

Contemplation Of Human Factors In Impelling Software Project Management

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Abstract

With its origins in Industrial Revolution, Human Factors became widely incorporated discipline during the World War II. Many giant companies came to recognize that the success of a product depends upon a solid Human Factors design. Human Factors discovers and applies information about human behaviour, abilities, limitations, and other characteristics to the design of tools, machines, systems, tasks, jobs, and environments for productive, safe, comfortable, and effective human use. Chatzoglou and Macaulay (1997)^[1] claim that the scientific discussion about the work situation in software development and about productivity factors in such projects is done based on an insufficient empirical basis. According to them, it is dominated by shallow surveys and qualitative experience reports. Moreover, the software engineering literature in that area often has a strong emphasis on mainly technical factors such as the software size or the product complexity. While half of the typical programmer's time is spent interacting with other colleagues, thirty percent of the time he/she will spend working alone and the other twenty will be spent in activities such as travel and training. There is scant research in this area and this article aims to alleviate these gaps by contemplating human factors in impelling software project management. Through review of literature, it's endeavoured to identify those human factors (dimensions and related variables) which play a major role in impacting software project management.

Keywords: Organisational Culture, Team Identity, Manager Application Experience, Analyst Capability, Developer Temperaments

INTRODUCTION

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REVIEW OF LITERATURE

1. Influence of Human Factor

Pothireddy (2003)² identified the essentiality of defining Human Factors and Human Computer Interaction, which are imperative for the design and development of any software work. It laid down the underlying idea for incorporating these factors into the software life cycle and shows the diverse applications of Human Computer Interaction in various fields. A software engineer must always keep in mind the end user who is going to use the product and should make things as simple as possible and provide the best, at the same time not being too hard at his/her pocket. Usability testing and software ergonomics deal also deal with the effective designing of a product. Since human computer interaction and software ergonomics are a new concept in the field of software engineering, they have a wide scope of being developed later on. Any software engineer should realize that software systems are predominantly interactive and aspects of user friendliness and easy learn- ability therefore hold the same significance in software design as functionality and efficiency.

Sajid et al. (2009)³ analyzed the software industry of Pakistan with respect to human and soft issues. It explored whether these soft issues have considerable impact to achieve, enhance

and sustain productivity and quality. Unfortunately it is generally believed in most software companies in Pakistan that soft issues like motivation, job security, salaries and incentives, Employee's sense of ownership, team building, values, individual self-respect and dignity, open communication, skills enhancements and leadership style are not important by respective managers. This study has shown that productivity and quality of work are directly influenced by the environment and culture where people work. To gain full benefit of the workforce skills and talent good working environment should be provided where they feel valued, respected and affiliated. Importance of the process improvement and maturity should not be ignored. Likewise, human and culture related issues to increase the satisfaction and motivation of the people who execute that process should also be considered.

Lalsing et al. (2012)⁴ aimed at identifying the underlying people factors to consider when adopting agile for a team to be effective. The method used is the study of three different sized agile teams developing products based on the same technologies and using Scrum. Both objective and subjective measures were used and the results are supported by a survey. The results clearly showed that for agile methodologies to work well, it is crucial to select the right people for the right team. This study was aimed at evaluating the people factors that can affect the performance of an agile team. The research was made with a small group of similar projects that differed by size and team size only. This work will give valuable insight to team leaders to select the appropriate number and type of people on each project. It will also be highly beneficial to software organisation which will be in a better position to assess whether agile could work for them. Future work will need to be performed to evaluate whether the same result can be obtained with projects of varying organization, complexity and technology.

