Structural Equation Model for Effectiveness of Technical Managers in Information Technology Industry

Yogesh Naik[#1], Dr. Monika Bisht[*2]

[#1]*Director in the Department of Research and Innovation, IGATE Global Solutions Ltd.*
Mumbai, India.
[1]Yogesh.Naik@igate.com

[2*]*Assistant Professor in the Department of Management, Birla Institute of Technology*
Noida, India
[2]monika@bitmesra.ac.in

Abstract **— In age of technology, the effectiveness of technical manager is keenly sought towards organizational growth and competitive advantage. Technical managers require a special combination of knowledge about science and technology to acquire respect, knowledge about behaviour, and skills to lead. This research presents a unique point of view, backed by empirical data analysis on how five key competencies, "other than technology know-how" impacts overall effectiveness of technical managers in Information Technology IT industry. A structural equation model (SEM) mines complex interdependencies amongst competency clusters which yield managerial effectiveness directly or indirectly. The survey instruments were employed on 520 technical managers from various technology centric departments across 19 IT organizations. Statistical techniques used include exploratory factor analysis (EFA); confirmatory factor analysis (CFA) and structural equation modelling (SEM). The role of project management, emotional intelligence (EI), domain knowledge, ethical values and business skills besides technical acumen is presented. Research findings are expected to help organizations in selection and development of technical managerial talent, and individuals towards self realization and self development.**

Keywords— *Emotional Intelligence, Technical Manager, Information Technology, Effectiveness, Structural Equation Model*

1. Introduction

Technical functions are part of every organization and their contribution towards the organizational growth and competitive advantage are keenly discussed. Consequently, the need for effective technical managers cannot be overemphasized. Practitioners would agree that effective technical management demands many attributes beyond technology expertise and know-how.

Contemporary research on technical managers emphasize that technical managers require a special combination of knowledge about science and technology to acquire respect, knowledge about behaviour, and skills to lead. Ref. [4] refers the growing importance of technical managers in driving growth possibilities offered by market discontinuities and rapidly evolving scientific field for both existing and emerging markets.

Information Technology (IT) industry is a global industry with technology as a key contributor. The relevance and impact of Emotional Intelligence (EI) towards technical managerial effectiveness remains largely undiscovered by researchers. In simplistic terms, effectiveness is the degree to which objectives are achieved and the extent to which targeted problems are solved. Performance and effectiveness are often used interchangeably. Performance is an elusive and easily misunderstood concept. It is commonly used to refer to the assessment of an employee's effort during some evaluation period. Effectiveness refers to the evaluation of the results of actions, while productivity refers to the ratio of output to input. Thus effectiveness refers to outcomes, and productivity relates the resources used in obtaining those outcomes themselves.

Literature review highlights role of technology competence, managerial competence and social competence in the effectiveness of the manager. These competencies are often interdependent and exclusive analysis of each of them remains a challenge for the research studies. This paper

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empirically evaluates inter-relationships amongst key competencies towards overall effectiveness of technical manager. Given the complexity of multiple relationships at play, Structural Equation Modelling (SEM) method is preferred. SEM represents the relationship between the latent variables of interest, and measurement models, representing the relationship between the latent variables and their manifestation or observable indicators.

The organization of the paper is as follows. In section 2, we briefly introduce literature related to effectiveness of the manager, covering realms of competencies viz. technology, managerial and social. The conceptual framework and hypothesised model is discussed in the Section 3. In Section 4, research methodology is discussed with finer focus on need for exploratory factor analysis and structural equation modelling. Section 5, discusses the data analysis and model fitment in detail. Finally, we provide conclusions and future work in Section 7.

2. Literature Review

Over last 25 years, there are many studies related to managerial effectiveness. Towards identifying most relevant studies in the given context; the selection criterion is devised. The selection criteria included attributes such as applicability to technology professionals (specifically towards technology management), applicability across industries, coverage of non-technical skills (such as behavioral and managerial), concrete support of empirical analysis and ease of access towards findings and inferences. Specific attributes contributing to effectiveness of technical manager are discussed further.

