



ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF COMPUTING

**Innovation Assessment Framework in Software Development Projects
for Software Startups**

Kelemework Kindie

January, 2016



**ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF COMPUTING**

**A Thesis Submitted to the Department of Computing of Adama Science
and Technology University in Partial Fulfillment of the Requirements
for Degree of Master of Science in Software Engineering**

By

Kelemework Kindie

**January 2016
Adama, Ethiopia**



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DECLARATION

This thesis is my original work and has not been submitted as a partial requirement for a degree in any university.

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ACKNOWLEDGEMENT

First and foremost thanks to God, who makes everything possible. My gratitude goes to my advisor Dr. Mesfin Kifle without him such work would have been impossible. He gave me constructive and invaluable comments throughout this thesis work. Without the presence of his constructive, critical and friendly suggestions, this thesis would not have been Possible.

My special thanks goes to the software development and ICT organizations in Addis Ababa for their support by providing valuable information regarding my research work.

I would also like to thank Dr. Nirmala Mungumaru, for her Commitment, constructive suggestion, constant support and encouragement. Her appreciation and input to my work helped me to make my research more vital.

I would like to express my deepest thanks to my Classmate and my friend Mr. Mesay Aschalew who has been on my side at every time whenever I am in need of him in terms of providing me moral and knowledge shares during my stay in the University. He has been there with me up to end of the research work. He has been acting as my brother in those times. I never forget him. I would also express my gratitude to my friend Mr. Duresa Deksiso who helped and with me during gathering of the research data.

Finally, the acknowledgement would be incomplete without extending my deepest gratitude and respect to those people who were not mentioned here but their presence and efforts have been inspiring me. Thank you all!

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LIST OF ACRONYMS AND ABBREVIATIONS

ASTU.....	Adama Science and Technology University
TIEC.....	Technology Innovation and Entrepreneurship Center
CEO.....	Chief Executive Officer
RQ.....	Research Question
SLR.....	Systematic Literature Review
INT.....	Interviewee
Sr.....	Senior
HR.....	Human resource
ROI.....	Return on investment
SW.....	Software
Org.....	Organization
SPI.....	Software Process Improvement

ABSTRACT

In today's highly competitive business environment, it is essential for software startups to continuously develop innovative software projects. To help startup organizations to achieve this goal, a better understanding and awareness about innovation which can be achieved through innovation assessment is required. This study develop innovation assessment framework of software startups for development of innovative software projects through idea development process.

In this study, a systematic literature review followed by questionnaire and face-to-face interviews were conducted. The questionnaire targeted software industry practitioners with different roles and firm sizes. A total of 42 completed and usable responses from 5 software startup firms were collected. A total of five face-to-face semi-structured interviews were conducted with industry practitioners from each software startup which have administrative and software practitioner roles. A comprehensive definition, challenges and solutions of innovation was identified which may be used in software startups. A conceptual innovation assessment framework was developed from process viewpoint. The viewpoints for assessment of innovation based on inputs, processes and outputs were categorized. The framework was further refined after feedback from software industry experts through interviews.

Innovation assessment is not a common practice in startups; the challenges are lack of uniform definition, lack of awareness, lack of guidelines and framework, lack of innovation culture, lack of innovation strategy, lack of strong leadership, lack of competency, lack of proper process and resource constraint to assess innovation. The conceptual framework developed in this study is one step towards identifying key process assessments of innovation to understand the innovation concept in startups during development of innovative software projects.

Keywords: Innovation, Software Startups, Innovation Assessment, Software Development, Software Innovation, Assessment Challenges, Assessment Solutions, Assessment Framework

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Innovation is a very wide concept and has many dimensions [3]. According to the definition adopted by TIEC (Technology Innovation and Entrepreneurship Center), Innovation is the introduction of a new product, service or process through a certain business model into the marketplace, either by utilization or by commercialization. Hence, it encompasses: product innovation, service innovation, process innovation and business model innovation, and all contribute to strengthen the competitive advantage of a certain organization. Innovation has long been recognized as an important driver of economic growth. It leads to new products and services that are higher in quality and lower in price [3] [14].

Startups are new and small businesses designed to create new products and services under conditions of extreme uncertainty, and typically they are accompanied by high innovation-driven growth [6]. Startups are special type of organizations. They are different from large organizations. Startups are small, which are different from large organizations in terms of business goals, achievements and vision. For instance while established or larger organizations develop new products to expand their market presence and their brands, startups struggle to begin their revenue stream from their innovations. They are not also similar to well established and large organizations in terms of available resources, flexibility and market presence for their products [12]. Software startups are new created organizations designed to grow fast [38].

Main characteristic in startups is that they are facing resource limitation more than other organizations. These resource constraints are regarding skills, experiences in new venture creation, product development, limited human resource accessibility and capital constraints. These mentioned constraints affect ability of founders for growing their startups in terms of revenues and market achievements [12]. One of the valuable assets in such organizations is their products based on innovations. The other valuable asset in startups is their human resource whom involve in product development [16] [8]. Organizations including IT startups are focusing on innovation to produce better products with considerable competitive advantage. Such innovation could gain better return of investment and offer better market place for their organizations [24].

According to [8] innovation is the main driving force of sustainable growth in organizations. Specifically, innovation is about applying new positive change in four dimensions. These dimensions are product,

process, position and paradigm [10]. Such changes can help organizations which produce products or services to meet new requirements and achieve more competitive advantages. Hence they perform at a higher level than others in industry. Therefore success and growth of organizations depends on how innovative they are in the market [10]. It has been argued that failures in innovative software projects are directly related to understanding of potential and risks within an idea [2].

Hence, accurate assessment process of a novel innovation concept, which fits industry needs, is a critical subject matter to investigate. The underpinning idea is that a framework that assesses and places an innovative idea through several processes is likely to reduce uncertainty and provides a basis for managing innovation as well as yielding a higher return on investment [1]. On the other hand, software startups which are the center of focus in this research have their own characteristics such as resource constraints, market positioning difficulties and organization flexibility [16].

1.2 MOTIVATION

Innovation is considered a key success factor [18] and central to increasing economic output and productivity [20]. Innovation is crucial for industrial organizations in order to be competitive on the market over time. Organizations need to trust their capability to innovate more by deploying appropriate mechanisms of innovation [40]. An increasing number of organizations emphasize its critical role in the success and sustainability of business [21] [22] [25] [26]. According to Boston Consulting Group (BCG) [27], 66% of senior executives consider innovation among their top three strategic priorities. It is the ability to dictate and modify the 'rules of the game' [25] which enables organizations to gain entry to new markets and challenge established market leaders [29]. It is important for modern day software organizations to remain competitive in the market. Being innovative is important for the survival of the organizations [52].

In past, management has focused on cost, lead time reduction and quality improvement for competitiveness in the market [31]. However, in today's competitive business environment, quality is a necessity but not sufficient enough [31] [32] [33]. Therefore, organizations must continuously innovate, develop new processes and deliver novel products to achieve and sustain competitive advantage [31] [34]. Innovation is an inevitable issue in the high end technological and innovative organizations [53].

In every industry, the leading organizations are innovators. Startup organizations should have little or no means to assess their innovativeness. The innovation assessment can vary widely from organization to organization [17] [52]. Assessing innovation is an important issue, as business growth and profitability in the knowledge age depend on innovation [3]. Hence, we are motivated by this area to do the research.

1.3 STATEMENT OF PROBLEM

According to [19], the rising trend toward entrepreneurship and rapid advances in IT are encouraging many software startups to enter to the market place. Software startups contribute to the society by creating jobs and by driving innovation. IT innovation is the source of software startup growth. With the development of information technology, such as cloud computing and open source software, the barriers to entry for software startups have decreased significantly in recent years [19]. Many software startups poured into the market place triggering intensive competition. Moreover, startup organizations often display a lack of resources and operating history. Thus, the failure rate is extremely high with nearly 80% of startup organizations failing in the competitive environment within their first three years [7]. The uncertainty of new markets and development of cutting-edge technologies pose challenges in startups different from those faced by more mature organizations [38].

Software startups are flexible in nature because they have limited operating history and they cannot follow certain procedures to operate business like mature organizations do. Therefore, flexibility-based capabilities are beneficial for them to build up business. Moreover, the software industry is characterized by the short product lifecycle. To get the first-mover advantage, software startups need to respond in a timely manner to the market demand and quickly enable the new product. Innovation is the heart of entrepreneurial process [19], so IT innovation is always the engine of driving a software startup organization to move forward. During the course of enabling and maintaining IT innovation, software startups need to contact customers.

Larger and well established organizations would face some challenges and difficulties during innovation evaluation process. Such difficulties are including finding of relevant data for market positioning, involving reliable participants or designing the evaluation process [11]. These challenges show that such difficulties could exist in startups as well. Hence, identifying them is critical for creating a framework for assessing innovations in software startups. Such a framework may become a standard format for assessment innovation process among startups [11] [24]. Tongshi and JiShunzhu [13] suggest in their study about assessment frameworks in software development processes that “people are the most important ingredient

of success” in assessments. They further suggest that, a “good process will not save the project from failure if the team does not have strong players; but a bad process can make even the strongest of players ineffective”.

According to [24], there are several processes for assessing product capabilities and product development in larger organizations. Nevertheless none of them could meet all the requirements for fulfilling the need for innovation assessment in their organizations. Larger organizations have more capital and in-market brands. These organizations are more flexible to apply new products in the market. They are using different processes for their prospective product evaluation. In light of this, larger organizations use different frameworks for organizational improvement; for instance Capability Maturity Model (CMM) consists of five maturity levels i.e. “initial, managed, defined, quantitatively managed, and optimizing” [15] [16]. Applying such framework in organizations could be beneficial for creating an environment to produce better innovative ideas. Such ideas could be developed to become prospective products with capability to get better position in the market. This could also increase the organizational innovation capability [5]. Nevertheless, in comparison with larger organizations, such framework is not used widely as part of idea development in startups due to their early establishment.

On the other hand, there are several studies regarding using of development processes in different organizations. For instance, there are proposed procedures in Software Process Improvement (SPI) which could be used in startups. Such process would highlight the role of development processes in the area of product development. According to characteristics of startups including their resource accessibility; the role of processes and SPI is important for being flexible to change. Such change would be required based on customer needs or market shift [13] [16]. Such processes are not directly related to innovation assessments before development. Nevertheless some features in the area of SPI such as “Speed, Quality, Flexibility, Proactively and Improvement” [13], could be considered in assessment processes. It means that such features could be used in evaluation of the capability of related frameworks in organizations. Additionally, software startups are not able to produce different products or innovative prototypes at a time. They cannot even tolerate market shift as easy as larger organizations can do. Hence startups are in need to be more certain about potential of their innovations and their value propositions before development of ideas.

In light of this, startups are required to put more effort on innovation assessment. The reason behind this effort is that the prospective product from each idea is the core of revenue stream and growth of startups [24]. Therefore we need to find a proper approach for evaluation of their innovations. Such approach would

be used as an assessment framework of innovations. The assessment result should find positioning of prospective software products in the market.

Mobtahej [9] explore and identify the challenges that currently involves in assessment processes within software startups. Such startups are mainly working with innovations. This assessment process applies before development of new software products. Therefore exploring current innovation assessment procedures in such startups and finding challenges and difficulties on their innovation assessment could be a roadmap for improvement in the area of innovation assessment and may help to create a customized framework to empower and facilitate such process in software startups as future steps [9].

