

Information Technology Project Management Via Redesigned Frame And Approach

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Abstract- Professional project management organizations have extensively described best practices such as PMBOK, PRINCE2, CMMI, ITIL, MSF etc. in general project management and there are also many text books [1] [2] based on those extensive guidelines. In this paper, we consider software development type Information Technology (IT) projects in presenting the redesigned frame and approach for their management. Software development produces intangible products and requirements for software products are difficult to capture as well as they are changing faster than expected. This has made software development type IT projects more complicated resulting many failures. Therefore many researches are being conducted to minimize failures in recent past. Frame, model, phases, processes, tasks, activities, etc. are some of key terminology used in project management. We observed in the literature, these terminologies are described in different ways. When it comes to IT project management, these terms must be properly described considering software engineering practices. At the same time, there must be a methodical approach illustrating relationships among frame, model, phases, processes, tasks, activities etc, to minimize the confusion that arises in the practice. As presented in this paper, we observed these proposals have created more confusion among young practitioners to make mistakes when managing or participating in IT projects. There is also a number of proposals in related research publications describing how generally accepted project management practices can be extended with respect to Software engineering practices. At the same time, we observed the project management practices must be integrated with respect to software engineering practices to avoid ad hoc interpretations. Hence, this paper presents IT project management via a redesigned frame and approach for tailored to software development.

Keywords - Information Technology Project, Project Management Practices, Software Engineering Practices, Software Development, Project Frame, Model and Process.

I. INTRODUCTION

A number of software development projects that are conducted by different organizations are rapidly increasing with the proliferation of information technology in the society

to meet the demand of new products and services. Whether it is a big or small organization, the management is very concern to complete such projects within estimated budget and schedule agreed at the beginning of a given project. Information Technology (IT) projects describe not only software development projects. They may also include software maintenance type, feasibility studies with respect to IT products and service development, infrastructure development projects with respect to hardware and networking etc. However, the most complex IT projects are software development type projects. In this paper, we have considered onl management of software development type IT projects in presenting the redesigned frame, and approach. [7] classifies website construction as a separate type of projects but our analysis shows that they are also a kind of the software development type projects.

According to CHAOS reports [10] published in 1994 - 2009 by the Standish Group, we can observe some improvement in managing software projects during last 8 years but it is still remain important issue to be addressed when undertaking softw are development type projects. As given in the Table1 below according to CHAOS reports, the failure rate of IT projects has increased compared to the success rate of such projects. However, the changing environment and complex business structure results agile requirements and increased risks of managing projects. This crisis in the software development is not a new thing and it was identified many years ago when the software engineering was proposed to adopt the methodical and disciplined approach in the software development [11].

Table 1. CHAOS Report Results

MODERN RESOLUTION FOR ALL PROJECTS					
	2011	2012	2013	2014	2015
SUCCESSFUL	29%	27%	31%	28%	29%
CHALLENGED	49%	56%	50%	55%	52%
FAILED	22%	17%	19%	17%	19%

The Modern Resolution (OnTime, OnBudget, with a satisfactory result) of all software projects from FY2011 - 2015 within the new CHAOS database. Please note that for the rest of this report CHAOS Resolution will refer to the Modern Resolution definition not the Traditional Resolution definition.

Compared to other engineering products, software is intangible products and the automation of development of

software projects using tools is limited. Hence, the most of time, failures are blamed due to part of human error with respect to management or technical work undertaken by the relevant members of the project. Hence, to reduce the terrible track records of IT projects, many studies have been conducted specially to enhance IT project management. Specially, the basic definitions related to frame, model, processes, phases, activities are interpreted in an ad hoc manner creating confusion. For example, authors of [5] haven't defined the term "process" properly and have considered related "activities" also as "processes". [6] has mentioned the "project life cycle" as the project "processes" in their proposal. In this paper, we are presenting several such published works that we came across in our survey of related literature. All these publications are proposing many new models, frames, methodologies etc. for the IT project management. However, in our analysis we observed that terminology related to IT project management was misunderstood in many studies since they did not consider both aspects of engineering and management in the software development. Similarly many other works presented in the recent past (more details are given later in the paper) has created more confusion in basic terminology in describing IT project management. Therefore authors in this paper have defined those key terms by considering both management and engineering aspects of software development.

