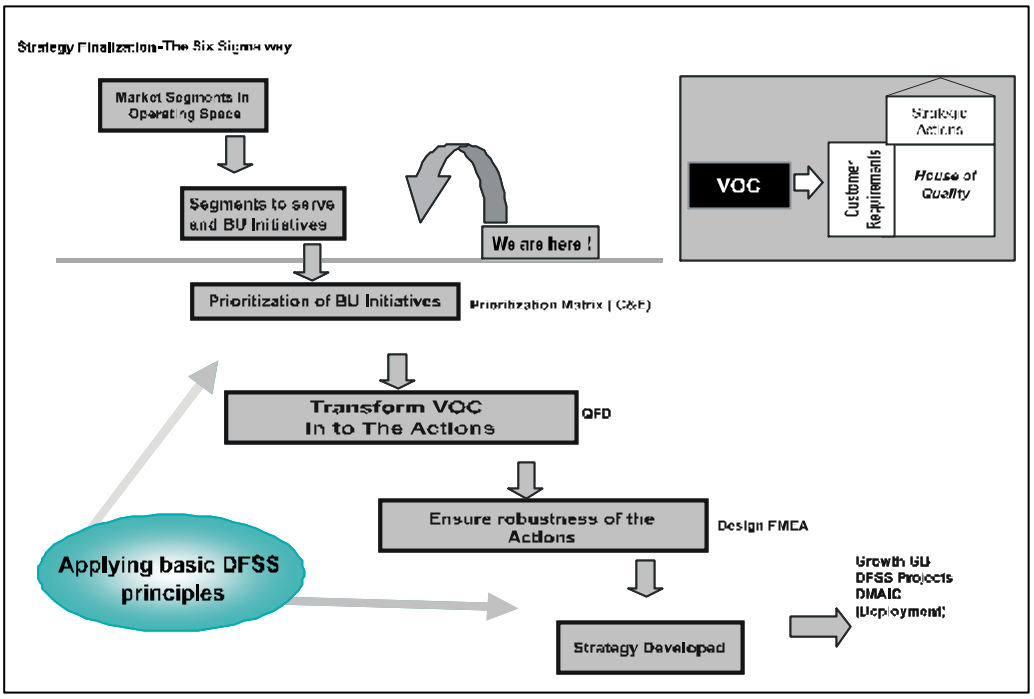


Figure 4 : Strategy Implementation-The Six Sigma Way

Robustness with Flexibility by Stage Gate based Checks and Balances

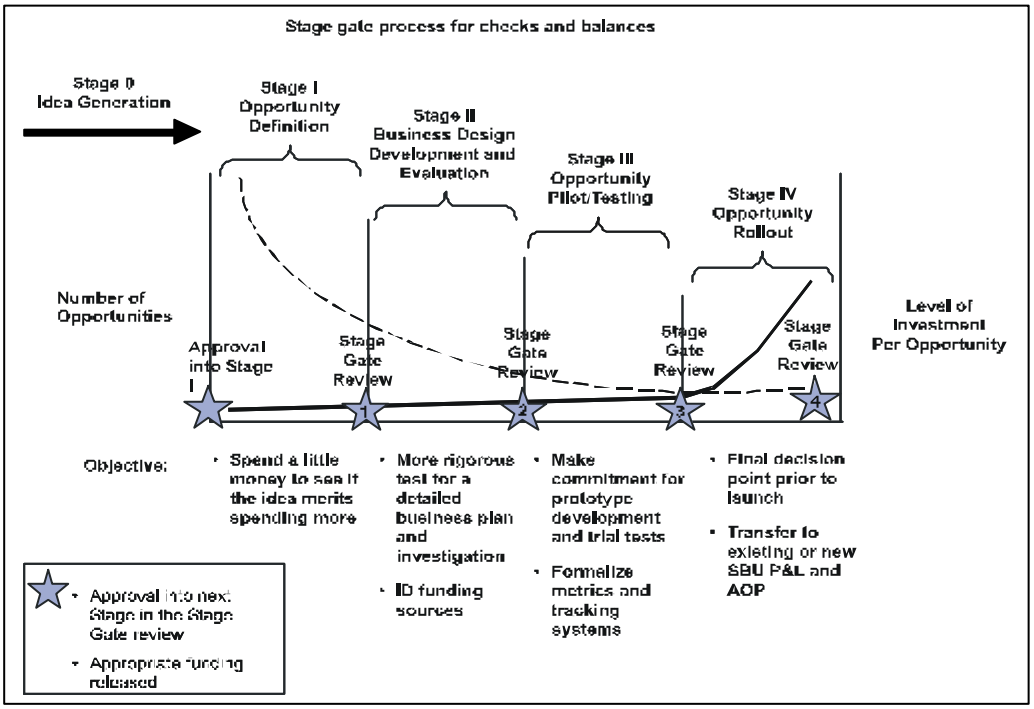


Figure 5 : Stage Gate Balancing for Optimal Investment Profile

Conclusion

Todays competitive environments leaves no room for error

Six sigma act as long range radar that provide balanced insight and flexibility

Globalization, disruptive technologies and instant access to information, products and services have changed the way our customers conduct business – old business models no longer work. Today's competitive environment leaves no room for error. The dynamics of change is shifting the context of business over night, hence leaderships approach in setting the strategic direction has to be guided by a sensitive radar. Six sigma strategy tools and framework acts as such a long range radar that guides and develops a balanced insight and at the same time

provides for the flexibility of options needed for strategic corrections in journey to growth and excellence.