From this point of view, there is a possibility to make a survey based on the current result for identified challenges of [9]. Such survey could distribute among other startups in different software startups to find priority of the challenges. The findings of [9] also lead to design a customized framework for better development of innovative software startup organizations and improvement of current assessment procedures concerned with the innovation evaluation process for software projects. Additionally, more cases in software development are required to assess by interviews and questionnaires. In creation of the new questionnaire, identified themes in [9] could be used as new area for evaluation. These questionnaires could be conducted in different software startups. On the other hand, this research could also be followed by considering different solutions for identified weakness points and challenges in innovation assessment of software development projects in previous researches.

1.4 RESEARCH QUESTIONS

In order to explore innovation assessment challenges, solutions and evaluation framework for software project assessment, based on the questionnaire and interview held with people involved in software startup organizations we should answer the research questions.

RQ1-What are the challenges of innovation assessment in software startup organizations for software development projects?

RQ2- What are the solutions of innovation assessment in software startup organizations for software projects?

RQ3-How to assess innovation in software startup organizations during development of their software projects?

Investigating the answers for **RQ1** show the way for achieving a better understanding of the difficulties and issues that need to be covered during innovation assessment, The answers of **RQ2** could show different solutions for identified weakness points and challenges in innovation assessment of software development projects and the answers for **RQ3** could also show what kind of innovation assessment perceptions followed in software startup organizations during development of their innovative software projects.

1.5 OBJECTIVE OF THE STUDY

In the following sections the general and specific objectives of the study are identified.

1.5.1 GENERAL OBJECTIVE

The general aim of this study is to explore innovation assessment framework for better development of innovative software projects in innovation assessment process for software startup organizations.

1.5.2 SPECIFIC OBJECTIVES

The following are the specific objectives of the study.

- To understand importance of innovation practices in software startups during development of their software projects
- To collect and review of previously conducted researches and literatures
- To explore innovation assessment challenges in startups during development of software projects
- To identify innovation assessment solutions in software startups
- To identify and analyze innovation assessment process for software startup organizations
- To collect and review of previously conducted researches and literatures
- To develop innovation assessment framework
- To evaluate the proposed framework

1.6 METHODOLOGY OF THE STUDY

To accomplish the main goal of this study, different methods and techniques are used. Basically, research methodology is traditionally separated into two main parts, qualitative and quantitative research. Qualitative research is about understanding behavior and reasons, questions to be asked and gathering data. But the result is not measured in a quantifiably way, it is more concerned with why and how. It is the quality, not the quantity of samples that is important. On the other hand in quantitative research the researcher tried to measure the result in an empirical way having statistics and calculations to back up the result. Quantitative research relies on high quantity of samples to create statistics and to show trends [4].

This study used both qualitative and quantitative research method. The purpose of qualitative method was to build the theoretical perspective and quantitative study was intended to give researchers better understanding about the topic [4]. Qualitative methods used in this study were systematic literature review, Questionnaire and face-to-face interviews. Hence, to meet the objectives of this study, the following techniques are adopted for this research.

1.6.1. LITERATURE REVIEW

For proper understanding of innovation related practices, to collect necessary information related to innovation assessment in project development of software startup organizations and for successful completion of this study we reviewed relevant literatures such as books, journals, magazines, conference papers, manuals, and resources from electronic databases like Inspec, IEEE Xplore, ACM Digital Library, Cite Seer, Science Direct, Elsevier etc. for achieving the research objective.

1.6.2. METHOD OF DATA COLLECTION AND ANALYSIS

In this study, we acquire the required information from software development organizations of different startups through face-to-face interviewing and questionnaire method. To elicit requirements from developers, both structured and unstructured interview have been used. Structured interview is used for questions that have predefined answers (both closed questions and listing of items). Whereas unstructured interview is used when a question needs explanation and even the interviewee can add his/her own ideas that are expected to be important to the research [23].

We also acquire the required information by preparing a questionnaire. We use purposive sampling technique to collect and identify information from different software startup organizations for this study for participant selection technique. To select individual participants within these startups, it was based on positions working on the software development and year of experience. Based on the findings from literature review, interview and questionnaire methods, we conducted conceptual analysis to analyze innovation assessment in software startups.

1.7 SIGNIFICANCE OF THE STUDY

For this study, Software development startup organizations are the primary beneficiaries. As a result, those software developing startup organizations and software developers can use the study to evaluate their software development project innovativeness. Specifically it can contribute:

- To increase the awareness and importance of innovation concept, encouraging innovation culture in the startup organizations.
- To identify challenges, areas of strength and opportunities for increasing innovation in software startup organizations.
- Assist organizations in understanding their current innovation practices and to clarify where the startup needs to focus to maximize innovation success.
- This study will indicate the innovation assessment framework for software startup organizations.
- In addition, the study will be an input for further research and the result will help future researchers that aim to work on to improve this study.

1.8. SCOPE AND LIMITATION OF THE STUDY

The scope of the study focuses on an assessment of innovation in software startup organizations. In this research we identify innovation assessment challenges, solutions for identified challenges of software startup organizations during their software development projects. Since, the aim of the research is to develop an innovation assessment framework for software development startup organizations, so the study will evaluate the innovation assessment process framework for software startup organizations. We made Single interview in each startups that may be one of the limitation, difficult to interview all participants due to time constraints which influence on our research results.

1.9. ORGANIZATION OF THE THESIS

The remainder of this study is structured as follows: Chapter 2 covers the review of literature and related work about innovation, software startups, innovation assessment framework and different roles of innovation assessments in software startup organizations. The study followed by Chapter 3 and chapter 4 where the research methodology and method of analysis is presented.

Chapter 5 presents result of the analysis and discusses the findings. Finally, in the last chapter conclusions about the research and recommendations for future research direction are presented.

CHAPTER 2

LITERATURE REVIEW

In this chapter, we present a review of literatures by considering the following main issues: definition of innovation from different perceptions (process, organizational, product, market etc.), software innovation, software development in startups, innovation assessment framework in startups, and innovation practices in software industry with its importance. Hence, in order to perceive a full idea of an innovation assessment practices in software startups we reviewed literatures in the following sections.

2.1. DEFINITION OF INNOVATION

Some of studies considered innovation in different terms, i.e. product, process, market, organization innovation, etc. Most of the definitions have a different point of view e.g. Caloghirou et al. [63] defined innovation in knowledge creation perspective as they wrote Innovation can be better understood as a process in which the organization creates and defines problems and then actively develops new knowledge to solve them. Jong et al. [64] looked at innovation in organizational perspective when they said Innovation behaviour can be defined as all individual actions directed at the generation, introduction and application of beneficial novelty at any organization level. According to [67] Innovation is defined as an application of knowledge to produce new knowledge. And there is a distinction between invention and innovation that the former is referring to the first occurrence of an idea for a new product or process, while the latter to its first commercialization.

Software innovativeness can be related to several aspects of the product, such as its features the impression of its newness, the novelty of architectural structure. Innovation can also take several forms [72] [83] Position innovation: changes in the context in which the products/services are introduced, paradigm innovation: changes in the underlying mental models which frame what the organization does.' Delivery innovation: relates to the development of changes in how the enterprise delivers its products (goods or services) to its customers.

Examples include introduction of just-in-time delivery, consumer e-commerce, introduction of new or significantly improved home shopping services. Strategic innovation: relates to the implementation of new or significantly modified business strategies. Examples include targeting different markets, implementing

new or significantly modified missions. Managerial innovation: relates to the implementation of new or significantly modified managerial techniques. Examples include the introduction of knowledge management practices, quality circles. Innovation is the successful exploitation of new ideas [80]. Innovating means putting new ideas to gainful use [90].

Innovation is usually understood as the introduction of something new or significantly improved, like products (goods or services) or processes [76]. Innovations vary in complexity and can range from minor changes to existing products, processes, or services to breakthrough products, and processes or services that introduce first-time features or exceptional performance [70]. Innovative capability is defined as the capacity of developing new products satisfying market needs, the capacity of applying appropriate process technologies to produce these new products, the capacity of developing and adopting new product and processing technologies to satisfy the future needs, the capacity of responding to accidental technology activities and unexpected opportunities created by the competitors[18]. Innovation as new products, processes and organizational arrangements that are new to the firm rather than new to the world [73]. Despite innovation is defined from different perspectives, in the following section we describe definitions of innovation from process, product, market, organizational and product points of view.

2.1.1. PROCESS INNOVATION

Innovation refers to a process that begins with a novel idea and concludes with market introduction [74]. Innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing task striving for the commercial success of the invention. Innovativeness is the capacity of new innovation to create a paradigm shift in the science and technology and/or market structure in an industry. Innovativeness is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skill, knowledge, capabilities, or strategies[77]. Innovation as a process that involves the generation, adoption, implementation and incorporation of new ideas, practices or artifacts within the organization[89]. Innovation processes generate new products and new routines of an innovating firm[91]. process innovation means changes in the ways in which they are created and delivered[72]. It also relates to the introduction of any new or significantly improved production process (but not delivery, unless this is integral to the process of production/ delivery) [83].

2.1.2. ORGANIZATIONAL INNOVATION

Organizational innovation has been consistently defined as the adoption of an idea of behavior that is new to the organization. The innovation can either be a new product, a new service, a new technology, or a new administrative practice [69]. Innovation behavior can be defined as all individual actions directed at the generation, introduction and application of beneficial novelty at any organization level [64]. Innovation is defined as all intentional results of action (products or processes) that bring about perceived changes within the organization [66]. Innovation is defined as the adoption of an idea or behavior whether a system, policy, program, device, process, product or service that is new to the adopting organization [82]. Organizational innovation was conceptualized as the tendency of the organization to develop new or improved products or services and its success in bringing those products or services to the market. Innovation is defined as the successful implementation of creative ideas within an organization [41]. Innovation is the generation, adaptation of an idea or behavior, new to the adopting organization. Innovation is the first successful application of a product or process. It is conceived as a means of changing an organization, either as a response to changes in the external environment, or as a pre-emptive action to influence the environment. It is also the process of successfully creating something new that has significant value to the relevant unit of adoption [32]. Rodriguez et al. [5] model innovation capability of organizations for guiding future innovation.

2.1.3. PRODUCT INNOVATION

Product innovation is defined as changes in the things (products/services) which an organization offers [72]. It relates to the introduction into the market of any new or significant improved products (goods or services) [83]. It is also a continuous and cross-functional process involving and integrating a growing number of different competencies inside and outside the organizational boundaries. Simply put, it is the process of transforming business opportunities into tangible products and services [65]. According to [81] product innovation is defined as the introduction of technologically new (or significantly improved) products which are new to the firm (it does not have to be new to the world). Product innovativeness differs from the term product innovation, to mean the degree of newness in the development of new products changes in design of established products, or use of new materials or components in the manufacture of established products [88]. Yague et al. [24] identify product innovation evaluation by considering main goals of innovation.

2.1.4. MARKET INNOVATION

Innovations are new ideas that are valued in the marketplace [79]. An innovation is defined by the first economic utilization or application of an invention to achieve corporate goals [78]. A radical innovation is a product, process or service with either unprecedented performance features or familiar features that offer significant improvements in performance or cost that transform existing markets or create new ones. A successfully exploited radical new product, process, or concept that significantly transforms the demand and needs of an existing market or industry, disrupts its former key players and creates whole new business practices or markets with significant societal impact [32]. It also relates to the implementation of new or significantly modified marketing strategies and concepts. Examples include the introduction of new or significantly improved marketing methods [83]. According to the definitions adopted by TIEC (Technology Innovation and Entrepreneurship Center); Innovation is the introduction of a new product, service or process through a certain business model into the marketplace, either by utilization or by commercialization [3].