Methodical approach is very important key aspect in both management and engineering disciplines according to code of ethics proposed by the both the Project Management Institute (PMI) [9] and the Software Engineering Institute (SEI) [12]. Once the proper terminology is proposed, it is very important to identify the appropriate approach illustrating from the frame to model, phases, processes, etc, to carry out the both managerial and engineering work. However, it is very hard to find out such a methodical approach in the current research works. For example [2] describes the components, i.e. knowledge areas and tools & techniques of a frame but doesn't give the approach to show the road map to conduct the project work. [7] proposes a certain model to support the implementation of the IT projects, but it doesn't clearly define neither terminology nor approach to proceed in IT projects. Many of the recent publications contain ad hoc interpretations for some project management terms such as model, lifecycle, milestones, task etc. This creates some confusion such as processes vs. phases, model vs. methodology etc. Consequently, it creates many problems for the young project practitioners, when they are managing or participating in IT projects.

The redesigned frame and approach for IT project management presented in this paper clearly defines the

terminology with respect to considering both the software engineering and project management practices. We have extensively study the Project Management Institute (PMI) and other related professional organizations' publications as well as recent research publications to define the terminology, frame and methodical approach.

Rest of the paper is organized as follows. Section 2 describes different guidelines from professional project management organizations. We present our analysis of related research studies published in Journals and Conference Proceedings in Section 3. Our proposed redesigned frame together with its two parent frames are described in detail in Section 4. In the Section 5, we discuss the relevant approach for a given project by extending the proposed frame. Finally we conclude the paper in the Section 6 by summarizing the work presented in the paper.

II. GUIDELINES FROM PROFESSIONAL PM ORGANIZATIONS

Professional project management organizations have extensively published best practices according to their frame of reference, for example PMBOK (Project Management Body Of Knowledge), PRINCE 2 (Projects IN Controlled Environments), CMMI (Capability Maturity Model Integration), MSF (Microsoft Solutions Frame), RUP (Rational Unified Process), ITIL (Information Technology Infrastructure Library). In this section, we present our analysis about these published practices.

PMBOK (Project Management Body of Knowledge) [3]

The PMBOK which is published by the Project Management Institute (PMI), has become a widely practice standard in many industries around the world. Since the PMBOK describes a set of generally accepted practices, the project management (PM) practitioners can use to manage all aspects in any types of projects. The PMBOK defines a project as "a temporary endeavor undertaken to create a unique product or service" [3] and the PM as "the application of knowledge, skills, tools and techniques to project activities to meet project requirements". PMBOK describes nine knowledge areas in the project management in terms of processes that may take place in the actual execution of a project. Each process is further described in terms of its inputs, outputs and tools and techniques. Most of the time, inputs and outputs are documents or documentable artifacts. Tools and techniques are mechanisms applied to the inputs to create the outputs. The 42 processes are organized into five process groups. The PMBOK prescribe the generic lifecycle for any kind of projects. It specifies that the project lifecycle

should be divided into phases. The number of phases varies based on the project scope and the application domain. The PMBOK defines a deliverable as “a tangible, verifiable work product such as a feasibility study, a detail design, or a working prototype. Hence, the PMBOK give the clear definition for some project management terms and describes the required components for the frame, but it doesn’t give the required approach to conduct the information technology project since PMBOK address all types of projects in abstract terms. Tools and techniques described in the PMBOK must be used properly considering the domain knowledge of IT projects to carry out project activities.

PRINCE 2 (Projects IN Controlled Environments) [8]

PRINCE 2 is a kind of de-facto standard used extensively in the United Kingdom. It could be described as a project management method designed to provide a frame covering the wide variety of disciplines and activities required within a project. PRINCE 2 is focused on a business case which describes the rationale and business justification for the project. It is a process -based method and the structure comprises 5 phases and 8 high level processes. In the PRINCE 2, it has mentioned that it can be applied to any size or any type of project. One of the main shortcomings of PRINCE 2 is that it does not cover and provide any support for the project human resource management and project procurement management [4]. Main argument was that those aspects are covered at the organizational level.

PRINCE 2 is general practice and does not focus on software engineering practices. At the same time, sometimes it is hard to interpret the terminology and approach with respect to practices in the software engineering. It presents a frame for the project management, but there is no proper approach to guide the project. When we consider the software development type projects, human resource management and procurement management are very important components in a project management to be consider but PRINCE 2 doesn’t support for them.

ITIL (Information Technology Infrastructure Library) [15]

ITIL is a set of books that describes good practices on how to manage IT services. It presents a frame that describes best practice guidance for IT Service Management. Hence, ITIL frame is focused on an approach towards service lifecycle. The main phases of the service lifecycle are service strategy, service design, service transition, service operation and service improvement.

In some of the project management research works [13], the authors compare the project management works with the service management works in ITIL. However, the main purpose of the ITIL frame is different and it addresses how IT organizations as a whole should be operated. Project management addresses how individual projects within the organization should be executed.

