Dr. Praseet Poduval, PhD

Project Management in Healthcare R&D

Identification of Factors Influencing the Process

PREFACE

"If I were a ship, I'd rather discover the seas rather than dock safely in the harbour".

Knowledge and skills in management is increasingly considered to be indispensable in the contemporary environment. Moreover, one can realise that these skills are not only valuable at one's work place but can also come in handy in managing one's day-to-day life. Systematic learning of management was my dream since 2002, a dream that began to realise in 2010, thanks to the decision makers who evaluated the entrance examination results at my host university.

The management courses were designed to be really interesting evidently by the efforts from our instructors, especially Dr Marjatta Huhta and Dr Thomas Rohweder.

The challenges I faced during this degree program made me realise my strengths and weaknesses. Full-time demanding work and a demanding degree program required special effort and effective personal time management. I am satisfied that I was able to cruise through this challenging journey and submit all my assignments on time. This wouldn't have been possible without the understanding and ready-to-help minded instructors.

I shall always be indebted to Dr Marjatta Huhta, who apart from being a kind person also showed a lot of patience in guiding my Thesis work. Special thanks go to Dr Thomas Rohweder for helping me bring clarity to my thesis.

I am also grateful to Zinaida Merezhinskaya for her experienced input in developing the language and structure of my Thesis. My deep appreciation also goes to my colleagues who eventually became my good friends and my hat's off for their contribution in making this degree program a pleasant learning experience.

This Thesis wouldn't be possible without the patience and understanding from my wife. She kindheartedly forgave me for not being able to be of help at home during our life-transforming journey of becoming parents. Last but not the least, my special appreciation goes to my parents and sister's family who shall always be in my mind.

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Dr. Praseet Poduval

Abstract

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This study seeks to find out relevant factors that can influence an R&D project functioning in the field of healthcare R&D. Among the factors that can influence the success of a project are: clear goals and objectives, better communication within the team, high work satisfaction, frequent progress reports, free sharing of ideas and information, and maintaining focus throughout the project process.

The data for this study were collected through a questionnaire survey conducted in R&D teams and additionally through interviews. The findings revealed that there were several factors that showed low as well as high level of agreement. The factors that showed low level of agreement included clarity of the project goals, sufficiency of communication, initial agreement of appreciation and reward, free sharing of ideas and information, preparation of a contingency plan, and low work satisfaction. Similarly, the factors that showed a high level of agreement comprised of: clarity with respect to immediate objectives, frequent reporting of progress in group meetings, frequent project meetings, and satisfactory level of management support.

This Thesis also analysed and described the issues that influence the project and management of a team. The issues include clarity of goals, roles and responsibilities of individuals in a project team, availability of a proper structure of the project processes and communication. Overall, the survey revealed that most of the investigated projects lacked a proper structure and many respondents felt that this lack caused inept productivity and inefficiency.

This study also suggests a number of managerial implications that can be used for running a project, based on the results of the surveyed R&D teams. Therefore, it was important for this Thesis to provide a framework that will help project managers, as well as team members, to better understand various processes in R&D project management and how these processes can be separated from one another. Such separation helps in precise resource allotment, scheduling and identifying bottlenecks in the project processes. The proposed framework also shows the relation between the processes and the paths that must be taken in order to carry out the project effectively.

Key words	Project management, team management, R&D, healthcare

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1   Introduction

A project in business or technology is usually defined as a collaborative enterprise, frequently involving research or design, which is carefully planned to achieve a particular aim. In simple terms, a project is an undertaking or a venture to accomplish some objective or goal. It inevitably involves a set of interrelated tasks, the accomplishment of which leads to the completion of the project.

Projects can be of a global level, national level, organizational level, local neighbourhood level or even a personal level. In relation to healthcare projects, examples for these project levels are: the human genome project (Collins et al. 2003: 286) or a vaccination to eradicate small pox undertaken by WHO (global); health care education to rural women (national); R&D project for a biopharmaceutical firm (organisational); organizing street cleanliness (local); dietary regulation to improve one's health performance (personal), respectively.

Thus, projects are made up of a collection of tasks, and it is the management of this portfolio of tasks that is significant in determining the overall success of the project. Another notable feature of the project is that a project is generally non-repetitive and constitutes a one-time effort. It can be said that projects are never exactly the same; therefore, no project can be managed exactly in the same fashion. Each project can be said to have its unique array of challenges to overcome. To address these challenges, project management provides a set of tools to be able to manage projects better (Kanda 2011: 28).

1.1. Background of Project Management in Health Care R&D

According to the industry classification benchmark (ICB), developed by Dow Jones and FTSE, the healthcare sector encompasses a range of fields, such as pharmaceuticals, biotechnology and life sciences. R&D projects in these fields share a high degree of similarity compared to other projects from some other fields.

R&D projects quite typically share the same managerial and team management issues, encompassing characteristics such as clarity of goals; delegation of roles and

responsibilities; requirement of a proper structure or a model serving as a backbone of the project process; work commitments, and ethics. But the individuals, who form the team, and the leadership style, which directs the project to success and mutual understanding and respect within the team members, may differ.

Although it is obvious that an in-depth knowledge of the field and a broad level of skills are a unique requirement for R&D projects, collaborations between several teams within and from the outside of the organisation can also be an important determinant of a failure or a success of the project. In addition, an efficient utilization of the available resources needs careful and detailed planning from the very beginning of the project implementation.

Like in any other area, the size of a scientific R&D team can range from a minimum of two to any number of members, though a larger team means many individuals and, therefore, larger managerial concerns. Hence, most experts in the field of project management recommend keeping a project team as small as possible.

Typically, in an academic R&D project, the final goal and outcome of the project are the published results in a peer reviewed journal, with an impact factor as high as possible; unless the project was from a private company that may not want its results to be made public.

In addition, projects that are related to R&D quite often require significant investments, yet the financial returns are often difficult to predict because of the significant technological and commercial uncertainty (Wouters et al. 2011: 39). The funding comes from the funding authorities, such as those of private or government sector. The main purpose of investing money in health R&D projects is to increase scientific understanding and, in the long term, to improve health of the people.

However, to translate efficiently the research findings into health benefits, the project requires reliable and usable data and a meticulously communicated research. Research articles published in peer reviewed journals provide scientific findings and evidence that can further be used either for direct clinical application or as a benchmark for

further scientific study. Eventually, without the published articles, research findings would be oblivious to the outside world.

However, not all research activities seem to be reliable due to a growing evidence of widespread deficiencies in the reporting of health research studies; and one of the reasons for this is the lack of transparency (Simera et al. 2009: 132, Simera et al. 2010: 35). The project teams in scientific R&D are similar to any other teams from any other projects. Among other problems, the levels and diversity of skills and motivation may significantly differ from individual to individual.

1.2   Research Problem

In healthcare R&D projects, the situation currently seems to call for a critical analysis of the factors that influence the successful completion of a scientific R&D project. Inefficiency and lack of collective work are among the major factors that cause project delays and overspending.

It especially concerns the scientific R&D projects that are carried out in academic institutions, where there seems to be a shortage of a proper work structure and an effective framework for effective R&D process. Quite often, project teams find themselves plagued by the lack of resources, poor communication, ineffective team management, or lack of collective effort.

1.3   Reseach Objective

This Thesis attempts to study some of the factors that can influence the functioning of a typical academic healthcare R&D project. These factors include: the clarity of goals and objectives, communication within the team, a proper contingency plan, progress reporting, and appreciation and rewarding, which target to increase motivation and project focus. In addition, this Thesis aims at providing a set of recommendations based on the findings from this study, and will also attempt to suggest a framework for the functioning scientific R&D project process.

The study aims at helping to identify and increase the understanding of the factors, within the project processes and the project team, that act as a driving force of the project. In parallel, this Thesis also attempts to come up with a prototype of an R&D process in academia that can be utilised by R&D team leaders, who can then modify it to fit their specific situations.

1.4   Research Design

The initial step in the research is to define the research question and explore the theoretical basis in the field of project and team management. The second step is to collect the research data by sending out questionnaires and interviewing respondents. The data thus obtained are compared with the theoretical platform that was framed by the literature review. The Likert's scale is used to measure the levels of agreement in the collected questionnaires. The results are pooled and analysed using elements of statistical analysis methods. The research design is shown in Figure 1.
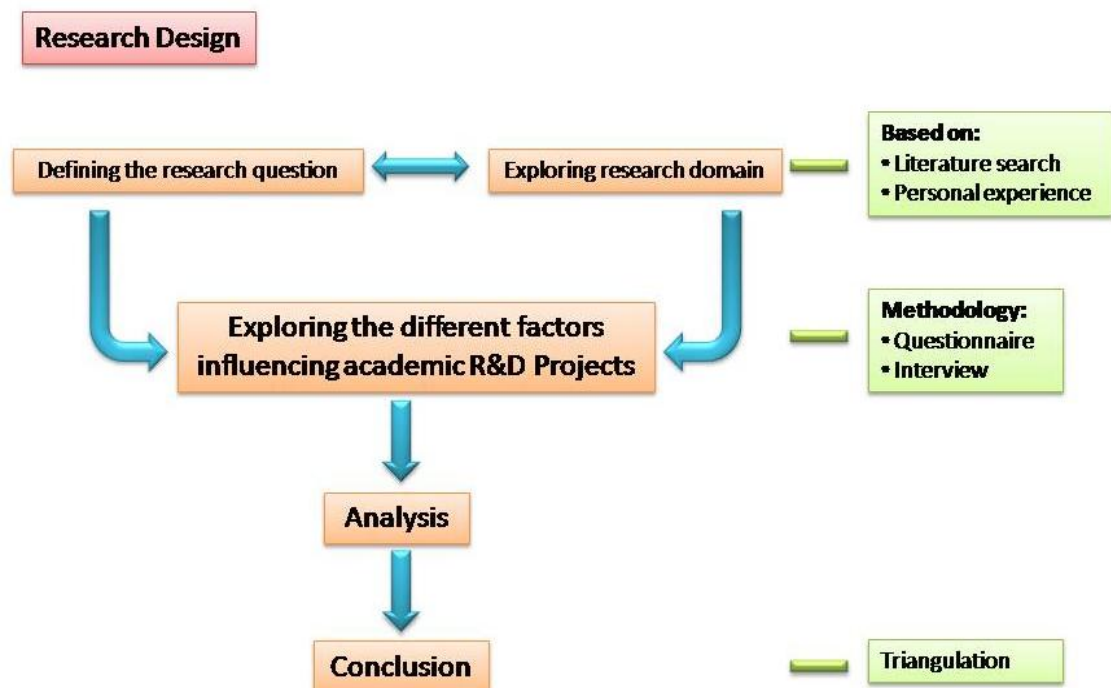
Figure 1.   Research design

The research design, detailed above, shows the steps taken to resolve the research question in this study. The research question is formulated based on a detailed literature search. Relevant factors are subsequently identified and the questionnaire was prepared. The results obtained from the questionnaires are then further analysed and conclusions were drawn. The triangulation of methods and data sources is applied to increase reliability and validity of the study, comprising the literature review, interviews and questionnaire surveys.

2 Conceptual Framework for R&D Project Management

This section describes the basis behind the selection of the aspects investigated in this study, by reviewing the relevant literature and setting up a theoretical platform for comparing the obtained results. This conceptual framework is set by detailing the lifecycle of a typical healthcare R&D project, to improve the understanding of project management and the project team machinery. Backed by this theoretical knowledge, the practical aspects will later be surveyed in healthcare R&D projects.

2.1 Project Life Cycle

If project can be considered as a venture, project management is a journey that drives the project from the current condition to the desired state. Generally, there are a number of paths that can be chosen to reach the desired state (Figure 1). A good path will ideally maintain the factors, which are necessary during this journey, at the best possible level.

This is, however, mostly an idealistic vision which is rarely free from challenges. The best path to choose varies from project to project and the circumstances associated with it. Therefore, this study needs, first, to explore the deviation from these mainstream paths that are associated with academic healthcare R&D projects.
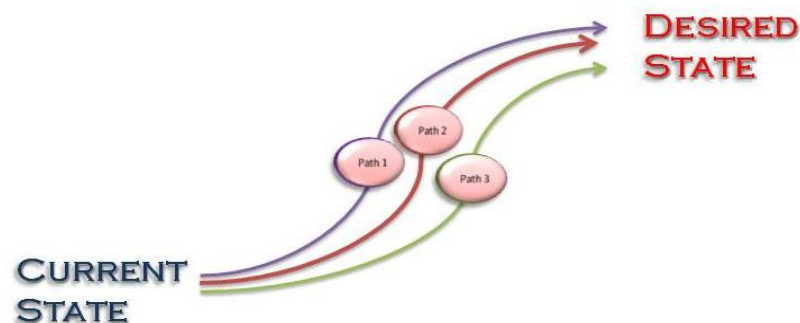

Figure 2.   Possible paths of a project. (Kanda, 2011: 3)

If we continue with this metaphor of a path and a journey which the project has to tread from the current state to the desired state, where the project is expected to be at the end of its life cycle; to achieve this target, the project has to go through a sequence of stages. Similar to other projects, healthcare R&D projects follow a sequence of stages in their life cycle that can often be generalized as: *project initiation, project planning, project implementation* and *project termination stages*.
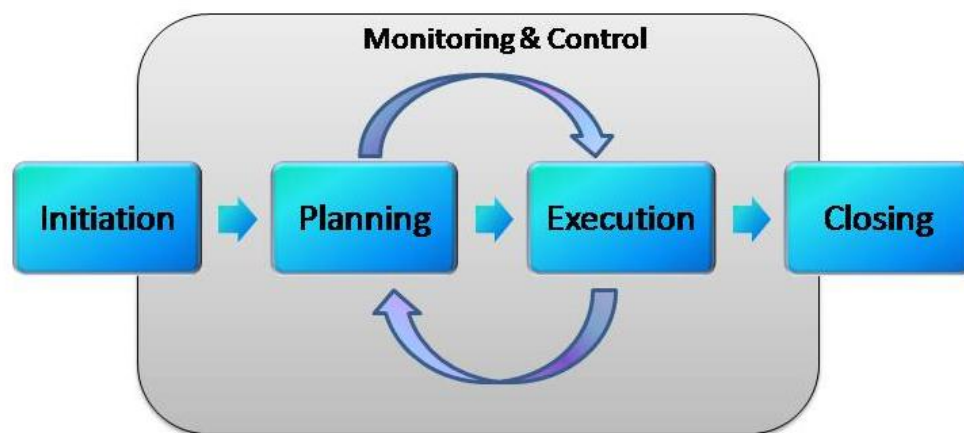

Figure 3. A single phase project: the basic steps in project management.

Project initiation is the first step in the project life cycle, and it can be challenging (Orr 2007: 2). The importance of initial planning activities has been investigated previously in several studies (Khurana et al. 1998: 57). It was discovered that advanced planning in developing R&D projects positively contributes to a number of success factors, which include the reduction of time and failure rates later on, as well as more financial returns and innovation (Moorman et al. 1998: 1).

During the project initiation stage, the project needs to identify itself. The idea for a new project can come from any team or individual in the organization, or even from an end user who knows about a problem with a healthcare product or about certain piece of missing knowledge. Therefore, during the project initiation stage, the organization and the team leader must always be receptive to new ideas, whatever source it may come from; have a vision of future growth; and be clear about the long term

objectives (Senge 2006: 445). A SWOT analysis can be done to help identify the project features and its suitability for an organization.