The expectations from effective technical management in spheres of strategy, organizational leadership, technical expertise, leadership in informal organization, personnel development, climate creation and finally as a responsive leader are articulated by [7]. Ref. [23] proposed a pyramid structured hierarchical framework for a technical manager competency model. Technology is synonymous with continuous change and change brings uncertainty, thereof stress. Ability of technical manager to cope up with work exhaustion (or job burnout) is identified as a key element in effectiveness by [19]. Ref. [20] came up with a comprehensive framework outlining professional development attributes of project managers through Project Manager Competency Development (PMCD) Framework. Selection of high-performing IT professionals, especially the technology talent, has been the key focus of [26]. It compares supervisory ratings along four orthogonal criteria – technical proficiency, relationship management skills, adherence to document standards and requirements and self-initiated professional development.

Ref. [25] provides with the results of a field study of technology-based projects specific barriers and drivers to effective team performance. Research community is provided with a model consisting of skill factors including technical skills, group problem-solving skills, managerial skills and aptitudes comprising of analytical ability, creativity and risk-taking orientation by [21].

Ref. [24] and [10] explored the linkage between the characteristics of IT Project leaders and project success: examines the factors affecting the success of IT Projects in context of leadership capabilities of IT project managers. The importance of good visioning is highlighted by [18]. Good visioning demonstrates the qualities termed “Strategic Intelligence” including foresight, scanning for the trends in technology, business, demographics, politics, and the environment that can change markets; systems thinking, creating a vision that integrates purpose, processes and people. It is important to determine the competencies that predict highly effective performance in technical managers.

It is a key to differentiate effective managers from typical ones. Ref. [5] infers findings including nine variables that differentiate the two groups of managers. Most managers found it challenging to transform themselves from technical expert to leader. The process with catalyzing attributes is articulated by [6]. The question of whether technical skills provide incremental value over managerial skill in managerial performance for first-tier managers has been explored by [13]. Ref. [15] concludes that an effective leader was found to be the aware of and sensitive to the dynamics of the business environment, the people, tasks and organizational structure. It asserts necessity of wide variety of critical competencies at the operational, tactical and strategic business levels.

The role of technology leadership in turbulent times is investigated by [4]. It highlights the importance of leaders of research and technology in playing an essential role in creating pathways out of the recession by helping their corporations make the right choices, driving corporations to bring clarity to their strategy and options for future growth, and

fighting for the right balance of short-term needs with long-term priorities. Ref. [9] investigated requisite variety of skills for IT professionals. It shows that in IT departments while both technical and non-technical skills are important, the skills most critical to retain in-house and most sought in new mid-level employees are non-technical skills. Inter-relation of emotional competencies and relevance of organization emotional intelligence is articulated in [11]. This study suggests that organizational emotional intelligence (EI) is an important framework to examine in future research.

In summary, referenced studies point to twenty nine unique and exclusive attributes that claim to influence effectiveness of the technical manager. These attributes lay the foundation for effectiveness. The objective of this research is to validate relevance of these attributes in information technology managers, identifying critical ones through empirical methods and build a comprehensive model which will assist in predicting the effectiveness. This is achieved through systematic research methodology articulated in next section.

3. Conceptual Framework

Based on the past literature review; this research concentrates on conceptual framework of effectiveness of technical managers and various attributes and factors impacting the same. This framework emphasises those factors such as technical competence, emotional intelligence, team competence, cognitive competence and managerial competence are positively related to the effectiveness of the technical managers. These factors are made up of various attributes which have been ascertained by literature review.

Through systematic research methodology, backed by sound empirical methods, interaction relationships and dependency amongst these factors, in context of technical manager effectiveness needs to be ascertained. Figure 1, articulates the conceptual framework of the proposed model.

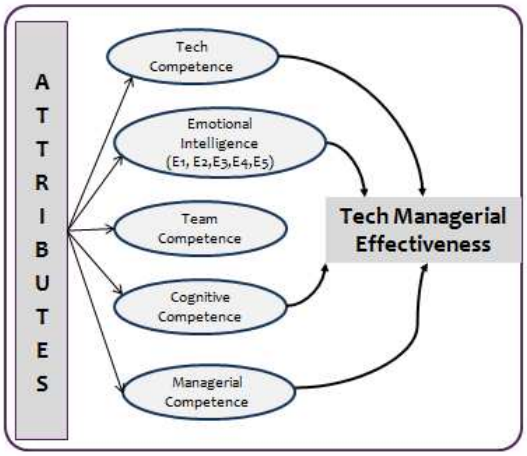

Figure 1. Conceptual Framework of Effectiveness

4. Research Methodology

Based on 29 attributes identified through literature review, a survey questionnaire was prepared on Likert scale. The type of sampling method selected for this study is purposive quota sampling. Purposive sampling includes obtaining necessary group from specific target groups. Purposive sampling is considered desirable when the universe happens to be small and a known characteristic of it is to be studied intensively [17].