Gandomani et al. (2014)⁵ carried out that many software companies are interested in using agile methods in their software projects. Contrary to traditional software development methods, agile methods are people oriented. This fact shows the significant role of individuals in these methods. Increasing prevalence of agile methods forces software companies to consider people related factors as critical issues in adoption and transition to agile methods and practices. This study focused on human aspects of agile transformation process by conducting a Grounded Theory study involving 32 agile experts. The main contribution of this study was identification and classification of diverse human aspects of agile transformation process. Analysing collected data showed that human aspects of agile transformation process can be classified in several categories. While some of them are impediments to change, some others act as change accelerators. It was concluded that due to the people-centred nature of agile transformation process, awareness of human aspects of this process and potential challenges is a critical and necessary prerequisites before starting this process

2. Organisational Culture

2.1. Credibility

Lankes (2007)⁶ determined credibility in the internet environment from a conceptual level and the implications of these new methods of credibility determination on internet tools and services. This study presented a model that posited knowledge is gained through conversation, and that digital networks and tools must address this underlying reality. This study discussed how the internet and digital networks that allow for community participation in the construction of the underlying network and infrastructure have become the predominant model for existing and future digital media. This study showed how this need for participating and involvement has impacted information services, and finally the users themselves in terms of how they define and assess credible information. It was concluded that the omnipresent nature of the digital environment is necessitating more technical fluency and greater explicit consideration of credibility and technology for information professionals and information organizations.

Anuradha (2013)⁷ recognised the importance of managing the success of software development projects. Using agile methodologies is seen as a way that may result in improved project success. Cultural impacts and influences are also recognised and to be known a critical factor in successful projects. The growing need to work between cultures have also been identified as an important factor. This study also aimed to determine the extent to which agile methodology can be adopted within and among different cultures, to provide a framework to assist practitioners and researchers to work in global teams, and to understand and manage cross-cultural challenges. This research through investigation has summarised negative/positive influence of cultural agile attributes in implementing agile methods in different cultures and provided a theoretical framework to manage cross-cultural challenges.

2.2. Respect

Pirzadeh (2010)⁸ aimed to identify and characterize human factors influencing the software development process from development lifecycle and software management perspectives. Despite of the human factors impact on software development process and its level of success/failure, there has not been enough focus by primary study researchers on the area. Human factors have been overlooked in late phases of development process as well as software engineering management. In contrast with all other areas of business which their highest concern is the customer, among the inspected papers this role has been overlooked by researchers. It was concluded that as transferring from pre-planned to agile development process, there will be more interpersonal level of human factors involved that has not been addressed well by researchers so far.

Khan et al. (2014)⁹ analysed some critical factors associated with the software development productivity, using the industrial case study data gathered after conducting questionnaire, interviews, etc. in a typical medium sized software firm. The data analysis is done through the structural equation modelling approach. Next this study presented the effect of human factors on software development productivity.

It's important to combine both the Human factors and software productivity, in our study so as to arrive at one final conclusion about factors affecting the software development productivity. Therefore, this paper presented good and new ideas about human productivity and factors affecting it. By getting the insight into different productivity terms, one can find the ways to enhance software development productivity. Also, this approach can be applied for not only just for a medium sized software company, but also on small and big software companies, so as to observe the effect of size of software company on productivity related factors. This could help us in deriving at some conclusion about different productivity factors and their relation with sizes of Software Company.

2.3. Fairness

Bjeirmi & Munns (1996)¹⁰ aimed to identify the overlap between the definition of the project and project management and to discuss how the confusion between the two may affect their relationship. It identified the different individuals involved on the project and project management, together with their objectives, expectations and influences. It demonstrated how a better appreciation of the distinction between the two will bring a higher possibility of project success. It had also attempted to highlight how the objectives of a project and project management are different and how the emphasis of project management is towards achieving specific and short-term targets compared to the wider aims of a project. The conclusion is that to make the project management team totally responsible for success would appear to be inappropriate and that the client should take an increased interest in the development and use of the project. Finally, the successful project management techniques will contribute to the achievement of project from failing to succeed.

