J. Engg. Sc. Mgmt. Ed. Vol-5 Issue-II (495–501)

Journal of Engineering, Science & Management Education

Developing Interpretive Structural Model for Quality Framework in Higher Education: Indian Context

Neena Sohani[1]* Nagendra Sohani[2]

[1]*Christian Eminent Academy of Management Professional Education and Research, Indore(M.P), India.*

[2]*Institute of Engineering & Technology, Devi Ahilya Vishwavidyalaya, Indore(M.P), India.*

*E-mail : neenasohani@rediffmail.com

Article History : Received 13th December 2011 Revised 12th March 2012 Accepted 07th June 2012

Abstract : *Quality in the context of higher education is a complex term. The functioning of a higher education institution is multidimensional. Education system in India has been facing challenges in terms of greater responsibility, accountability and increased expectations by stakeholders. The higher education system today finds itself in a market oriented environment, with internal and external customers and has been pressurized to shift its focus from the quantitative expansion to the improvement in quality and excellence. With the increasing emphasis on quality and increasing demands of various stakeholders, the issues related to quality need to be addressed from varying perspectives on the very conceptualization, implementation and assessment.This paper presents the development of Interpretive Structural Model (ISM) for quality frame work of higher education institution. The ISM technique helps prioritize the strategic issues in quality assessment qualitatively, so as to propose a hierarchical structure through prioritizing, sequencing and categorizing of ideas. The elements are classified as drivers, enablers and dependents and the hierarchically structured. An implementation of such model can help the educational system to grow and survive in the rapidly changing environment*

Keywords: *Quality management, Interpretive Structural Model, Structural self introducation matrix*

I– INTRODUCTION

In present competitive context as worldwide higher education tends to be, quality issues are increasingly relevant for its institutions and universities. Quality means different things to different people. Widely differing conceptualizations of quality were grouped into five discrete but interrelated categories: quality can be viewed as exception, as perfection, as fitness for purpose, as value for money and as transformative. Quality was also viewed as relative to "processes" or "outcomes". Systematic quality management was originally developed in the manufacturing sector. In keeping with the newer demand that have been placed on the educational system by the various stakeholders, the higher education system in particular, has been pressurized to shift its focus from one in quantitative expansion to one with emphasis on quality. Such shifts and changes are being witnessed not only in the developed countries, but also in the developing countries of the world.

The Indian higher educational system has witnessed a phenomenal expansion both in terms of growth and diversity. It has been considered largest education system in the world, with wide range of disciplines ranging from basic to applied knowledge in fields of both professional and vocational education. In the present competitive era education sector is flourished as biggest service sector and education is becoming much more of a "product" with varying customers and stakeholders. In the Indian scenario in last few years there is a steep rise in the number of educational institutions, primarily in the fields of engineering and management. This competitive environment generates tremendous pressure to become more responsive to the stake holders and gain overall upper edge in business.

The demanding stakeholders expect value for money. What the varying customers and stakeholders demand today, is value for money with expectation of improvement in academic activities, academic environment, better learning and cocurriculam activities with physical facilities and infrastructure. With the government being the highest body that is accountable to its people and the society at large, there are increasing strains and pressures from the social and political system. To survive in the Indian education industry, institution has to get recognition from the government accreditation bodies and maintain consistency in the performance which is further monitored by the regulatory agencies. Attempts by educational institutions to become more efficient, effective and customer-centric are underway. The educational system must improve the quality of their services, achieve competitive advantage and move on a path of academic excellence. A customer centric philosophy of management needs to be all encompassing throughout the organization with the ultimate objective being customer satisfaction.

Quality is budding as a theme that is fast spreading within the educational system in India. The dynamic behavior of the market and operating forces are creating new challenges, and forcing educational institutes for conceptualization, and measuring the quality of services offered and assesses the gap between expectation and perception of the stakeholder's Higher education has varying stakeholders, with often complementary and contradictory expectations. This dictates the need for a very vital and judicious analysis on the subject of quality against a backdrop of the varying customer and stakeholder expectations, the accompanying problems, limitations, and conflicts. The identification of strategic components to assess quality, and their prioritization and modeling, thus becomes necessary.