2.2. SOFTWARE INNOVATION

According to [92] Software innovation can be seen as a process leading to development of a novel aspect, feature or application of an existing software product or process. It is also introduction of a new software product or process or an improvement in the previous generation of the software product or process and entry to the market or use within the production process [92].

Software innovation is often driven by user needs and expectations, and at times in the development process, software designers often solicit user feedback. Yet software development primarily takes place in an environment dominated by firms and developers that to some degree specialize in creating software, and whose incentives for doing so are usually pecuniary in nature. Some of these incentives may be driven by the potential profits to be earned from developing a new innovation, but other goals may be realizing lower production costs or increased efficiencies in production and delivery [92]. Software innovation is also perceived as being important by software developers [23].

2.3. INNOVATION ASSESSMENT FRAMEWORK

Innovation assessment framework may become a standard format for assessment of innovation process among startups [11] [24] [9]. Startups are required to put more effort on innovation assessment. The reason behind this effort is that the prospective product from each idea is the core of revenue stream and growth of startups. A proper approach for evaluation of their innovations would be used as an assessment framework. The assessment result should find positioning of prospective products in the market [24].

This research conducted by studying similar researches which are related to several similar frameworks and evaluation processes. These frameworks and evaluation approaches are directly related to evaluation of capabilities in innovations and would show importance of proper process in startups. These related frameworks consist of studies including: Disruptive innovation assessment framework [11] [24], Open innovation empirical analysis [12], Analyzing software product innovation assessment [24], Studying role of software processes within software startups [16] and [5] a framework for positioning and assessing innovation from an organizational perspective. According to [5] applying such framework increases the organizational innovation capability.

According to [11], there is an innovation assessment framework which is designed to enhance the specification of the prospective products. This framework is designed based on identified factors. These factors considered as “success factors”. Fulfilling of these factors is directly related to failure or success of an innovation. These factors consist of variables in regards to “market positioning, technology and other favorable drivers” [11]. These identified factors would be evaluated by a defined questionnaire from participants. The aim for using such framework is to improve innovative software projects within its staged processes before development. Such framework could improve organizational performance through gaining better market place at last [24].

The studied literatures would clear an approach for identifying assumption of existing challenges in IT startups. Such challenges could be existed for proceeding with innovation assessment. This assumption has been identified through analyzing similar studies. These studies are about the need for assessment of an innovation before development and identifying the market. Nevertheless since there is no specific formalized process or designed framework which is customized for IT startups in their innovation assessment process, they could have confronted some issues during their evaluation and assessment process.

The previous studies related to Research Questions, highlighted set of relevant features which should be measured by interview and questionnaire (see Appendix A and B). Such interviews and questionnaires are a well-known approach to be distributed among software startups for finding out challenges and solutions involves during their innovation assessment [11] [24]. Each organization could have its own defined approach to consider whether an idea or innovation worth pursuing or not. During their assessment, enterprises could experience barriers that they are facing while applying their assessment procedure.

Among these organizations, there are startups which have the need for special attention for managing the resources. To be able to meet their desired market place they are in need to reduce the risk of failure before development of an innovation. The result would verify the validity of the assumption. It would be also compared with the similar research. The result would show the similarities and differences about challenges that organizations involve. Hence, the real needs and requirements in assessment processes would be identified to be fulfilled. Fulfilling the weaknesses on current processes would increase the value of innovation outcome in software startups.

2.4. SOFTWARE DEVELOPMENT IN STARTUPS

Startups are newly created organizations with little or no history of facing high volatility in technologies and markets [95]. As such, startups are an important factor in the economy. However, the environment of startups is dynamic, unpredictable, and even chaotic, forcing entrepreneurs to act quickly, fail fast, and learn faster to find a market niche and acquire a sustainable income. According to [96], Sixty percent of startups don't survive the first five years, and 75 percent of venture capital funded startups fail.

Most of this is due to the high risk of startups, missed market windows, and other business reasons. In the past, the term "startup" had different meanings. Looking at the recurrent themes (Table 2.1 offers a complete list) adopted by researchers and practitioners, a startup is a small organization exploring new business opportunities, working to solve a problem where the solution isn't well known and the market is highly volatile. Being newly founded does not in itself make a company a startup. High uncertainty and rapid evolution are the two key characteristics for startups retrieved by the studies, which better differentiate them from more established organizations [110].

Software development in startups represents all the engineering activities used to manage product development. Because the flexibility to accommodate frequent changes is essential in the startup context, agile methodologies have been considered the most viable process-they embrace change, allowing development to adapt to the business strategy [107]. Fast release with an iterative and incremental approach shortens the lead time from idea conception to production with fast deployment. A variant to agile is the lean methodology [6], which advocates the identification of the riskiest parts of a software business and provides a minimum viable product to systematically test and plan modification for the next iteration.

In this regard, prototyping is essential to shorten the time to market. To allow better prototyping activities, evolutionary workflows are needed to implement “soft-coded” solutions in the first phases until the optimal solution is found. Despite the number of methodologies that embrace fast prototyping in development, none of the processes are strictly followed by startups. Yet, the uncertainty and fast-changing needs of startups drive them to opportunistically tailor minimal process management to their short-term objectives and adapt to the fast-paced learning process of their users to address market uncertainty. Startups are under constant pressure to rapidly demonstrate that they’re developing a solution that fixes a real problem [100]. They’re constantly optimizing the problem/solution fit. To achieve it, startups must discover the real needs of their first customers, testing business speculations only by defining a minimal set of functional requirements [101]. Startups contribute to the society by creating jobs and by driving innovation [19].

In the startup context, customers often steer requirements, and developers must be ready to embrace change from day one [102]. Time pressure and lack of resources often lead startups to adopt a loose organizational structure without traditional management hierarchies [103]. Empowerment of team members represents the main viable strategy for enhancing performance and success [104]. The team must be able to absorb and learn from trial and error quickly enough to adapt to new emergent practices. Working on innovative products requires creativity-an ability to adapt to new roles and face new challenges every day, working overtime if necessary. Indeed, in building a startup company, the team needs expertise to counterbalance its lack of resources. In addition, having previous experience in similar business domains and exhibiting entrepreneurial characteristics (courage, enthusiasm, commitment, and leadership) are important parts of a startup employee’s skillset.

Nevertheless, the absence of structure might hinder important activities, such as sharing knowledge and team coordination, especially when the company grows. In this case, collocation is essential to facilitate informal communication and close interactions between team members. Startups can take advantage of the newest technologies and development tools without having to worry about legacy or previous working experiences [16]. But the selection of a technology requires some domain-or product-specific requirements, which are typically unknown in the early stages. In general, startup employees prefer using those technologies that can quickly accommodate change in the product and its management [105]. Easy-to-implement tools, such as whiteboards and technologies that can handle fast-paced changing information, will lower a startup’s training and maintenance costs. To mitigate the lack of resources, startups often appear to take advantage of

open source solutions when possible, which also give them access to a large pool of evaluators and evolving contributions.

Startup organizations seek to generate revenue and obtain funding to continue the development, which means that software quality isn't their most critical concern. To quickly validate the product, they tend to use agile and lean methods in an ad hoc manner [106]. Evidence suggests that engineering activities must be tailored to the startup context to allow flexibility and reactivity in development workflows. Decision makers in startups confront continuous unpredictability; the relationship between cause and effect can only be perceived in retrospect [98]. Applying rigorous methodologies to control development activities isn't effective because no matter how much time is spent on analysis, it isn't possible to identify all the risks or accurately predict what practices are required to develop a product.

On the other hand, flexible and reactive methods designed to stimulate customer feedback increase the number of perspectives and solutions available to decision makers. Developers need the freedom to choose activities quickly, stop immediately when the results are wrong, fix the approach, and learn from previous failures. In line with the lean startup movement, we would expect methodologies and techniques tailored from common agile practices to specific startups' cultures and needs; failures should be completely acceptable or even preferred in favor of a faster learning process. Reported common practices, which ride the wave of rapidly evolving technologies and markets, are as follows [98]:

- Use of well-known frameworks to quickly change the product according to market needs;
- Use of evolutionary prototyping and experimentations via existing components;
- Ongoing customer acceptance through early adopters' focus groups;
- Continuous value delivery, focusing on core functionalities that engage paying customers;
- Empowerment of teams to influence final outcomes;
- Use of metrics to quickly learn from consumers' feedback and demand; and
- Use of easy-to-implement tools to facilitate product development and handle fast-paced, changing information.

According to the assessments made [39], try to assess the software development practice; the success and failure rates of software projects in software development situation so far is mostly dominated by improvements in business efficiency and value[30]. The following table presents a list of recurrent themes adopted by researchers and practitioners in software startups as identified in [110].

Theme	Description
Lack of resources	Economical, human ,and physical resources are extremely limited
Highly reactive	Startups are able to quickly react to changes in the underlying market, Technologies, and product (compared to more established organizations)
Innovation	Given the highly competitive ecosystem, startups need to focus on and Explore highly innovative segments of the market
Uncertainty	Startups deal with a highly uncertain ecosystem under different perspectives: market, product features, competition , people, and finance
Rapidly evolving	Successful startups aim to grow and scale rapidly
Time pressure	The environment often forces startups to release fast and to work under constant pressure(terms sheets, demo days, investors requests)
Third-party dependency	Due to lack of resource startups heavily rely on external solutions to build their product: external APIs, open source software, outsourcing, and so on.
Small team	Startups start with a small number of individuals
One product	Company activities gravitate around one product/service only.
Low-experienced team	A good part of the development team is formed by people with less than five years of experience and often recently graduated students
New company	The company has been recently created
Full organization	Startups are usually founder-centric, and everyone in the company has big responsibilities, with no need for upper management
Highly risky	The failure rate of startups is extremely high
Not self-sustained	Especially in the early stage, startups need external funding to sustain their activities (venture capitalist, investments, personal funds, and so on).
Little working Experience	The basis of an organizational culture isn't present initially.

Table -2.1: Recurrent themes in software startups

2.5. INNOVATION IN SOFTWARE INDUSTRY

The modern dynamic business environment is characterized by high competition. This competition is derived from deregulation, empowered customers, new market entrants [34], emerging technology [18] [34] [41], ecommerce [18], globalization of economy [18] [34] [32] [41] [4], dynamic and complex markets, uncertain economic circumstances and rapid product development [34] [32] [33]. In this environment with shortened product [34] [32] [33] and technology life-cycles [33] [42], software industry is influenced in particular owing to its knowledge intensive [43] and technology driven nature [42]. This calls for innovation to survive, compete, grow and preferably lead the market [41] [33]. Moreover, software innovations have influenced industries and our everyday lives and software has become an integral part of them [44]. This ubiquity of software further necessitates continuous innovation in software more than ever before.

2.6 IMPORTANCE OF INNOVATION ASSESSMENT

Most innovators are the leading organizations in a market yet overtime changes and they are replaced by new emerging firms [34]. Such turnover signifies the importance of sustained innovation thus the problem is not accident innovation rather doing it continuously on a regular basis. For sustained innovation to become a reality, a better understanding of innovation is required, which will be possible only when it is measured [45]. Researchers have suggested relation of innovation to organizational structure, culture and knowledge management practices [46] [47]. Similarly, organizations undergo structural changes, pursue policies and spend aggressively to create an environment conducive to creativity and innovation [27] [48]. Innovation assessment can help to assess the results and determine whether these changes are paying off. It will further enable a better understanding and development of improved models of evolving innovation process [31].