CMMI (Capability Maturity Model Integration) [14]

CMMI was developed by a group of experts from industry, government, and the Software Engineering Institute (SEI) at Carnegie Mellon University. CMMI addresses project management of engineering endeavors and addresses a larger organization composed of engineering projects. It provides a process improvement approach that provides guidance for developing or improving processes that meet the business goals of an organization. Hence, it helps organizations to improve their performance. CMMI structure consists of Maturity Levels, Process Areas, Goals and Practices. A CMMI model may also be used as a frame for appraising the process maturity of the organization.

However, CMMI main focus towards developing the organization culture to manage software projects uniformly across the organization. At the same time, it is complex for small scale projects or small medium enterprises (SME) to adopt these practices at very beginning to manage projects.

RUP (Rational Unified Process) [16]

RUP is a software engineering process that describes who does what, when and how in a software development and deployment project published by the Rational Software Cooperation (acquired by the IBM later). It has the characteristics of being use -case driven, architecture-centric, risk-driven and iterative approach. Throughout a project guided by RUP, functional requirements expressed in the form of use cases drive the realization of the application’s executable architecture. In addition, the process focuses team effort on building the important behavioral and structural elements of the application (the architectural elements) before building the less important elements. Mitigation of the most important risk elements drives the scope definition of the early iterations of its lifecycle. And finally, RUP partitions the software development lifecycle into iterations that produce incremental versions of the executable application.

RUP implements the best practices within a two -dimensional process. One dimension describes “disciplines” and other one describes “phases” within the lifecycle of the process. Within RUP, each discipline is expressed in terms of

roles (who performs which tasks), activities (how they perform these tasks), and artifacts (what the activity achieves). The RUP lifecycle is iterative and its lifecycle dimension is divided into four phases known as, Inception, Elaboration, Construction and Transition.

RUP can be directly applied to the software development type projects, but it doesn't support some important areas in project management such as Human Resource Management, Cost Management and Project Procurement Management. Simply, RUP is a software development model based on the object oriented approach rather than a frame to manage software development projects.

MSF (Microsoft Solution Frame) [17]

MSF published by the Microsoft Cooperation provides a flexible and scalable frame to meet the needs of the software organization or project team. MSF guidance consists of principles, models, and disciplines for managing the people, process, and technology elements that most projects encounter. Hence, the MSF process model has been designed to support the processes in the software development lifecycle. MSF team model is to manage the human resources in a project.

The MSF process model describes a high-level sequence of activities for building and deploying IT solutions. Rather than prescribing a specific series of procedures, it is flexible enough to accommodate a broad range of IT projects. It combines two software development models: the waterfall and the spiral. An innovative aspect of this new version of the MSF model is that it covers the life cycle of a solution. The phases of the life cycle are envisioning phase, planning phase, developing phase, stabilizing phase and deploying phase. MSF is a milestone-driven process. Milestones are points in the project when important deliverables have to be completed and/or reviewed.

MSF frame has been designed a collection of models to support the people, process and technology categories. Those models have been designed and developed as separate projects. However, when managing a project, all categories have to be considered together. In that case, the integration management is very important to coordinate all project activities. But, MSF frame has not given enough emphasis on the integration management.

III. RELATED PUBLICATIONS AND RESEARCH WORK

There are many text books that describe extensive guidelines for the IT project management. It can be found also a number of interesting proposals in related research publications describing how generally accepted project management practices can be extended with respect to Software development practices.

The text book [2] which is written by the Cathy Schewalbe is the only one book to apply all nine project management knowledge areas (i.e. project integration, scope, time, cost, quality, human resource, communications, risk, and procurement management) and all five process groups (i.e. initiating, planning, executing, monitoring and controlling, and closing) to information technology projects. This text builds on the PMBOK Guide and American National Standard to provide a solid frame and context for managing information technology projects. That frame is called Project management frame, consists of 9 knowledge areas and tools and techniques. It has described about the 5 process groups and their mapping with the 9 knowledge areas. This book describes all nine knowledge areas of PM in detail allocating separate chapters for each knowledge area.

This is the very good resource to learn about the concepts, principles, tools, techniques etc. of the project management. However, when we are going to conduct a project, it doesn't explain about how to implement the project and how to use those tools and techniques for the implementation. It is clear that, it doesn't give the approach to conduct the project.

The book [1] (Jack T. Marchewka), describes a generic Information Technology Project Methodology (ITPM), which attempts to bridge the questions: How do I get started?, What do I do next?, How do we know when we're finished? This methodology provides a structure for understanding how projects are initiated, conceptualized, planned, carried out, terminated and evaluated. This methodology will take you through the different phases of the project life cycle and introduce the concepts and tools that are appropriate for each specific phase or stage of the project. The text provides an integrated approach to IT project management. It incorporates the nine areas outlined in the Project Management Institute's Project Management Body of Knowledge (PMBOK). The concepts associated with information systems management and software engineering, when integrated with PMBOK provide an important base of knowledge that builds a foundation for IT project management. This integration helps to distinguish IT projects from other types of projects such as construction or engineering.