Furthermore, a part of the project initiation stage is a project selection step. Here, a preliminary project analysis can be done on candidate projects to narrow down those ones that must be investigated in greater detail. A project appraisal can be done at these preliminary stages to assess the scope of the end product, in a structured way. To assess the project's viability, a feasibility report can be prepared, which would consider all the issues of appraisal prior to the project adoption (Kanda 2011: 165).

The second stage of the project life cycle is the *project planning phase*, which is carried out to define the scope of the work and network development. Basic scheduling can be done to keep up with the time and consider its time-cost tradeoffs (Graves 1989: 1). Time cost tradeoffs literally mean the trading of any of the components of time or cost in exchange for the other one; for instance, whether it makes sense to invest more money to save time, and vice versa. Importantly, the project plan also involves evaluating the resources at hand and those that can be obtained during the life of the project (Cohen et al. 1996: 173).

There are several steps that are needed to be considered in project planning. First, an initial step involves forming a project team and choosing a leader. The project team leader is usually chosen by the management, and usually a preferred candidate is an individual who has experience in handling similar projects. Second, defining the scope and terms of project is essential in project planning as it sets goals and a focus for the project. Third, preparing a work breakdown structure for the project under consideration can help in separating tasks by creating manageable "work packages" . Third, basic scheduling of each tasks of the project is done to stay abreast with the time schedule. Fourth, time-cost tradeoffs can be done, if the benefit of completing the project earlier is more than the cost of running it. Fifth, consideration of the resources is yet another important component. For example, lack of resources can result in bottleneck in the smooth running of project processes (Gido 2009: 22).

After the planning stage, the third stage is started, namely the execution or *project implementation* stage. It is in that part of the project that the real action takes place.

For instance, at this stage the experiments are carried out and the results and data are collected. During this stage, maximum expenditure of resources and coordination with the various partners becomes essential. This stage also involves monitoring and control. This is done to ensure that work is progressing as planned, and if deviation from the plan occurs, appropriate measures can be taken to guide the project back on track or change and revise the plan (Lewis 2007: 4).

The fourth stage of the project life cycle is the closing or *termination of the project*. All the documentations related to the project, such as the results or the data, documentation on the deviations or paths taken, solutions during the trouble shooting, resources including the budget allotment, are collected, so that they can be kept as reference for future projects (PMBOK 2008b: 6).

Monitoring and control forms an essential part of the project management and are typically relevant throughout the project phases. These two separate processes go hand in hand: monitoring helps in knowing where one is, while control is a process of taking appropriate corrective measures. If no corrective measures are taken, then the monitoring is performed, but the control system is not done (Lewis 2007: 112).

The PMBOK® is a one of the books of knowledge for members involved in a project in any field. It details the necessary steps and the actions that are necessary to be taken for running a project. Among the factors that can significantly influence the project are those that describes the project management and team management. Both will be discussed in the following subsections.

2.2   Project Management

From the management point of view, a project can be defined as a temporary endeavor undertaken to create a unique product or service. "Temporary" means that every project has a definite beginning and a definite end. The work "unique" signals that the product or service is different in some distinguishing way from all similar products or services (PMBOK 2008b: 5).

Figure 4.   Steps in managing a project (Lewis 2007: 15).

Figure 4 illustrates the basic steps in managing a project. *Define a problem* forms the initial step in project management. It often helps in visualizing the end result. The next step is to *develop a solution* for the defined problem. This may require evaluating and analysing different choices of path that can be taken to guide the project to the desired state. *Planning* is the next stage of the project process. Often, at the end of this stage, answers are given to the questions such as what must be done, by whom, how, when it will be available. Then, the following step in project management is to *execute the plan*. *Monitoring and control* are necessary to be carried out throughout the life cycle of the project. They help in identifying deviations and considering alternatives to get the project back on track or change the baseline of the project goals. The last stage is the termination or *closing of the project*. Here, the key learning moments are reflected upon and documented (Lewis 2007: 16). Overall, these are the stages that all projects have to tackle as they mature through each stage of the process.

The competing constraints in managing a project belong to the scope, quality, schedule, budget, resources and risks (PMBOK 2008b: 6). These factors are mostly

interrelated. For example, when schedule is shortened, the budget might often be higher and more resources may be required to accomplish the same amount of the task in a shorter time. But if the budget is limited, then the scope needs to be shortened or quality has to be compromised.

The essential elements for marking out the scope for a project are: preparing a project scope statement, developing a work breakdown structure, and compiling a work breakdown structure dictionary (PMBOK 2008: 124-125). The scope statement often includes the description of the scope and the project deliverables. A work breakdown structure would define each of the components and decompose the deliverables into 'work packages'. The work breakdown structure dictionary would detail the description of the work and provide a technical description of each of the included components. The scope of the project must be controlled by monitoring the status and changes that may occur during the life cycle of the project (Ibid.).

Monitoring and control are important stages of the project ensuring quality. Quality management is a system that focuses on achieving consistent quality of the end results of the undertaken project. Jayawarna and Holt (2009) investigated the experiences of how the use of quality systems promotes and/or discourages the exploration and exploitation of R&D knowledge. They used case study analysis of seven technology-based R&D organizations in the UK and argue that the knowledge-intensive nature of R&D activity, coupled with the endlessly re-constructing nature of knowledge, precludes the use of generic frameworks or best-practice guidelines. Organizational systems, within which each team member can inquire about the organization's strategic concerns, are a prerequisite for effective 'quality management systems' in R&D environments. On the contrary, when such systems are externally imposed as a procedure, they tend to be least effective (Jayawarna et al. 2009: 775).

Since monitoring and control during the stages of the project life cycle aim at ensuring better quality of the end results, managing quality through monitoring and control forms an essential part of project management. Ultimately, they are done to make sure that the product satisfies the needs for which the project was undertaken. The quality management process includes preparing a plan for the quality, and performing quality

assurance and quality control measures to monitor and record the processes during the critical stages of the process (PMBOK 2008: 189).

In practice, to maintain the project process on time and avoid bottlenecks, all the activities, that are to be scheduled first, are listed down. This list can then be used for preparing a schedule for various other functions, such as selection, placing orders, and prioritising scheduled activities. These activities can then be prioritized using logical relationships with the other activities. It may at times be necessary to allow a time lag between activities, so as to be in conformation with realistic situation. Sequencing of these activities can be done with the help of any of several project management software tools available (PMBOK 2008: 136). Allotment of resources, depending upon the project, can be sequenced, when it is needed during the project processes, to avoid any unnecessary cost in handling and storage.

Planning and estimating the requirement of resources is closely coordinated with the cost and budget records. Resource includes materials, workforce, equipments and supplies that are required for each activity. A resource list can be prepared which details the resources required for each activity in the activity list. In addition, a resource calendar can be prepared so as to provide information on which resource are potentially available during the period of the planned activity (PMBOK 2008: 141-142). Cost management form an important part of project management. It generally includes estimating cost for completing each project activity, determining the budget that would be needed to fulfil the total costs of all the activities and thirdly, control the cost by continuous monitoring the status of the project, managing changes to the cost baseline (PMBOK 2008: 165).

Another aspect in project management is managing the risks involved with the project. Thus, those projects that involves managing risks can be controlled by identifying which risks can potentially harm the project, monitoring and controlling these risks during the vulnerable stages of the project, and preparing contingency plans, if any of the known risks would show up (PMBOK 2008: 273).

All these project management issues are also relevant for R&D projects that are innovative and intended to produce unique or novel end results. Song et al. (1998)

suggest that it is necessary to align the planning activity and the style of these kinds of projects according to their novelty (Song et al. 1998: 124). Innovative projects can be classified as radical or incremental, and the management styles that is required may differ accordingly. Radical projects require greater flexibility and can cost more, when compared to the projects that are incremental. They can also be more difficult to plan in detail (Ettlie et al. 2004: 95). Therefore, management practices, that are thought to be suitable for incremental innovation, may hamper the progress of radical innovations (Rice et al. 1998: 52).

The best practice for managing R&D project is, however, arguable. The matrix structure might seem to be a convenient framework for most R&D teams. However, this structure tends to generate considerable amount of conflicts within the management. Environmental factors that can generally affect project management include organizational culture, structure and processes, infrastructure, personnel, political climate, communication channel within the organization, and project management information system, amongst others (PMBOK 2008b: 14).

2.2.1 Project Clarity

Studies have shown that better performance within a project was associated with higher clarity of individual´s role in the project process (Sbragia 1984: 113). On the contrary, ambiguous roles can result in greater anxiety and tension amongst members of a project team (Burns 1994: 54).

R&D projects can often be technically complex, involving high level of knowledge and technical experience. This characteristic can, therefore, often contribute to the decrease in clarity and hazy understanding of one's role in the project. Not surprisingly, researchers associate academic research management with knowledge management (Sousa et al. 2008: 811). Wozniak operationalizes these project complexities based on a range of diverse factors such as criticality of the project, project visibility and accountability, clarity of the definition of the scope (Wozniak 1993: 1).

Clarity of the project goals and objectives, in particular, can influence the outcome of the project. A project can be considered to have low clarity, if the members cannot easily state their goals or define what they want from the project. On the other hand, a project with high clarity is the one in which the requirements can be easily documented, and which do not change during the project progress (Pearlson 2006: 50).

If there is a lack of a true understanding about the tasks that are specific to the project, or the precedence of these tasks, or the potential interdependencies amongst them, or the schedule of the project, such projects do not normally succeed (Tatikonda et al. 2000: 401). In addition, uncertain project environment, such as those of academic R&D healthcare projects, influence the nature of project targets, which, in turn, affects the level of teamwork (Hong et al. 2004: 1269). In contrast, lower specificity in these kinds of projects may provide flexibility for greater innovation (Burns 1994: 54). Flexibility is a prime requirement for radically innovative projects.

Monitoring and control plays an important role in preventing deviation and maintaining the clarity of the goals and objectives of the project. Therefore, frequent assessment of the status of project is necessary to detect deviation from the scope of the project and take necessary actions. Hoegl and Parboteeah (2006) call this frequent reviewing

and questioning of plans as 'reflexivity' (Hoegl et al. 2006: 113). Lundvall and Nielsen ascertain that innovating firms adopt practices, such as "cross-occupational working groups", "self-directed teams", "delegation of responsibilities" and "closer cooperation", is a way to achieve a higher level of flexibility (Lundvall et al. 2003: 3).

Thus, project clarity, which includes clear understanding of the tasks and final goals, helps to provide directions for the project process and address the scope of the project. Furthermore, frequent assessment by monitoring and control during the entire project process can help maintain the focus of the project.

2.2.2   Project Handling

The parts that are typically included in project handling are: (a) forming a project management process group, (b) initiating this process group, (c) planning, executing, monitoring and controlling, and, finally, (d) terminating the process. *Forming a project management process group* involves selection of a project team, including the project leader. When the management decides to *initiate the group*, required funding and necessary resources are allotted. *The planning executing and the monitoring and control* stage goes hand in hand. The *planning* stage includes several steps: first, the development of a plan, at which the plan is fixed and the scope is defined. Second, collection of resources and other requirements, that is necessary for the functioning of the project. Then, creation of a work breakdown structure intended to split tasks in to manageable 'work packages'. Other actions of the planning stage include: defining the activities for forming the 'work packages'; estimating the resources, duration and costs of the project, so as to not over use it; developing a schedule of the work to keep up with the time; and finally, planning communication methods and contingency plans.

During the *execution* phase, the project team comes to deal with the issues related to developing a team and managing it, which become particularly important (PMBOK 2008b: 37-65). In many projects, these steps in project management can turn out to be a bottleneck with respect to meeting the deadline and, to a larger extent, influence the success or failure of the project as a whole. For these phases to be accomplished better, planning activities must be aligned to a degree of novelty, particularly in the innovation projects (Song et al. 1998: 124).

Monitoring and control during the project lifecycle may be necessary to make required modifications and adjustments to the project processes. But caution must be taken. Dvir and Lechler (2004) show that changes to the original plan can have a negative effect on the results, which would otherwise be expected in case of high-quality planning (Dvir et al. 2004: 1). The occurrence of many changes during the project design and implementation stages may also hinder meeting the project schedule and budget goals (Dvir et al. 2003: 382). Controlling and monitoring of the time, cost and performance, therefore, form some of the essential features of the project management.

Each of the steps in the R&D project can be carried out either by using formal procedures (control) or left to the member's discretion with a hope to get the problems solved and the work done (Naveh 2007: 110). Each of these strategies has its own advantages and disadvantages. Naveh showed that both these methods of project execution are interrelated and can positively affect the R&D project performance. For example, projects that allow for members' discretion have a positive effect by applying appropriate formality and performance measures, as compared to those that do not allow discretion, in other words, being too formal, regardless of the project's inherent uncertainty (Ibid.).

Finally, projects can be better handled with greater experience and better knowledge of the project process. Learning is an important factor and can be a source of improving ones' skill and extending knowledge. It comes from, at least, three sources: 1) from the projects requirements itself, 2) from changes in the project processes which were handled successfully, and 3) from the unforeseen events that arose during the life of the project, but were successfully overcome (Stockstrom et al. 2008: 480). In addition, another important source of learning comes from the post-project evaluation (Koners et al. 2007: 242). Therefore, while *terminating the project*, the experience and the learning from the project should be well documented for future reference.

In summary, project handling can be challenging as it is composed of several stages that must be managed. These stages include preparation of a plan, forming a project

group, execution, control and monitoring, and termination of the project. Each of these stages requires attention and demands special skills from team managers. A proper work breakdown structure can help to assist in identifying and controlling this project processes.

2.3   The Project Team

A team can be described as a union in which individuals work interdependently to achieve a common goal. From the organizational point of view, teamwork is a cooperative effort by the members constituting the team to achieve a common goal. A project team generally works as a driver of the project. Soft skills, such as a commitment, innovation, passion and enthusiasm, comprise human characteristics that can be poured into the project, on part of the human side of the team and its members.

Projects usually find it difficult to achieve success without the teams that makes it possible. It is this team that can influence the project performance and success rates. The organisational structure governing the project team can be either functional, matrix or projectized. In a *functional* structure, the project manager has little or no authority and has a part time role in the project process. In a balanced *matrix* organisation, the project manager enjoys moderate authority, but plays a full time role in the project process. And in a *projectized* organisation, the project manager exercises total authority and plays a full time role in influencing the project (Gido 2009: 302).

Researchers distinguish general recommendations governing the composition of a project team. First, the team should be as small as possible avoiding members with duplicate skill sets and non-essential members (Clements 2006: 265). A typical problem with a larger team is that the communication suffers essentially when the members have different levels of commitments. Second, it is important for each member to clearly understand the goals and each objective at every stage of the project, in particular. Third, the team members also have the responsibility to be ethical at work and try to be as efficient at work as possible (Gido 2009: 351). Fourth, positive attitude and respectful behaviour builds a work environment that ensures the

best out of each team member. Melymuka (2004) mentions that even one cynical member may negatively influence the team's outlook (Melymuka 2004: 54). Fifth, a project manager could overrides experience of a person with strong work ethics and a positive attitude (Ibid.).

As the development of the team matures, the stability of the project membership increases, and project groups tend to become increasingly isolated from the key information sources both within and outside their organization. Such reduction in communication was previously shown to adversely affect the technical performance of the project groups (Katz 1982: 81). A case study within the organization found communication to be a problem, in particular (Bergen 1988: 5).