Practitioners need instruments to assess the innovation management and outcomes as innovation performance is linked with business performance [49]. Managers need appropriate metrics and tools to evaluate and diagnose innovation process and capacity to make informed decisions about innovation programs [34]. Senior management will be able to track innovation performance and adapt the organizations strategy to the outcomes in a more timely way [34].

According to Andrew et al. [50] one of the characteristics of highly innovative firms is that they develop and use meaningful assessments to track inputs, performance, cash pay-backs, and indirect benefits for innovation management.

2.7 RELATED WORKS

In the previous chapter, we provide a review of literatures by considering the following major issue: Innovation definition from different perspectives, software innovation, software development in startups, innovation assessment frameworks, innovation practices in software startups with its importance.

Moreover the following related literatures are selected in order to perceive a full idea of an innovation assessment practices in software startup organizations and to find a gap on the related works. To the best of our knowledge, there is no more related works on innovation assessment in software startup organizations. The researchers have identified several studies in related and other domains that attempt to address the issues which are also the focus of this study.

According to Rodriguez et al. [5] the evolution of a new information society and new technologies has led to the involvement of organizations in a highly competitive business market where innovation plays a key role. Understanding Innovation Process will help organizations to quickly incorporate innovation to offer solutions that are more competitive and useful for society. This is particularly important for software organizations or ICT organizations in general. Currently, there are still too few mechanisms that help organizations to model innovation knowledge and measure their innovation capability.

To deal with this gap, the authors present the Innovation Capability Framework that models innovation knowledge and assesses the innovation capability of organizations for guiding future innovation processes. This framework comprises a conceptual model, a graphical modeling language, and an Innovation Positioning System (IPS), which are supported by an Inno Modeling Tool (InnoTool). Modeling capabilities and the IPS mechanism of the framework have been empirically validated through various case studies. In this study, the authors present the InnoTool to assess the innovation process of an exemplar innovative product such as Skype.

According to Shi et al. [19], entrepreneurship and rapid advances in IT are encouraging many software startups to enter to the market place. Software startups contribute to the society by creating jobs and by driving innovation. IT innovation is considered as the direct source of software startup growth. It is influenced by dynamic capabilities in terms of learning capability, integration capability, and responsiveness capability. Customer involvement is viewed as enhancing the effect of dynamic capabilities on IT

innovation. Shi et al. [19], aims to contribute to existing literature by investigating a little-studied phenomenon - software startup and formulating a software startup growth model.

Furthermore, they attempted to advance the understanding of the theory of dynamic capabilities by specifying three types of dynamic capabilities and by examining their effect on IT innovation. It also opens up an avenue of investigating the impact of the alignment between the customer involvement and dynamic capabilities.

Yague et al. [24] identify the main goals of product innovation evaluation. In addition, the advantages of different organizational levels of product innovation assessment have been identified. Using SLR Method of analysis they have been structured around 13 findings and have answered 5 research questions that address multiple aspects of product innovation assessment. Product innovation evaluation has been used mainly to increase the knowledge and understanding of innovation factors in product development. Evaluation schemas have three main sources: questionnaires, professional experiences, and the existing literature.

Two main evaluation schemas have been identified: un-weighted and weighted. Both evaluation schemas are based on what has been called “innovation factors”. These factors are grouped into factor families. Organization, market, environment, and technology are the most referenced factor families. Their findings of this research are related to three areas of focus: (1) general findings about product innovation assessment, (2) findings regarding product innovation assessment preparation, (3) and findings related to the assessment process. Yague et al. [24] Define a framework specifically adapted to evaluating software product innovation. This framework will include an assessment process, a software product innovation assessment model, and a process for updating the innovation factors and the assessment rationale with innovation knowledge.

Mobtahej [9] conducted a qualitative research with in depth interview using thematic analysis data analysis method. Innovation assessment process is an essential step for increasing chance of developing successful products from innovative ideas. Successful innovation products are driving force for growth of IT startups. The author focuses on innovation assessment within IT startup companies to emphasize challenges on their process. The related work for this study has been summarized in the following table.

Author(s)	Methodology	Document type	Focus area of study	Result
Rodriguez et al.[5]	SLR	Journal article	Software organizations	Assess innovation capability of organizations based on dimensions and determinants of innovation
Shi et al.[19]	Not specified	Journal article	Software startups	Formulate software startup growth model by investigating an alignment between customer involvement and dynamic capabilities
Yague et al.[24]	SLR	Journal article	General	Analyzing software product innovation assessment using SLR; by focusing and finding on product innovation assessment, product innovation assessment preparation and product innovation related to assessment process
Mobtahej [9]	Thematic analysis	Journal article	IT startups	Explore the challenges that involves in innovation assessment processes within software startups

Table -2.2: Summary of related work

As we have seen from the above table (table 2.2), most authors focus area of study is on software firms; [5] and [24] of the related works use systematic review of research methodology, [9] used thematic analysis, and in [19] methodology of research is not clearly specified. Even though, most authors focus on software firms (startups and large firms) we concentrate on the study of startups in [19] [9]. Hence, by considering the findings of [9] needs further study as we review the study.

We need to explore the other challenges by considering the identified innovation assessment difficulties and practices during startups development of software projects. In [9] there is a possibility to make a survey based on the current result for identified challenges in this study.

The findings of [9] lead to design a customized framework for better development of innovative software projects in startups. There is a need to consider different solutions for identified challenges [9] in innovation assessment of software development projects in startup firms.

In this study, the area of innovation assessment in software startups was explored. The study attempts to contribute to the innovation assessment for software startups. By performing systematic literature review, the study has identified the challenges of innovation assessment in software startups. The findings of the literature review were added with a questionnaire and interview to elicit the perception of innovation in the software industry.

CHAPTER 3

RESEARCH METHODOLOGY

In this chapter we will elaborate on our choice of research methods, identified in chapter 1. We will present a short understanding of our choice of the research methodology. In addition to this we will elaborate on the choice of data collection methods used throughout this thesis. This chapter will give a broader insight on how we have utilized the research methodology and the data collection methods to develop our thesis. We will also compare the different research methodologies available in order to get an in depth insight on the research method chosen.

Our guiding research questionnaires are open ended and close ended which would explore the innovation assessment challenges and solutions in software development projects within software startups. Since the case for our study is explorative, the research followed by qualitative approach and used in-depth interviews to gather data from a selected group of participants [33] [12]. This approach would allow the author in-depth understanding of the topic. Qualitative methods used in this study were literature review, questionnaire and face-to-face interviews. Literature review was conducted to answer **RQ1**, which was intended to collect data from existing literature: innovation assessment challenges and insight to current innovation practices in software startups.

To answer **RQ2**, we used questionnaire and face-to-face meetings to collect opinions of software startups in innovative software development practitioners. By using questionnaire, we can reach more respondents than face-to-face meetings. The main goals of questionnaire were to get the perception of startup organizations about innovation assessment, innovation solutions to identified challenges in **RQ1**. The results of the questionnaire were used to confirm the findings of literature review. Based on the findings from systematic literature review and questionnaire, we conducted content analysis to answer **RQ3**. Content analysis is used to categorize qualitative textual data into clusters of similar, or conceptual categories, to identify consistent patterns and relationship between variables or theme [54]. There are two types of content analysis: conceptual analysis and relational analysis. In this study, we followed the steps of conceptual analysis [49] [52] [55] to examine innovation assessment in software startup firms. According to [69] there are 8 steps in conceptual analysis:

- 1) Deciding the level of analysis. In this step, individual words or phrases that will be analyzed are defined.
- 2) Deciding how many concepts to code for. In this step, researchers decide whether to code the predefined or interactive set of concepts.
- 3) Deciding whether to code for existence or frequency of a concept. In this step, researchers decide whether to code the existence or the frequency of the concept.
- 4) Deciding on how to distinguish among concepts. If two concepts that express the same idea are found in the paper, the researchers must decide whether to code them in the same or a separate group.
- 5) Developing rules for coding the text. In this step, researchers define a set of rules that allow them to code the concepts consistently.
- 6) Deciding what to do with 'irrelevant' information. Not all information is relevant to the study. Therefore, researchers must decide whether to ignore or re-examine the irrelevant information.
- 7) Coding the texts. After deciding the concepts and the rules, researchers perform the actual coding.
- 8) Analyzing the results. After completing the coding, researchers analyze the data. Based on this data, researchers are able to draw conclusions and generalization.

In this study, step 1-6 were incorporated as part of systematic literature review. The data is analyzed and defined systematically. Step 7 was conducted as the data extraction strategy. Using conceptual analysis method finally, we developed an innovation assessment framework. According to Creswell [4] validity is one of the strengths in a research; Threats to the validity of the outcome could be internal or external. The threats therefore should be considered in "validation procedure" [4]. To validate the framework, static validation [56] was performed through interviews with software industry practitioners. Beside to capture the perception of innovation and state of practice regarding innovation assessment challenges and solutions in software startups, we make an interview with practitioners and accept feedback to evaluate the usefulness and applicability of the proposed framework.

Hence, the aim of this study is to identify and elaborate the important idea about innovation assessment in software startups. To achieve the research objective, the research questions presented in chapter 1 should be mapped with different research methods. The mapping of research methods and research questions is shown in the following figure (Figure 3.1).

