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DEVELOPING QUALITY ENHANCEMENT FRAMEWORK USING ISM IN SOFTWARE INDUSTRIES

Rana Majumdar[*], Veenu Singh[**], Hina Gupta[***] and Chetna Choudhary[****]

Abstract: In Software Industry, the term Software quality is well-defined by experts. It is in general acknowledged by a number of features which can be internal and external from software development point of view. The external quality factors are those which a user experiences while working with the software. These features affect end users directly; hence, maximum risk in terms of goodwill is always associated with such features. On the contrary, internal quality features are not directly associated with operational users as these are internal to the development phase. In this work the objective is to identify factors that affect the systems' performance and hence a framework is proposed for measuring quality in terms of transformation and improvement. For this, the author implements ISM as basic building block for proposing the framework.

Key Words: Quality Analysis, Interpretive Structure Modelling, Resource Management

1. INTRODUCTION

Software quality is defined by number of factors; these factors could be internal or external. The external quality factors are those which a user experiences while working on the software, these factors affects end users and internal quality factors are those which are code related and are not visible to the end user. These factors affect developers while developing new products.[5]. Quality assurance (QA) is a way by which any defects or mistakes could be avoided, and finally a good quality product is delivered to the customers. This is a way by which mistakes are prevented in the product. ISO 9000 defines it as a "part of quality management that ensures end users that quality product will be delivered".

Quality can be maintained by incorporating one dimensional matrix seeking information from stakeholders as well as users and implementing them as an inherent process should be adopted by industry practitioners.

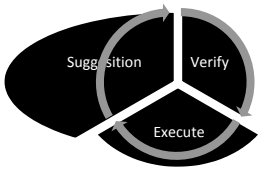

Figure 1: Quality Process

[*] Amity University Uttar Pradesh rmajumdar@amity.edu
[**] veens1824@gmail.com
[***] guptahina189@gmail.com
[****] cchoudhary@amity.edu

- Suggestion: It indicates the objectives and what processes should be applied in order to meet the desired objectives
- Verify: It is to compare the expected results with the actual results and identifying the difference.
- Execution /Action: If checking implies that the plan implemented in Do is an improvement then it becomes a new Standard. : It indicated implementing the framed plan and making the desired product

For the quality enhancement in the software production, we discussed and conducted surveys with the expertise, technical people form industries and academicians in the quality field, which resulted in the identification of ten factors. After the identification of the factors we intimated the same to the surveyed group to get their view in confirmatory. We then applied the technique of ISM to identify the contextual relationship among the various elements/variables of the system which defines the issue. It is interpretive because judgement of the group decides whether and how the variables are related. The application of ISM results into the identification of the dependent and driving factors. These factors depict that variation in the dependent factors will lead to the enhancement of the quality assurance.

Factors	*Factor name*	*Description*
F1	**Predict Market Scenario**:	It is reading the market conditions, by which we can get idea of trends and could predict future as well. This helps us in designing our product as per market conditions
F2	**Strategic Planning**	This is the Organization's process by which the strategy is defined .It is also defined as the direction in which organization should move in order to reach the target. The resources are allocated to pursue the strategy
F3	**Resource Management**	In this effectively and efficiently resources are allocated by the Organization wherever needed. Resources could be human resources, inventory related resources etc .
F4	**Education**	It is the process to facilitate knowledge , learning and skills of a group of people and is transferred to other people through discussion and training.
F5	**Agility**	Agility is defined as the rapid response to any changes , effective communication among all Team members , involvement of customer , iterative development of software
F6	**Fault Tolerance**	It is the property of a system to continue its working even at the time of failure.
F7	**Innovation**	It is the process of bringing any change, revolution, alterations , transformation etc.
F8	**Customer Satisfaction**	Is measured in terms of how the product or services delivered, meets the customer's expectations.
F9	**Periodic Troubleshooting**	It is time to time or regularly monitoring of the system, in order to remove any faults in the system.
F10	**Continual Improvement**	It is termed as continuous improvement in the processes, products or services.

2. LITERATURE REVIEW

Changing trends and globalization has given rise to various challenges to the software industry. Today the reputation of any software industry is related to its quality and timely delivery of product. The repute also depends on how the industry keeps in pace with the new technologies and changing market scenario. The factors like fault tolerance, customer satisfaction, periodic troubleshooting etc. play a significant role in maintaining the competitive edge.