Melymuka (2004) suggests that, in riskier projects, diversity within the project team lowers the risk of project failure and consequently increase its success rates. Project managers, however, show the tendency to select members of a similar type. This is a tendency that must be avoided while selecting a team (Melymuka 2004: 54). Jackson and Ruderman argue that the diversity of talents and the views of members of the work team can be harnessed only in an organization that can learn to understand and adjust to the diversity in the workplace (Jackson et al. 1995: 271). Building a team requires understanding between its members; therefore, team members who are familiar with one another are rather preferable. If this is not the case, it may take time for members to get accustomed with each other's personality, work style, and therefore, speed of productivity may become somewhat slower. This issue of organising and building up the project team form the core of team development principles.

The project management plan in management of a project team must include, but may not be limited to, the roles and responsibilities of individuals in a project team. The role typically describes the part of the project in which an individual is involved, while the responsibility refers to the scope of work that the individual in a project team is expected to perform (PMBOK 2008c;222-223). Project managers are supposed to be able to motivate their team at all stages of the project life cycle. This can be achieved, for example, by rewarding and recognising good performance, providing challenging opportunities, providing timely feedback and support, when needed. To achieve high

team performance open and effective communication and collaborative problem solving is also essential. To handle these challenges, project managers should also seek top management support to acquire resources that are needed to develop an effective project team (PMBOK 2008c;229).

Overall, a good characteristic of a project team is its ability to work together based on mutual cooperation and understanding between all individuals in the team, with each individual working towards the ultimate goal of the project (Hendarto, 2007). Even though initially it may seem that there are few internal problems, it is the duty of the project manager to keep all the individuals together and successfully travel through the storming stage of team development.

2.3.1   Project Team Development

This section details the general stages of team development and the issues that generally arise during these stages. The role of the project manager during these stages is also briefly discussed.

Typically, it is the plans and the models along with the project team that are usually important for successfully seeing the project through. Developing a team forms an important process aimed at improving factors that enhance team performance such as team competencies, interaction within the team, and the overall team environment (PMBOK 2008c: 229). Interpersonal skills sometimes known as "soft skills" are important for team development, but they may take time to develop. Soft skills that can be valuable for managing a project team can include empathy, influence, creativity and group facilitation (PMBOK 2008a: 232). Initially, an individual is apprehensive and are curious about other team members, but as the time passes, through disagreements and difference, the attitude may change. Once those disagreements are overcome, the relations may become even closer, and members of the team can again be open and accept personal differences in working styles (Ibid.).

Importantly, communication within a team can be a factor to influence the fate of most components of team management and their interdependencies (Rico et al. 2009;229).

Most of the conflicts that may arise during the life cycle of a project, ranging from conflicts of the individual members up to the conflicts involving the management of the project, can be related to the level of communication within the team (Aula et al. 2010: 128). Conflicts often arise just after the initial phase of the project and team development, and will usually normalise later on. It is the responsibility of the project team leader, and partly the responsibility of its individual members, to solve these problems, to show more understanding in terms of reality of the situation (Clements 2006: 176).

Other factors that are important to the proper management include: setting objectives, critical path analysis, preparing a work breakdown structure, resource allocation, and risk management (Cowie 2003: 257). To assist in the assessment of the competitive level of the project team, certain aspects can be helpful, such as how an individual prefers to relate to others; how he/she gathers and uses information; how he/she makes decisions; how he/she organizes themselves, and similar issues. For this reason, knowledge of these issues has become an important factor to most teams seeking competitive advantage.
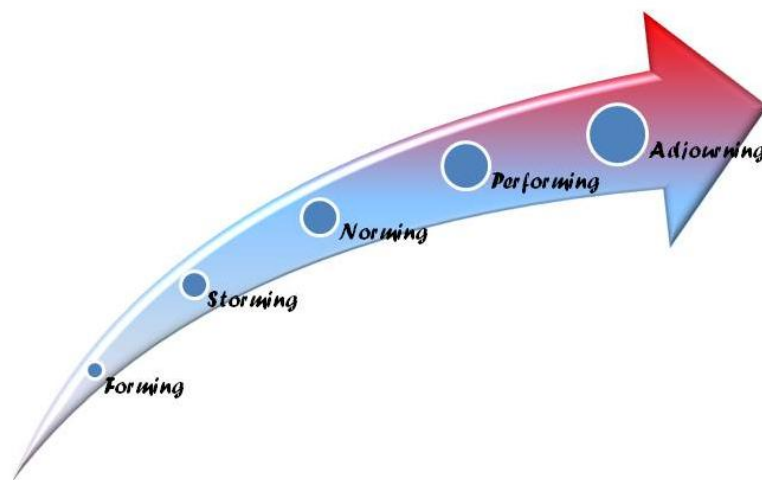

Figure 5.   Team development stages (based on: Tuckman, 1965: 384; PMBOK, 2008c: 233).

According to Tuckman (Tuckman 1965: 384), there are four stages in team development, in addition to which PMBOK suggests a fifth stage, as shown in Figure 4 . *Forming* is considered as the initial stage, at the start of a project, at which team

members get acquainted with each other. During this stage, team members are positive and want to get started with the work. However, at the initial stage, little actual work typically gets accomplished. The project manager must, first, provide direction to the entire team. The next, *storming,* phase is tough on each member, when reality sets in, and many a times team members may fall behind individual expectations. Individuals may question their role in the team; frustration, anger and hostility may develop. At this stage, conflict may arise - suppressing conflict may not be good, as they may build up and put the project at risk. After struggling through the storming phase, the team moves in to the *norming* phase of team development. Relations between the individual team members are now settled. Interpersonal conflicts and dissatisfaction are reduced; control and decision making are transferred from the project manager to the project team; and the unity and team spirit are enhanced. At this stage, trust becomes developed, and there is a stable sharing of information and ideas (Clements 2006: 362).

During the *performing* stage, the team becomes highly committed and eager to achieve the project objectives. The level of work performance is high; there is a sense of unity and pride in each other and the achievements gained; the team feels fully empowered. In the case of troubleshooting, team members can form subgroups and come up with solutions. At this stage, the project manager has a choice to fully delegate the responsibility and authority to the team and simply act as a mentor. Communication is frank, and confidence is high. (Tuckman 1965: 384)

The final stage is that of *adjourning*, at which the team finishes the tasks and moves on from the project (PMBOK 2008: 233).

2.3.2   Managing a Project Team

The project team provides the skills that are required for accomplishing the project tasks, but these skills are intricately related to human issues, and therefore, demand managerial attention. Team management is an ongoing process, which can become a crucial factor in determining the project success. Though usually it plays an important role at the beginning of the project, it is a never ending process. The environment of the projects is often dynamic, and therefore, it is important to manage the team by

monitoring it continuously for its functioning and performance, and taking corrective measures, if needed (PMBOK 2008c;233).

Managing a project team would include monitoring team performance, providing feedback, resolving issues and managing flexibility to the project process. Project management task is to observe team behaviour, manage conflict, resolve issues and appraise team members' performance. This section details the various factors that influence team management and highlight the essential components of a high performing team.

The effectiveness or slack in the team performance will contribute to the success or the failure of the project. To attain effectiveness, an ideal team would have a clear understanding of the project objectives that is essentially needed to maintain efficiency within a team and the execution of the project processes. Secondly, a clear expectation of each person's role and responsibility is required to be listed. This can be done at the initial stage, during the project planning. Thirdly, the team members and the management must be goal-oriented and focused throughout the project life cycle. Fourth, a high degree of collaboration and cooperation is necessary to guide the project to its successful completion, and trust makes a significant difference in team performance (Gido 2009: 337). Chen et al. suggest that social interaction and network ties have significant and positive impacts on creativity of R&D project teams (Chen et al. 2008: 21).

Even though in scientific R&D each individual in a team may have his own project, inevitably he often seeks the expertise of others within the team. The proof of this mutual cooperation or collaboration is evident when the article is drafted for publication. The number of co-authors directly corresponds to the number of members from within the group or from outside the group that formed a team to realise the successful completion of the project. Therefore, quite often healthcare R&D projects publications are composed of a more than one author. During the planning meeting the project leader must make clear the expectation of each person's role and responsibility in the project.

The project leader as well as each member of a team must take necessary measures to make clear his/her roles and responsibility and be committed to his work, thereby setting a good example to the other members. The environment must be so created that it must be conducive for readily sharing information, ideas and feelings. High level of collaboration may be necessary at times. Team members must be ready to provide critical comments and constructive criticism whenever needed.

Interdependency within a team is inevitable and the each team member must realise that everyone in a team is important for project success. Trust is important as members can count on other members to deliver what is promised without compromise in quality. Members can freely and openly express disagreement without fearing any consequences. An effective project team timely resolves conflict through constructive and timely feedback and positive confrontation of issues (Gido 2009: 351).

Teams strive to succeed in their objectives they pursue. But this too is not devoid of management challenges. To meet success without compromise in quality barriers must be overcome with persistent effort.

The goals could be clarified right at the beginning of the project, probably at the first project meeting itself. The clarification of the goals helps each individual team member to understand the ultimate goal and each objective better, thus permitting the unity of effort of the team members towards a single direction. It is up to the project manager to often remind the team members about the objectives and goals. This information may also be provided in written form. It is also important that the individual objectives and the goals be revised and discussed periodically at status review meetings.

At the beginning of any project most members may be surrounded with ambiguity regarding their role in the team and the responsibilities they are entrusted upon. It is up to the project manager to delegate the responsibility and make sure that the members understand what is expected from them. Distributing pamphlets indicating the role of each member is a good way to bring clarity within the team.

Overlap of skill between two members may be required but overlap of responsibilities must be avoided. Each member should thus be provided a chance to identify tools and

prepare a work break down structure for their respective responsibilities (Clements 2006: 333). For the effective management of a project the work breakdown structure is an essential tool. A work breakdown structure divides tasks that are a part of the project in to "work packages". These work packages are placed hierarchal according to the logical needs of the project there by assisting the project to the next phase. The work breakdown structure helps in maintaining processes according to schedule and scope. Moreover, a work breakdown structure can help to show the team members how they fit in to the project. Ideally each task in the work breakdown structure and the rationale behind establishing it must be explained to the team members at project meetings.

However the project manager must be open to suggestions for eliminating or streamlining work packages that are no longer logical or irrelevant. The project manager must also look out for "soft" elements that can affect the performance of the project. These elements can include lack of motivation, poor communication, poor leadership and individual's behaviour.

It is common for team members to lose motivation during the life cycle of the project, especially at the storming phase of team development. Here, it is the duty of the project manager to determine what motivated each individual and create an environment within the project where these motivators are available (Clements 2006: 289). Typically, project manager can also increase motivation by rewarding and appreciate ones progress (Homel et al. 2010;11). It is important to understand that a particular reward will be effective to an individual only if it satisfies his/her need (PMBOK 2008c;234).

Poor communication within the team is practically important for the effectiveness in meeting objectives. It is typical that individuals get so engrossed within their own responsibilities that communication suffers or sometimes they may become deliberate when negative human nature takes over, such as jealousy or hatred. The project manager must identify these issues and arrange periodic meetings and ask individuals to report about their work progress. The project manager should prepare a meeting agenda each time and create an amicable environment within the meeting for putting

forward ones opinion, seeking assistance from other team members and resolving issues.

Poor leadership can arise due to the leader's personality or due to ignorance of reality. If the former is the case the leader must consider reassessing his leadership skills. While if the later is the case, the leader can ask the simple question "how am I doing?" to each individual member of the team. The leader must be open to suggestions and must remind the team that the intention to improve his skills is to finally benefit the project.

Individuals can sometimes exhibit behaviour that may affect the team development. Hostility towards another individual within the team, passing personal and derogatory remarks, excessive clowning are few examples of bad behaviour. An ideal member of a project team will experience an enriching and satisfying growth experience. This comes only by commitment, open mindedness; respect towards fellow colleagues and a desire to further self develop. "A good team member just doesn't let things happen but make things happen". They are motivated to maintain the inertia of the team and the forward movement of the project processes. They communicate and participate in meetings. They do not fear in offering positive criticism aimed at the achieving the final goal. Effective team members provide constructive feedback to each other. Blaming each other and passing derogatory remarks are avoided in an efficient team. Finally in an effective team "Us" stands before "I" (Gido 2009: 341).

The performance of a team can be measured and appropriate corrective measure can be taken enabling the team to remain at its highest level of performance. Teams are classified as high performing, medium performing and low performing on the basis of how much the team members are connected with each other , 'degree of connectivity'. High performing teams during meetings showed an 'atmosphere of buoyancy' and they showed appreciation and encouragement to their colleagues within the team. This created an emotional space that would create possibility for action and creativity (Losada 1999: 179-180). He also found that high performance teams are usually associated with a chaotic dynamics (Losada 1999: 188). Freeman concluded in his study that chaos underlies the ability to respond flexibly to the outside world and to

generate novel activity patterns (Freeman 1991: 78). To create a high-performance team, managerial skills are required that would encourage team work.

An important skill in team development involves managing conflicts that arise in teams. The whole team must consider it as a team issue and must be encouraged to work collaboratively to resolve issues. In addition, an effective project team are characterized by having top management support, commitment from team members, reward and recognition, manage conflicts effectively, trust and open sharing of ideas (PMBOK 2008a: 232). Apart from these aspects, issues arising from cultural values can be of significance. Cultural norms often determine the outcome of the project. These "norms" are nothing but a common set of understanding of how and by what means a work must be accomplished and who would influence the facilitation of the project process. Project managers must understand these norms and can take decision accordingly.

The performance of a successful team can be measured in terms of reaching the objectives, completing it within the allotted time and completing it without any extra financial burden. The indicators of an effective team may include improvement in skills, competencies and increased cohesiveness within the team. As a result of the assessment of these factors the project management can prescribe training, coaching, assistance or changes that may be required to improve team performance (PMBOK 2008c: 235).

Contemporary project managers operate in a global environment where their team members may be from different geographical regions with different cultures and languages. The project manager must strive to capitalize on these cultural differences and focus on the development and sustainability of the project team with mutual trust and cooperation. Developing a project team involves improving the soft skills, technical competencies and overall team environment and project performance. Therefore the objectives of team development may include necessary steps to increase in knowledge and skills of team members to which in turn will raise their ability to complete their project (PMBOK 2008c: 230).

Tacit knowledge is embodied in the minds of people, and is part and parcel of their skills. External knowledge is also an important source that can help firms leverage their R&D efforts. Internal and external knowledge have to be knitted together on the work floor giving rise to innovative products and processes. Previous study show that absorptive capacity, embodied within the team member, is a key element in using external knowledge (Spithoven et al. 2010: 967). Nemanich et al. found that the capability of R&D team members to evaluate external knowledge is related to their ability to assimilate it. They also emphasize that prior knowledge may negatively moderates the relationship between individual assimilation and application ability. They also argue that team autonomy positively moderates this relationship (Nemanich 2010: 674).

Part of the team development and team management involves rewarding and recognising desirable behaviour. The initial plans as to how members are rewarded are usually agreed initially at the human resource meeting. The award decision can be made formally or informally and cultural differences must be considered before determining the recognition and reward. For example team reward in a culture that values individualism may be difficult. Only desirable behaviour must be rewarded. For example, overtime must be rewarded only if it is meant to meet short deadlines while if it a result of poor planning it must not be rewarded. Rewards make people motivated by feeling that they are valued by the organisation.