Purposive sampling is chosen for the study. Rationale for using purposive sampling is as follows: as part of technical staff, there are many technologists who are primarily associated only with technology aspects but not managerial functions. Since the study is intended for techno-managerial population of IT industry, a special care is taken to reach out to intended audience and select only those who are involved in techno-managerial functions and not as solo technologist which may otherwise appear as part of sample in random sampling method. The sampling is confined to certain types of people for two reasons: a) they conform to some criteria set by the researcher (Quota Sampling) & b) some specific people have the information (Judgment Sampling). Based on the above-mentioned reasons, quota sampling was used. Quota sampling ensures that certain groups are adequately represented in this study through the assignment of a quota. A quota is fixed for each sub-group based on the total number of each group in the population. Quota samples are stratified groups from which subjects are selected non-randomly.

Table 1 highlights the sample demography and other relevant details.

TABLE1: Sample Demography

Description	Value
Population Size	1164
Sample size	520
Survey Yield	44.6%
Male / Female	329/191
IT Organizations sampled	19
Revenue Size (Sampled Organizations)	US $100 Million to US $1 Billion +
Technology Management Experience	5 Years to 25+ Years
Team Size (Direct and Indirect)	5 members to 100 + members

The sample included IT technical managers performing various technical roles such as Centre of Excellence (CoE) Head or Manager, Tech Intensive Business Unit Head, Manager of Technology intensive project/program, Information System Manager, R & D Manager, Technical Architect, Technical Designer and Technology Practice Head or Manager. The sample also included top management role holder with technology centric roles such as Chief Technology Officer (CTO) and Chief Information Officer (CIO). For each of 520 respondents, 360 degree assessment on "overall effectiveness rating" using Likert scale was sought from respective supervisor, peer and subordinate (at least one each).

To minimize the bias, most conservative rating (least of all) was picked up and assigned for overall effectiveness. The first stage of the data analysis conducted an exploratory factor analysis (EFA) to identify the factor structure for measuring the factor(s) that impact the overall effectiveness. The second part of the data analysis was employed with confirmatory factor analysis (CFA) to confirm the factor structure. Structural Equation Model (SEM) provides a method of testing relationships among latent and observed variables by estimating a set of separate multiple regression equations simultaneously. It draws together elements of path analysis and factor analysis and is a more powerful tool than other multivariate techniques that are capable of examining only single relationships at one time [2] [14]. Hence in this study structural equation models (SEM) were used to test the model.

The application of SEM in this research demonstrates benefits of "measurement and prediction" over standard multiple regression methods [16]. Also, SEM enhances study further as it "captures a truer representation of the variation of variables" and as path analysis is subsumed in the model.

To examine the general fit of the proposed model and to test the research questions factor constructs employed in the research were based on maximum likelihood derived from an earlier exploratory factor analysis. Fit indices included in the current investigation are the comparative fit index (CFI), the goodness-of-fit index (GFI) and the normed fit index (NFI) and the root mean square error approximation (RMSEA) [14] [8] [1].

5. Data Analysis

Apart from descriptive analysis, this study leveraged inter-item consistency reliability measure. Inter-item consistency reliability is a test of the consistency of respondent's answers to all the items in a measure. The most popular test of inter-item consistency reliability is the Cronbach's coefficient alpha, which is used for multipoint scaled items. We got the Cronbach's Alpha as .786, which means that our measurement is very consistent.