This text book provides good concept to the IT project management. In their proposed methodology (ITPM), it has been illustrated the IT Project Management Foundation (i.e. processes, tools, infrastructure, PMBOK areas etc.) below that. But it is not clear that how it is situated. At the same time, it also does not describe properly the relationship between the PM processes and PM phases and only shows 5 processes as components within a certain phase. We believe it would be much better if these processes could be described within each phases.

[7] proposes a model called “Developmental Management Model” for the software type IT projects. It classifies website construction as a separate type of IT projects but we understood such type of projects can be easily included as a software development type IT projects. In this work, they have presented the mapping between the project work and development activities. However, in the proposed model, they used the terms model, life cycle, task, milestones etc., but they didn’t define properly these terminology in their presentation. Hence, it is hard to understand the proposed model because of misusing the key terms to illustrate the model. For example they have used the term “milestones” for the main work of IT project. It is described about the different categories of the “developmental management model” such as “self - developmental management model”, “commissioned-developmental management model”, cooperative developmental management model”, etc. But it is not clear how to integrate those all models together.

[18] proposes a software agent to improve the software project management and also Software Agent Frame to support the distributed Software Project Management. This looks very interesting theoretical paper, but practically it is far from reality due to complications and difficulty of tasks undertaken in a project. Especially in the software development type IT projects, environmental changes and the complexity of the software projects are the main reasons for the failures of the projects. Using agent technology, it will be very difficult task to capture such kind of factors. In this paper, they have illustrated the generic project management frame (presented in the Cathy Schewalbe’s textbook [2]) as the software project management frame. In order to support the software project management, it should be focused on the project management practices as well as software engineering practices.

[5]proposes PM methodology with customizing existing methodologies and knowledge areas. In this paper, fifteen (15) parameters have been identified to select the methodology and processes. Based on the values of different parameters, a certain set of processes would then be selected

that best satisfy the needs of the project. Then it has listed the selected processes for each knowledge areas (described in the PMBOK). This is also an interesting research work.

However, in practically assigning the values for the parameters are very difficult since those values are not constant for a whole life of the project. For example the parameter “Nature of the project” addresses the complex ity of the problem domain and criticality of the project. It is very hard to specify the boundaries/ limitations to assign the values such as non-critical, average or critical. At the same time, in this paper, it is not clearly defined the terms such as methodology, process, activity etc. Therefore in the set of processes, we can identify some simple activities too (For example write features).

[6]presents an approach called Balanced Approach to manage the IT Project. After identifying the Balanced Scorecard as a possible methodology, the research then develops a management model based on the Project Management Body of Knowledge (PMBOK). This is also a very interesting work. However, it has not clearly defined the terms and used them in ad hoc manner (for ex: people processes, project processes, life cycle etc.). However, when we look at their illustration of the “Balanced Approach”, it is difficult to understand the difference between the project phases and the project processes and how the project processes exist in the project phases.

[13] proposes a Comparative Approach for the Software Project Management. For this, they have compared the five important project management methodologies/frames (i.e. PRINCE2, RUP, MSF, ITIL & Agile Method) with PMBOK, which is a growing and established project management methodology. Then they proposed a generic software project management model to use with any project management methodology and any project management frame. However, it doesn’t clearly define the terms “Frame”, “Methodology”& “Model”. Therefore the model proposed in the paper is difficult to understand as well as there are no good description how the model could be used to combine any frame or methodology as described in the paper. The illustration of the “Proposed Generic Software Project Management Model” [13], shows the two planning components in their model without any clear explanation. Many suggested approaches contradict in this paper with the proposed generic software project management model.

[22] proposes an Object-Oriented Formal Model for managing the Software Projects. The model and the description of this paper are very complicated and very confusing. The detailed descriptions given in the paper are not

based on the practical reality of the software development projects. It is very hard to apply, this type of highly theoretical model for managing software development projects.

[19] text book describes the agile project management approach for creating innovative products. [20] proposes a Heavy Weight IT Project Management Frame based on Agile Theory in order to improve the Traditional IT Project Management method. [21] also proposes Agile Project Management Frame for the product design project management by using some knowledge transferred from the branch of software engineering.

Agile Project Management is a kind of novel approach focused towards agile software development which is an iterative method of determining requirements for software and for delivering projects in a highly flexible and interactive manner. It requires empowered and dedicated individuals from the relevant business, with supplier and customer input. Agile techniques are best used in small -scale or medium size. Agile, has its own disadvantages. Many believe that agile approach doesn't scale well, hence large software projects are still being conducted in Waterfall. Additionally, since the strength and usefulness of agile are both exhibited in projects with frequent changes, it does not offer any advantage over Waterfall when it comes to classical projects where requirements can be properly identified using structured methods.