The quality assessment and evaluation practices are very important part of quality assurance system in higher education institutes. Quality enhancement need complete system approach with quality practices at each and every level of system which ultimately creates a satisfied customer with we can say "customer delighted. In this paper an empirical study conducted to develop structural model (ISM) with level of importance to different enables indentified to achieve quality assurance system in the higher education. Based on the literature review and pilot test with opinion from the eminent academicians certain elements, indicators and strategic issues in quality assessment were identified. The ISM was applied to prioritize these elements qualitatively, and thereby propose a hierarchical structure based on sequencing, and categorization.

II– THEORETICAL BACKGROUND

Studies on quality in education have examined institutional inputs, outputs and processes. An educational system is a constituent of subsystems and processes, comprising the inputs, processes and outputs that must work together to produce a synergistic effect. With the basic contention that an educational institution education should aim to satisfy the needs of various stakeholders, reference [11] have tried to study the various stakeholders and arrive at an integrated model; in fact, they define quality in education as multi-faceted that includes within its realm the quality of inputs in the form of students, faculty, support staff, and infrastructure; the quality of processes in the form of the learning and teaching activity; and the quality of outputs in the form of the students that move out of the system.

Quality means different things to different people [3]. Widely differing conceptualizations of quality were grouped by the authors into five discrete but interrelated categories: quality can be viewed as exception, as perfection, as fitness for purpose, as value for money and as transformative. Quality was also viewed as relative to "processes" or "outcomes". Quality management in education has been well researched and documented [1],[4],[5],[7],[8]and[14]. As with any service, there is not much of a consensus as to what constitutes quality in education, with the matter being debatable [2],[10]. Most definitions of quality in education are customer focused, i.e. meeting or exceeding customer's expectations of education [9], with an emphasis on identification of relevant bases and measurement criteria to use in evaluating quality. A widely accepted view on quality is the degree to which stakeholders' needs and expectations are consistently satisfied. However, with the educational system having various customers and stakeholders, formulating a single,

Comprehensive definition that can integrate the interests of all the customers and stakeholders becomes challenging. With numerous customers and stakeholders, both internal and external to the system, with their own demands and expectations, the identification of design characteristics that would impact the processes part, integrate the interests of the various stakeholders and lead to customer satisfaction becomes precarious and complicated. There is difficulty of understanding and managing the dynamics of what would constitute a success model.

Amongst the literature that exists, mention may be made of the process and satisfaction models proposed by reference [1]. The process model studies quality in education as an internal process of a transformation that enables the administrative staff to perform the administrative tasks, the teachers to perform the teaching task and students to gain knowledge. The satisfaction model defines quality in education as satisfaction of the various customers and stakeholders. Against a backdrop of the systems view, with a focus on the process model and the satisfaction model, there is need to identify strategic components and design elements that can integrate the interests of the various stakeholders and lead to customer satisfaction.

Researchers all over the world, have primarily focused on the external customer, be it the student or the industry. Reference [11], have tried to arrive at a synthesized and integrated model of quality management in education by following a double pronged strategy:

(1) Study the various customer groups to examine simultaneously the perspectives of each group so as to be sensitive to the expectations of different groups of people involved.

(2) Apply multiple tools, techniques and methodologies, both qualitative and quantitative.

III– EMPIRICAL STUDY

A. Objectives of the study

Understanding and managing the dynamics of quality would include knowing what the customer wants, and, designing a system accordingly. This study has been conducted with the objectives of developing a quality based structural framework of quality education system in higher education in Indian context with identification, sequencing categorizing and prioritizing quality characteristics and structuring into a systematic model.

B. Methodology of the study

1) *Scope of the study:* The study was confined to the City of Indore, India. On the basis of non-probabilistic and convenience sampling institutions imparting graduate and post-graduate degrees/diplomas were chosen. Within such institutions, the respondents were selected by stratified random sampling.

2) *Variable conceptualization:* Various theoretical and empirical studies of quality in education were reviewed and measures and indicators of educational performance were identified. The pilot study was conducted to examine the validity and reliability of the scale facilitated the identification of quantitative and statistically proven items and attributes.

   Qualitative validity was tested through the theoretical study as well as through expert comments. The focus of the study is on "quality system framework," which is essentials that an educational institution must possess in order to satisfy the needs and wants of the stakeholder and customer groups.

3) *Technique used for the study*: Interpretive Structural Modeling (ISM) technique was applied on these quality characteristics to establish linkage between them and identify them as enablers.