5.1 Exploratory factor analysis

The results obtained from 520 respondents were thoroughly analyzed and the outputs of the results have clearly been explained in this section. Applying SPSS, the principal component analysis (PCA) was carried out to explore the underlying factors associated with 29 items. The constructs validity was tested through Bartlett's Test of Sphericity and the Kaiser-Mayer-Olkin Measure of sampling adequacy. The Kaiser-Mayer-Olkin measures of sampling adequacy (KMO) were first computed to determine the suitability of using factor analysis. The value of KMO varies from 0 to 1, and KMO overall should be 0.60 or higher to perform factor analysis. Results for the Bartlett's Test of Sphericity and the KMO revealed from this research that both were highly significant and eventually we concluded that this variable was suitable for the factor analysis (refer Table 2).For this study, the general criteria were accepted items with loading of 0.45 or greater. The result showed in explained total variance explained by the six factors was 62.9%. The values of the following Table 3 indicate the affiliation of the items to a factor.

TABLE2: KMO AND BARTLETT'S TEST

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.718
Bartlett's Test of Sphericity	
Approx. Chi-Square	2894.144
df	171
Sig.	.000

Generally, the factor is the natural affinity of an item for a group. The higher loading (factor) indicates the stronger affiliation of an item to a specific factor. The findings of this study indicate that 19 items homogeneously loaded to the six factors leading to effectiveness. They are Project Management, Business Competence, Value System, Emotional Intelligence, Domain Competence and Technology Competence.

TABLE 3: OUTPUT OF FACTOR ANALYSIS

			Component					
Factors	Items	Notation	1	2	3	4	5	6
Project Management (PM)	Opportunity Spotting	PM1	.702					
	Team Management	PM2	.633					
	Stretch	PM3	.628					
	Project Leadership	PM4	.602					
Business Connect (BC)	Business Acumen	BC1		.615				
	Networking	BC2		.637				
	Personnel Developer	BC2		.815				
	Impact & Influence	BC4		.446				
Value System (VS)	Competitive advantage	V0			.470			
	Ethical / Moral Values	V1			.764			
	Aversion to Politics (non MACH)	V2			.741			
Emotional Intelligence (EI)	Achieving balance	EI1				.777		
	Coping with Stress	EI2				.707		
	People Orientation	EI3				.751		
Domain Competence (DC)	Cognition leverage	DC1					.874	
	Domain Excellence	DC2					.726	
Tech Competence (TC)	Technical Acumen	TA1						.684
	Future gazing	TA2						.680
	R & D Focus	TA3						.531

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A Rotation converged in 5 iterations.

5.2 Confirmatory Factor Analysis

Overall exploratory factor analysis gives the researchers confidence to do confirmatory factor analysis (CFA) which was used to assess uni-dimensionality in this study. Empirical evidence in CFA (and SEM in general) is generally assessed using criteria such as the comparative fit index (CFI), the root-mean square of approximation (RMSEA), the significance of parameter estimates and the amount of explained variance.

5.2.1 Comparative Fit Index (CFI)

Comparative Fit Index compares a proposed model with the null measures. CFI values close to 1 are generally accepted as being indications of well-fitting models [22]. This incremental measure of is directly based on the non-centrality measure. The Comparative Fit Index or CFI is represented as per equation (1) below

$$\left(\frac{\chi 2-df(NullModel)-\chi 2-df(\mathrm{Pr}oposedModel)}{\chi 2-df(NullModel)}\right) \quad (1)$$

Where

$\chi 2$: Chi-square measure of the model

df : The degrees of freedom of the model

An analysis of Table 4 reveals that the CFI value is moderately high at 0.8 suggesting good model fits.

5.2.2 Root Mean Square Error of Approximation (RMSEA)

The RMSEA is an index used to assess the residuals. It adjusts the parsimony in the model and is relatively insensitive to sample size. RMSEA must be equal to or less than 0.06 for an adequate model fit. This absolute measure of fit, identified by equation (2), is based on the non-centrality parameter. Its computational equation is:

$$\frac{\sqrt{(\chi 2-df)}}{\sqrt{(df(N-1)}} \quad (2)$$

Where

$\chi 2$: Chi-square measure of the model

N : Sample size

df : The degrees of freedom of the model

If $\chi 2$ is less than df, then the RMSEA is set to zero. Like Tucker Lewis Index or Non-normed Fit Index (NNFI), its penalty for complexity is the chi square to df ratio. The measure is positively biased (i.e., tends to be too large) and the amount of the bias depends on smallness of sample size and df, primarily the latter. The RMSEA is currently the most popular measure of model fit and it is now reported in virtually all papers that use CFA or SEM while some refer to the measure as the "Ramsey." Table 4 shows that the RMSEA value at 0.043, is well below 0.06 which indicate adequate model fits.