In our analysis of related research work as well as our investigation of practices in IT Project Management, we would like to summarize our findings as follows.

- PMBOK is the most widely used guide and practice among IT project management professionals irrespective of CMMI Knowledge areas, process groups defined in PMBOK are important components used in describing activities in IT projects.
- Many organizations still follow the traditional project management methods rather than the agile approach. However, many project managers prefer to adopt some agile practices in the traditional management process.
- Many proposals to project management have suggested cost management, human resource, procurement management should be considered at the organization level and it should not be part of projects. However, due to complexity and nature of some projects, in some cases, those management activities have to be modified or to be addressed at the project level to complete the project successfully. Hence, we believe, there must be a provision

if it is necessary to address cost management, HR management and procurement management too at the project level depending on the case.

- Product and Project are two different things but they must be coordinated properly to achieve pre-defined objectives under both Product Life Cycle and Project Life Cycle. Generally, Product life cycle could be larger compared that of project life cycle. In some cases, there could be several projects within the single product life cycle. For example, development and maintenance of a particular software product could be considered as two separate projects.
- When reviewing the current researches, the most of the proposals for software development type IT project management are based on a specific software development models for example, RUP, OOM, Agile etc. However, selecting and applying a software model is an operational decision but the frame and approach should be unique irrespective of this decision.
- Many confusion have occurred since the terminology was not defined clearly, for example, the frame is described as a model and the model is described as a methodology.
- Both management and engineering practices highlight the methodical approach in carrying out a complex task. It must be presented in a very simple way allowing novice users to understand practices in IT project management. Rather than presenting a complex picture of IT project management, it is very important to clear the confusion by properly defining the terminology as well as guiding them through a methodical approach. Unfortunately, many published work in this area lacks this requirement and some work have added more complexity than making it simpler to understand.

Our main emphasis in this paper is to present a redesigned frame and approach for managing the IT projects. Since we are considering the software development type IT projects, this frame and the approach are designed focusing on management practices and software engineering practices. In order to reduce the confusion of the terminology, first we give the proper definitions for the key terms for the IT project management with referring PMBOK, SWEBOK, some Software Engineering text books and other important dictionaries.

IV. PROPOSED REDESIGNED FRAME

When we refer many previous work carried out, we observed terminology and interpretation of key terms in IT project management are different from one work to another work. This was affecting very badly when research works are described and also creates confusion among new readers in this field. In order to redesign the frame and approach properly, therefore, we have defined key terms after carefully analyzing exiting literature as given below.

Terminology

- Project - A project is a temporary endeavor undertaken to create a unique product or service [3].
- Project Management - Project Management is the application of knowledge, skills, tools and techniques to carry out project activities according to project requirements [3].
- Frame - A basic conceptual structure as of ideas.
- Approach - Ideas or actions intended to deal with a problem or situation in order to find the solution or improved situation. (e.g. Procedural approach , Object-oriented approach)
- Methodology - A set of selected methods to achieve a particular objective.
- Architecture – A designed structure for a system (e.g. Client-Server Architecture)
- Model - A model is a representation of a given thing in abstract terms with respect to the specific context. (e.g. waterfall model, and given thing: software development phases)
- Process - A set of logically related tasks to produce a defined output.
- Task - A set of logically related activities (A piece of work) assigned to an individual or a group.
- Activity - An activity is a set of logically related actions done by an individual or a group. For example, writing a report (a set of actions may be reading relevant documents, Analyzing collected factors, Summarizing findings and Writing the report to present findings).
- Action - An action is a single, atomic thing that can be done by an individual or a group. (e.g. Reading a relevant document).

In this paper, our scope covers only the software development type IT projects, and the proposed frame for IT project management is based on the generic project management frame and the generic software development frame, which we proposed based on the exiting literature and practices . The Subsection 4.1 describes the generic frame for project management in general and subsection 4.2 presents the details of the generic frame of software development. We hope these details will make the terminology more clear to present the redesigned frame and approach for IT project management.

Generic Frame for Project Management

A project is a temporary endeavor undertaken to create a unique product, service or result [3]. This temporary nature of projects indicates a definite beginning and end. The end is reached when the project's objectives have been achieved successfully or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists.