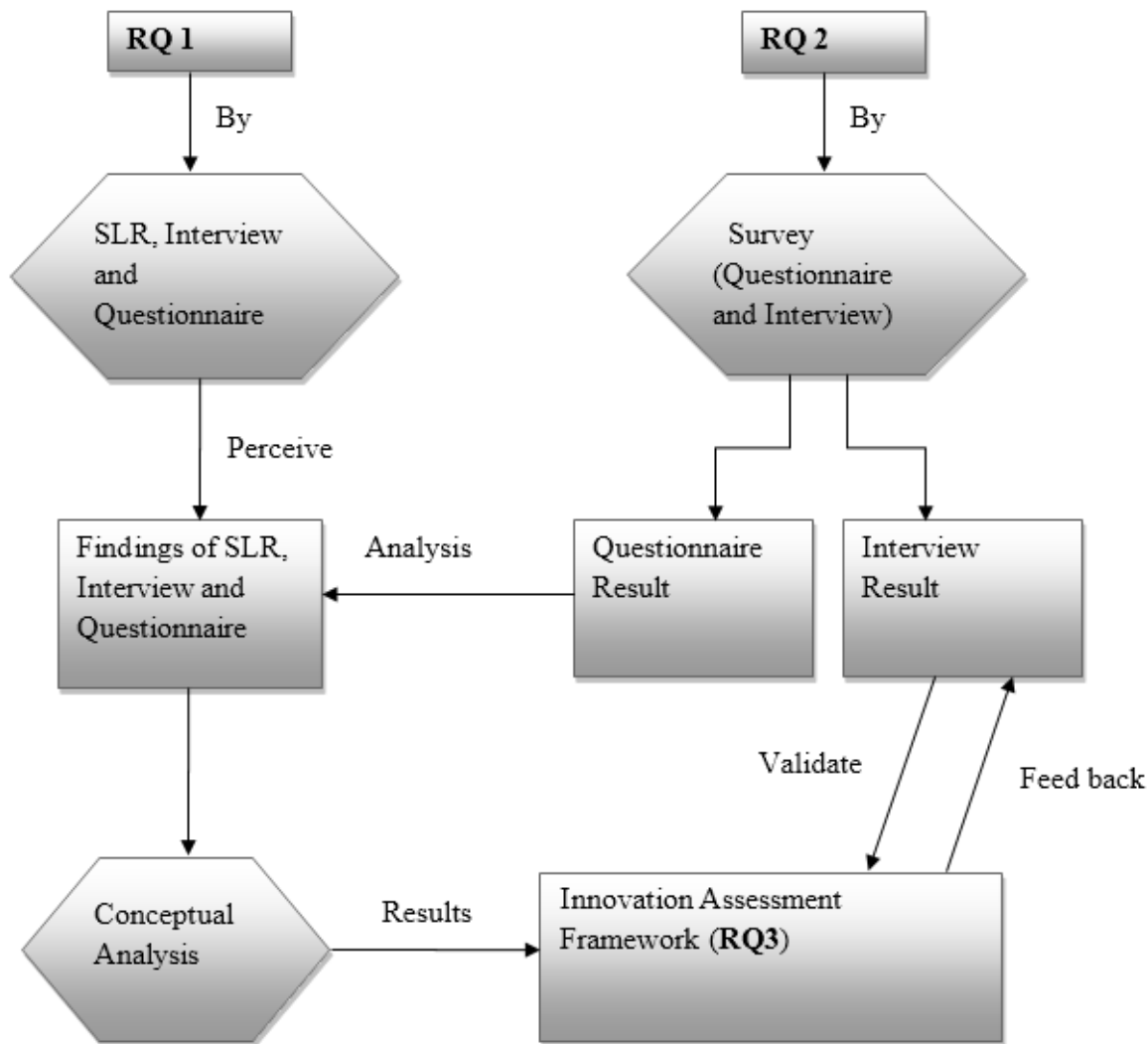


Figure-3.1: Mapping research questions to research methods

The following sections describe the approach which has been followed for conducting this research:

3.1. RESEARCH SETTING

For conducting this research, we contacted different startup organizations in Addis Ababa. The aim was to select participants for evaluating the ability of their organizations on innovation assessment and exploring the challenges and solutions that they are facing during their innovation assessment process. From the contacted organizations, five volunteered startups selected and agreed to work with this research based on different criteria to meet the research objective. This research finally conducted in collaboration with the following participants from each different startups. The following table is showing the participants demography.

Organization ID	Total number of Respondents involved	Type of Organization
Organization A	6	Software Development
Organization B	8	Software Development
Organization C	7	Software Development
Organization D	11	Software Development, ICT
Organization E	10	Software Development

Table -3.1: Participants demography

The participant selection in this research was “volunteer basis” [33]. Volunteered participants were 42 individuals in different positions (CEO, Software Developer, Project Manager, ICT Expert, etc.) from five different organizations. The reason behind the selection was to have a group of individuals with different opinions and experiences that they had based on their position in the organizations. Since participants were volunteered employees, the chance of having more reliable data increased. The main reason behind this concept is because volunteer employees are willing to participate in research process and share their experiences to be aware of the outcome of this research. Participants were also being independent from each other to not affect the result. Most Participants had key position in each organization. They had also a key role in making decision in the startups. Hence their role makes them aware of the innovation issues, challenges and solutions during assessment processes of their prospective products.

3.2. METHOD OF REVIEWING LITERATURE

We choose to perform a systematic literature review (SLR) to analyze the study as used by [24]. SLR is a critical assessment and evaluation of the existing research that address a particular issue. The objective is to determine in advance the selection of the studies to analyze, data collection, and the aggregation strategy. SLR uses a rigorous and auditable methodology for identifying, evaluating, and explaining the available research on specific research questions [35]. According to Budgen et al. [36], SLRs are important for (1) summarizing existing evidence concerning a practice or technology, (2) identifying the gaps in the current research, (3) helping position new research activities, and (4) to determine whether the given hypothesis is supported or contradicted.

As described by Kitchenham [35], SLR is composed of three phases: planning, conducting, and reporting the review. The planning phase involves developing a review protocol, and the conducting phase involves

executing the planned protocol. Finally, the reporting phase is comprised of relating the results of the review to the broader community. This process ensures the repeatability of the review and enables understanding of certain decisions have been made. The systematic review as proposed by Kitchenham et al. [37] consists of the same phases as [35]. In the following section we describe the activities taken while conducting SLR in its phases [24].

First phase-planning the review: In this phase, the need for the systematic review is justified and the review protocol (research questions, search strategy and selection criteria) is developed.

Second phase-conducting the review: The second phase involves identification of research, selection of studies based on criteria developed in review protocol, data extraction and data synthesis.

Third phase-reporting the review: The last phase involves writing a report to effectively communicate the results. A defined review protocol, search strategy, explicit inclusion and exclusion criteria, and specified information that will be retrieved from primary studies differentiate a systematic review from a conventional literature review [37].

The results of this systematic review are reported in chapter five of Section 5.1. The objective of the proposed review is to address the research question- the challenges of innovation assessment in software startup organizations during software development projects. To address this research question we use the following techniques as used in [24]. In the following sections (Section 3.2.1, 3.2.2, 3.2.3 and 3.2.4) we describe the first phase (planning) of this review.

3.2.1. SEARCH STRATEGY

A search strategy is a formal method for finding the scientific publications that are relevant to the proposed research questions [24]. In this study to conduct the review, we used online databases to perform the search: Inspec and Compendex (through Engineering Village), Scopus, IEEE Xplore, ACM Digital Library, ScienceDirect, Elsevier, Business Source Premier (BSP), CiteSeer etc. The target for this review was mostly journals published in software engineering, economics, computer science, health, finance and management, etc. To ensure that all the performed searches were consistent and comparable for each database, we used selected keywords and expressions derived from the research questions in chapter 1. The search retrieved scientific papers, which are considered primary studies. After defining the search strategy, the next step was to select the search terms. A wide list of search strings such as, “innovation”, “software innovation”, “innovation assessment”, “software startups”, “process innovation”, “software development”, “innovation assessment challenges” and so on. After refining based on the objective of research the following are the

terms selected: “innovation”, “software innovation”, “software startups”, innovation assessment challenges” as we are interested on this issues that how innovation has been assessed. From the selection result, we found the studies that discuss assessment framework also discuss the definition and different aspects of innovation. Furthermore, the keyword innovation itself was so generic. Therefore, **RQ1** was answered indirectly from the studies found using this searching technique.

3.2.2. STUDY SELECTION CRITERIA AND PROCEDURE

All potential primary studies were reviewed based on different selection criteria [24]. The inclusion/exclusion criteria were defined to select the relevant articles for this study. The preliminary criteria were intended to make sure the uniqueness of the article. In this phase, we mostly considered those primary studies, which are published in journals and are written in English. No duplicate studies were allowed. The second inclusion/exclusion criteria were based on the relevance of the primary studies to innovation and innovation assessment. The relevance of the studies was decided after reading the title and abstract. If after reading the title and abstract a decision cannot be made, we read the introduction and conclusion also. If there was still an uncertainty about the paper, it was classified as ‘uncertain’ and it is reviewed again for the final judgment to accept or reject.

3.2.3. STUDY QUALITY ASSESSMENT CRITERIA

As suggested by Kitchenham [57], we developed questions to assess the quality of the selected primary studies. The primary studies were evaluated based on the quality criteria presented for each fulfilled quality criterion. Kitchenham's guidelines [35] suggest performing a quality assessment of each included study, which is complementary to the inclusion/exclusion process. There is no universal definition of the term “quality”, but the Critical Appraisal Skill Programme (CASP) [24] presents a checklist for assessing the quality of qualitative research. These are the criteria, adapted from CASP (Critical Appraisal Skill Programme), that were used in the quality assessment in this systematic review:

- 1) Is there a clear statement of the aims/objectives of the study?
- 2) Is there an adequate description of the context in which the study was carried out?
- 3) Is there a clear description of the proposed contribution, method, or approach?
- 4) Are the threats to validity of the study analyzed?
- 5) Is the study valuable for research or practice?
- 6) Is an appropriate definition of innovation provided?

3.2.4 DATA EXTRACTION STRATEGY

Before executing the data extraction, we performed a pilot extraction to ensure that each reviewer understood and had the same interpretation of the form and data to be extracted [24] [23]. The pilot extraction was performed in a manner similar to the studies selection procedure. After having the same understanding and interpretation of the data extraction strategy, the actual data extraction was performed. While reading the studies, key concepts from each study were extracted according to the form of innovation definition, challenges and framework based on title, authors, publication date and source of databases.

3.3 INTERVIEW METHOD

Interview is a commonly used research method in qualitative research [4] [58] [59]. The aims of interview are to collect historical data from interviewee's memories, to gather the opinions or impression about something or to identify the terminology in a particular setting [58]. For this purpose, interview can be done through three methods [58]:

- 1) **Structured interview:** In this method, the interviewer has prepared all the questions clearly and specific.
- 2) **Unstructured interview:** Opposed to structured interview, the interviewer does not know clearly about information that he or she is looking for. Therefore, the questions are asked as open-ended as possible.
- 3) **Semi-structured interview:** In this method, a mix of open-ended and specific questions is employed to elicit information.

According to Creswell [4], interview can be conducted either by having face-to-face interview, telephone interview, focus group or email interview. In this study, we conducted face-to-face interviews with industry practitioners in software startups each lasting for 30-40 minutes. We used semi-structured method to get as much information as we want from the interviewees. The details of semi-structured interview questions used in this study are presented in Appendix A.

3.4. QUESTIONNAIRE METHOD

To answer the research questions of this study we conducted an explorative questionnaire [60]. Questionnaires are a good instrument to conduct opinion polls [60]. The purpose of this questionnaire was to identify the insight of innovation, challenges or difficulties and solutions to assess innovation practices during software development projects. Questionnaire served as an instrument to collect the expert's opinion that we could not interview face-to face.

The target respondents were software industry practitioners i.e. software developers, analysts, project managers, ICT, CEO, etc. We followed the main steps in developing questionnaire as suggested by Kasunic [61]:

- 1) Determine the question to be asked. In this step, researchers decide what information they need to collect. There are four types of information that can be asked: attributes, attitudes, beliefs or behaviors.
- 2) Select the question type, format and specific wording. In this step, researchers develop the actual questionnaire so the responses can be analyzed and understandable to the target respondents.
- 3) Design the question sequence and overall questionnaire layout. In this step, researchers decide the length of the questionnaire, the sequence of the questions, the transition paragraph and questionnaire layout.
- 4) Develop ancillary documents. Before distributing the questionnaire, researchers need to prepare documents that serve as pre-notification letter, reminder letter or thank you letter. In this study, the details of questionnaires are presented in Appendix B.

CHAPTER 4

METHOD OF ANALYSIS AND INTERPRETATION

In this section we examine the study by using the methods we used (Questionnaire, interview and review of literatures).

4.1. QUESTIONNAIRE ANALYSIS

In total, we had 50 respondents out of which 44 completed the questionnaire (response rate 88%). As suggested by Wohlin et al. [60] for data validation before analysis each response was checked. The responses with incomplete responses were discarded. Furthermore, two responses were discarded because they were received after the deadline. The remaining 42 responses were used for analysis.

4.1.1 ROLES OF RESPONDENTS

We categorized the respondents into similar roles. Eight different roles were identified from the results as shown in Figure 4.1. 16.66% of the respondents were Senior Software developers, 28.57% of the respondents were Software developers, 7.14% of the respondents were Senior ICT Experts, 9.52 % of the respondents were ICT Experts, 14.28% of the respondents were Analysts and 23.80% had Section Head, Management or Executive responsibilities in their respective firms.