Muthengi (2014)¹¹ provided an introduction to human coordination issues that are of influence in software development. Human factors are key elements that contribute to the quality of the final software system. The time to be spent in the development process is also affected by internal issues in the development team. Team composition is a critical aspect of group work that influences communication among software developers. Constituting a skill wise balanced team can guarantee success given good coordination from the management team. The ultimate goal of software development is to develop software within the allocated budget and deliver a good quality software product to the client. As future work, one can delve into a specific factor such as communication, team composition or management role and how it contributes to software development in different set ups such as open source and commercial development software projects. It was concluded that software developments being a broad and wide subject, various references are cited for others willing to delve in other human factor issues in software development.

3. Team Culture

3.1. Team Cohesion

Elena (2010)¹² outlined the importance of cultural differences aspects in project management. The main objectives followed

by the paper are to see the impact of cultural differences of project management, to find the advantages of a multicultural team and how can we use them to face the challenges of operating in a dynamic business environment characterized by high levels of uncertainty. With globalization comes an increased interaction between people of different countries and an increase in the need to deal with cultural differences. A project manager needs to understand their own culture and the cultures of the project stakeholders. The culture gap tool highlighted the biggest cultural differences between major stakeholders such as the project manager, the customer and the project team. It was concluded that the purpose of the cultural gap tool is to raise awareness of the project manager regarding the manifestation of cultural differences in their project.

3.2. Camaraderie

Alexander et al. (2010)¹³ carried out this study to measure how can management handle relationship problems arising from cultural differences in multinational IT project teams. This study used a social capital lens to better understand the negative impact of cultural differences in IT project teams. In contrast to many previous works this study doesn't consider cultural differences as a whole but explore the role of the different national culture dimensions. This allows for a more detailed view on cultural differences in a team context and this contributes to a better understanding about which dimensions of national culture drive relationship problem and which management measures can help to dampen the negative effects. It was concluded that based on several exploratory cases, the study identified three patterns showing typical problems in team social relationships which arise from differences in particular dimensions of national culture.

Stare (2011)¹⁴ showed that a significant number of projects exceed the planned time and costs, consequently reducing the benefits. Among many causes of project failure, it is widely recognised that organisational culture has an impact on project performance. The goal of the research presented was to identify the level of project organisational culture in Slovenian enterprises. It also analysed the strength of the impact of the culture on project execution. The research was focused on the top and line management's attitudes and some other factors connected with managers' attitudes. It also investigated the most common project organisation types and the correlations among the organisation, culture and project performance. The research showed a high level of project organisational culture and a high impact level of measured culture factors on project performance. It was concluded that an increasing level of project manager authority in different organisation types positively impacts on several cultural dimensions and also has a direct impact on the project's performance.

3.3. Clear Goals

Gopalakrishnan et al. (2012)¹⁵ presented an empirical investigation on several projects from a product based software industry to signify the impact analysis of efficiency of project manager in effectively allocating resources. Generating high quality software is dependent of various parameters which includes cost, time, and number of

developers, technology, and complexity of the project and so on. Role of project manager is one of the highly modulating factors that aimed towards estimation and apt allocation of resources in successfully developing projects. The investigation result showed a significant impact of aforementioned factors on the success of software and on the company. The analysis further indicated the vital role of project managers in optimizing the resource allocation towards development of software. This study brought in impact analysis of efficiency of project manager in effectively allocating resources such as time, cost, number of developers etc. An awareness of efficiency level of project manager in optimal allocation of resources enables one to realize the desired level of quality. It was concluded that the knowledge of impact of variations in these resources assures the organization in effectively planning, controlling and developing projects that ultimately leads towards production of high quality software which in turn guarantee completely satisfied software products.