A project life cycle is a collection of generally sequential and sometimes overlapping project phases. The name and the number of phases are determined by the management based on the needs of the organization involved in the project, the nature of the project itself, and its area of application. While every project has a definite start and a definite end, the specific deliverables and activities that take place in between will vary widely with respect to product/service to be produced and external factors (or cultural factors) in a project [3]. Generally, projects vary in size and complexity. No matter how large or small, simple or complex, all projects can be mapped to the generic life cycle structure. There are four phases in the generic project life cycle such as project starting, project planning, project executing and closing. According to our analysis, if something cannot be mapped to those four phases, it may not be a project.

Project phases are divisions within a project where extra control is needed to effectively manage the completion of a major deliverable. That extra control is considered as project management. Project Management is defined as the application of knowledge, skills, tools and techniques to project activities to meet the project requirements [3].

According to the terminology described in the previous section, a frame is illustrated as the basic conceptual structure of the project management based on the definition of the project management. This frame is called the generic project management frame as shown in the Figure 1.

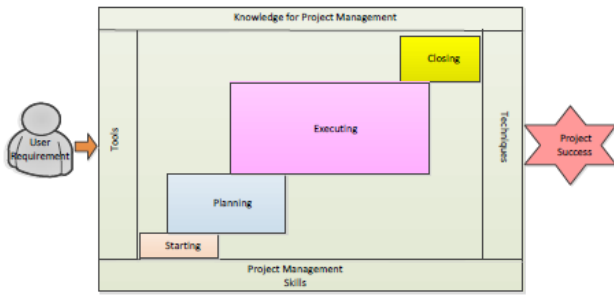


Figure 1: Generic Project Management Framework

In this generic frame, main components are project phases, knowledge for project management, project management skills, project management tools and techniques. The project phases includes project starting, planning, executing and closing and all these phases are defined according PMBOK guidelines [3] and they are the core components of the basic structure of the project management frame.

Project management knowledge and skills are very important components to conduct the project activities with applying suitable tools and techniques successfully. Hence, these four components are inter related each other to conduct activities identified each phase of a project. According to PMBOK [3], there are nine important knowledge areas namely, integration management, scope management, time management, cost management, quality management, human resource management, communication management, risk management and procurement management. Skills are identified and mapped based on the knowledge areas in the frame and it describes the practical application of knowledge to conduct the project activities and they also could be classified with respect to knowledge area. For example, the human resource management (a knowledge area) describes the leadership skills that are required to guide and motivate the project team to conduct the project activities in all phases. Responsibility Assignment Matrix (RAM) is a kind of tool that could be used to guide the team members and the tools component in the frame describes all such tools including the software tool and relevant document templates required to conduct activities. Some important tools include scope statements, work breakdown structures, Gantt charts, kick-off meetings, lesson-learned reports, progress reports, etc. Technique depends on the best practices, and the organizational culture. For the above example, RAM could be prepared by using description given in the WBS (Work Breakdown Structure) and OBS (Organization Breakdown Structure) as a technique. Knowledge and skills of relevant project team members are very important to prepare this tool at the planning phase using correct techniques. Hence, by analyzing all possible project activities, we identify

knowledge, skills, tools and techniques are identified to conduct them in the generic project management frame.

Generic Frame for Software Development

When you build a software product or system which is intangible thing, it’s important to go through a series of predictable steps that helps you create a timely and good quality product. This set of steps is known as the “software development life cycle”. It consists of a set of phases and how each phase is linked to produce an iterative process. Generic software development frame presents these generic phases together with basic components of knowledge, skills, tools and techniques that require to carry out activities defined in the phases. According to practices and guidelines given in the SWEBOK [23], [11] and [12], we identify four phases as the core components, namely requirement analysis, software designing, implementation, testing and deployment. These phases as the core component give the foundation for the generic frame for the software development as shown in the Figure 2.

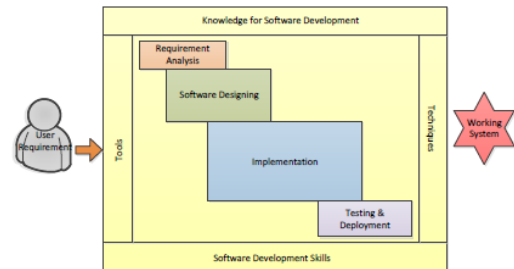


Figure 2: Generic Framework for Software Development

SWEBOK describes 10 knowledge areas considering the full product life cycle. Since the product life cycle is larger than the project life cycle, we consider only the knowledge areas that would require for the software development. Hence, the relevant knowledge areas are requirement engineering, software design and modeling, software construction management, testing and quality assurance. Similar to the generic frame of the project management, the skills areas for the software development is identified with respect to corresponding knowledge areas in the frame. These skills most of the time describes how the knowledge can be applied to carry out activities based on the general practices, past experience and organizational culture. For example , requirement engineering knowledge area describes different methods that can be used to identify the list of requirements. For example, interviewing, observation, questionnaires, brainstorm sessions, etc. The selection of appropriate method is a kind of skill of relevant persons who carry out the requirement gathering, and it depends on the past experience of users as well as general practices.