Glossary of Terms and Definitions

DFSS – (Design for Six Sigma) is a systematic methodology utilizing tools, training and measurements to enable us to design products and processes that meet customer expectations and can be produced at Six Sigma quality levels.

DMAIC – (Define, Measure, Analyze, Innovate and Control) is a process for continued improvement. It is systematic, scientific and fact based. This closed-loop process eliminates unproductive steps, often focuses on new measurements, and applies technology for improvement.

Six Sigma – A vision of quality which equates with only 3.4 defects per million opportunities for each product or service transaction. Strives for perfection.

Quality Tools

Associates are exposed to various tools and terms related to quality. Given below are just a few of them.

Control Chart – Monitors variance in a process over time and alerts the business to unexpected variance which may cause defects.

Defect Measurement – Accounting for the number or frequency of defects that cause lapses in product or service quality.

Pareto Diagram – Focuses on efforts or the problems that have the greatest potential for improvement by showing relative frequency and/or size in a descending bar graph. Based on the proven Pareto principle: 20% of the sources cause 80% of any problems.

Process Mapping – Illustrated description of how things get done, which enables participants to visualize an entire process and identify areas of strength and weaknesses. It helps reduce cycle time and defects while recognizing the value of individual contributions.

Root Cause Analysis – Study of original reason for nonconformance with a process. When the root cause is removed or corrected, the nonconformance will be eliminated.

Statistical Process Control – The application of statistical methods to analyze data, study and monitor process capability and performance.

Tree Diagram – Graphically shows any broad goal broken into different levels of detailed actions. It encourages team members to expand their thinking when creating solutions.

Black Belt – Leaders of team responsible for measuring, analyzing, improving and controlling key processes that influence customer satisfaction and/or productivity growth. Black Belts are full-time positions.

Control – The state of stability, normal variation and predictability. Process of regulating and guiding operations and processes using quantitative data.

CTQ : Critical to Quality (Critical "Y") – Element of a process or practice which has a direct impact on its perceived quality.

Customer Needs, Expectations – Needs, as defined by customers, which meet their basic requirements and standards.

Defects – Sources of customer irritation. Defects are costly to both customers and to manufacturers or service providers. Eliminating defects provides cost benefits.

Green Belt – Similar to Black Belt but not a full-time position.

Master Black Belt – First and foremost teachers. They also review and mentor Black Belts. Selection criteria for Master Black Belts are quantitative skills and the ability to teach and mentor. Master Black Belts are full-time positions.

Variance – A change in a process or business practice that may alter its expected outcome.

Third Global Conference on Flexible Systems Management 'GLOGIFT'

From March 13 to 15 2004

Theme : TECHNOLOGY TRANSFER INNOVATION & FLEXIBILITY FOR RESHAPING THE WORLD

at

Jamia Millia Islamia, Jamia Nagar, New Delhi -25, INDIA

Introduction

Third GLOGIFT International Conference with the theme on **"Technology Transfer, Innovation and Flexibility for Reshaping the world"** is an effort to bring together leading representatives of academic, business and government sectors worldwide to present and discuss current and future issues of critical importance related to technology management. It will provide a platform to technology researchers, practitioners, developers and users to explore cutting edge ideas and to exchange techniques, tools and experiences.

Conference Coverage

GLOGIFT International Conference invites researchers and practitioners to submit papers in areas such as technology flexibility, technology transfer, innovation systems and human aspects of innovation management. The Program Committee encourages practical papers on experience or on the validation of implementation. The broad areas that will be of interest for the conference are as follows:

- Technology Flexibility
- Technology Acquisition and Transfer
- Innovation Management
- Culture of Innovation and Flexibility
- Technology Practices in Developing Countries

Who Should Attend

Following the GLOGIFT tradition, this conference will set the stage and define the directions of technology management for decades to come. Leading experts from academic institutions, industrial corporations and government agencies will participate in the discussions.

Important Dates for Papers

The papers are invited from professionals, executives, practitioners and researchers from the world of business and academics on the topics related to the theme of the conference. A spectrum of relevant areas has been exhibited under the coverage.