Tangible rewards such as cash are widely accepted while intangible rewards such as opportunity to grow, apply their professional skills to meet new challenges are also equally effective. It is usually a good strategy to provide the team all the recognition during the life cycle of the project rather than after the project is completed. Before serving the reward managers must asses each individual team member. Assessment by observation and conversation with team members can reflect the level of work and attitude of each member of the project team and the progress of each deliverables and interpersonal issues. Project performance appraisals can be done during the course of the project to clarify the roles and responsibilities of team members, provide constructive feedback to team members and to identify any new issues such as conflicts (PMBOK 2008c: 238).

Conflicts are a common occurrence in a project environment. The sources of such conflicts may include scarce resources, scheduling priorities and individual work styles. Ground rules of the team, norms of the team, efficient project management practice such as communication, planning and definition of roles and responsibilities, usually tend to reduce conflicts. Difference in opinion can be turned in to an advantage by increasing creativity and better decision making if the conflicts are managed properly.

It is important for the project managers to understand that the conflicts are common and is a team issue. Openness within a team can resolve conflicts. Conflict resolution should usually focus on issues and not personalities, and not on the past but present issues. The success of a project manager depends mostly on his conflict managing ability. Factors that may influence conflict resolution are; importance or the scope of the conflict; time constrains; sides taken by the individuals involved; and the motivation to resolve the conflict. Generally there are six different ways to approach a conflict- Withdrawing/Avoiding; Smoothing/Accommodating; Compromising; Forcing; collaborating; Confronting/Problem solving. An issue log can be maintained to track who is responsible for resolving issues and the issue under consideration.

In addition, the project manager can utilize a combination of technical, human, and conceptual skills to analyze situations and act accordingly. Some of the "soft"/interpersonal skills that that managers can display are either leadership skills, influencing ability and/or effective decision making.
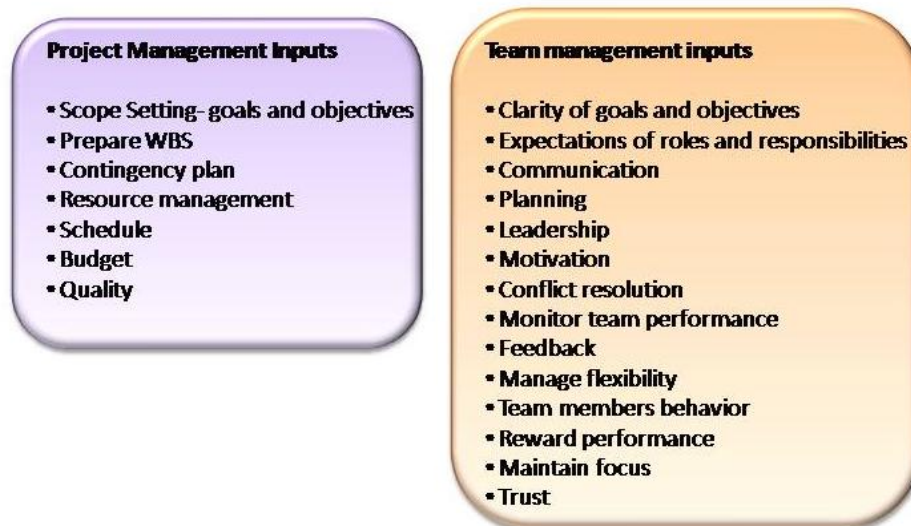
Figure 6.   Summary of the inputs in project management and team management

The summary of project management and team management relevant in Healthcare R&D are as shown in Figure 5. Setting of scope includes setting of the goals and the objectives of the project. A work breakdown structure of the project at hand must be prepared which would include all the activities details in manageable work tasks. Contingency plans help in confronting risks and can be prepared at the beginning of the project. Resources need to be managed efficiently especially when they are limited. Schedule planning helps maintain the project abreast with time and quality, so that the budget is not affected. Inputs in team management include clarity of goals and objectives to each individual member of the project team, as well as, the expectations of their roles and responsibilities. Communication is an essential factor in a project team. It is also suggested that team members when located in close proximity to one another can result in better communication. Leadership style varies from person to person but can largely affect team management. The leader must be able to identify reasons for lack of motivation and try to find solutions. In addition the leader and the team must seek to resolve conflicts. The team leader and the top management must monitor team performance by common team management tools available. Feedback sessions are particularly important in the assessment of the leader and the team members. The team leader must be able to be flexible with the changes during the project but at the same time maintain focus towards the goal of the project. Negative

behaviour by a team member can affect the whole team. The team leader must identify these members and resolve the issue as far as possible. Good performance may be rewarded to increase loyalty and motivation. It is important to maintain focus throughout the project and deviations must be avoided. Trust between team members must be always at a healthy level and can be an important factor during the project life cycle.

3   Method and Material

This section describes the method and material used in this study and relates how the data were collected, processed and interpreted.

3.1   Research Methodology

This study utilised qualitative research methods, including a triangulation approach, based on the results of the literature review, data from the survey and interviews.

The main research method applied in this study is a survey research, added with interviews and discussions. Survey research is a method of collecting information by asking pre-formulated questions in a predetermined sequence. These structured questions are asked to a sample of individuals that are drawn from a set of population to represents the entire defined population (Blaxter 2006: 70).

Most surveys are carried out on a certain target group of individuals. An example is the students or the teachers in an academic institution. The researcher will mostly try to generalise the results obtained from the samples which represents the population. Surveys that have academic interest are mostly always needed to be backed up by literature survey unless not needed by the research (Blaxter 2006: 100).

Literature survey mostly gives us an idea about the current study and also previous understandings regarding the area of study. It helps in broadening the set of work and the perspective of the investigator. Direct personal experiences are valuable but not enough especially in academic research. Literature survey also helps in bringing legitimacy to ones argument by citing appropriate sources. Last but not limited to, literature survey can help spot gaps or deficiencies in the field of interest.

At the start of the research, literature survey can assist in identifying what has been researched and what needs to be researched. It helps in focusing ideas, shapes the hypothesis and explores the context for the project. During the research it helps in better understanding the field and the methods used. At the end of the research it

helps in recognising what impact the current research can potentially have and develop ideas for further research (Blaxter 2006: 101).

The amount of literature available is usually overwhelming and can demand considerable amount of time. In addition, unless the research is tightly defined the boundary of the literature survey may be unrestricted. Therefore it is important to narrow down the search to good relevant sources and to know what to read from those sources. Library databases, such as EBSCO, and internet search engines, such as Google scholar, provide an essential tool to search literature of interest.

After identifying the area of interest the next step is to research it using available methodologies. It is common for researcher, especially in social science, to use more than one method to validate the results. For instance surveys can be complemented with interviews. When two or more methods are used to verify and validate the results the process is known as 'triangulation' (Blaxter 2006: 86).

A structured interview method typically involves a set of pre-set questions with the help of which the sample population is questioned. Depending upon the preference interviewer and interview, taking down notes or voice recoding are methods commonly used to document the interview. Recording at times may make the respondent anxious.

Interview can be conducted at a neutral location either face to face or at a distance for example over the internet. Face to face research high response rate but can often be time consuming for the researcher. Interviews can be conducted with either one or more persons and can be either in a structured, semi structured or an open format.

Structured interviews usually have a formalized set of questions and strictly adhere to the questions in the questionnaire. While in a semi structured interview offers flexibility, slowing new questions to be brought up during the interview as a result of what the interviewee replies. An interview in the form of an open format discussion is considered to be naturalistic, in-depth, narrative or non-directive (Blaxter 2006: 172). These kinds of discussions have their own set of informal rules and can vary with the situation interviewer. But, generally the role of the researcher is to put forth questions

or statements that will instigate the people to talk and put forth their opinion or ideas by arguing or debating.

In this study, the survey was conducted by distributing out the questionnaire (Appendix A) to researchers at three academic institutions - the University of Helsinki, Aalto University and at the University of Turku. The questions were divided into three parts. The first part comprised the questions related to the clarity of goals; the second part included the questions related to project handling; and the third part contained questions related to team management. In addition, selected members were interviewed to identify issues that were either not covered or insufficiently covered by the questionnaire. The interview questions were prepared so as to investigate the issues related to the clarity of goals and objectives, the clarity of roles and responsibilities, communication and collaboration, monitoring and control, and the management of team.

3.2   Data Collection

This section describes the method for data collection that was used in the analysis in this Thesis. Basically, three data collection methods were used: a) survey using questionnaire, b) semi-structured interview, and c) an open format discussion. This resulted in the triangulation of research data, as illustrated in Figure 7.
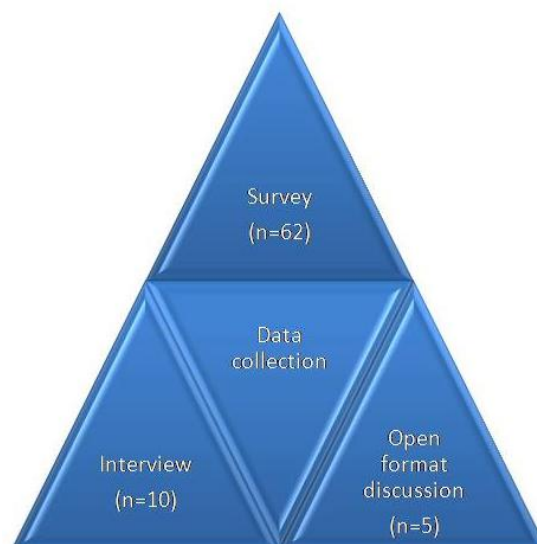

Figure 7.   Triangulation of data sources.

As Figure 7 illustrates, three types of data sources are utilized in this study:

a) Survey

The survey was carried out in the Helsinki and Turku regions of Finland. A questionnaire was prepared (see Appendix I) and sent to 200 researchers working on healthcare R&D projects, irrespective of their level of work experience. Out of 200, 62 responses were collected, which makes the response rate 31%. In addition, 36 researchers were personally approached to explain the goal and structure of the questionnaire, and distance guidance was provided to the remaining 26 respondents, who sent their responses via e-mail.

The questions in the questionnaire were designed in such a way as to make the assessments on a Likert scale, from 1 to 5. Mode, median and the mean of the levels of agreements from each question were then calculated for further analysis.

b) Interviews

A series of semi-structured interviews was conducted with 10 healthcare R&D researchers. Seven of the respondents were postdoctoral fellows working at various laboratories in Helsinki and Turku, while the remaining three were experienced researchers in the healthcare field, with a minimum of three years of experience. The interviews were conducted as an organised meeting, with a prior appointment. All participants were made acquainted with the interview questions beforehand. Questions were put forth and subsequently notes were taken by the researcher during the interview. The results of the interviews are interpreted and discussed in Section 4 and Section 6.

c) Discussions

In addition, an open format discussion was organised with healthcare researchers (the researcher's colleagues) to further understand and validate the issues mentioned in the questionnaire, and to find out about other issues that have not been touched, but considered important by the participants. Five of the project team members were chosen for the participation in this open format discussion. During the meeting, notes were taken by the researcher to record the results of the discussion. These results are interpreted and discussed in Section 4 and Section 6.

The overview of the collected data is presented in Table 1.

No.	Type	Method	Number of participants	Data
1	Survey	Questionnaire used	Sent to 200 Respondents: 62	Feb 2011
2	Interviews	Semi structured	10	March 2011
3	Discussion	Open format	5	April 2011

Table 1. Sources of data and the method used to collect them.

As Table 1 illustrates, a formalized questionnaire was sent to 200 respondents of which only 62 responded. A semi structured interview was conducted with 10 individual researchers belonging to a research team while 5 individuals were selected for an open format discussion. The data were collected during February to April 2011.

3.3   Reliability and Validity

The researcher has been an active project team member for more than 7 years and has a considerable experience in healthcare R&D. The survey, interviews and open discussions were conducted in English (the *lingua franca* of the project participants) and the collected data were documented in the same language. The response of the respondents depended on their motivation to complete the answered in the questionnaire. Therefore it is likely that some of the answers in the questionnaire and some of the interview questions were answered hurriedly, without due consideration of the questions. Responses to the questions and the input in the discussions may also be affected by the current mode of the participant's scenario, which may affect the resulting picture. However, these issues may diminish the reliability of any survey and can hardly be avoided.

This study can be repeated with a larger number of respondents (> 200 respondents) to test the validity of these results. This study strived to provide an initial platform for further research into this topic.

4 Results of the Project Team Members Survey and Interviews

This section details the responses to the survey, interviews and open discussion collected as research material for this study. The responses are separated in blocks according to: goals and objectives, roles and responsibilities, communication and collaboration, monitoring and control, and management of the team.

4.1 Questionnairere Survey

This subsection describes the results of the survey that were obtained from the questionnaire.

The data collected from the questionnaire were grouped together, and a histogram was plotted depending on the number of times each level of agreement appeared (see Appendix II).

The "level of agreement" in this Thesis means the value that lie in between 1 and 5 in the Likert's scale. As the numerical value of the average median decreases the level of agreement is said to be 'low' while when the numerical value of the average median number is higher the level of agreement is said to be 'higher'. For example, 1 and 2 indicates low level of agreement, while 4 and 5 indicated high level of agreement.

The mode, in its turn, shows the most frequent reply to a particular question, while *the median* shows the middle value that separates the greater and the lesser half of the data. Although *the mean* value was also calculated, it provided no use to the interpretation of the results; except for it gave the estimation of the collective level of agreement (See Appendix 1).

Block I: Project Goals and Objectives

The questions that are relevent to the project goals and communication were formulated in the following way: whether the goals and the objectives were clear in the respondts team; and second, whether a clear work breakdown structure was prepared prior to the project initiation.

The responses to these two questions are grouped, marked with roman numbers. The results revealed that, (i) in an academic scientific R&D team, not all team members had a clear understanding of the project goals (mode =2, median =2), but the objectives were quite clear (mode =4, median =4). (ii) Another, interesting finding, pertaining to the clarity of the project objectives and goals, as well as the preparation of a work breakdown structure at the initial stages of the project, showed that the level of disagreement was high. Out of the total, 42 respondents disagreed that no formal structure was prepared during the initial project planning stages.

Based on the responses, a conclusion can be made that, for most team members, their immediate objectives in the project were clear, but the goals often remain unclear. Also, no work breakdown structure was often prepared at the initial phase of projects.

Block II: Roles and responsibilities of individual members

The questions that were surveyed were in this block concerned roles and responsibilities of each individual person in the project. These questions were: whether the roles and responsibilities of each individual person in the project team were clarified; and if this has a possibility to create a feeling of dissatisfaction amongst other members.

The obtained responses are grouped, marked with roman numbers. (i) With respect to the roles and the responsibility, the results from the surveyed individuals showed the mode and the median to remain at 3. Out of the total, 17 participants knew, or somewhat knew, what their role and responsibility were within the project. While 38 participants responded neutrally, indicating that this was not a major issue amongst the surveyed project team (mode=median =3). (ii) The participants gave a mixed response, when asked if they felt that their colleagues performed satisfactorily. Although, most of the respondents (30) gave a neutral answer, 18 disagreed, while 14 agreed. The mode and the median values remained at 3.

Based on these two questions, we can suspect that, there might be a relation between dissatisfaction with the team members' which may have been probably caused by unclear knowledge of their roles and responsibility.

Block III: Communication and collaboration in the project

The questions that were surveyed here was intended to investigate the level of communication and collaboration between members of the project, including whether the project meetings were frequent enough in their team; do they have regular feedback sessions to give and receive feedback with relation to the project; and whether during project meetings any discussions are held so as to maintain the project focus on delivering its unique outcome. The participants were asked if the communication levels within the team were sufficient. They were also asked if the information was shared freely amongst all members of the project team. Finally, they were asked if they had a good understanding (cooperation) with other team members.