Tools and techniques are facilitating components to apply the knowledge and skills to carry out the project activities successfully. Hence, they are identified by considering all possible general project activities in the project. CASE tools, programming tools/IDE (integrated development environment), prototyping tools, testing tools and document templates are some of common tools that we can identify in the tools component. Techniques include different guidelines to apply those tools as well as techniques that define a specific set of tools for example, object oriented techniques, structured techniques, etc. For example, requirement gathering can be carried out using object-oriented techniques in which analyst identify objects and classes considering the real world entities. Object-oriented case tool such as Rational Rose could be used as a tool to record these gathered requirements to identify functional and non-functional requirements. Its success depends on the knowledge and skills of relevant individuals who carry out these activities.

The software development frame is higher in abstraction with respect to different software development models described in the software engineering. Frame describes all sets of different models by identify common things and using the abstraction as a technique. Traditional software development models propose a discipline approach with respect to phases and work carried out in developing software. For example, the design must be completed before completing the implementation. Documentation is also very important when completing a particular phase in the development lifecycle. Hence, these traditional models, such as waterfall, spiral, etc, are known as heavyweight models. In the modern software development, agile methods [19] are proposed as lightweight models to develop the flexible software development lifecycle. Development phases could overlap significantly, no restrictions on the begin and end, and the reserve order of task carried out. However, the generic software development frame proposed in this paper, supports both traditional models as well as agile models. In the figure 2, we have shown sequential arrangement of phases with some overlap considering traditional development lifecycle but there is no restriction with respect to begin, end and positioning of phases in this generic frame.

Redesigned Frame for IT Project Management

To carry out a software development type IT projects successfully, it is very important to integrate both the project management and software engineering practices described in previous two sections. It is hard to mention that success is purely due to one aspect of management or engineering. We have observed the success was based on the

proper integration of both the software development and project management. (Project is not a product but the project produces the product). Therefore, we integrate both generic project management frame and generic software development frame as the first step to integrate both practices to carry out activities productively and efficiently as required to achieve the project success. Figure 3 shows the generic IT project management frame that was resulted due to integration of those two frames.

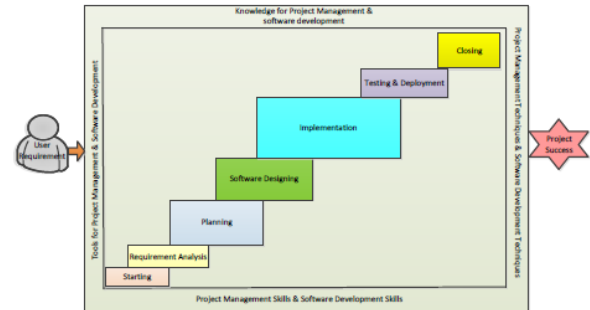


Figure 3: Generic Framework for IT Project Management

When we integrate phases in the generic project management and software development frames, seven new phases are identified between the beginning and end of the project. These phases are overlapped one after another with respect to time and activities conducted during the phases to create a methodical step by step approach to complete the project tasks successfully. Phases are identified with respect to tasks to be completed and they are not one to one mapping with respect to phases in the two parent frames of project management and software development. For example, starting phase consists of both managerial and development activities. Some intermediate outcomes of requirement analysis are required to complete the starting phase and that's why they overlap each other. Outcome of one phase could be an input to next phase in this incremental development of the software product. When the next immediate phase has already started, it provides the immediate feedback before completing the current phase. At the same time, an activity that is carried out in one phase could be extended in the next phase once it reaches a particular milestone. Hence, this overlap creates a strong relationship among phases in the IT project management frame with respect to both managerial and engineering activities carried out.

In the generic frame, only seven phases are shown as the primary phases in the project. However, in a real project, number of phases as well as overlapping period could vary and it depends on how the project complexity, development model and organization practices. In fact, it is a generic frame of IT project management is a kind of guideline for the project team to plan and carry out the project activities.

The knowledge area for IT Project Management frame consists of both managerial and software development knowledge identified in the parent frames and they are regrouped based on the seven new phases defined in this proposed frame. For example, activities such as identifying functional and non-functional requirements as well as the scope management will be carried out in the requirement analysis stage. Required knowledge is derived from the knowledge component of both parent frames. Tools component consists of all possible tools required to carry out these activities but relevant individual selects what is good enough based on their skills and selected techniques. For example, when the project activities are carried out by the team members, initial use case diagrams could be developed using Rational Rose software tool at the same time initial work breakdown structure could be developed using Microsoft project. Although these two tools are not integrated, the common numbering and naming convention helps the project team to manage the scope changes very easily.