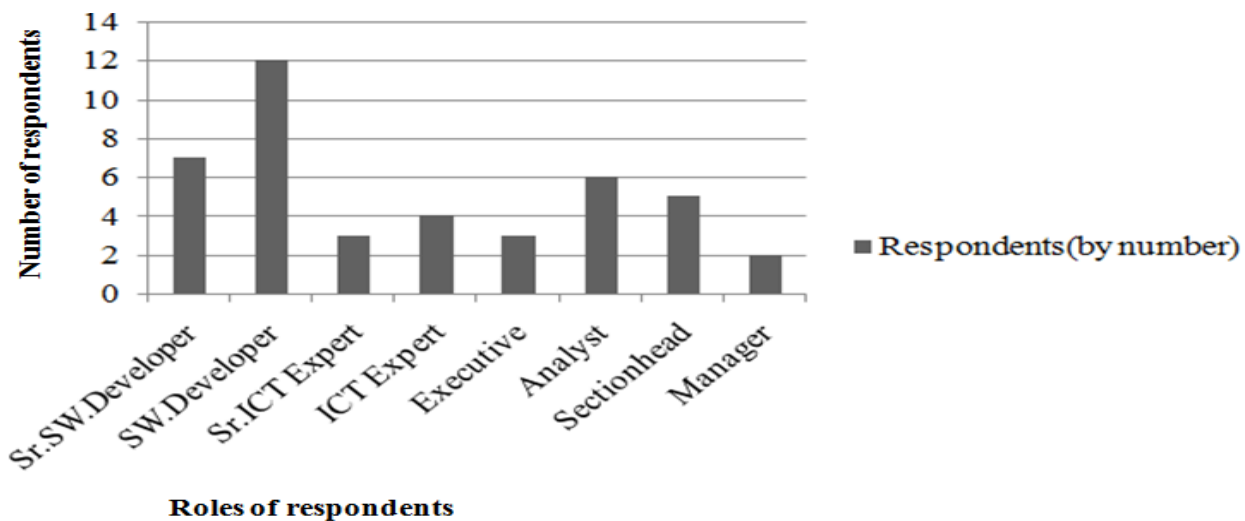


Figure-4.1: Roles of respondents

4.1.2 JOB EXPERIENCE OF RESPONDENTS

The respondents had varying experience in software development and related tasks. The respondents were divided into experience ranges as shown in Figure 4.2. 21.42% of respondents had 2 to 5 years of experience, 61.90% of respondents had 5 to 10 years of experience, 11.90% of respondents had 10 to 15 years of experience and 4.76% of respondents had above 15 years of software development experience.

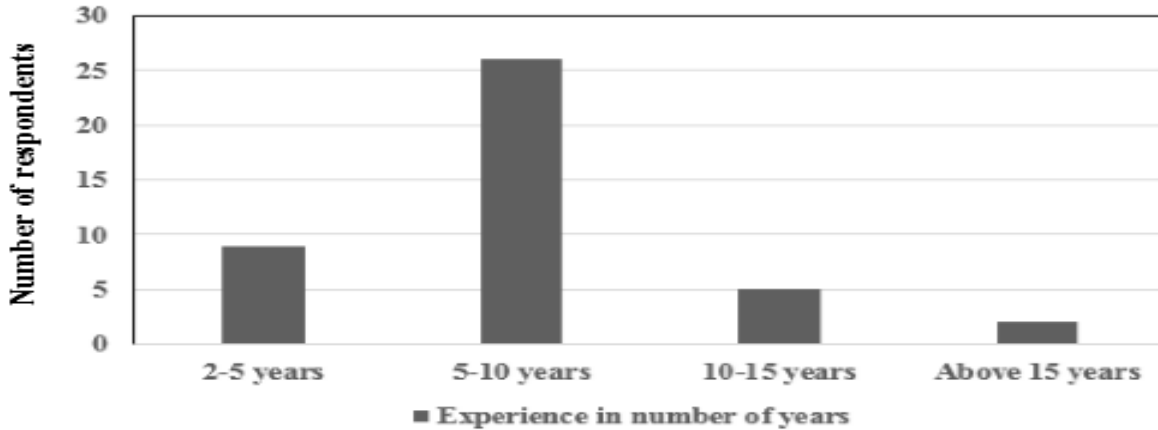


Figure-4.2: Job experience of respondents

4.1.3 FIRM SIZE OF RESPONDENTS

The respondents are from a range of firms of varying sizes (in terms of number of employees). For categorization based on firm size, the Small and Medium Enterprise (SME) definition was followed [93]. 14.28% of respondents were from organizations with 25 to 30 employees, 19.04% from 30 to 35 employee firms, 16.66% from 35 to 40 employee firms, 26.19% from 40 to 50 employee firms and 23.80% from firms with 50-55 employees. The distribution of respondents and number of firms in each category are shown in Figure 4.3 below.

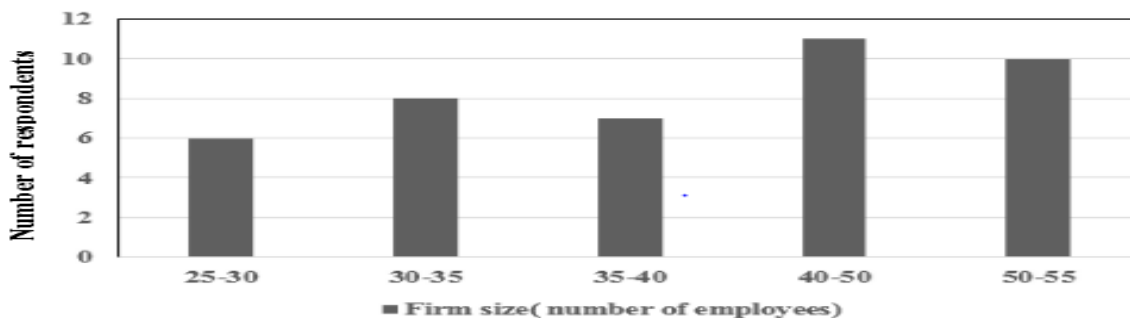


Figure-4.3: Firm size of respondents

In the following sections, the main research questions of the study (RQ1 and RQ2) are answered.

4.2. CHALLENGES OF INNOVATION ASSESSMENT

Based on systematic literature review, we identified common challenges of innovation assessment in other domains (lack of resource, lack of uniform definition, lack of proper process, lack of guidelines and framework, lack of awareness and lack of competency). We asked the respondents whether the same challenges also existed in their context. The following section discusses the results of the study about innovation challenges and solutions.

4.2.1. LACK OF AWARENESS ABOUT THE IMPORTANCE OF INNOVATION

Respondents from firms smaller than 55 employees generally agree to the statement that the importance of innovation is not recognized. On the contrary, respondents from firms larger than 55 (as found in this questionnaire see Figure 4.4) do not consider that there is a lack of recognition of innovation Assessment importance. Notice that the firm sizes for organization A, B, C, D and E are 25-30, 30-35, 35-40, 40-50, and 50-55 respectively.

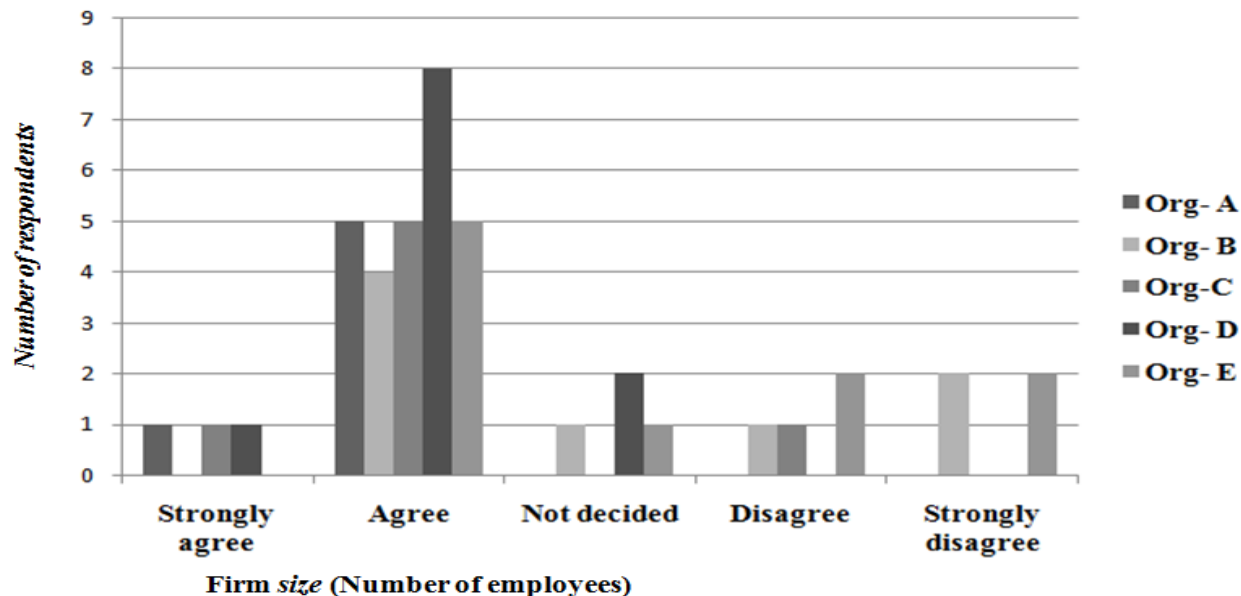


Figure-4.4: Lack of Awareness about innovation

4.2.2 LACK OF UNIFORM DEFINITION FOR INNOVATION

All respondents tend to agree upon this issue that, there is a lack of uniform definition and it hinders the innovation assessment (see Figure 4.5). This result is consistent with the findings of the SLR where 26 definitions were found.

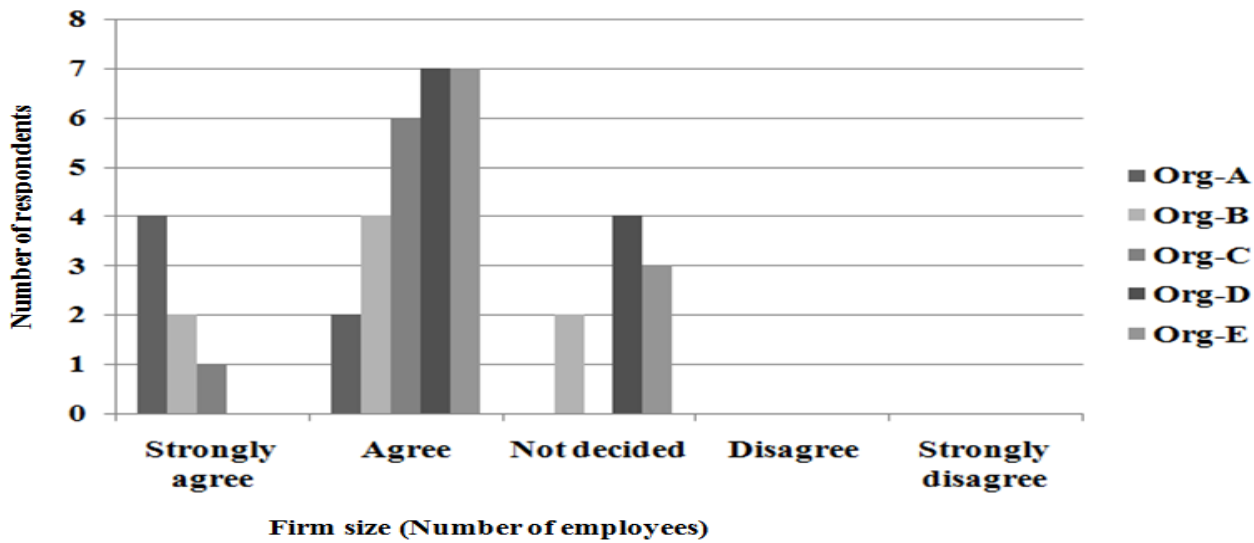


Figure-4.5: Lack of uniform definition for innovation

4.2.3. LACK OF GUIDELINES AND FRAMEWORK

Except for respondents from 30-35(Org-B) employee firms, majority of respondents agree that lack of guidelines and framework is a main challenge for innovation assessment in their firm (see Figure. 4.6).