3.4. Sense of Eliteness

Basri & O'Connor (2011)¹⁶ found that due to small team size which creates a flat work structure, direct and active communication, close relationship and open environment have created positive team dynamics environments in respondents' organization. These situations also have encouraged software development teams to share and create knowledge in organization. In addition the analysis in the first stage (qualitative) have indicated that management style in VSEs which is more informal and macro, and working style which more autonomous have helps to create team dynamics environments. A survey was conducted in a variety of VSEs and through statistical and qualitative content analysis for the research data, results indicate that small teams, informal team process and structure have an important influence on the level of team dynamics in the software development process. It showed that respondents claimed that their software development activities are not affected by the knowledge atrophy problem. They claimed that by, having frequent guidance and mentoring activities, being active in knowledge sharing and proactive coaching could mitigate this problem from occurring

3.5. Team Identity

Alkandari (2006)¹⁷ revealed that managing software engineering teams in a systematic, controlled, and efficient manner often results in higher quality software. Today, with around the clock software development, software teams consist of members from geographically different locations and a variety of cultures. A few software development team compositions have been presented based on tasks, personality, and role descriptions. In addition, this study not only investigated how those models could be applied to software development teams but also explored the relationship between personality profiles and cultural differences. This study found evidence that all Belbin roles are important and could be applied successfully to software projects, except the Monitor-Evaluator role, since prior research provides some evidence that the role of ME might be beneficial to software teams but is not necessary. Furthermore, every software engineering role

requires a different set of Belbin roles depending on the nature of the task. The findings of the study revealed that there was some validation beyond opinionative reasoning about the connections between roles, personalities, and culture since we did not have enough time to run experiments to significantly verify and validate the RPC model.

3.6. Support for Innovation

Belassi (2013)¹⁸ introduced culture as key factor in determining the success of NPD projects. Culture to organizations is personality to people. It determined how they do things and why they do them that way. Without adopting the right culture, trying to present micro changes might prove not useful. This study presented a theoretical framework discussing the effects of organizational culture on project-related variables, and consequently on project success or failure. The study integrated three disciplines into one-organizational culture, new product development, and project management. It was given better understanding of why NPD projects succeed or fail by integrating the knowledge from organizational culture, NPD, and project management. It provided a comprehensive model that explains the effects of organizational culture on the implementation of NPD projects, and the relative importance of the factors affecting NPD projects. The study constituted an initial effort to model and measures the relationships among project level variables and the organizations' degree of innovativeness, all of which are affected by the organizational culture.

3.7. Communication

Hamdan et al. (2013)¹⁹ revealed that in a global and diverse environment, culture and leadership play an important role in that impacts work performance, and consequently, software cost estimation. The notions of leadership and culture carry with them highly variable assumptions, and thus must be explicitly modelled. A new model that incorporates leadership and culture is proposed, elaborated and validated. A survey was undertaken to determine the impact of culture and its effect on the software development process in the areas of project team timeliness, collaboration and team work, leadership characteristics, cultural intelligence, motivation and communication. The use of the bootstrap method for estimating the effort involved in a given project, along with analogies using real historical data, demonstrates the effectiveness of this approach in surmounting difficulties in describing abstract quantitative variables. The findings revealed that the inclusion of leadership and culture in the cost estimation model improves the accuracy of software cost estimation.

3.8. Labour Turnover (Attrition)

Liang et al. (2007)²⁰ investigated the relationship between knowledge diversity (KD) in software teams and project performance. This paper proposed a novel way to measure knowledge and value diversity (VD) in teams and reports the effects of these attributes on team performance. The work also showed that a proper level of task conflict in a software team is necessary for achieving high performance. It was found that KD increases task conflict, which in turn has significant positive effects on team performance and that value diversity

increases relationship conflict, which in turn negatively affects team performance. The findings indicated that task conflict can enhance team performance, while relationship conflict can reduce team performance. Therefore, it is important to maintain healthy relationships among team members. This research concluded that KD is beneficial and that VD is harmful to project outcome in software development. It is, therefore, useful for managers to form teams whose members encompass a broad knowledge base.

4. Capabilities and Experience

4.1. Manager Application Experience

Wagner & Ruhe (2009)²¹ conducted this study to measure productivity factors in software development. Analysing and improving productivity have been one of the main goals of software engineering research since its beginnings. This study reported that a plethora of studies has been conducted on various factors that resulted in several models for analysis and prediction of productivity. However, productivity is still an issue in current software development and not all factors and their relationships are known. This paper reviewed the large body of available literature in order to distil a list of the main factors influencing productivity investigated so far. The measure for importance here is the number of articles a factor is mentioned in. Special consideration is given to soft or human-related factors in software engineering that are often not analysed with equal detail as more technical factors. The resulting list can be used to guide further analysis and as basis for building productivity models. Furthermore, there are influences between factors that can also have significant effects that need to be considered in this list and corresponding models.