This frame is the initial foundation that integrates both project management and software engineering practices to carry out the software development type IT project. To make things easy to understand, the level of abstraction is very high in the frame. However, to conduct a project, more specific details are required as an overall project plan to guide the project team. In the next section, we propose a suitable approach to extend this frame to identify the overall project plan to carry out the IT Projects.

V. A PROPOSED APPROACH TO CONDUCT THE IT PROJECTS

An approach is a detail strategy to identify the overall project plan to carry out a project. In other words, it describes the road map to follow to expand abstract things defined or described in the components and phases of the frame to identify details together with the domain knowledge. Figure 4 illustrates the approach proposed in this paper to expand the proposed IT project management frame.

In software engineering, the software development models are playing a crucial role to identify the overall project plan to carry out software development activities. A software model identifies a set of processes in abstract terms. Waterfall model is the well known and was the first model proposed to create a discipline in software engineering [24]. However, later many weaknesses identified with respect to waterfall model, especially when requirements have to change before completing the development, or when it is hard/difficult to identify relevant set of requirements. Several other models were proposed thereafter considering different techniques that

can be followed in software development. However, the selection of the software development model is based on the project details of a given project such as project requirements, complexity and other parameters. For example, for a large project when requirements could be identified using data gathering and analyzing techniques, waterfall model is usually selected. Hence, in this approach, the first stage is to expand the IT Project management frame using the selected software development model to identify set of suitable processes.

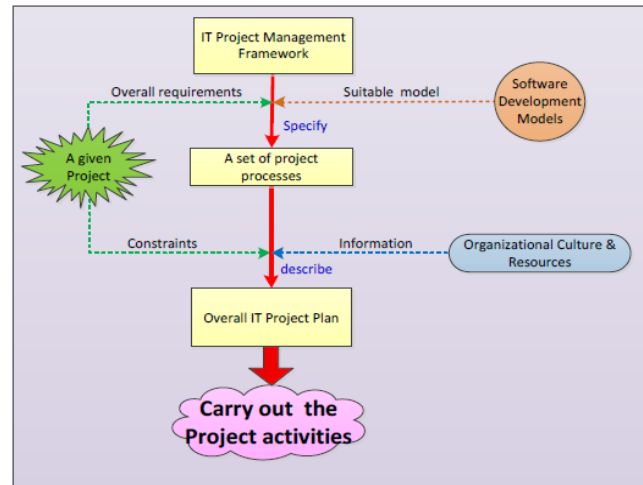


Figure 4: An Approach to Conduct the IT Projects

A phase in a project, can be described as a set of abstract processes that may be carried out in a methodical way to produce different work products required to achieve the milestone at the end of the phase. A work product is a managerial or software engineering requirement and it could be intermediate output that could be input to other processes. Depending on the model selected, how the relationship could exist among processes can be described. For example, when the waterfall model is selected, the process organization is completely different from when the RAD (Rapid Application Development) model is selected.

The process organization is further expanded using the organization culture, available resources and project constraints to derive the overall project plan. In other words, the project overall plan describes how the project activities are ordered based on the selected software development model.

VI. CONCLUSION

This paper presents a redesigned frame and approach for managing the IT projects. We have considered only the software development type IT projects, since they are the most difficult to manage with the changing project requirements.

Terminology which defines the key terms is very important glossary to clearly define and describe anything

with minimum misunderstandings among all participants. In this paper, we have given various examples where confusion has aroused in the domain of IT project management. After analyzing several well known text books of project management and software engineering together with PMI latest publication, PMBOK and the latest version of SWEBOK, we have defined the basic terminology clearly in this paper.

The debates of who plays the most important role, managers or engineers, is an unending dialog that sometimes affect badly for the relationship between these two parties. We believe that both parties contribute significantly, where one cannot win without others. Proposed IT project management frame respects both managerial and software engineering practices together in the phases by complementing each other. To identify this IT project management frame, two parent frames with respect to general project management and software development are described based on the existing literature in these fields. This IT project management frame describes the conceptual structure of a project from the beginning to end. Both management processes and development processes are grouped to define the phases in this frame. Hence, it is a generic description without much reference to context. Knowledge, skills, tools and techniques are components which define the dimensions to carry out relevant activities.

Overall project requirements together with the selected software development model helps to extend the IT project management frame to identify the relevant processes of a given project. In the approach, we showed these processes could be extended to identify the overall project plan using affected project constraints and organizational culture / resources available for the project. This overall project plan is the foundation to make several management and development decisions. Thereafter this overall plan could be extended to develop the detail plan to carry out the project activities.

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