IV– INTERPRETIVE STRUCTURAL MODELING (ISM)

Interpretive Structural Modeling (ISM) is an effective methodology for dealing with complex issues. It has been used for over 25 years to understand complex situations and find solutions to complex problems. ISM is often used to provide fundamental understanding of complex situations, as well as to put together a course of action for solving a problem. ISM can be used for identifying and summarizing relationships among specific variables, which define a problem or an issue [13]. It provides us a means by which order can be imposed on the complexity of such variables [6]. In this research, quality systems in higher education, in Indian institutes have been analyzed using the ISM methodology, which shows the interrelationships of different enablers of quality system in higher education and their levels. These are also categorized depending on their driving power and dependence.

After review of literature and expert opinion of the survey response from higher education institutes in education hub of the central India, Indore (MP) following 14 enables has been identified. The literature review, together with the experts' opinion, was used in developing the relationship matrix, which is later used in the development of an ISM model. Figure 1 clearly shows flow diagram for the methodology adopted for the ISM.

Enablers

1. Curriculum design and development
2. Academic Flexibility
3. Teaching Learning Process
4. Teacher Quality
5. Evaluation Process and Reformation
6. Research and Promotion
7. Extension activities and collaboration
8. Physical facility and Infrastructure
9. Library and learning
10. Student support and progression
11. Vision and Leadership
12. Finance and Resource Management
13. Quality Enhancement
14. Stake holder Relationship

A. ISM Methodology and Model Development

The methodology of ISM is an interactive learning process. In this a set of different and directly related variables affecting the system under consideration is structured in to a comprehensive systematic model. The beauty of ISM model is that it portrays the structure of complex issues of the problem under study, in a carefully designed pattern employing graphics as well as words. The methodology of ISM can act as a tool for imposing order and direction on the complexity of relationship among elements of a system [13]. Reference [15] used ISM methodology for modeling of knowledge management in engineering industries. Reference [12] applied the ISM methodology for energy conservation in Indian cement industry. They identified relationship amongst direct and indirect key variables. Reference [16] have employed ISM methodology to develop a hierarchy of actions required to achieve the future objective of waste management in India. Vendor selection criteria, interrelationship of criteria and their levels were analyzed by reference [12] by using the ISM methodology. These criteria have also been categorized depending on their driver power and dependence. The ISM can be judiciously employed for getting better insights into the present case of strategic information modeling.

The ISM methodology is interpretive from the fact that as the judgment of the group decides whether and how the variables are related. It is structural too, as on the basis of relationship; an overall structure is extracted from the complex set of variables. It is a modeling technique in which the specific relationships of the variables and the overall structure of the system under consideration are portrayed in a digraph model. ISM is primarily intended as a group learning process, but it can also be used individually.

The steps suggested by reference [13] for implementing ISM methodology are:

Step 1 : Variables affecting the system under consideration are listed, which can be objectives, actions and individuals etc.

Step 2 : From the variables identified in step 1, a contextual relationship is established among variables with respect to which pairs of variables would be examined.

Step 3 **:** A Structural Self-Interaction Matrix (SSIM) is developed for variables, which indicates pair wise relationships among variables of the system under consideration.

Step 4 : Reachability matrix is developed from the SSIM and the matrix is checked for transitivity. The transitivity of the contextual relation is a basic assumption made in ISM. It states that if a variable A is related to B and B is related to C, then A is necessarily related to C.

Step 5 : The reachability matrix obtained in Step 4 is partitioned into different levels.

Step 6 : Based on the relationships given above in the reachability matrix, a directed graph is drawn and the transitive links are removed.

Step 7 : The resultant digraph is converted into an ISM, by replacing variable nodes with statements.

Step 8 : The ISM model developed in Step 7 is reviewed to check for conceptual inconsistency and necessary modifications are made.