4.2. Language and tool experience

Geambasu et al. (2011)²² reviewed the main categories of development methodologies and then focuses, for a detailed study, on three of them; Rational Unified Process (RUP), Rapid Application (RAD) and Extreme Programming (XP). For each methodology it is presented the structure of software life cycle, there are identified the situations in which the methodology can be used successfully and the situations in which it tends to fail. Based on the literature review of software development methodologies and on a series of surveys, published by different researchers, exploring the state of practices in this field, this study have identified a number of factors that influence the decision of choosing the most adequate development methodology for a specific project. The methodologies that are subject of this study were evaluated in relation to these factors to find out which development methodology is the most adequate depending on the level of the factors for a specific project. The results of this research were useful for the developers by helping them to identify what software development methodology can be used with success for a specific project.

4.3. Analyst Capability

Villiers (2003)²³ considered that the use of RUP methodology contributes to project success, because it is based on some of the most modern software engineering practices such as:

iterative development, requirements management, visual modelling, components based architecture, continuous verification of quality and change control. An important advantage of using RUP is that it imposes risk identification and establishment of mitigation strategies at an early stage, which helps to a more realistic estimation of costs and development time of project. RUP emphasised on accurate documentation and provides a detailed description of activities to be performed, roles related to each activity and artefacts to be obtained. Beside the advantages, the use of RUP methodology also has some disadvantages. The high complexity of the methodology requires the use of a large number of resources which makes it difficult to learn and manage. The process of tailoring the methodology is a difficult one, which must take into account many factors in order to avoid the appearance of inconsistencies due to reduction of activities.

4.4. Programmer Capability

Gupta & Suma (2013)²⁴ focused on the human aspect of software engineering to achieve good quality of software by building a classification model for predicting employees' performance based on certain attributes. Data mining techniques could identify those attributes required in a project member which will contribute to good performance and thereby enhance software quality and success. However, this study showed that other talent attributes like programming skills and reasoning skills have proved to be more important, although software companies emphasize upon aggregate percentile and followed the same trend for many years. Due to lack of analytical method in human aspects, software companies were not selecting the right people who could perform well in the software process and thereby failed to achieve the desired quality in the time and cost constraints. The results demonstrated that there is a need to refocus on selection criteria for quality objectives. Better selection criteria was identified by patterns obtained from data mining models by integrating knowledge from software project database and authors research techniques.

4.5. Developer Temperaments

Kwak & Stoddard (2004)²⁵ stressed that software project success or failure is a result of multiplicity of several factors among them being risks and interaction among team members. Many software projects involve several multiple companies with varying interests. Usually, there is a feeling of disconnection between software developers and the management team. Consequently, some of the developers may establish close ties with the software product client in search of a companion. This in turn may influence the role of the developer – interfacing the client and the software development company. As such, organizational issues play a major role in software product delivery. It was concluded that human factors in software development team coordination will depend on the type of development.

4.6. Platform experience

Brietzke & Rabelo (2006)²⁶ presented a set of resistance factors identified in software processes improvement projects, which is it presented the factors of influence in the transition

phase from the current software process to the improved one within the companies. Several companies have been carrying out software processes improvement projects. However, some of them give up before the project ends and others take much longer than expected to get it accomplished. This way, identifying the resistance factors that influence the implementation of such projects might serve as a reference to professionals in this area on the one hand, and help to manage future projects on the other, through the use of preventive actions that either lessen or eliminate the resistance factors consequences. It was concluded that a software processes improvement project may use more than a standard as reference, since they can be complementary due to the differentiation in focus of action and of the roles involved.