Submission of abstracts (250 words)	**December**	**10, 2003**
Acceptance of abstracts	**December**	**20, 2003**
Submission of full papers	**January**	**30, 2004**
Acceptance of full papers	**February**	**15, 2004**

All submissions through e-mail at:
glogift@giftsociety.org

Registration Details

Registration Fee	**within India**	**Overseas**
Delegates (Academic /R & D)	Rs.3000/-	US$ 150
Delegate (others)	Rs.5000/-	US$ 200
Students	Rs.2000/-	US$ 100

Note - Delegates/Authors will be offered one-year complimentary membership of GIFT - 10% discount to Annual Members of GIFT, and 15% discount to Life Members & Corporate Members of GIFT. Registration fee includes a copy of the conference proceedings, registration kit, tea, lunch and attendance in session services. The registration fee does not include the cost of boarding/ lodging etc.

About Jamia Millia Islamia

Jamia Millia Islamia was founded in 1920 during the non cooperation movement. It was elevated to the status of a Central University vide Jamia Millia Islamia Act 1988 Today, Jamia Millia Islamia is one of the most prominent and promising Central University of India

Conference Proceedings

All the accepted papers will be published in the form of proceedings and shall be available at the time of conference. Selected papers presented at the conference will also be considered for publication in ***"Global Journal of Flexible Systems Management"*** after due review process.

Sponsorship

Organizations are invited to sponsor the conference. The contribution made will be prominently acknowledged in all promotional and other conference material. The payment is to be made in favour of "Jamia Millia Islamia" payable at New Delhi.

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Short Communication

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Event Diary

This section will contain events related to flexibility. Only highlights and important dates are provided. For more details, please visit the web page or contact the organizers. If you are planning any major flexibility related event (global conference/workshop/seminar), please submit the details (Event title, Dates, Place, Theme, Deadlines, Contact Information, Email, Web Page, etc.) to Mr Ashish Jain, at email giftjournal@giftsociety.org.

Event : **The 12th International Forum on Technology Management**

Dates : November 18 - 20, 2003

Place : Shanghai, China

Theme : Technology Leadership in the 21st Century: Global Challenge for East and West

Contact : From China, Mrs Vicky YU at yuxb@mail.tongji.edu.cn
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jean-jacques.chanaron@wanadoo.fr
More details on the program available on the website: www.iftm.net

Event : **Bridging the Gap: Sustainable Environment**
The First UN Global Compact Academic Conference. Organized by The Wharton School-Sabanci University with the Support of UNEP

Theme : **Part 1**- Innovation and Diffusion of Environmentally Sound Technologies

Dates : May 31 - June 1, 2004.

Place : Istanbul, Turkey

Theme : **Part 2**- Globalization, Development and Environmental Management

Dates : September 17-18, 2004

Place : Philadelphia, U.S.A.

Contact : Dr. Oktem , oktem@wharton.upenn.edu

See details in the following Internet address: http://opim.wharton.upenn.edu/gc/

Event : **IAMOT 2004**

The 13^{th} International Conference on Management of Technology

Theme : New Directions in Technology Management: Changing Collaboration Between Government, Industry and University

Dates : April 3-7, 2004

Place : Washington D.C.

Contact : Program Information: Dr. Yasser Hosni, University of Central Florida: iamot@mail.ucf.edu or for more information visit www.iamot.org

About GIFT

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

Mission

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.

Schools

The Institute comprises of various schools, which are autonomous bodies, dealing with contemporary areas at the cutting edge contributing to the flexible systems management paradigm. At any point of time, each member can opt for an association with any two of the following schools in the respective thrust areas:

* GIFT School of Global Management
* GIFT School of Technology and Innovation Management
* GIFT School of Information Technology & Knowledge Management
* GIFT School of E-Governance
* GIFT School of Learning Organisation and Strategic Transformation
* GIFT School of Quality, Productivity and Wastivity Management
* GIFT School of Environment Management and Sustainable Development
* GIFT School of Human Values and Management Ethos

Publications

– Book Series on Flexible Systems Management

– Quarterly Journal - ***"Global Journal of Flexible Systems Management"*** *giftjourn@I*

– Newsletter - ***"Flexibility"***

Membership

The membership fees for different types of members, unless changed/revised by the Governing Council from time to time, will be as given under:

	With in India	Overseas
Student (Annual)	Rs. 500.00	US$ 25.00
Annual	Rs. 1,000.00	US$ 50.00
Life	Rs. 10,000.00	US$ 500.00
Corporate/ Institutional	(a) for corporate bodies having turnover has less than Rs 20 Crore and for non-business/non-profit making organisations/institutions:	
	Rs. 50,000.00	US$ 5,000.00
	(b) for corporate bodies having turnover more than Rs 20 Crore:	
	Rs. 1,00,000.00	U$ 5,000.00

- All individual members will get one complimentary copy of the *giftjourn@I* .
- All corporate/institutional members will get three complimentary copies of the *giftjourn@I*, one for library and two for nominees.

Correspondence :

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

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