The results are grouped, marked with roman numbers. (i) Most of the surveyed project team members agreed that they do have frequent project meetings, at which they are provided with the opportunity to report their progress (mode=median =4). (ii) Feedback sessions are also organised frequently to give and receive regular feedback (mode=median =4). (iii) In most team, the project focus is maintained with an intention to deliver a unique outcome, and their project processes are constantly discussed in meetings to maintain focused on delivering its unique outcome (mode=median =4). (iv) Interestingly, 41 respondents felt that the communication within the team is not sufficient (mode=median =2). (v) Moreover, among the total number of respondents, 33 believed and 6 strongly believed that project ideas and information are not freely shared by all within the team, with 19 participants choosing to remain neutral (mode=median =2). (vi) Out of the total number of respondents, 17 respondents felt that they had a good understanding; 2 had very good understanding; 14 felt the understanding was not so good; and 2 had a poor understanding with other members of their teams. The mode and median values remained at 3.

These results indicated that the project meetings in an average healthcare R&D project can be considered as frequent, with each member having enough opportunity to report

and collect feedback. At the same time, the project members felt that the level of communication was not sufficient. The free sharing of the project ideas and information was limited, which may partly be explained by the internal competition. However, as the results indicate, did not generally affect the understanding that members had with each other.

Block IV: Monitoring and control during project progress

To investigate the level and kind of monitoring and control in project groups, the questions were included as for: whether the level of monitoring and control was excessive or less that they would prefer; and if there existed any specific person to monitor and control the project, or the responsibility to monitor and control rested with each member independently. For monitoring and control, top management support may be required. Consequently, the respondents were asked if they had any top management support for their project. In addition, they were asked a question to detect if their teams had any contingency plans in case of any risk or deviations from the schedule.

The results are grouped, marked with roman numbers. (i) The enforcement of control regarding the time, cost and quality of the project did not seem to be neither excessive nor lower that what was needed in most project teams (mode=median =3). While 19 respondents agreed with this, 41 choose to remain neutral. When inquired if the members felt that control was necessary, 16 responded that it was not necessary, while 41 of the members chose to remain neutral. (ii) Among the surveyed teams, most participants responded neutrally (mode=median =3), or slightly towards disagreement (disagree=20, strongly disagree=6), when asked if they had any specific person to identify faults and deviances during the project processes (mode=2). (iii) Most team members responded positively that the responsibility to identify faults and deviances during the course of the project is the duty of each individual member (mode=median =4). (iv). From the total number of the surveyed respondents, 32 respondents disagreed and 7 strongly disagreed that any contingency plans were made to handle unexpected crisis, while only 17 chose to remain neutral. Both the mode and the median values remained at 2. (v) Top management support during the project process was mostly always available (Mode=median =3).

These results allow making a conclusion that the monitoring and control were generally implemented in the surveyed projects. These monitoring tasks were delegated to the each team members as his/her responsibility. If unexpected crises were observed during the monitoring process, contingency plans were mostly not available. But, according to the results, support during monitoring and control from the top management was mostly always available

Block V: Management of the Team

To investigate the management issues in project team several question were asked to the respondents. First, whether rewards and appreciation were agreed upon at the initial stages of the project. Second, whether the overall working environment that was created by other team members were satisfactory. Third, whether there were enough social activity related to the project so as to improve communication and relation between team members. Fourth, if tem members felt that better management could further improve the efficiency of their team. Fifth, whether they felt that the projects were managed with excellence in their team. Sixth, if any project management tool was used to better manage their project. Seventh, if there were any formal selection procedure while selecting a new team member. And eight if failure were accepted and built in to the learning curve.

The results are divided in roman numbers for better clarity (i) Another interesting finding in this study showed that the appreciation, reward and recognition are mostly never agreed at the beginning of a project. Data from this study showed that statically 42 disagreed, 2 strongly disagreed, while 17 remained neutral (mode=median =2) to the above. (ii) But the overall satisfaction with the team member and the working environment created by them was lower. Of the total respondents 34 disagreed while 3 strongly disagreed. (iii) The level of social activities, according to the level of agreement, within the team remained mostly neutral with a mode and median value of 3. All the project teams had some form of social activity once in a while. (iv) Not surprisingly, 42 individuals believed and 12 strongly believed that better management could increase the efficiency of the project with a mode and median value of 4. (v) From the total, 21 disagreed and 5 strongly disagreed while 14 and 4 of the

respondents agreed and strongly agreed that the projects are managed with excellence in their team. 18 respondents chose to be neutral with a mode and median value of 2 and 3 respectively. (vi) In addition, 25 members agreed that no formal processes are used that would otherwise help better manage the projects. (vii) The survey revealed that there is always some sort of a formal procedure for selection of team members while forming the project team (mode=median =4). (viii) Learning from failures forms an important part of the learning curve of most project teams. Amongst the surveyed project team members, 30 of the total respondents felt that failures were not accepted and built into the learning process, while 30 respondents gave a neutral answer (mode=median =3).

The results of the survey showed that the rewards are mostly not agreed at the beginning of the project, and the satisfaction with the environment, which was created by other team members, was low. Most team members also felt that better management within their team could result in improved efficiency. In most surveyed teams, no formal methods or tools for project management were implemented.
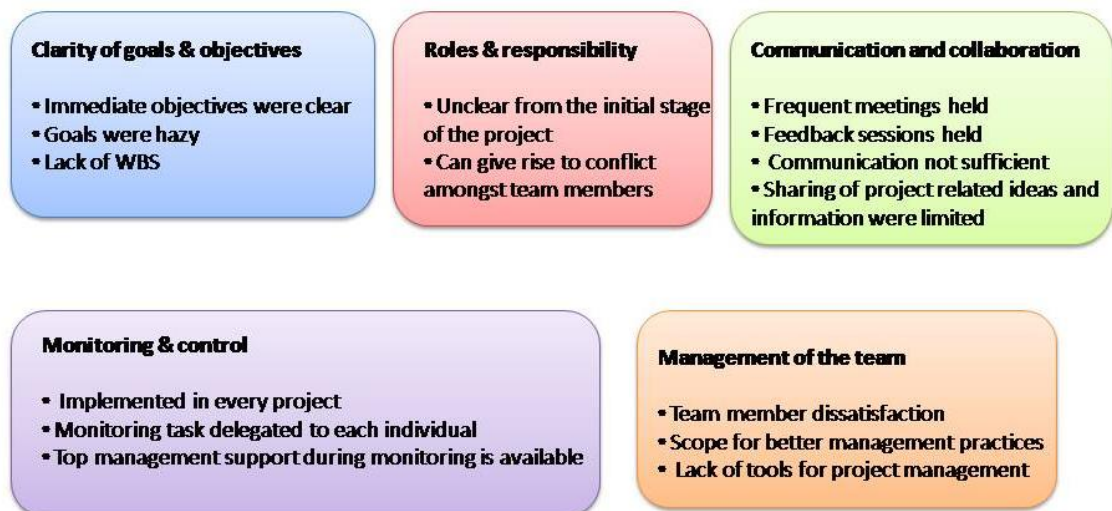
Clarity of goals & objectives

- Immediate objectives were clear
- Goals were hazy
- Lack of WBS

Roles & responsibility

- Unclear from the initial stage of the project
- Can give rise to conflict amongst team members

Communication and collaboration

- Frequent meetings held
- Feedback sessions held
- Communication not sufficient
- Sharing of project related ideas and information were limited

Monitoring & control

- Implemented in every project
- Monitoring task delegated to each individual
- Top management support during monitoring is available

Management of the team

- Team member dissatisfaction
- Scope for better management practices
- Lack of tools for project management

Figure 8.   Summary of the survey results.

The survey results can be summarised as follows. The clarity of the goals were discovered to be rather hazy, but the immediate objectives were clear for most of the surveyed participants. There was a lack of work breakdown structure which could be

useful in bringing more clarity to the project. The roles and the responsibilities were unclear at the initial stage of the project. Frequent project meetings and feedback sessions were held, but the members felt that communication was still lacking. The survey registered a limited sharing of project ideas and information. Monitoring and control were implemented in every project, and the tasks of monitoring and control were delegated to each individual. Team dissatisfaction with the working environment and other team members was high and there was room for better management in most surveyed teams. A proper project management tool was considered desirable in most project teams.

4.2   Interviews and Open Format Discussions

In the next stage of the study, ten individuals from academic R&D healthcare project teams were interviewed (Appendix B) and five researchers were invited to an open format discussion. This supplementary investigation was done to further study the project management problems and also provides a opportunity for individual researchers to discuss certain issues that could not be detailed in the questionnaire.

Block I: Project goals and objectives

(i) Eight of the total number of the interviewed team members felt that, for them, the immediate objectives of the project were generally clear. (ii) Moreover, as the project proceeded, the clarity of the goals tends to increase.

Block II: Roles and responsibilities of individual members

(i) Based on the results of the interviews, all the project team members felt that their roles and responsibilities within the project teams were "quite" clear. Further investigation through the semi-structured interviews and open discussion revealed that generally, during the early stages of the project, the team members tend to have a hazy understanding regarding the clarity of their roles and responsibility. But, as the projects matured, the clarity of the team member's specific roles and responsibilities within the project and the team was felt to increase.

Block III: Communication and collaboration in the project

(i) The interview results revealed that, at times, insufficient communication could result in delays in the project processes, and therefore, influence the duration of the whole project. (ii) All the interviewed researchers invited for the discussion agreed that they had weekly meetings where the project progress was evaluated. Further investigation revealed that these project meetings lasted, on average, for about one hour. The rest of the communication among team members mostly took place informally, through e-mails, or chats in the corridor or the laboratory. (iii) Even then, four of the project team members interviewed felt that the level of communication could have been better, as frequent misunderstandings existed within their teams.

Block IV: Monitoring and control during project progress

(i) Seven members of the total ten interviewed believed that the responsibility to monitor and control the project progress rested with each individual. The team leaders in their teams also play a role in decision making. Team leaders often influence their decision based on the feedback about the project progress from the individual researcher.

Block V: Management of the Team

(i) Eight out of ten interviewed project team members were satisfied with their team members and the overall working environment created by them. They expressed no open complains. In further discussion, they felt that this could be mostly because each member has his/her own sub projects many-a-times requiring limited interaction with other members of the team. But, those collaborative projects that require continuous interactions might have greater team issues, than projects handled by single person (ii) Seven of the interviewed team member felt that failure to obtain results was generally considered "normal" and subsequently analysed for its causes and further built upon it, but further questioning during interview and at open discussion revealed that continuous failure to obtain results can have detrimental effect on the individual member and can sometimes be tagged with the reputation of "being incapable" (iii)

Results from the interview from selected members revealed that even thought the authorship are usually agreed upon at the beginning of the project; other perks such as increase in salary or any other reward to boost motivation are not common.

Block VI: Management of the Project

(i) Most of the researchers that were invited for interviewed and open discussion agreed that their project usually takes more time than it actually deserved. When inquired about the reason for this lag, six researchers felt that it is common for academic basic healthcare R&D research to be slow in most of the stages of the project life cycle compared to applied research in an industry, where it is more important to complete the project successfully and quickly for financial gains. When discussed further, they concluded that this could be one of the reasons for more work pressure amongst their counterparts in the industrial sector compared to academics. (ii) When asked why do projects take more time to accomplish, researchers responded with one or more reasons, which main included insufficient planning, communication and team politics. Four researchers felt that it is due to insufficient communication within their team, seven of the researchers agreed that it was mainly due to insufficient planning, while five researchers felt that team politics at times played a significant role during the life cycle of the project. Some of the minor outcomes of this discussion revealed other reasons for such delays or bottlenecks that may arise during the project life cycle. Some of these are for example, short supply of resources such as reagents, delays in responses from collaborators and/or other members of the project team or at times digression from the main goal of the project. (iii) Seven of the researchers that were interviewed and were discussion with, felt that the projects were managed efficiently within their team. In addition, all agreed that there is still scope for better management through which better efficiency can be achieved.

To summarize the main findings from the interviews and open discussion, most of the interviewed project team members felt that, in their project, the immediate objective was clear, but the final goals were mostly vague. Also, the roles and responsibilities were unclear at the beginning, but as the project matured, the roles and the responsibilities began to clarify. Most delays in project were caused by the insufficient communication between team members and delays in response from collaborators. In

addition, there was a considerable room for improvement in terms of more communication. In the surveyed projects, team leaders generally collected feedback regarding the project, and the decisions were made accordingly. Interviewed members felt that negative results can be accepted few times but are usually not taken positively when they are often the outcome. Only authorship is decided at the start of the project, but rewards, such as a rise in salary, is not a common occurrence. Insufficient planning and team politics issues were observed to result in bottle necks in normal project process functioning. Last but not the least, most project teams lacked a contingency plan that could be useful in handling unexpected situations during the life cycle of the project.

5 A Proposal for Process Framework in Healthcare R&D Projects

To effectively achieve project goals, each project requires defining and drawing out a project process, which, in its simplest form, can be represented by a work breakdown structure. Defining the process, described by a work breakdown structure, involves subdividing the project deliverables and all project activities into smaller and more manageable components (PMBOK 2008b: 49) and then creating a sequence of actions, comprising the project prosess. This work breakdown structure assists in taking decisions and managing the project process. Components of WBS, if summarised, compose a model framework. This chapter will attempt to define a generic framework for a typical R&D project process, and characterize its features, with particular relevance to decision making during the proposed team and project management process.

The proposed framework/prototype for an academic healthcare R&D project process is intended to provide a useful platform for researchers. By utilising this framework/prototype, they are hoped to be helped better predict, control and monitor the project process and, thus, enhance its overall performance. Creating a framework/prototype for a healthcare R&D project process should also help to focus on its relevant variables. Secondly, it is intended to provide a common solution (platform) for R&D project management without incurring any extra costs.

Typically, frameworks/prototype can be of two types: *physical*, which is represented by specific designs; *graphical,* which is represented by different variables of the process in a two or even a three dimensional space; *pictorial*, which is represented by pictures or cartoons used to illustrate the model; and lastly, models can be *schematic*, they are represented by bar graphs, charts, information flow and other abstract images (Kanda 2011).

As for its structure, frameworks/prototypes can be classified as *iconic* or *symbolic*. An iconic model is a scaled up version of a real life situation. For example, the whole process of running a scientific R&D project can be modelled from at the beginning until the end, so as to form a rough estimation of the whole process. If the clarity of the project processes is not high, or there is a limitation of space and time, or there is a

need for a simplified model, a scaled down version of a model can be created. The scaled up version of a model is useful when a greater expression of the process is required; for example, it can be used for describing a mechanism of action of a particular pharmacologically active agent or a molecular pathway in a biological process. Another type of the model based on the structure is the *symbolic* model, where mathematical symbols and principles are utilized Kanda 2009:41.

This Thesis also provides a symbolic model showing the work breakdown structure by drawing a prototype of an academic healthcare R&D process.