Since the inception of software industry, it has never been easy to predict rightly the performance and results of developing softwares. The probability of malfunctioning can never be eliminated. Balzer explicitly mentioned that "software is unreliable, delivered late, unresponsive to change, inefficient, and expensive" [1].

Arcade and Godet discussed about the analysis of structure with MICMAC (Impact Matrix Cross-Reference Multiplication Applied to a Classification). This technique states a structural analysis by comparing the issues based on different classifications such as potential, direct and indirect. This proves to be a source of information to define the major implicates of a specific domain [2].

The ISM is a methodology for interactive learning process. In this method the variables that affect the system directly or indirectly are framed into a comprehensive structure model.

The major advantage of the ISM model is that it graphically represents the structure of complex factors of the issue in consideration. It also does the same in words. As a tool, it organizes the elements affecting the system's credibility. It also highlights the hierarchical complexity among the factors of the system. [3].

3. METHODOLOGY AND PROBLEM CONCEPTUALIZATION

The authors identified quality factors and based on experts expertise and knowledge formulate a frame using ISM methods as a MCDM technique.

Step 1: Structural self- interactive matrix [4]

In step 1, a table is constructed with the identified factors on row and column. The table is then filled in the values 'V', 'A','X','O'. The values 'VAXO' have different significance in the table. The value 'V' is filled when the factor A in the row implies B. In other words if the value of B depends on A(A->B), the value V is filled in the corresponding cell. Similarly if the value in the cell has 'A', it states the value of B in column is responsible for the value of A (B->A) in row. Value 'X' is filled in the cell if the values in the corresponding row and column are totally dependent on each other. The value 'O' is filled if the values in the corresponding row and column have no relation with each other.

In step 1, we obtain a table called SSIM as shown below

Table 1
SSIM

	A	B	C	D	E	F	G	H	I	J
A	1	V	V	V	V	0	X	V	X	V
B		1	X	V	X	V	X	V	V	V
C			1	V	X	0	0	0	V	V
D				1	0	0	X	X	0	X
E					1	V	V	V	0	X
F						1	0	V	X	X
G							1	V	0	X
H								1	X	X
I									1	0
J										1

Step 2: From the above table a new table called initial reachability matrix is created by replacing the values for ‘V’, ‘A’, ‘X’, and ‘O’ by ‘1 in row and 0 in column’, ‘0 in row and 1 in column’, ‘1 in row and column’ and ‘0 in row and column’ respectively. Once the initial reachability matrix is obtained, it is checked for iteration and the final reachability matrix is obtained as shown in table 2 and 3.

Table 2
Initial Reachability Matrix

	A	B	C	D	E	F	G	H	I	J
A	1	1	1	1	1	0	1	1	1	1
B	0	1	1	1	1	1	1	1	1	1
C	0	1	1	1	1	0	0	0	1	1
D	0	0	0	1	0	0	1	1	0	1
E	0	1	1	0	1	1	1	1	0	1
F	0	0	0	0	0	1	0	1	1	1
G	1	1	0	1	0	0	1	1	0	1
H	0	0	0	1	0	0	0	1	1	1
I	1	0	0	0	0	1	0	1	1	0
J	0	0	0	1	1	1	1	1	0	1

Step 3: FRM Matrix

Table 3
Final Reachability Matrix (With Transitive closure)

	A	B	C	D	E	F	G	H	I	J	
A	1	1	1	1	1	0*	1	1	1	1	10
B	0*	1	1	1	1	1	1	1	1	1	10
C	0*	1	1	1	1	0*	0*	0*	1	1	10
D	0*	0*	0	1	0*	0*	1	1	0*	1	9
E	0*	1	1	0*	1	1	1	1	0*	1	10
F	0*	0	0	0*	0*	1	0*	1	1	1	8
G	1	1	0	1	0*	0*	1	1	0*	1	9
H	0*	0	0	1	0*	0*	0*	1	1	1	8
I	1	0	0	0	0	1	0	1	1	0	4
J	0	0	0	1	1	1	1	1	0	1	6
	9	6	4	9	9	10	9	10	9	9	84/84

In order to categorize factors one need to apply iteration approach until all factors are identified as Level/hierarchy factors.