4.7. Manager capability

Bruce (1999)²⁷ summarised the outcomes of an investigation into the experience of information literacy amongst various types of professionals; and explores the possible differences and interrelations between individual and organizational information literacy suggested by these outcomes. Seven different ways of experiencing information literacy were identified. These experiences are closely related to important workplace processes such as environmental scanning, information management, corporate memory, and research and development; conforming that information literacy should be considered a significant part of the character of learning organizations as well as being a key characteristic of organization's employees. It was concluded that information literacy involved with critical thinking, an awareness of personal and professional ethics, information evaluation, conceptualizing information needs, organizing information, interacting with information professionals and making effecting use of information in problem-solving, decision-making research.

4.8. Applications Experience

Perumal & Abubakar (2011)²⁸ explored the relative importance of technology usage as one of the motivational factor concerning in the area of communication within the project team, team work and efficiency. Project success not only relying on organization process and structures, but technologies gives a higher impact that keeps the team motivated all the time. The aim of this study is to examine the mutual relationship between technologies impact and motivational factor. This study also aimed to explore how these interrelated elements of technologies and motivation could be emphasized in every organization to reinforce and strengthen the project team from all level. The focus of this study is design oriented to address motivation factors in project management field. It was concluded that implementation of technological systems can either act as a medium for change or be the means of achieving a desired change in a project.

5. Environment

5.1. Proper workplace

Tsay (2014)²⁹ examined how social and technical information in the transparent open source software environment of

GitHub is used to make contribution decisions. This study created a statistical model analysing the association of different pull request, submitter, and repository measures of contributions with the likelihood of the contribution being accepted. It found that project managers made use of information involving both the technical contribution practices of a pull request and the strength of the social connection between the submitter and project manager when evaluating pull requests. The findings of the study inform how software developers and project managers make use of information in social work environments such as GitHub and imply a variety of ways that social features in work environments can support software development. Future research may investigate how developers use signals in other work environments, transparent or not. These findings provided evidence that developers use both technical and social information when evaluating potential contributions to open source software projects.

5.2. E-factor

Trendowicz & Munch (2009)³⁰ informed that managing software development productivity is a key issue in software organizations. Business demands for shorter time-to-market while maintaining high product quality force software organizations to look for new strategies to increase development productivity. The productivity of software production processes may vary across development contexts dependent on numerous influencing factors. Effective productivity management requires considering these factors. Yet, there are thousands of possible factors and considering all of them would make no sense from the economical point of view. Therefore, productivity modelling should focus on a limited number of factors with the most significant impact on productivity. Findings of the study expressed that selecting the right factors is just a first step towards quantitative productivity management. The respective project data must be collected, analyzed, and interpreted from the perspective of stated productivity objectives.

5.3. Time fragmentation

Spalek (2013)³¹ demonstrated the link between reaching a certain level of project management maturity by the company and its projects cost performance. The world-wise study was conducted in order to measure the influence of the project management maturity level on the cost of projects. It was found that an increasing level of maturity in project management can have an influence on the reduction of costs of projects managed by the company. However, the strength of this influence depends on various factors. There are a limited number of world-wide studies on Project Management Maturity in companies. Moreover, the studies examining the influence of a certain maturity level on projects' key performance indicators are limited to single case studies. It was concluded that the information technology industry reported only the influence causes by different types of change of maturity.

5.4. Physical separation

Penzenstadler (2011)³² presented emerging research on supporting different aspects of sustainability via requirements

engineering and quality assurance. Sustainability is not supported by traditional software engineering methods. This lack of support leads to inefficient efforts to address sustainability or complete omission of this important concept. Aim of the study is to support the dimensions of sustainability – human, social, economic, and environmental – within different phases of the software lifecycle, especially requirements engineering and quality assurance. This study contributed a description of the aspects of sustainability in software engineering. The application of sustainability actions on the basis of these aspects is sketched in usage scenarios. Sustainability in the usage processes in the application domain triggered by the software system as product. This takes into account responsibility in the impact on the environment and using green business process. However, it was concluded that the system usage aspect, as this hypothesis is that it might have the biggest impact in terms of improvement potential.