5.2.3 Content (internal) validity

Content validity depends on how well the researcher created measurement items using the relevant literature to cover the content domain of the variable that is being measured. The selection of items in this study was based on an extensive review of the literature, giving a strong content validity to the variables being measured.

5.2.4 Goodness of Fit Index (GFI)

The goodness-of-fit index tells you what proportion of the variance in the sample variance-covariance matrix is accounted for by the model. This should be closer to 0.9 for an adequately fitting model. The GFI Index is represented by equation (3) as follows:

$$(1-\frac{Vresidual}{Vtotal}) \quad (3)$$

Where

Vresidual : Residual variance in co-variance matrix that can't be explained by the model

Vtotal : Total variance of the covariance matrix

The result shows the value 0.85 coming close to fitting model.

5.2.5 Convergent validity

The [1] normed fit index (NFI) obtained from CFA can be used to assess convergent validity. This index measures the extent to which different approaches to measuring a construct produces the same results. The best model is defined as model with a $\chi 2$ of zero and the worst model by the $\chi 2$ of the null model. It is represented by following equation (4):

$$\left(\frac{\chi 2(NullModel)-\chi 2(\mathrm{Pr}oposedModel)}{\chi 2(NullModel)}\right) \quad (4)$$

Table 4 shows that all the NFI value is at 0.78 suggest moderate convergent validity.

5.2.6 Tucker Lewis Index (TLI) or Non-normed Fit Index (NNFI)

A problem with the Bentler-Bonett index is that there is no penalty for adding parameters. The Tucker-Lewis index, another incremental fit index, does have such a penalty. Let $\chi 2/df$ be the ratio of chi square to its degrees of freedom, and the TLI is computed as equation (5) below:

$$\left(\frac{\chi 2/df(NullModel)-\chi 2/df(\mathrm{Pr}oposedModel)}{\chi 2(NullModel)-1}\right) \quad (5)$$

The Bentler-Bonett normed fit index (NFI) obtained from CFA can be used to assess convergent validity. This index measures the extent to which different approaches to measuring a construct produces the same results. If the index is greater than one, it is set at one. It is interpreted as the Bentler-Bonett index. Note that for a given model, a lower chi square to df ratio (as long as it is not less than one) implies a better fitting model. Its penalty for complexity is $\chi 2/df$. That is, if the chi square to df ratio does not change, the TLI does not change. Table 4 shows that all the NNFI value is at 0.75 suggest fitting model measure.

5.3 Structural Equation Model

Structural equation modelling is a general term that has been used to describe a large number of statistical models used to evaluate the validity of substantive theories with empirical data. Statistically, it represents an extension of general linear modelling (GLM) procedures, such as the ANOVA and multiple regression analysis. One of the primary advantages of SEM is that it can be used to study the relationships among latent constructs that are indicated by multiple measures. It is also applicable to both experimental and non-experimental data, as well as cross-sectional and longitudinal data. SEM takes a confirmatory (hypothesis testing) approach to the multivariate analysis of a structural theory, one that stipulates causal relations among multiple variables. The causal pattern of inter-variable relations within the theory is specified a priori. The goal is to determine whether a hypothesized theoretical model is consistent with the data collected to reflect this theory. The consistency is evaluated through model-data fit, which indicates the extent to which the postulated network of relations among variables is plausible. SEM is a large sample technique (usually N > 200) and the sample size required is somewhat dependent on model complexity, the estimation method used, and the distributional characteristics of observed variables SEM has a number of synonyms and special cases in the literature including path analysis, causal modelling, and covariance structure analysis. In simple terms, SEM involves the evaluation of two models: a measurement model and a path model.

Based on a probability level 0.05, then, the test statistic needs to be >±1.96 before the hypothesis (that estimates equals 0.0) can be rejected. Non-significant parameters, with the exception of error variances, can be considered unimportant to the model; in the interest of scientific parsimony, albeit given an adequate sample size, they should be deleted from the model. On the other hand, it is important to note that non-significant parameters can be indicative of a sample size that is too small [3].