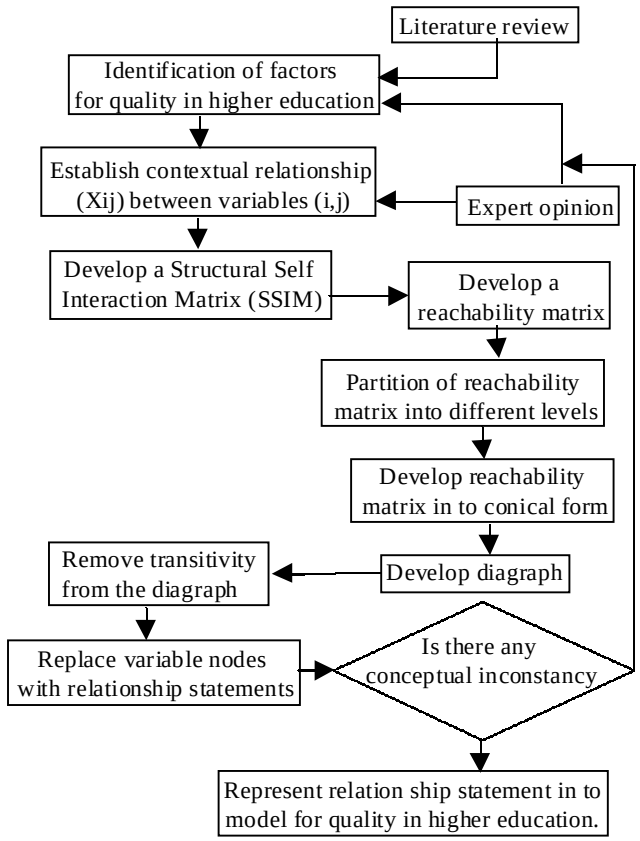

Fig.1 ISM based methodology

B. Structural Self-Interaction Matrix(SSIM)

ISM methodology suggests the use of the expert opinions based on various management techniques such as brain storming, nominal technique, etc., in developing the contextual relationship among the variables. Thus, in this research for identifying the contextual relationship among quality system variables academia, were consulted for the same. These experts from the academia were well conversant quality management practices in higher education.

1) For analyzing the quality variables in higher education, a contextual relationship of b leads to Q type is chosen. This means that one variable leads to another variable. Based on this, contextual relationship between the variables is developed (Table I). Keeping in mind the contextual relationship for each variable, the existence of a relation between any two variables (i and j) and the associated direction of the relation is questioned. As suggested by Sage (1977), four standards symbols (i and j) are used to denote the direction of relationship between the variables.
   V: Variable i will help alleviates j ;
   A: Variable j will be alleviated by Variable i ;
   X: Variables i and j will help achieve each other; and
   O: Variables i andj are unrelated.
2) Reachability matrix was developed from the SSIM by expressing the information in each cell entry of the SSIM into 1s and 0s (Table II).
3) The reachability matrix was partitioned on the basis of the reachability and antecedent sets for each of the ariables, and, through a series of iterations, these were grouped into various levels [Tables III(A) and III(B)].
4) The reachability matrix was then converted to a conical form, based on the 0and 1 relationship (i.e. absence and presence of relationships) (Table IV).
5) A directed graph, was drawn portraying direct and indirect relationships through arrows, and then converted into an ISM, by replacing elements/codes with the statement of the respective design characteristics (Figure 2).

Table I. Structural Self-Interaction Matrix

	14	13	12	11	10	9	8	7	6	5	4	3	2
1	X	V	O	A	V	X	O	V	X	A	X	V	V
2	X	V	A	A	V	V	A	V	V	V	V	V	
3	V	V	A	A	V	A	A	X	V	X	X		

Table II. Reachability Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*0*	*1*	*1*	*0*	*0*	*1*	*1*
2	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*0*	*0*	*1*	*1*
3	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
4	*1*	*0*	*1*	*1*	*0*	*1*	*1*	*0*	*1*	*1*	*0*	*0*	*1*	*1*
5	*1*	*0*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
6	*1*	*0*	*0*	*1*	*0*	*1*	*1*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
7	*0*	*0*	*1*	*0*	*0*	*1*	*1*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
8	*0*	*1*	*1*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*1*	*1*
9	*1*	*0*	*1*	*1*	*0*	*1*	*0*	*0*	*1*	*1*	*0*	*0*	*1*	*1*
10	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
11	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
12	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*1*
13	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
14	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*

Table III (A). level of elements (partitioning the reachabiloty matrix based on 10 iterations