As described in Section 2, project management typically include the following stages: (a) initiating a project, (b) building a macro-plan, with subsequently building a detailed plan, and building a project team plan, (c) monitoring and controlling the project, and (d) terminating the project. They can similarly be summarized according to another four basic parts, namely: an initiation phase, a planning phase, an execution phase and a termination phase. If combined and detailed, the steps in an academic healthcare R&D project process can be made into a framework, illustrated in Figure 9.
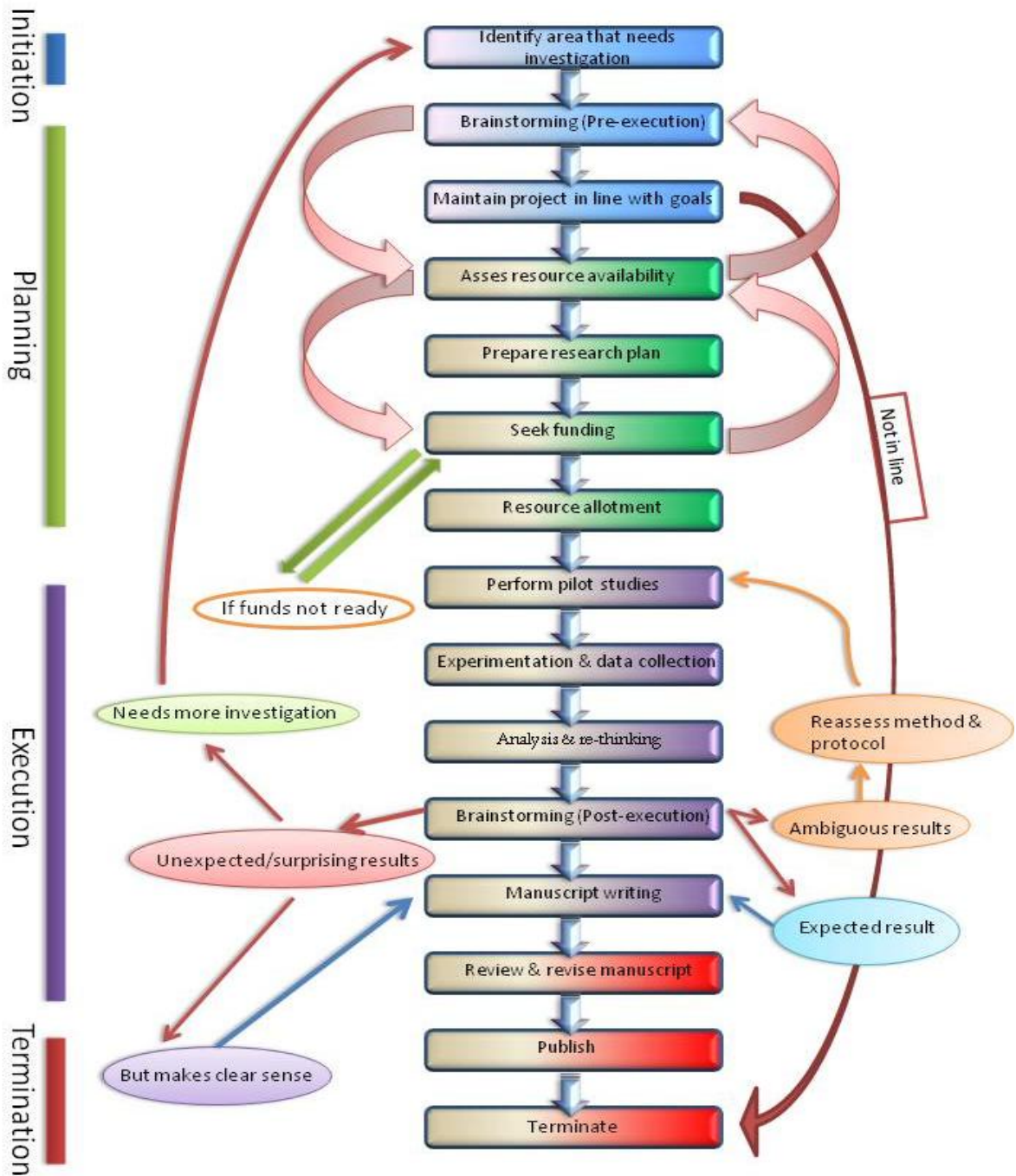
Figure 9. A proposed framework for an R&D project, and the possible paths to be taken during the project process.

As Figure 9 illustrated, the proposed framework has 15 steps. These steps are as follows:

1. Identify areas that need investigation. This may come from any sources such as, results from past project, from an end user (if the outcome of the project is a product or data that can be used by doctor, patient or any other relevant person), and an individual from within a team including the team member.

2. Pre-execution brainstorming with the team members to discuss and understand the realistic situation, share known knowledge and throw in new ideas about the area under investigation. During this stage the availability of resources to be able to complete the project can be assessed.

3. Defining the scope of the project to maintain it in line with the goals of the research group. If the idea is not in line with the goals of the project team then it is often better to terminate the project, unless the project team is seeking diversification of their research area of focus.

4. Assessing the availability of resources that will be needed during the life cycle of the project. If the resources such as funds, materials or instruments are not sufficiently available, funding must be sort. The project often cannot proceed without sufficient resources.

5. Preparing a research proposal or a research plan that will form a baseline for the entire project processes at different phases of the project. This research plan can also be helpful while seeking funds as most funding bodies ask for a research plan, before taking an appropriate decision.

6. Seek funding that is necessary to see the project through with minimal financial constrains.

7. Allot tangible resources, such as manpower, funds and materials to each stage of the project. Resources such as funds and materials must not be fully allotted and a reserve must always be kept to meet any unexpected requirements.

8. Once the plan and the resources are available, a pilot study can be initiated.

9. If successful, a full scale experiment can be initiated so as to collect necessary data required to prove the study.

10. The next step is to analyse the data and reflect upon it.

11. Post-execution brain storming with the team members. This can be done to discuss the results, its relevance and importance within the scientific community, patients and the general public.

a. If unexpected results are the outcome but they make clear sense, manuscript writing can be initiated.

b. But is the unexpected results are dubious, more investigation is needed to identify this interesting result. This can sometimes turn out to be a new project in itself.

c. If the results are ambiguous then the experimental methodology can be reassessed, reagents and all relevant experiment related issues can be rechecked and the pilot can be re-run.

d. If the results are expected results, then the project proceeds to the next step f manuscript writing.

12. The next step is to draft a manuscript which will highlight the details of the experimental procedure, results obtained and the significance of the project.

13. Review and revise the manuscript, with the other team members of the research group, to discuss, constructively criticize and pour in new ideas that may have been previously not thought of.

14. The next stage is to send the written manuscript for publication to a relevant journal and subsequently revise the manuscript before the final publication.

15. The final stage, but may not be limited to, is that of termination. Here the documentation regarding the entire project stages are collected and stored. The team leader as well as the team members can meet to reflect upon the project and identify causes of failure and success encountered during the project life cycle with an intention to take experienced decision and build upon it in the future projects.

Control and monitoring- forms an important part of the planning and execution phase. The preplanning phase includes identifying the area the issue that needs investigation. Once the area of interest is drawn the scope is then narrowed down so as to make it practical and avoid digression of focus, taking into consideration all the other relevant aspect such as availability of resources and the project team. This brain storming process does not confine only at this stage, but must be kept running at the background at all the stages of the project process.

It is important to maintain the project in line with the goal of the organisation or the higher goal of the team. If the project idea is good but it is not in line with the ultimate

goal then it is often better to let go of the idea and terminate the project, instead of spending useful time and resources in divergence. Further scoping of the project can be done if necessary. Divergence has to be as far as possible avoided to maintain expertise and leadership status in a particular area.

Resource and time are most often limited in most projects. Therefore it is important for the team leader to maintain the budget and get most work done within the time schedule. It will be naive of the team leader to expect his/her junior team members to be efficient at resource management and provide them the liberty to utilize the resources at will.

The next step of the project process is to prepare a research plan which is in fact a documentation of the proposal of a path to be taken for solving the issue that is has been identified. This research plan is also utilized to apply for funding for the project. The subsequent step is to seek funding from funding bodies. Once the funds are available, it is not wise to dwell in to the execution stage directly. Considerable attention must be devoted to allot resources to specific stages of project process. Resources must never be utilised completely, a balance amount must always be kept aside to counter any unexpected situation.

During the execution and control stage of the project management, the project manager can delegate decision making tasks to his/her team members. The project manager can at this stage simply act as a mentor and closely observe the progress of the process. The execution processes includes performing pilot studies, experimentation and collection of data, analysis of the data, post execution brain storming and manuscript writing.

It is important that all these processes are closely controlled and monitor by individual team members and the project manager. In case the results obtained are unexpected or surprising then they must be carefully evaluated. If they make obvious sense then manuscript writing can be commenced. If the results are complicated and are leading to an entirely new idea then it project processes must be started from the beginning.

When ambiguous results are the outcome then the method and protocol must be evaluated. After few changes in the method or the protocol previously used, pilot studies must be carried out once again. The final stage in the project management is to review the manuscript, submit it and terminate the project. Terminating the project must be done carefully. All the documentation done during the project processes must be collected and stored for further reference.

Never the less, the smooth functioning of the project is not free from challenges. There are several factors that can influence, either directly or indirectly, the outcome of the project. These factors can come from the project management itself, such as clarity of goal, clarity of roles and responsibilities and a proper functioning structure. In addition, it may also arise from human characteristics, such as the level of commitment by each individual and the team as a whole; the personality of the leader and his leadership style, and the issues of mutual respect and understanding between the individual members of the team.

Summing up, this study proposes a framework/prototype for an academic healthcare R&D project process. The proposal framework aims at providing a common, generalized project management platform for researchers working in healthcare R&D sector. This framework consists of four phases and 15 steps, which starts from initiation phase of the project, continues with the planning phase, execution phase and end at the termination phase of the project life cycle. These four phases includes, but are not limited to, 15 steps that are suggested in this framework. To summarise these stages briefly, these stages include the initiation and the planning phases are identifying the area of research, project scoping and goal alignment, assessing resources, preparing a research plan for forming a baseline for the entire project stages and for subsequently seeking funding, allotting resources for the different stages of the project. The next phases are that of the execution and termination. The execution phase includes performing pilot study, depending upon its success a full-scale initiation of experimentation and/or data collection can be initiated. A team project meeting can be called upon to discuss the results and pour in new suggestions, arguments and constructive criticism. The next step is to draft, review and revise the manuscript and publish it in a relevant journal. The final stage of this frame work is to terminate the project. All relevant documents can be collected and stored. Useful

experiences during the success as well as failures during the project can be identified and used for better decision making in handling future projects. This model was generated based on the results of the study conducted among the members of healthcare R&D projects (survey, interviews and open discussion).

By utilising this framework/prototype, the study intends to suggest a solution which is hoped to help better predict, control and monitor the project process in healthcare R&D projects and, this, help to enhance their overall performance. Another objective in creating this framework/prototype was to better define the constituents of the project process. This framework also aims to provide projects in healthcare with a common tool (platform) for R&D project management without incurring any extra costs in its management. For practical use, this framework is represented as a scheme, comprising a sequence of actions into the holistic healthcare R&D project prosess.

6 Discussion and Conclusions

An increasing speed of new knowledge generation and a growing specialization of individuals in specific fields make R&D projects more and more widespread to stay abreast of the latest technological developments. However, studies targeting R&D project management have almost exclusively focused on industrial R&D projects, neglecting the importance of academic R&D projects in other fields (Niedergassel et al. 2011: 142). Consequently, this area called for investigation, and this study has taken up this challenge and attempted to partly fulfill this need. A project in the healthcare R&D sector is an endeavour to accomplish specific objectives connected with the project management in this field, requires practical skill as much as knowledge.

To accomplish research objectives, two main tasks were performed: first, the currents state in healthcare R&D projects was investigated (by conducting a survey, interviews and open discussion); and second, a framework for a healthcare R&D project process was developed.

The survey, which opened this study by investigating the opinions of the project participants, discovered the following. The clarity of the overall project goals, when the participants start the project at the initial project stage, was discovered to be typically quite vague. However, the immediate objectives in the projects, according to the survey results, were typically clear for most of the surveyed participants. Concerning the typical work breakdown structure of the projects, developed and presented to the participants, it was discovered to be lacking. The development of work breakdown structures was considered as a possible useful measure to bringing in more clarity to the projects. As for the distribution of roles and the responsibilities in the projects, they were characterized as unclear at the initial stage of projects. Frequent project meetings and feedback sessions were proved to be held, but the surveyed participants felt that communication was still lacking. The survey registered a limited sharing of project ideas and information in the project teams. Monitoring and control were answered to be implemented in every project, with the tasks of monitoring and control mostly delegated to each individual member. Team dissatisfaction with regards to the team members and the environment created by the team members was high, but there was

room for better management in most surveyed teams. Importantly, a proper project management tool was considered desirable in most project teams.

The survey findings can provide managerial implication and insights for project team members involved in healthcare R&D project. Training sessions are conducted once in a while in most established organisation, while the fact of the matter is that in an academic R&D scenario, team managers do not usually find time to inculcate best practices in project management within their project processes and project team. In other words most, academic scientific R&D teams are less familiar with the project management and how to complete projects successfully. This Thesis surveyed individual researchers who were a part of an academic scientific R&D team. A questionnaire that was prepared based on existing theory was prepared and used in this survey study. This study not only aims to be an eye-opener of project leaders but also would provide recommendations and a prototype on how projects could be handled for better. Based on our finding from the results of the survey and the interviews, the following conclusions were made.

Block I: Project goals and objectives

Most of the surveyed researchers start the project with only immediate objectives in mind and usually an unclear idea of the goal. Another interesting finding this survey revealed was that most of the surveyed team lacked a proper structure of the project process. Thus it became evident in among the surveyed researchers that the clarity of goals did not or most often did not always appear at the initiation stage. Understandably, R&D project is an endeavor to achieve uniqueness initial planning may not be feasible as uniqueness implies that it is impossible to know all the necessary activities at such an early stage (Andersen 1996;89). An advantage of this is that the flexibility of the project is maintained while the disadvantage is that since the clarity is lacking the project goals become hazy and inefficiency and considerable wastage of time creeps in. But immediate project objectives are quite clear. This suggests that most project manager relies on an ideology that once the objectives are achieved the goal will become clearer. The approach taken by team leaders may be due to the fact that the R&D projects seldom turn the way that they were planned originally (Bart 1993;187). Similar to this line of thought, McGinnis and Ackelsberg argue that

ambiguity in goals and processes is necessary to produce better results by instigating better search and experimentation, which otherwise may not be thought about (McGinnis et al. 1983;59). The projects are only sometimes socialised within the organisation that involves usually a large number of teams. This may be due to the fact that contemporary members are faced with fierce competition that compels them to fear for the security of objectives or goals. But a symbiotic relation can foster only when it is clear that both the participants will reap benefits. Survey results showed that there is no formal method for preparing an initial project plan to clarify the project objectives and goals. Conversely, a detailed project plan would without any doubt increase the productivity of the project many fold.

Block II: Roles and responsibilities of individual members

Most of the surveyed team members somewhat understood their roles and responsibilities within the project. It is usually the case in research involving unique innovation that processes are also unique at some stages. Thus clarity with respect to roles and responsibility of most team members may get prominent as the project progresses. Differences in opinion may arise as each individual may have his/her own ideas as to how the project must proceed.