Iteration 1

Factors	*Reachability Matrix*	*Antecedent Set*	*Intersection Set*	*Level*
A	ABCDEFGHIJ	ABCDEFGHI	ABCDEFGHI	
B	ABCDEFGHIJ	ABCDEG	ABCDEG	
C	ABCDEFGHIJ	ABCE	ABCE	
D	ABDEFGHIJ	ABCDEFGHIJ	ABDEFGHJ	
E	ABCDEFGHIJ	ABCDEFGHJ	ABCEFGHJ	
F	ADEFGHIJ	ABCDEFGHIJ	ADEFGHIJ	I
G	ABDEFGHIJ	ABCDEFGHJ	ABDEFGHJ	
H	ADEFGHIJ	ABCDEFGHIJ	ADEFGHIJ	I
I	AFHI	ABCDEFGHI	AFHI	I
J	DEFGHJ	ABCDEFGHJ	DEFGHJ	I

Iteration 2

Factors	*Reachability Matrix*	*Antecedent Set*	*Intersection Set*	*Level*
A	ABCDEG	ABCDEG	ABCDEG	II
B	ABCDEG	ABCDEG	ABCDEG	II
C	ABCDEG	ABCE	ABCE	
D	ABDEG	ABCDEG	ABDEG	II
E	ABCDEG	ABCDEG	ABCDEG	II
G	ABDEG	ABCDEG	ABDEG	II

Iteration 3

Factors	*Reachability Matrix*	*Antecedent Set*	*Intersection Set*	*Level*
C	ABCDEG	ABCE	ABCE	III

Through iteration we identify levels of factors they are level 1 and level 2 factors. Factor C is identified as a Level 3 Factor.

In the next step is to identify canonical matrix and to prepare the digraph based on driver power and dependent power.

Table 4
Canonical Matrix

	I	**J**	**F**	**H**	**D**	**G**	**A**	**B**	**C**	**E**	
I	1	0	1	1	0	0	1	0	0	0	**4**
J	0	1	1	1	1	1	0	0	0	1	**6**
F	1	1	1	1	0*	0*	0*	0	0	0*	**8**
H	1	1	0*	1	1	0*	0*	0	0	0*	**8**
D	0*	1	0*	1	1	1	0*	0*	0	0*	**9**
G	0*	1	0*	1	1	1	1	1	0	0*	**9**
A	1	1	0*	1	1	1	1	1	1	1	**10**
B	1	1	1	1	1	1	0*	1	1	1	**10**
C	1	1	0*	0*	1	0*	0*	1	1	1	**10**
E	0*	1	1	1	0*	1	0*	1	1	1	**10**
	9	**9**	**10**	**10**	**9**	**9**	**9**	**5**	**4**	**9**	

In ISM technique clustering of factors defines the role of factors implementing QEF in terms of its driving and dependent factors, whereas linkage factors act as a bridge in between them to simplify and contribute for forming the framework. Table 5 shows resource management act as a driving Factor and Periodic Trouble Shooting dependent factors.

Table 5
Clustering of Variables

driver factor Recourse management (C)	B,A,E,D,G,F,H (linkage factor)
Autonomous factor NIL (Indicates Non Independent Factors)	dependent factor Periodic Trouble shooting (I)

4. DISCUSSION OF RESULTS AND CONCLUSION

In this research, an interpretation of flexibility factors in terms of their driving and dependence power has been carried out. Those factors having higher driving power in the proposed framework needs to be considered as a prime factors and timely action required on a priority basis because there are few other dependent factors being affected by them. The ISM results provide strategic insight also. This study has strong implications for researchers as well as manufacturing managers. The researchers may be prompted to identify some other issues, which may be significant in addressing these factors. The manufacturing managers can get an insight of these factors and understand their relative importance and interdependencies and try to overcome these factors which affect the flexibility of FMS. Therefore, ISM methodology strengthens the practical views of manufacturing managers and depicts a clear picture about the significance of different factors as shown in Appendix A. In this way, different factors can be identified and dealt with utmost care. Finally, it would be useful to suggest the direction of future research in this area. In this research, the relationship model among the identified flexibility factors has not been statistically validated. Structural equation modelling (SEM), also referred to as linear structural relationship approach, has the capability of testing the validity of such hypothetical models. Thus, this approach can be applied in the future research to test the validity of this model. ISM is a tool which can be helpful to develop an initial model whereas SEM has the capability of statistically testing an already developed theoretical mode. Hence, it has been suggested that future research may be targeted to develop the initial model through ISM and then testing it using SEM.

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5. APPENDIX

A FT – Fault Tolerance , CS- Customer Satisfaction , PT- Periodic Troubleshooting ,CI- Continual Improvement

PMS- Predict Market Scenario ,SP- Strategic Planning ,E- Education , A –Agility, I-Innovation, RM- Resource Management