Enabler	Reachability	Antecedents	Intersection	Level
1	1,2,3,4,6,7,9,10,13,14	1,4,5,6,9,11,14	1,4,6,9,14	VII
2	2,3,4,5,6,7,9,10,13,14	1,2,8,11,12,14	2,14	VI
3	3,4,5,6,7,10,13,14	1,2,3,4,5,7,8,9,11,12	3,4,5,7	IV
4	1,3,4,6,7,9,10,13,14	1,2,3,4,5,6,9,11,12	1,3,4,6,9	IV
5	1,3,4,5,6,10,13,14	2,3,5,11,12	3,5	VII
6	1,4,6,7,10,13,14	1,2,3,4,5,6,7,8,9,11,12	1,4,6,7	III
7	3,6,7,10,13,14	1,2,3,4,6,7,8,11,12	3,6,7	III
8	2,3,6,7,8,9,10,13,14	8,11,12	8	VII
9	1,3,4,6,9,10,13,14	1,2,4,8,9,11,12	1,4,9	V
10	10,11,13,14	1,2,3,4,5,6,7,8,9,11,12	110	II
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14	11	11	IX
12	2,3,4,5,6,7,8,9,10,12,13,14	11,12	12	VIII
13	13,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	13,14	I
14	1,2,13,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1,2,13,14	I

Table iii(b). Level of Elements (Partitioning the Reachabiloty Matrix Based on 10 Iterations

Enabler	Reachability	Antecedents	Intersection	Level
13	13,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	13,14	I
14	1,2,13,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1,2,13,14	I
10	10,11,13,14	1,2,3,4,5,6,7,8,9,11,12	110	II
6	1,4,6,7,10,13,14	1,2,3,4,5,6,7,8,9,11,12	1,4,6,7	III
7	3,6,7,10,13,14	1,2,3,4,6,7,8,11,12	3,6,7	III
3	3,4,5,6,7,10,13,14	1,2,3,4,5,7,8,9,11,12	3,4,5,7	IV
4	1,3,4,6,7,9,10,13,14	1,2,3,4,5,6,9,11,12	1,3,4,6,9	IV
9	1,3,4,6,9,10,13,14	1,2,4,8,9,11,12	1,4,9	V
2	2,3,4,5,6,7,9,10,13,14	1,2,8,11,12,14	2,14	VI
1	1,2,3,4,6,7,9,10,13,14	1,4,5,6,9,11,14	1,4,6,9,14	VII
5	1,3,4,5,6,10,13,14	2,3,5,11,12	3,5	VII
8	2,3,6,7,8,9,10,13,14	8,11,12	8	VII
12	2,3,4,5,6,7,8,9,10,12,13,14	11,12	12	VIII
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14	11	11	IX

Table IV. Conical from of Reachability Matrix

	13	14	10	6	7	3	4	9	2	1	5	8	12	11	Driving power
13	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
14	1	1	0	0	0	0	0	0	1	1	0	0	0	0	4
10	1	1	1	0	0	0	0	0	0	0	0	0	0	0	3
6	1	1	1	1	1	0	1	0	0	1	0	0	0	0	7
7	1	1	1	1	1	1	0	0	0	0	0	0	0	0	6
3	1	1	1	1	1	1	1	0	0	0	1	0	0	0	8
4	1	1	1	1	1	1	1	1	0	1	0	0	0	0	9
9	1	1	1	1	0	1	1	1	0	1	0	0	0	0	8
2	1	1	1	1	1	1	1	1	1	0	1	0	0	0	10
1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	10
5	1	1	1	1	0	1	1	0	0	1	1	0	0	0	8
8	1	1	1	1	1	1	0	1	1	0	0	1	0	0	9
12	1	1	1	1	1	1	1	1	1	0	1	1	1	0	12
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Dependent	14	14	12	11	9	10	9	7	6	7	5	3	2	1	

C. Formation of ISM-based model

From the final reachability matrix, the structural model is generated. If the relationship exists between the variables *j* and i, an arrow pointing from *i* to j shows this. This resulting graph is called a digraph. The digraph is finally converted into the ISM model as shown in Figure 2. It is observed that vision and leadership is a very significant variable for the quality system in higher education in the central Indian educational institutes at Indore as it comes as the base of the ISM hierarchy. Quality enhancement system and stakeholders relationship are appeared at the top of the hierarchy.