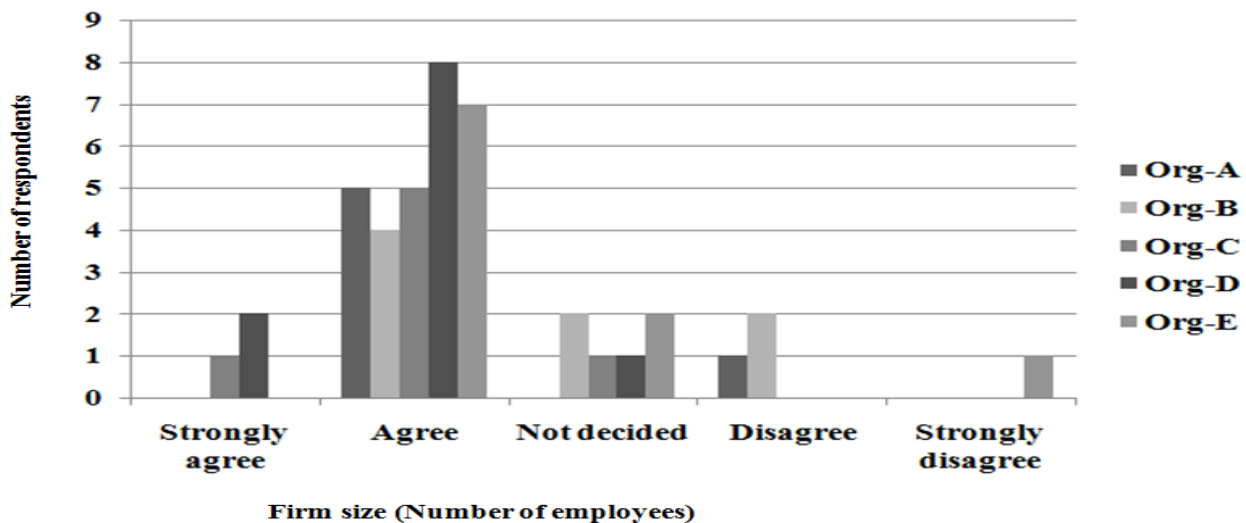


Figure-4.6: Lack of guidelines and framework for innovation assessment

4.2.4. LACK OF INNOVATION CULTURE

As most of the respondents agree that this is one of the challenges; innovation is highly dependent on organization culture and the people involved. As most of respondents said that leaders should responsible for building a culture for innovation. One respondent from org-A said that” there is lack of cultural habit, absence of disposition to support innovation such that one can easily say innovators are almost entirely

excluded in the startups reality and context”. Working on innovation culture has many features like addressing recognition and rewards to innovative employees. An innovation culture also encourages an acceptance towards innovation risk to reward successful innovation but be sure not to punish risk taking and failure [28]. Hence, Startups should have the appropriate innovation culture, and reward systems to drive innovation.

Except for only some respondents from 40-50(Org-D) employee firms, majority of respondents agree that lack of innovation cultural habit is a main challenge for innovation assessment in their firm (see Figure-4.7).

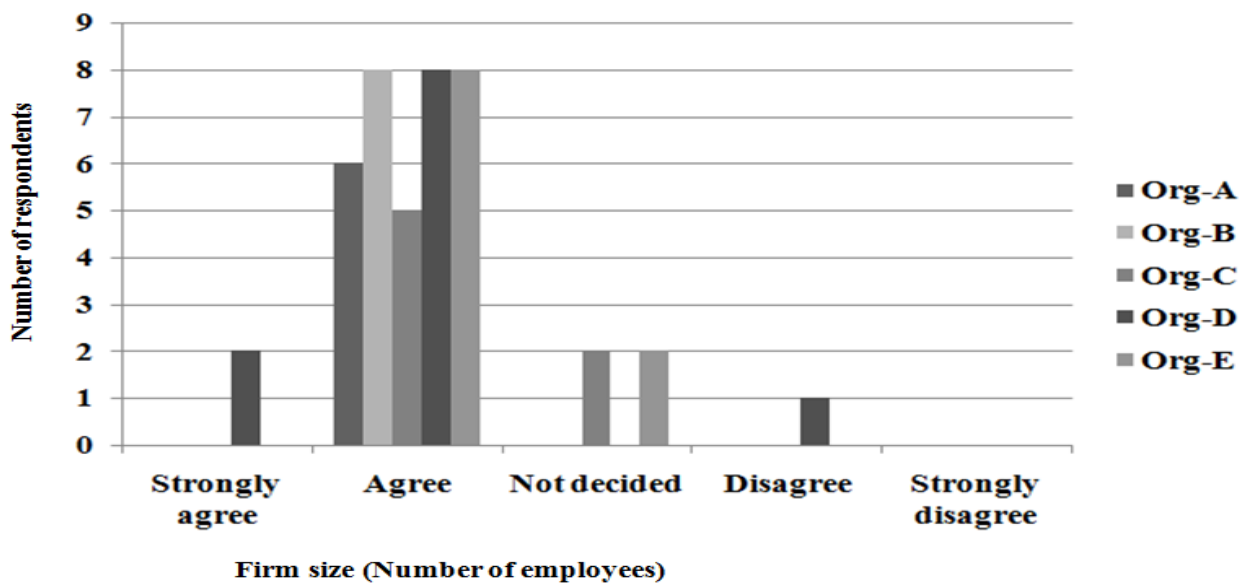


Figure-4.7: Lack of innovation culture

4.2.5. LACK OF INNOVATION STRATEGY

As most respondents agree that in startups there is a lack of formulated innovation strategy while developing software projects. Hence, they should define an innovation strategy internally in their organization during development of their projects (see Figure 4.8).

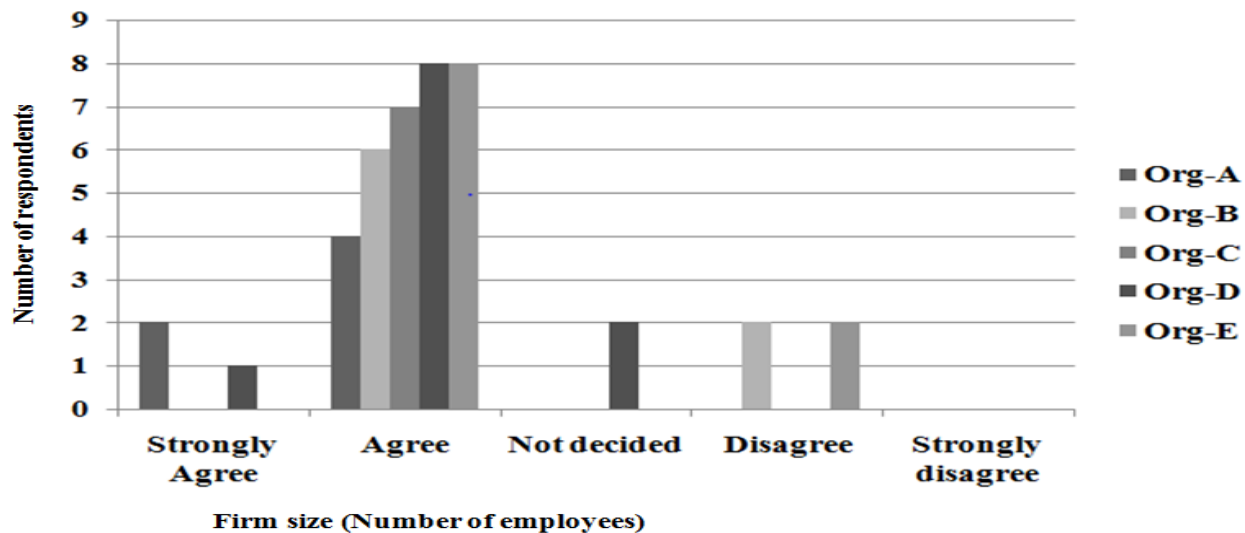


Figure-4.8: Lack of innovation strategy

4.2.6. LACK OF STRONG LEADERSHIP

Leadership is a process by which an individual or group creates direction, alignment, and commitment for their shared work. Innovation Leadership is a process for creating direction, alignment, and commitment needed to create and implement something new that adds value [92]. The development of effective creative leadership is a two-step process. First, leaders individually and collectively must get in touch with their own creative thinking skills in order to make sense of and deal with complexity. Second, rather than develop skills for the “management of creativity” (a control mindset), organizations must develop a creative leadership culture—a climate that promotes and acknowledges the creative process [92].

The Leadership view assesses the degree to which an organization’s leadership supports innovation. As such, it evaluates leaders’ involvement in innovation activities, the establishment of formal processes to promote innovation, and dissemination of innovation goals [34]. Leadership has an important role in the innovation process of organizations [108]. The leadership view attempts to assess the extent to which the organization has created conditions that are conducive to innovation. Leadership’s focus should be on rewarding employees and organizational learning [109]. Moreover, managers need to be aware of giving rewards to individuals or groups [34] [108] for successfully developing an Innovative software project, resulting in innovation empires whereby individuals or groups become overly invested in the success of their project in the organization.

Having strong leadership for innovation is crucial [28]. Most of respondents tend to agree upon this issue that, there is a lack of strong leadership which hinders the innovation assessment (see Figure 4.9). Senior management is essential to software startups to achieve success in innovation. Hence, strong leadership

should be the first innovation rule [109] because it is where startups need to start to develop innovative software projects.