5.5. Telecommunication facilities

Phillips (2005)³³ provided an analysis of the factors which influence the adoption of educational technology in higher education. It argued that the technology is mature enough, although care needs to be taken about definitions of terms used. The role of educational technology was analysed in terms of what we know about learning, and the conclusion drawn that we know enough about the design of educational technology environments, but that this knowledge is not widely applied. The paper then discussed the research about institutional factors which impact on adoption of new technologies in higher education, before concluding that the major factors affecting adoption are human, and these can only be addressed through effective leadership and change management.

6. Project Management

6.1. Schedule

Didraga (2013)³⁴ emphasized the role of risk management and its contribution to projects success in the existing literature. The methodology applied is based on documentary study review and analysis of the concepts used by the literature. The results revealed that risk management is a very important component of the project management process and it is assumed implicitly to work in favour of project success. The effects of risk management in IT projects include creating awareness, clarifying expectations, creating acceptance and commitment, establishing trust and setting priorities, thus contributing to a higher success probability of the IT project. Risk management practitioners are aware that risk management can help them gather information and support their decision making process, and also influence stakeholder expectations and perceptions, thus creating a better environment for more effective stakeholder actions. It was concluded that risk identification and risk planning do not influence the subjective performance of the project in terms of reliability, easiness, flexibility and satisfaction and quality.

6.2. Process Control and improvements

Jayanthi & Florence (2013)³⁵ carried out this study to measure software metrics and phase based defect removal pattern

technique for project management. Phase-based defect removal pattern metrics can also be used to evaluate the status of a development project. Software metrics can reveal a lot of information about the code at several stages of development. They can identify the routines which need to be redesigned due to higher complexity, routines which may require thorough testing and features which may require more support. This study revealed that measuring attributes of a software product under construction give insight to the stability and fitness for testing and delivery. Software measurement can also identify potential risks to a project. Early risk identification provides a development team with an opportunity to focus effort on the critical project tasks. It was concluded that the practice of applying software metrics to a software process and to a software product is a complex task that requires study and discipline and which brings knowledge of the status of the process and/or product of software in regards to the goals to achieve phase-based defect removal pattern.

6.3. Requirements stability

Hickey & Davis (2004)³⁶ requirements management has been identified as one of the most critical aspects in controlling technology related risks. Organizational analysis, user surveys, information hiding, task analysis, user characterization, requirement scrubbing have been discussed in this regard. Experimentation, synthesis from characteristics of the utilizing system, paying early attention to poorly defined parts and system functionality, allowing the project to be driven by the user community and not by the developers etc. are measures suggested to bring requirement changes under control. Poor execution of requirement elicitation will almost guarantee that the final project is a complete failure. Requirement issues need to be resolved as the project progresses. Unnecessary changes or requirements should not be entertained. The risk of unrealistic estimation of budget and cost can be minimised through software reuse and requirement scrubbing. The system should be kept as simple as possible and should be designed to cost. The project success rate increases with standardized processes and design methodologies.

6.4. Average team size

Kaur et al. (2013)³⁷ informed that software scheduling is one of the most important scheduling areas faced by software management team. For a successful project, both software engineering and software management are very necessary. The results of the study revealed that project scheduling consists of many activities, some are very critical that delay the overall project completion time. When team do not schedule the software completion time they leave the projects vulnerable to factors that cause major rework or project failure. But adopting any software project scheduling technique is the step every software project manager can take to more effectively manager software development initiatives of work have been done and still continue in different fields of software project scheduling to make it relevant. It was concluded that this software project scheduling techniques are helpful in handling the various type of scheduling used in software projects.