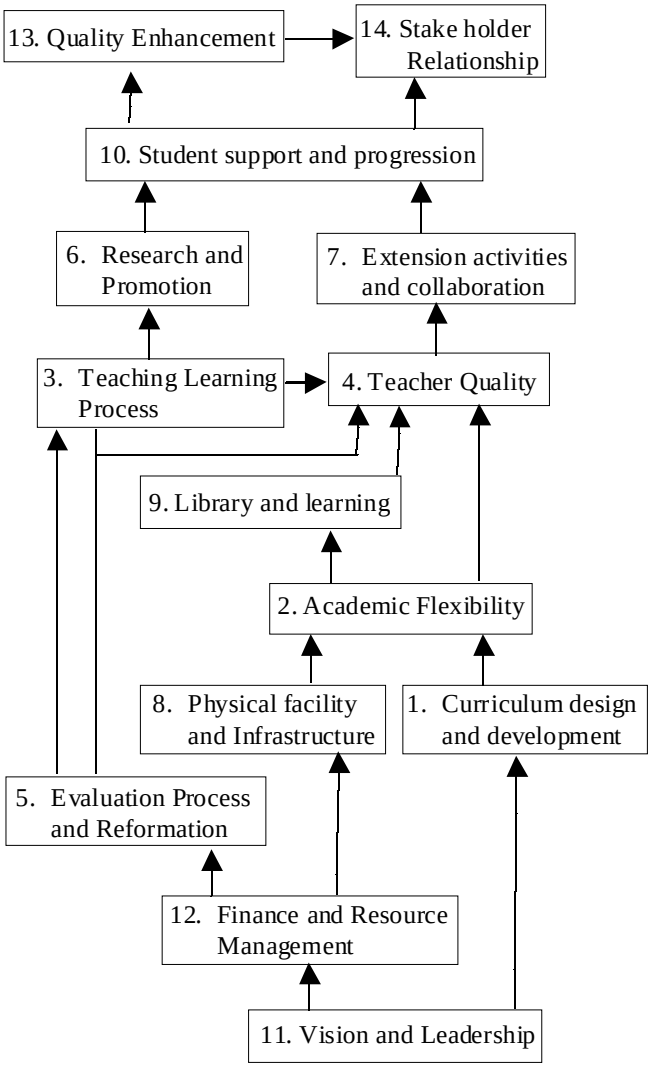

Fig. 2 Interpretive Structural Modeling

D. MICMAC analysis

It is called the *Matrice d'Impacts Croisés Multiplication Appliquée á un Classeement*, (cross impact analysis) or MICMAC Analysis, developed by Michel Godet in 1975.

The objective of the MICMAC analysis is to analyze the driver power and the dependence power of the variables

[6] The variables are classified into four clusters (Fig.3). The first cluster consists of the autonomous variables T that have weak driver power and weak dependence. These variables are relatively disconnected from the system, with which they have only few links, which may be strong. Second cluster consists of the dependent variables that have weak driver power but strong dependence. Third cluster has the linkage variables that have strong driving power and also strong dependence. These variables are unstable in the fact that any action on these variables will have an effect on others and also a feedback on themselves. Fourth cluster includes the independent variables having strong driving power but weak dependence. It is observed that a variable with a very strong driving power called the key variables, falls into the category of independent or linkage variables. The driving power and the dependence of each of these variables are shown in Table: IV. In this table, an entry of 1' along the columns and rows indicates the dependence and driving power, respectively. Subsequently, the driver power dependence diagram is constructed which is shown in Figure. 3.

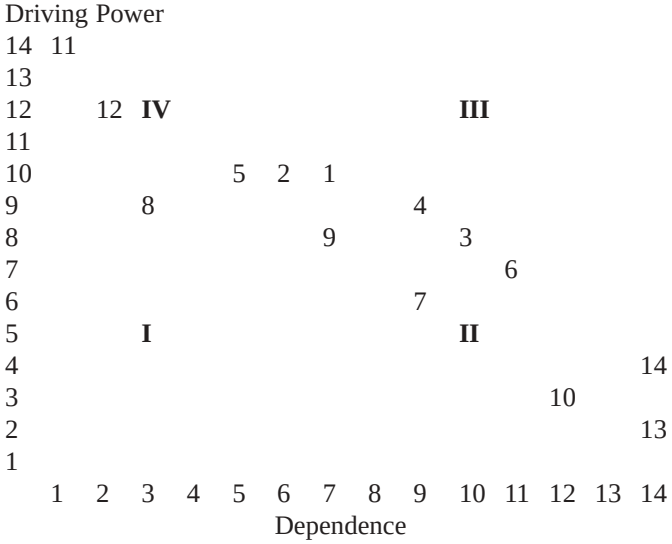

Fig.3 : MICMAC analysis

- I- Autonomous, II- Dependent
  III- Linkage, IV- Independent (Driver)
- IV : Driver
  - 2 Academic Flexibility,
  - 5 Evaluation Process and Reformation,
  - 8 Physical facility and Infrastructure,
  - 11 Vision and Leadership, 12 Finance and Resource Management are .
- III : Linkage
  - 1 Curriculum design and development,
  - 3 Teaching Learning Process ,
  - 4 Teacher Quality ,
  - 9 Library and learning resources .