TABLE 4: Goodness of Fit Statistics

Model Metric	Value
Chi-Square for Independence Model	4171.514
Normed Fit Index (NFI)	0.779
Non-Normed Fit Index (NNFI)	0.755
Comparative Fit Index (CFI)	0.804
Critical N (CN)	101.534
Root Mean Square Error of Approximation (RMSEA)	0.041
Goodness of Fit Index (GFI)	0.846
Adjusted Goodness of Fit Index (AGFI)	0.786
Root Mean Square Error of Approximation (RMSEA)	0.041

The structural equation model was examined to test the relationship among constructs. The Figure 2 depicts the full model that was run through LISREL for structural equation modelling output.

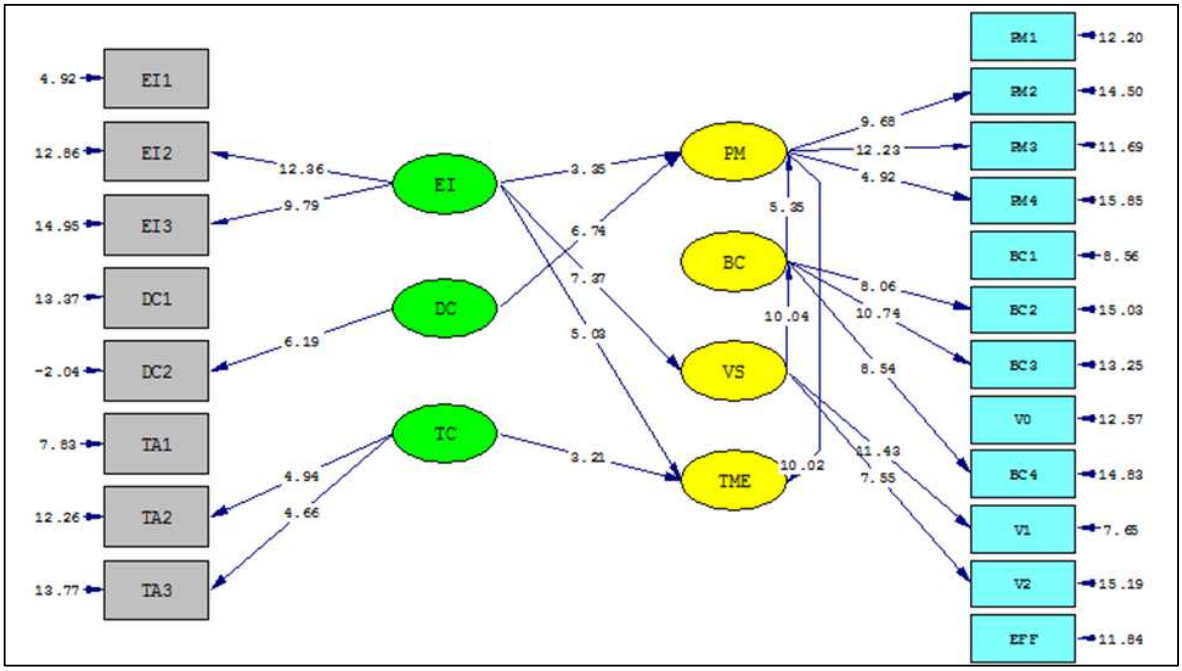

Figure 2. Structural Equation Model for Effectiveness (LISREL 9.1)

Emotional Intelligence (EI) positively impacts value system (VS), Project Management Competence (PM) and overall effectiveness (TME) of the technical manager. Domain Competence (DC) positively impacts Project Management Competence. Business Competence (BC) positively impacts Project Management Competence. Value System Competence (VS) positively impacts Business Competence. Technology Competence (TC) positively impacts overall effectiveness of the technical manager. Project Management competence positively impacts overall effectiveness of the technical manager. Direct impact of Emotional Intelligence, Project Management competence and Technical competence is established through SEM.