Block III: Communication and collaboration in the project

Communication is yet another important factor that increases unity and team work as well as affect the performance of the project directly. Project team meetings are organised to share and discuss issues that are relevant to the project. They form an important tool for communication during the project life cycle. To enhance the effectiveness of communication constant flow of information amongst the individuals of the team is essential and must not only be restricted to the project meetings. The survey revealed that most of the team members felt the communication lacked significantly, even though groups meetings and such organised planned sessions were organised frequently even though the project meetings are organised regularly, the level of communication was not sufficient. This is an indication to the project managers and the management running the organisation that the level communication individual members require goes beyond team meeting. Communication is a constant process

that needs to always be at its highest level and at all times. It is not only important for the project but also important to create an appreciable working environment. Also, the project ideas and information are not shared effectively. One of the reasons that may result in ineffective communication is due to fierce competition from outside and within the team. Nevertheless, the understanding between team members does not suffer.

Block IV: Monitoring and control during project progress

It is necessary to balance the control of time, cost and quality of work, with a target to maintain the project on schedule, within the budget and without compromising the quality of work. Often project teams find themselves constricted by the amount of funds available for the project, which includes salary of the team members and the cost of the materials and other resources needed for the project. It is often the case that the cost is controlled by hiring less skilled members, subsequently affecting the quality of the work and the more often than not exceeding the time schedule. On the other hand too much control may constrict the number of options that are considered during the R&D project process and the planning processes could turn out to be a danger itself (McGinnis and Ackelsberg, 1983;59). Project team members felt that it is each individual's responsibility to be a part of process monitoring and control. Therefore most surveyed teams did not have a specific person to control and monitor the project process during the entire project life cycle. Healthcare R&D projects academic can often deviate from their original plan and therefore a flexible contingency plans may suite these type of project. Amongst the responses obtained in this study most teams did not have a proper contingency plan to handle unexpected crisis.

Block V: Team Management

Formal selection process can be important, as teams members can be a decisive factor in determining the success of the project. The project manager and the management must not only look for core competencies of the member in the team but must also attempt to recognise the individuals personality and determine if it will be compatible with those of the project team. Personality clashes may arise at the initiation and the

storming stage of team development eventually neutralising and subsequently increasing in unity.

Motivation can be an important issue in most project teams and therefore has managerial implications. One of the ways it can be increased is by rewarding and appreciating good work or performance. Reward can be relevant only if the reward satisfies the needs of the recipient in some form. Rewards can be of two types- tangible and intangible (PMBOK 2008c;234). For the individuals in an academic healthcare R&D team tangible would include an increase in salary and the intangible would be authorship in the publication resulting from the study, recognition within the team or may be an award. The survey results revealed that usually the rewards are limited mostly to authorship in publication.

In addition results from the surveyed project team members revealed lower satisfaction with the working environment and most surveyed team members believed that the project team and the project process could improve with better management. It is quite common to see project managers overloaded with responsibilities which in turn compromise his/her management abilities. Prominence of this fact increases when the project manager has a larger team to manage.

Most of the surveyed team members agreed that no formal structure was constructed that would assist in managing the project. Typically in production collection of tasks are listed out and for each task standard operating protocol or better known as SOP's are employed to streamlined processes until completion of the project. Such a methodology can be to an extent employed in a scientific R&D project where most of the processes could be streamlined to avoid repetition. Neither do most surveyed project teams invest on a model/prototype to see their project through. Therefore, this Thesis also provides a prototype coupled with a work breakdown structure for carrying out scientific R&D projects.

It is essential that every team must learn continuously from success and failure that they go through. The causes of these successes and failure can then be documented for guiding projects in the future. This survey done on academic scientific R&D teams shows a distributed pattern towards this issue. Not all project members feel that the

causes of failure is determined within the team and built in to the learning process. In today's competitive environment negative results is often not acceptable. This can in turn result in an increased amount of pressure to obtain successful results that the team members find themselves in.

It is more important to identify causes of failure or success, document it if possible and rectify the failures or retain the causes of success for future projects. Learning seems to result from problems and failures from previous projects and also provides individuals with experience to be sued for future use (Verganti 1999;363). Every project and the project manager must imbibe previous learning experiences in to their current project processes.

Most successful teams have an abundance of new and old knowledge in their research and development laboratories, and only a fraction is being put into use in new product development. Knowledge gained during the project process that can be considered as left over's from projects are many-a-times ignored. Tukel *et al* in his article proposed a knowledge bank as a possible solution to preserve and possibly grow this knowledge (Tukel et al. 2011;59). It was observed that in academic R&D teams a considerable amount of members felt that learning experiences are not inculcated in the current project. One of the reasons for this is that the project managers most often find themselves stereotyped with time, thereby decreasing their level of flexibility on how to approach certain objectives or specific tasks in the project process.

Block VI: Project Assessment

Results from the interview showed that most project team member believed that their project took more time to accomplish than it actually deserved. This was often due to slowness of communication within the group and with the publication authority. Often also team politics or short supply of resources influenced the speed of the project at different stages of the project.
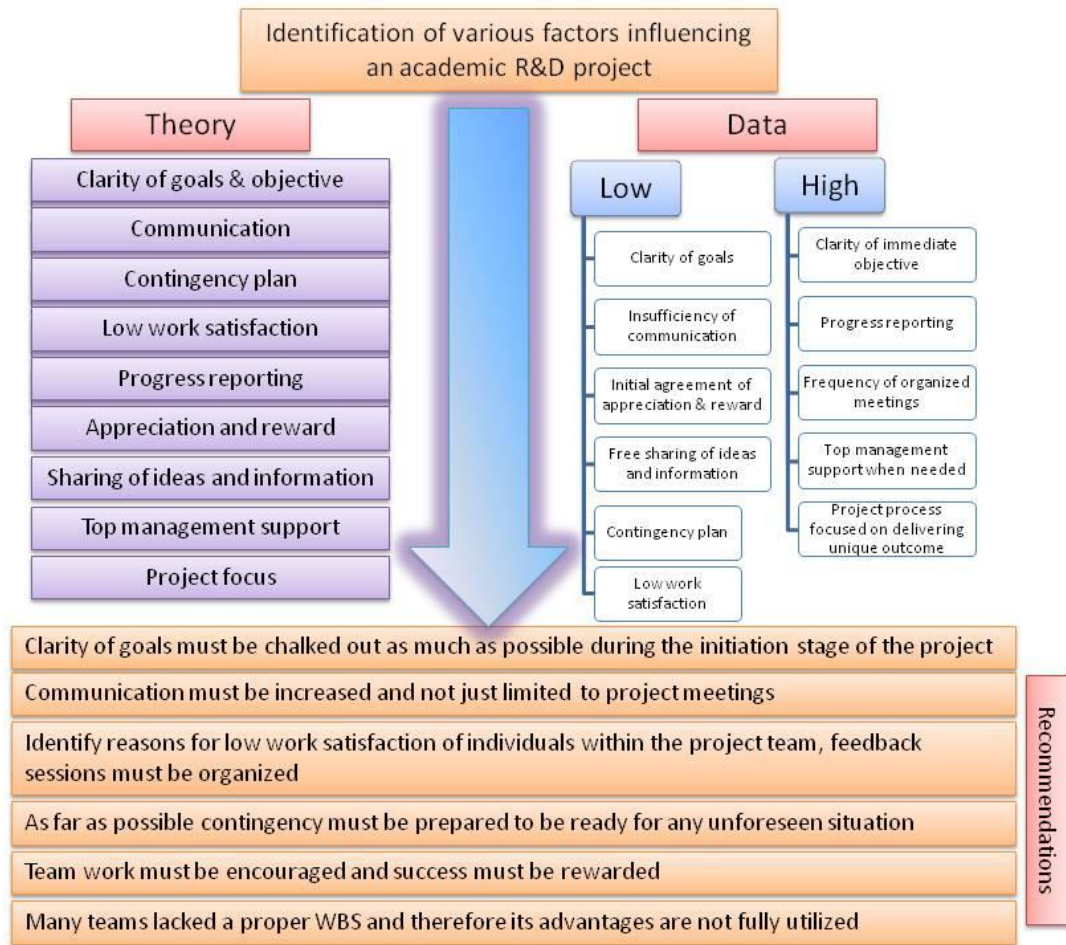
Figure 10. Outcome of theory and data obtained from results. The data was divided in to low and high level of agreement on the basis of likert's scale.

Top management support to see through the project was mostly available and did not seem to be a major problem, even though most team members felt that the team can improve even more in performance with an even better management. This management issues does not pertain only to the project manager higher up the management hierarchy.

Control is implemented in the project processes which are mostly aimed at delivering unique outcome. Most team members believed that their project team is result oriented. More often than not contingency plans are not chalked out initially but are dealt with as and when the project processes reveals it. There is likelihood that this

process may compromise the efficiency in project by exceeding the time schedule and increasing the costs directly.

This Thesis implemented a survey with 62 individuals who responded from a total of 200 individuals to whom the questionnaire that was sent. A larger number of respondents would be ideal, but due to time constrains, the relatively low number of respondents was considered sufficient to provide sufficient data for this study. Also, it would be ideal to enlarge this study involving teams from different countries and cultures and to measure the efficiency in handling similar kind of projects.

Nevertheless, this study highlights the important issues that face academic scientific R&D project teams. This Thesis reveals that the efficiency of project processes are relatively low and contrary measures must be taken to improve the productivity. Utilizing the understanding from this Thesis a frame work can be drawn as a recommendation as to how the process can be better streamlined so as to increase efficiency and productivity.

7   Managerial Implications

Based on the findings, this study suggests a set of recommendations for the managers of academic healthcare R&D projects. These recommendations include the following suggestions:

- The clarity of the goal must be detailed as far as possible, preferably at the very beginning of the project, that is, even before the project initiation stage.

- A contingency plan, developed beforehand, can help to face unexpected situation. It can be a useful alternative to the 'wait and see' policy.

- To avoid misunderstanding and repetitive work, as well as to enhance the clarity of objectives and goals, communication must be as efficient (and sufficient) as possible.

- Since frequent reporting of progress, with respect to the project goals, was found to be practiced, and approved of, in most surveyed teams, progress reporting can be considered as an important tool of the project implementation, which should be enhanced in those teams which neglect it.

- The reason for low work satisfaction amongst members in the team must be identified, and corresponding corrective measures must be taken. For instance, feedback meetings can be organised to collect information of any kind on issues that may arise during the project.

- Team work must be encouraged and, at the same time, individual participant's success must be appreciated, so that to increase motivation and loyalty towards the project. A good strategy could be to recognize the team's and members' progress during the cycle life of the project, rather than keep till the final completion of the project.

- Project focus must always be maintained, until the end of the whole project life cycle.

- Project teams that were surveyed lack a work breakdown structure, or a proper framework, which would enable a better project management. The framework suggested in this Thesis can be used as a trial, generalized prototype, with subsequent modification to suit a particular healthcare R&D project.

8   Summary

In today's competitive R&D world, project management has turned out to be a valuable skill to possess. However, it is evident that most of the papers published on project management issues are focused on industrial R&D projects, with healthcare project management being overlooked.

This study was devoted to the problem of identifying the factors that can influence the functioning of processes during the life cycle in healthcare R&D projects. To achieve these goals, the study identified a number of factors directly influencing the project management, such as the clarity of goals, communication within the project team, contingency plan, progress reporting, appreciation and reward to enhance motivation, open sharing of ideas and information, and some other factors that can influence the management of an academic healthcare R&D project.

This study, after investigating 62 members of healthcare R&D projects (in a survey), conducting 10 interviews, and carrying out one open discussion (with five project members), identified the following facts and areas for development.

Even though the *clarity* of the ultimate *goals* of the surveyed academic R&D projects are, to a certain extent, hazy, the immediate objectives are clearly understood by most members of the project team. *Communication* in healthcare R&D projects is perceived as not sufficient and is mostly limited to project meetings. Moreover, the data obtained from interviews suggest that the communication within the team suffer most, as compared to communication with the project team leader. *Progress reporting* is thought to be of high importance by project participants, with most teams organising their project reporting meetings frequently. It was discovered that many teams lack a proper *contingency plan* and a proper *work breakdown structure* of the project process. Low *work satisfaction* was prevalent amongst most team members that were surveyed, which, with caution, can be attributed to the above mentioned challenges. On the other hand, *top management support* was available in most of the teams whose members were coved by the survey. Participants also stressed that their academic R&D projects are focussed on delivering a unique outcome.

Based on the results of the survey, interviews and discussion, as well as backed by the finding from the literature review, this study proposed a framework/prototype for an academic healthcare R&D project process. The proposed framework aimed at providing a common, generalized project management platform for researchers and project managers working in healthcare R&D sector. This proposed framework consists of, but are not limited to, 15 steps, which starts from initiation phase, continues with the planning and execution phases and end at the termination stage of the project. In summary, the stages suggested in this framework include, identifying areas that needs to be investigated, scoping of the project and maintain the project in line with the goals of the research team, assessing the availability of resources, preparing the research plan, seeking funding and resource allotment. The next phase is that of executing the project. Here a pilot study can be performed, depending upon its success a full-scale experiment can be run to collect results and/or data. A post execution project meeting can be held to identify loopholes and pour in suggestions and thoughts. The next stage of the framework is to begin writing the manuscript. The manuscript will then be revised and resubmitted for publication. The final stage of this framework is to terminate the project. Relevant documents and protocols used can be sorted for future use. Useful learning experiences that were obtained as a part of the project life cycle can be noted. These experiences can be used for taking better decision in future projects.

By developing this framework/prototype, the study aimed to suggest a solution which is hoped to help better predict, control and monitor the project process in healthcare R&D projects, and, thus, help to enhance their overall performance. Another objective in creating this framework/prototype was to better define the constituents of the project process. This framework also aims to provide project management in healthcare R&D sector with a common tool (platform) for R&D project management, without incurring any extra costs. For easy practical use, the framework is represented as a scheme, comprising a sequence of actions into a holistic healthcare R&D project prosess.

Managers handling the projects in the healthcare R&D sector can utilize the results of this study in their everyday work on project management. This Thesis identified and

located relevant stages typically existing in healthcare R&D project. Understanding these factors and taking actions accordingly, can enhance the functioning of the projects and their desired outcomes. People management skills are equally important as process management skills, and the proposed model aimed to combine these skills in one process solution.

This study open this field for future research which is needed to further identify the factors that may influence the success or failure of an academic healthcare R&D project. In this Thesis, a set of factors was identified and built-in the framework in hope enable ordinary researchers and project managers to select most relevant factors making an impact on the project processes. A further, in-depth study is necessary to further develop and refine the proposed scheme, with a broader, more representative collection of data, using a plethora of research methodologies currently available.

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Appendix I: Questionnaire used for collection of data

Thesis Questionnaire

Dear respondent,

This questionnaire is a source for collecting data for my research aimed at understanding the factors related to project and team management which can influence healthcare R&D projects.

Project success in scientific research this can be evaluated by the quality of the publications or customer satisfaction. The measurements parameters used in this questionnaire include questions regarding team and project clarity, Project handling and team managementThis Thesis will try to distinguish a good project organization and recommendations on how to improve performance.

I take this opportunity to appreciate you in advance for your support and time. I hope that you will deliver the questionnaire back to me and please do not hesitate to ask me any further questions that you may have.

Sincerely,

Praseet Poduval., PhD
0400876859
praseet@gmail.com

PERSONAL INFORMATION

* Mandatory

1. Name   : _____
2. Age   :

_____

3. Gender*   : _____
4. Last Education*   : _____
5. Email Address   : _____
6. Company Name   : _____
7. Company Type*   : _____
8. Job title*   : _____

9. Experience* : _____

10. No. of years in the current team: _____

Based on your experience in managing projects, please choose one best answer which describes what is needed to achieve project success in your company.