- II : Dependent
  - 6 Research and Promotion,
  - 7 Extension activities and collaboration,
  - 10 Student support and progression,
  - 13 Quality Enhancement ,
  - 14 Stake holder Relationship

CONCLUSIONS

Quality management practices in an educational institute can be very well derived in the form of structural model through ISM. The derived hierarchical relationship among various identified variables shows that it is the top management with leadership , vision and effective allocation of funds with proper finance management plays critical role in the success of quality management system for higher education. There has been a paradigm shift in the manner in which customer interests in education are viewed today, with the ultimate objective of "delighting the customer." A satisfied stake-holder which comes out from quality enhancement and assurance are at the highest level of structure which can be achieved through good quality teacher, teaching learning process, research promotion and extension activities and collaboration. These variable works as linkage to achieve good quality enhancement along with stake –holder relationship.

References

[1]. Y.C. Cheng and W.M. Tam, "Multi-models of quality in education," *Quality Assurance in Education*, Vol. 5 No. 1, pp. 22-31, 1997.

[2]. L. Harvey, *Quality Assurance Systems, Total Quality*, Management and the New Collegialism, QHE, Birmingham, 1995.

[3]. L. Harvey and D. Green, "Defining quality", *Assessment and Evaluation in Higher Education*, Vol. 18, pp. 9-34,.1993

[4]. S.Sahney, D.K. Banwet and S. Karunes, "Conceptualizing total quality management in higher education", *The TQM Magazine*, Vol. 16, No. 2, pp. 145-159, 2004.G.K. Kanji, A.M.A. Tambi and W. Wallace, "A comparative study of quality practice in higher education institutions in the US and Malaysia", *Total Quality Management*, Vol. 10 No. 3, pp. 357-71, 1999

[5]. A. Mandal and S.G. Deshmukh, "Vendor selection using interpretive structural modeling (ISM)", *International Journal of Operations and Production Management*, Vol. 14, No. 6, pp.52-9,1994.

[6]. S.Sahney, D.K. Banwet and S. Karunes, "An integrated framework of indices for quality management in education: a faculty perspective", *The TQM Journal*, Vol. 20, No. 5, pp. 502-519, 2008..

[7]. M.S. Owlia and E.M. Aspinwall, "Quality in higher education – a survey", *Total Quality Management*, Vol. 7 No. 2, pp. 161-72.1996.

[8]. A. Parasuraman, V.A. Zeithaml and L.L. Berry, "A conceptual model of service quality and its implications for future research", *Journal of Marketing*, Vol. 49 No. 4, pp. 41-50.1985.

[9]. C.A. Reeves and D.A. Bednar, "Defining quality: alternatives and implications", *Academy of Management Review*, Vol. 19 No. 3, pp. 419-45.1994.

[10].S. Sahney, "Total quality management in higher education in India – a diagnostic study of select engineering and management institutions", unpublished paper, IIT, Department of Management Studies, New Delhi.2002.

[11].J. Saxena, P. Sushil, and P. Vrat, "Scenarios building: a critical study of energy conservation in Indian cement industry", *Technology Forecasting and Social Change*, Vol. 41, pp.121-146.1992.

[12].A.P. Sage, *Interpretive Structural Modeling: Methodology for Large-scale Systems*, McGraw-Hill, New York, NY, pp.91-164.1977.

[13].Kiran Banga Chhokar, "Higher education and curriculum innovation for sustainable development in India", *International Journal of Sustainability in Higher Education* Vol. 11 No. 2, pp. 141-152,2010

[14].M.D. Singh, R. Shankar, R. Narain, and A. Agarwal, "An interpretive structural modeling of knowledge management in engineering industries", *Journal of Advances in Management Research*, Vol. 1, No. 1, pp.28-40.2003.

[15].H.D. Sharma, A.D. Gupta, and S. Sushil, "The objectives of waste management in India: a futures inquiry", *Technological Forecasting and Social Change*, Vol. 48, pp.285-309.1995.