6.5. Organizational Climate and Support

Aronow, (2004)³⁸ organizational politics has been discussed with utmost importance in the literature over the last two decades. It is considered to be a primary component in contemporary business practices. Organizational politics refers to behaviours that occur on an informal basis within an organization and involve intentional acts of influence which are designed to protect or enhance individuals' careers when conflicting sources of action are possible. Several sources have indicated that political conflicts and power plays can increase software project risk and negatively affect its outcome. On the basis of his experience with cancelled projects estimates that corporate politics has been associated with more than one- third of them. There are various risk factors which are related to organizational climate. The lack of top management support has been cited as a possible risk factor in software development projects.

6.6. Project coordination

Jurison (1999)³⁹ projects involving new technology should rely more on internal integration tools that are designed to enhance the team's technical competence and operation as an integrated unit. Software project management requires different types of coordination at different stages and a major portion of the organizational design problem is choosing the particular type of coordination that matches the given uncertainty. Given the temporary nature of software projects (project teams are usually dissolved once their objectives are achieved) minor slippages in the control process can have a greater adverse impact than the same slippage in a more permanent organization This study suggested an impersonal mode of project coordination for low risk/uncertainty projects and group mode of coordination for high risk projects. This study also showed higher levels of formal planning in high risk projects when cost control is taken as a measure of performance. But when system quality is studied as the performance objective, it is seen to have positive correlation with user planning.

6.7. User coordination

Boehm (1991)⁴⁰ proper communication systems should be designed to integrate users into the development environment. Some of the strategies recommended include selection of a user as the project manager, creation of a user steering committee, frequent and in-depth meetings of this committee, a user-managed change control process, training of the user, frequency and detail of distribution of the minutes of the project meeting to key users, selection of users as team members, formal user specification approval process, progress reports prepared for corporate steering committee, giving users the responsibility for the installation of the system and letting users manage decisions on key action dates. Another measure is to insist on the mandatory use of the system developed and rely on diffusion and exposure.

6.8. Project Risk Control

Thomas (2008)⁴¹ identified major risk and risk management factors in the Indian context. The findings of the study could be used by practicing managers for better risk management. The models developed in this research can be refined and

improved further by future researchers. The objectives laid down in the beginning of the research could be finally achieved to a high degree of satisfaction. India has become the major destination of software development and there is no dearth of software projects. However, the study on risk, risk management and project outcome with respect to software development projects was not easy. Lack of published material in the Indian context was the first challenge. The study made extensive use of statistical techniques for developing and testing theories. These statistical techniques were explained in details so as to help new researchers to apply these tools in their research. The study demonstrated that risk varied across different categories of projects or organizations.

6.9. Project characteristics

Borade & Khalkar (2013)⁴² presented background information on software project models and software metrics to be used for effort and cost estimation. No model can estimate the cost of software with high degree of accuracy. Estimation is a complex activity that requires knowledge of a number of key attributes. The most critical problem is the lot of data is needed, which is often impossible to get in needed quantities. Software cost estimation is the process of predicting the amount effort required to build a software system. Software cost estimation is continuous activity which can start at the first stage of the software life cycle and continues through the life time. In this study, several existing methods for software project effort, cost estimation are illustrated and their aspects are discussed. Also, it described software metrics used for software project cost estimation.

CONCLUSION

Most research relating to software projects has dwelled on quality criteria only, namely Product Operation factors – Correctness, Reliability, Efficiency, Integrity, Usability; Product revision factors – Maintainability, Flexibility, Testability; Product transition factors – Portability, Reusability, Interoperability. There is scarce research on human factors influencing software projects. It may be recalled that Hawthorne experiments was a crucial period in history that led to the development of organizational behaviour as a new discipline of study. Human resources are the most important component in the service sector. Research has been mostly restricted to studying software quality only. Software quality is only one component of an entire software project. It is not the sole criteria to decide an organization's success story. Therefore a more holistic study is required to examine various inputs that influence software project management. Though there has been independent research on factors influencing software projects, there lacks a holistic study that simultaneously studies the impact of such factors on the project outcome. This research alleviates such a gap by considering various factors simultaneously with the aim of ascertaining their impact.

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