Please fill the circle.

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

CLARITY OF GOALS AND OBJECTIVES

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	Your project's goals and objectives are clearly defined	○	○	○	○	○
2.	Goals and objectives for your particular work in the project must be clearly defined	○	○	○	○	○
3.	In depth clarity of each project objectives is necessary	○	○	○	○	○

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	A formal process for selecting people to work in project team is needed	○	○	○	○	○
2.	Progress have to be reported frequently in project meetings	○	○	○	○	○
3.	The quality and timing of communication within the team is needed	○	○	○	○	○
4.	Roles and responsibilities should be define	○	○	○	○	○
5.	Discipline regarding time, cost and quality is necessary	○	○	○	○	○

6. The tasks assigned to the responsible people are carried out satisfactorily in my team

    ○   ○   ○   ○   ○

7. Successes should be determined and built into the learning process

    ○   ○   ○   ○   ○

8. Learning and continuous improvement should be part of projects

    ○   ○   ○   ○   ○

9. Planned communication sessions should be conducted to give and obtain feedback

    ○   ○   ○   ○   ○

10. Top management support for the project is essential

    ○   ○   ○   ○   ○

11. Appreciation, rewards and recognition should be agreed when goals are set and aligned with organization policy

    ○   ○   ○   ○   ○

12. Project ideas/information is freely shared by all

    ○   ○   ○   ○   ○

13. Social gatherings and festivities associated with projects are held in my team

    ○   ○   ○   ○   ○

14. My team can be more efficient with better management

    ○   ○   ○   ○   ○

15. Formal processes/procedures are used, helping us to better manage our projects

    ○   ○   ○   ○   ○

Project Handling

Project Life Cycle Management Processes (Initiation, Planning, Execution, Closure)

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	A model of stages of project life cycle are needed when managing projects (e.g initiation stage, definition stage, implementation stage)	○	○	○	○	○
2.	Control is necessary to monitor progress and take necessary action	○	○	○	○	○
3.	Our team understands and prepares a project life cycle model before beginning any project	○	○	○	○	○
4.		○	○	○	○	○
5.	The project process should be focused on result and delivering unique outcomes	○	○	○	○	○
6.	The project process must be clearly visualized and describe	○	○	○	○	○
7.	A detailed specification of individual actions for project implementation are needed	○	○	○	○	○
8.	Availability of technology and expertise is necessary to control and complete tasks with success	○	○	○	○	○
9.	Integration sessions add value to the overall process	○	○	○	○	○
10.	Contingency plans should be prepare to handle unexpected crises and deviations from the original plans	○	○	○	○	○

Appendix II: Questionnaire used during the interviews

1. Did you in the past feel that your past projects took more time than it actually deserved?

2. Why did you past academic healthcare R&D projects take more time to accomplish than it deserved? eg., inefficient communication, team politics, short supply of resources?

3. According to your past experience do you believe that detailed planning would have made your project achieve better success, accomplish tasks in a shorter time and made the process more efficient?

4. Projects are managed efficiently in my team

5. How often is the progress of your project evaluated

6. Do you work in collaboration turn out to be effective and produce desirable results?

7. How is monitoring and control of the project carried out in your team?

8. Is communication efficient within your team

9. Are you satisfied with satisfied with your team members and the working environment created by them?

10. Is failure accepted and built in to the learning process in your team?

11. Do you have a clear understanding of your role and your responsibility with respect to the project?

12. Is your goals and your immediate objectives with respect to your project clear?

Appendix III: The frequency of the different level of agreement (-5), the mode, median and the mean of the responses to the survey questions

Sr. No.	Questions	Frequency * 1 2 3 4 5					Mode	Median	Mean
1	The project's goals and objectives were clearly defined	6	35	17	4	0	2	2	2.306
2	Your immediate objectives for your particular work in the project was clearly defined	0	3	17	32	9	4	4	3.770
3	Project objectives were socialized in the organization to gain additional clarity of final goal	0	24	27	9	2	3	3	2.823
4	In depth clarity of each project objectives were chalked out during the initial project meetings	3	39	18	1	1	2	2	2.323
5	A formal process for selecting people to work in project team was carried out in my team	0	2	16	31	13	4	4	3.887
6	Progress were reported frequently in project meetings	0	3	8	28	23	4	4	4.145
7	The frequency, quality and timing of communication within my team were sufficient	6	35	17	4	0	2	2	2.306
8	Roles and responsibilities of each members were define	0	7	38	13	4	3	3	3.226
9	Control regarding time, cost and quality was enforced in my team	0	2	41	19	0	3	3	3.274
10	The tasks assigned to the responsible people were carried out satisfactorily in my team	3	15	30	14	0	3	3	2.887

11	Causes of failure were determined and built into the learning process	1	20	28	12	1	3	3	2.871
12	Failure was accepted and considered as a learning experience in my project team	2	27	30	3	0	3	3	2.548
13	Planned sessions were organized regularly to give and receive feedback	0	5	22	30	5	4	4	3.57
14	Top management support for the project was always available	0	1	31	27	3	3	3	3.52
15	Appreciation, rewards and recognition were agreed when goals are set	2	42	17	1	0	2	2	2.27
16	Project ideas and information were freely shared by all	6	33	19	2	2	2	2	2.37
17	Social activities associated with projects were held in my team	0	10	38	13	1	3	3	3.08
18	I feel that my team can be more efficient with better management	0	0	8	42	12	4	4	4.07
19	Formal processes/procedures were used, helping us to better manage our projects	0	25	33	4	0	3	3	2.97
20	Control is necessary to monitor progress and take necessary action	0	16	41	5	0	3	3	2.82
21	The project process are discussed during meetings to maintain focus on delivering unique outcomes	0	3	21	29	9	4	4	3.71
22	Contingency plans were prepare to handle unexpected crises and deviations from the original plans	7	32	17	5	0	2	2	2.63
23	Projects were managed with	5	21	18	14	4	2	3	2.86

#	Statement	1	2	3	4	5			Mean
	excellence in my Group/Company								
24	My team had specific person who identifies faults & errors and reports it before it is too late	6	20	28	6	2	3	3	2.65
25	Responsibility to identify and report faults and errors was a duty of each individual member of the team	1	5	14	25	16	4	4	4.47
26	I have a good understanding with most members of my team	2	14	27	17	2	3	3	3.05
27	I am highly satisfied with my team members and the working environment created by my team members.	3	34	12	10	3	2	2	2.61
28	There are teams within my team who share their expertise with great hesitation	1	8	41	11	1	3	3	3.05

*Level Of Agreement: 1= Strongly Disagree

2= Disagree

3= Neutral

4= Agree

5= Strongly Agree

Appendix IV: Bar graph of the results showing the level of agreements to the questions from the questionnaire.

Clarity of individuals immediate objectives
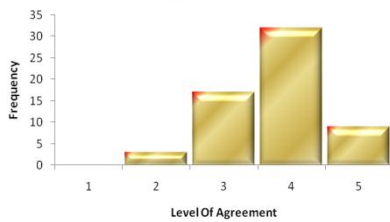
Clarity of project's goals and objectives
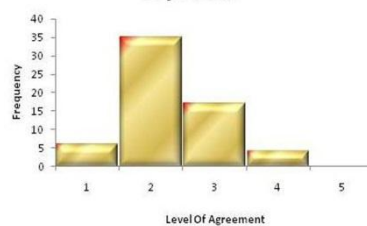
Initial chalking out of in-depth clarity of project objectives, such as WBS
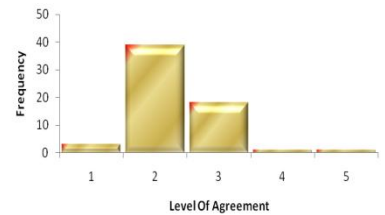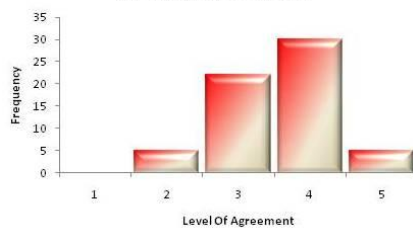
Roles and responsibility of individuals in the team
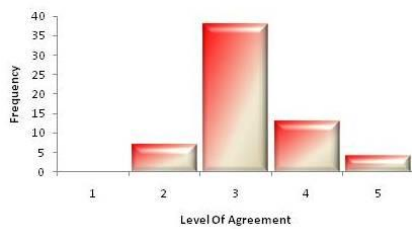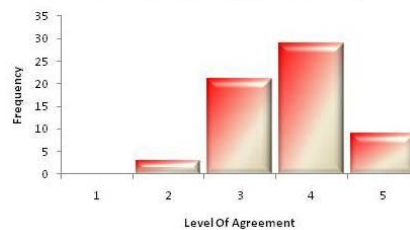
Individuals carry out assigned tasks satisfactorily
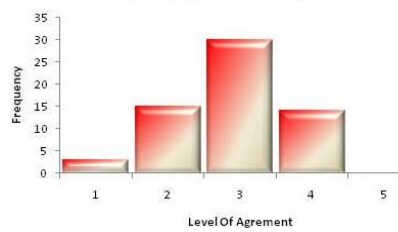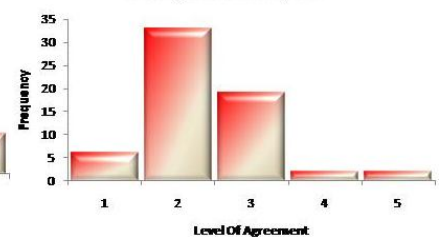
Reporting of progress in group meetings
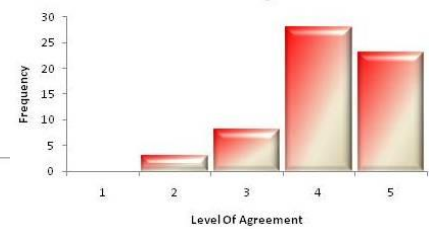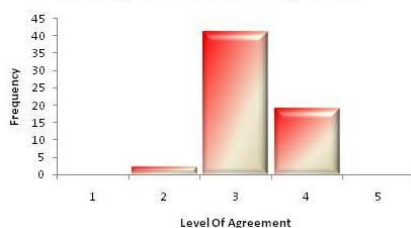
Planned sessions are organized to exchange feedback

Project processes are focused on results & unique outcomes
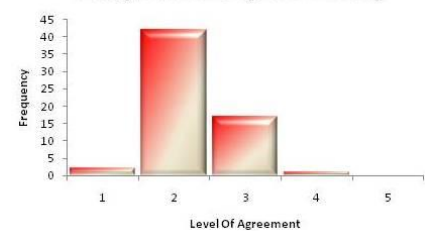
Project ideas & information are freely shared by all

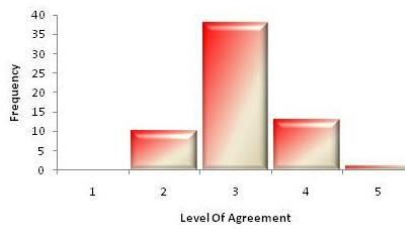**Control regarding time, cost and quality is inforced in my team**

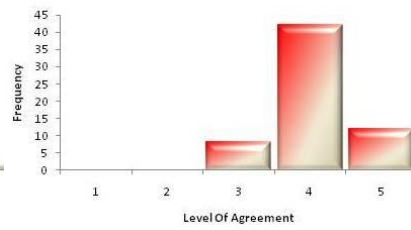**Contingency plan in unexpected situation or during deviations**
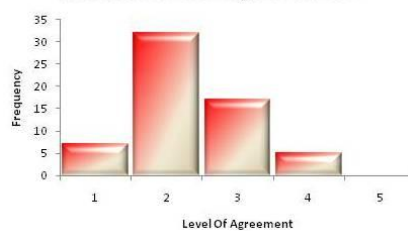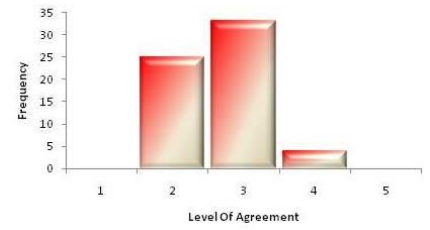
Appreciation, rewards & recognition are agreed initially

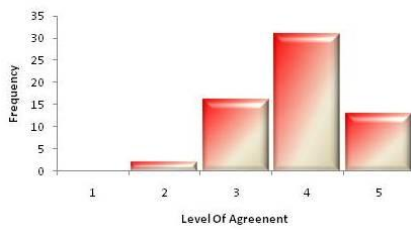## Gatherings & parties associated with projects are often held

Frequency vs Level Of Agreement

Level	Frequency
1	0
2	11
3	38
4	13
5	1

Team can be more efficient with better management

Frequency vs Level Of Agreement

Level	Frequency
1	0
2	0
3	8
4	42
5	11

Formal processes/procedures are used to help manage projects

Frequency vs Level Of Agreement

Level	Frequency
1	0
2	25
3	33
4	4
5	0

Formal selection process undertaken for project team

Frequency vs Level Of Agreeent

Level	Frequency
1	0
2	2
3	16
4	31
5	13

Causes of failure are determined & built into the learning process

Frequency vs Level Of Agreement

Level	Frequency
1	1
2	20
3	28
4	12
5	1
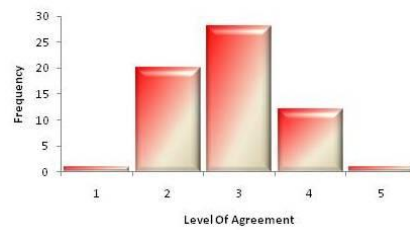
Availability of management support

Frequency vs Level Of Agreement

Level	Frequency
1	0
2	1
3	31
4	27
5	3

Projects are managed with excellence in my Group/Company

Frequency vs Level Of Agreement

Level	Frequency
1	5
2	21
3	18
4	14
5	4
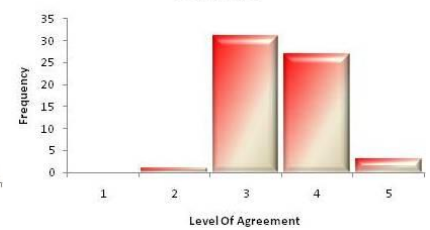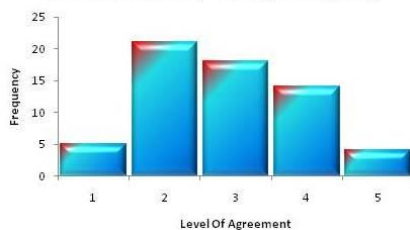
Person appointed to identifiy faults & errors

Frequency vs Level Of Agreement

Level	Frequency
1	6
2	20
3	28
4	6
5	2

Individuals have the responsibility to identify faults & errors

Frequency vs Level Of Agreement

Level	Frequency
1	1
2	5
3	14
4	25
5	16
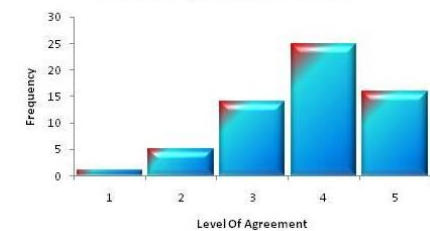
Good understanding with members of the team

Frequency vs Level Of Agreement

Level	Frequency
1	2
2	14
3	27
4	17
5	2

Satisfiacton with team members and the working environment

Frequency vs Level Of Agreement

Level	Frequency
1	3
2	34
3	12
4	10
5	3