6. Conclusions and Future Research

6.1 Conclusion

The focus areas of this study are Information Technology industry, technical managers, coverage of competencies beyond technology acumen and finally interrelations amongst these competencies resulting in overall effectiveness. It is a unique study of its kind providing findings in each of these areas with advanced statistical aid such as SEM. In subsequent authors will outline conclusions and significant contributions in each of the above mentioned areas.

The global economy has been turbulent during the last several years, and governments and enterprises are doing everything possible to inject momentum and effectuate sustainable growth. Although we still face serious challenges, the impact of information technologies on each industry has become more far reaching as its transformational effects spread to several sectors of the economy and society via innovations, the emergence of new industries, and the advent of the era of hyper-connectivity. This new era of hyper-connectivity will begin a bold new chapter and will be closely linked to continued economic growth worldwide. More importantly, Information Technology will significantly reduce geographic or other limitations, allowing people around the globe to communicate and share information and ideas freely. In this integrated and interwoven world, IT industry will contribute greatly to a variety of fields and industries. Relevant technological innovations will propel global economic growth further than ever before. Incidentally, IT industry is also associated with uncertainty and fast pace of technology change which makes the role of technical manager more critical as well as demanding. This study presents IT industry demands of technical managers through a systematic and scientific research process.

Technical managers are unique in the community of contemporary managers. Technology managers

bear a special responsibility to help corporations in making the right choices to emerge from these times—bolder, smarter and stronger for new economic reality. By driving corporations to bring clarity to their strategy and to become more selective in their choices for future growth, research and technology management must play an essential role in creating pathways towards the growth and effectiveness. This study highlights 19 key competency areas that technical managers need to posses. Given the rise of digital economy, role of technology and consequently technical managers will only increase. This research highlights the uniqueness and requirement for more research studies in technical management sphere.

This study covers attributes of importance beyond technology know-how towards managerial effectiveness. It highlights importance of competencies such as project management, business skills, strong value system, emotional intelligence, sound understanding of specific domain and finally the technical know-how. It is indeed insightful finding, in context of IT technical managers, that these soft or behavioural skills are equally important as technical know-how. There always exists a perception of effective managers being better on "human side".

One of the most fundamental conclusions of this study is exploration and presentation of inter-relationship amongst these competencies to achieve effectiveness. The underlying strength of SEM is leveraged in unearthing complex interrelationships amongst competency clusters. The model shows that overall effectiveness is directly contributed by technical competence, emotional intelligence and project management competency. It also proves that emotional intelligence directly impact individual's value system or ethical considerations as well as project management abilities. Value system impacts the ways and means one conducts business dealings (business competence) which further impacts project management as well. Domain skills are also direct contributor to project management competence.

Finally, individual effectiveness is a measure for individual's performance. Performance is often evaluated against the benchmark of implicit or explicit expectations. Often individuals exceeding the expectations are tagged as "effective". The same context holds true for IT technical managers as well.

6.2 Future Research

Technical Managers are expected to integrate technical and business knowledge to deliver effective solutions which meets business needs. A silo of technology expertise, without due notice of personality and managerial factors, would lead unfavourable results. Based on the findings emerged from this study, cohesive outcomes expected from IT technical manager to qualify for high effectiveness can be defined. This list of performance expectations would lead to better definition of key asks for IT technical managers.

A specific study to measure impact of emotional intelligence on overall effectiveness can be undertaken. Constituent sub-scales of emotional intelligence can be statistically tested for relevance. The sample technical managers can represent diverse conditions including role, gender, team size managed, years of technology experience and size of the organization working for. Correlation analysis can be performed in order to assess the association and the strength of association of each of the factors. Future research can highlight association of factors like intrapersonal (knowing self) ability, interpersonal (knowing others) ability, adaptability (flexibility), ability to cope with stress and ability to be remain happy and optimist with overall emotional intelligence. IT technical managers are expected to address short term needs by allocating right focus supplemented by resource (human, technical and otherwise) without losing vision of tomorrow. Right level of awareness on self as well as others including peers, subordinates customers and partners is a key to be effective. Future research can use these assertions to develop effective measures for IT technical managers including emotionally intelligence as of the key dependent factors.

This study had a specific focus on technical managers in IT industry. There exist a large number of technical managers in other industries as well. Future research need to conduct similar studies for other industries as well. The findings from such studies will help study research community in identifying similarities and differences amongst technical managers across various industries.

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