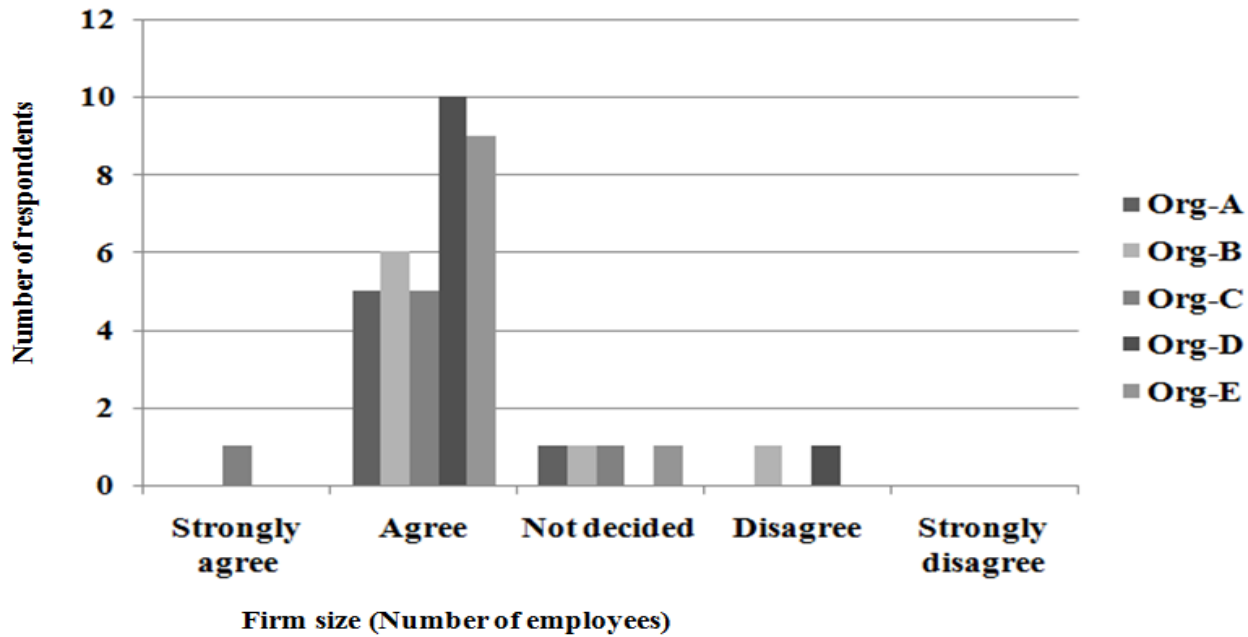


Figure-4.9: Lack of strong leadership

4.2.7. LACK OF COMPETENCY

As stated in [9] this is one of the challenges in startups during development of innovative software projects. As most of participants [9] were agreed that startups are inexperienced in compare with other participants in well-established organizations or large organizations. Hence one of the challenges that these participants facing for their assessment is their lack of skill. This could have negative influence on their assessment and making decision regarding their idea of software development. Another participant in [9] mentioned they need to have some consultant services from senior managers or IT specialists. Such advisors could help them during their assessment procedures. This could cover their gaps on skills and experiences. In other word, this could help them to find real shortcomings in their process and clear a roadmap for enhancement of their innovation projects.

According to participants' opinion they need to have these experienced employees to be involved in their assessment process of software development projects. Such experienced advisors would find out the blind spots that these startups could not find during their evaluation. However due to resource constraints, it is not possible for these startups to hire consultants. This would be a challenge for them to be able to proceed with assessment of ideas only by their own capabilities and knowledge. This means it is hard for these startup

innovators to find out their innovation advantages and disadvantages on their own. Participants mentioned this challenge would slow down the assessment process and affect the reliability of assessment result [9]. In light of this most respondents agreed“...It would be great if we could use help of senior managers in our assessment. However the reality is that according to our budget, it is less than possible for us to find a proper consultant...” (See Figure 4.10).

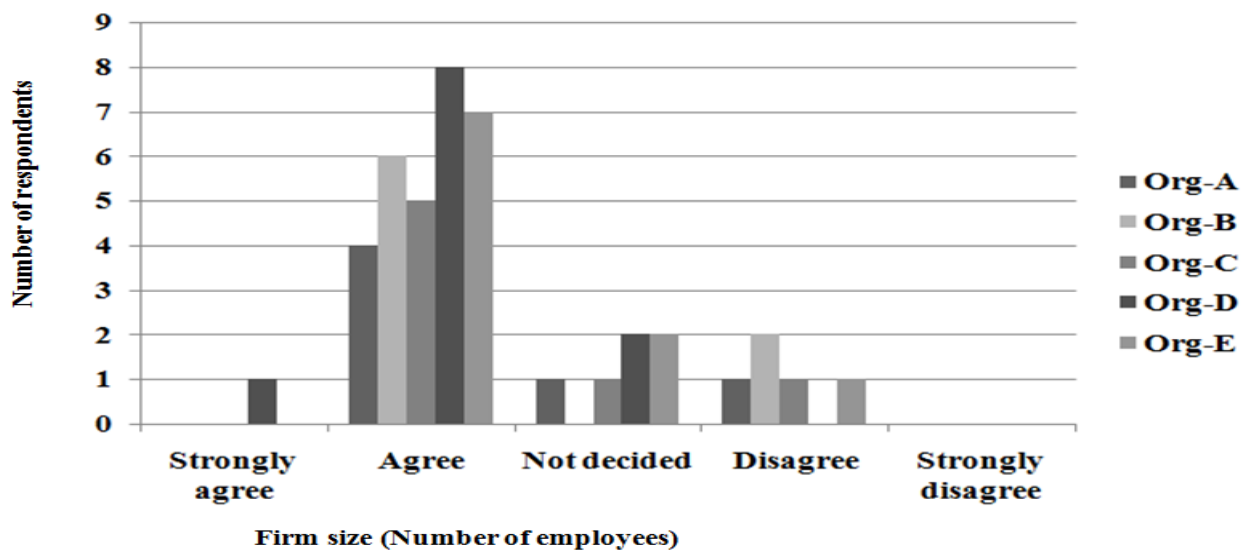


Figure-4.10: Lack of competency

4.2.8. LACK OF PROPER PROCESS

As the participants mentioned startups are not following any well-known process for their evaluation and assessment of software development projects [9]. According to interviewees’ answers about their procedures for innovation assessment, they have to design and use their self-made process. For instance some of participants designed a survey in their startup to distribute for evaluating defined factors.

Most participants mentioned there is not any process to be followed by them. Hence the lack of such a standard process which could be used as a guideline for their assessment caused putting extra and additional efforts and resources by them. Such effort is required for studying similar approaches and defining their own assessment process [9].

Participants stated their organization characteristics are different. These participants are working in startups which are established based on innovations. Therefore it is making them in higher pressure to use standard and well-known processes. It could help them to find real weaknesses and strengths in their ideas to be able

to overcome market barriers. For instance one of the participant from Org-A stated that “We should put so much effort to find out how we should design our innovation assessment process. This is because there is not such a standard process available for startups”.

Hence, as most respondents from all firms tend to agree upon this issue that almost there is no proper process that is hindering startups to pursue innovation assessment (see Figure 4.11).

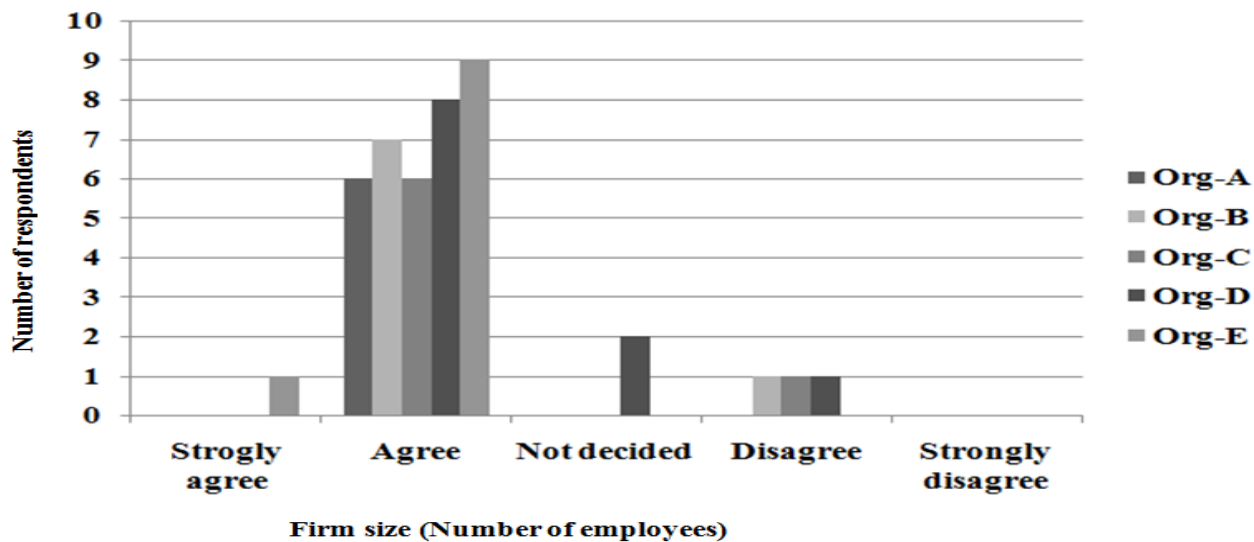


Figure-4.11: Lack of proper process

4.2.9. RESOURCE CONSTRAINT

According to Mobtahej [9] resource constraints such as time, capital and human resource are the main challenges in innovation assessment.

▪ Time

Participants have limited time resources. During assessment process in their innovative idea, one of the important concerns is time constraint. This time constraint is considered in two different dimensions. One of them is regarding available time from participant to put into assessment process as effort hours. On the other hand since these participants mentioned they are facing a dynamic and very competitive market which is shifting very fast; therefore they have time limitation for assessing the idea and developing that into the market. This means that to be able to survive and compete and gain profits, these startups need to be able to assess the novel idea, find strengths and weaknesses and focus on the competitive advantage in a limited time frame.

Based on the assessment outcome, participants would make decision regarding developing the product. However lack of enough time, make it hard for putting enough effort time on assessment and to find out whether the idea is worth pursuing or not. In light of this, one of the participants stated “our time is very limited to define a product which is valuable to the market. We need to put part of our limited time resources to find out about our idea validity through assessment of our designed idea which is sometimes not enough”. According to his opinion, this was because of putting insufficient time on assessment process before making decision for further development. This person mentioned “sometimes we have this feeling that due to constraint on our available resources such as human resource and budget and lack of enough time, we didn’t put sufficient effort on assessment of the idea before making decision on development. This can affect the outcome of the final product significantly” [9].

- **Capital**

Another constraint factor that [9] stated during was that startups have very limited capital. This is because they are at the early stage and have very limited market presence. Therefore they cannot change the product easily. For instance some of the participants stated they had to work somewhere else in parallel to their work in startups in order to survive and instill capital resources to the organization. Participants mentioned that these part-time jobs are required to be able to follow the goal of making their innovation as a prospective commercial product. This capital constraint had influence on the quality of their efforts on assessment procedure. They stated that budget constraint has direct influence on putting enough attention in assessment process. In light of this, one of the participants mentioned “Sometimes we do the assessment as a primary step without deep consideration. Since we don’t have very much capital we cannot put so much effort and capital resource on this step” [9].

- **Human Resource**

According to [9] innovators are facing constraints in their available human resources for their software project innovation assessment. There is limitation in having employees involving in startups in compare with larger organizations. Participants also stated they have very delimited number of people in their teams. The most devoted persons were idea owner/s and co-founders. Hence [9] mentioned they have less available participants for evaluating each idea during their assessment process. This constraint makes it difficult for them to assess all aspects of the idea and considering different opinions in-depth. Hence this is a challenge for them to evaluate whether the idea could meet the desired business goals and customer needs if it develops to a product. Hence, by considering these resource constraints from other domains and questionnaire we can conclude that it is one of the challenge in innovation assessment. Like any assessment program resource associated with innovation assessment would also require an undertaking [23] from the organizations in

terms of financial, time and human resources. Organizations must balance optimization and innovation .The resource view addresses the allocation of resources to effect this balance [34]. The resource inputs are capital, labor, and time. The resource output is the return on investment (ROI) [34]. Resource view inputs assess the resources that the organization is allocating to innovation software projects. Resource view outputs assess the organization's success at innovation assessment. Managers need to measure both inputs and outputs while assessing their organizations innovativeness. The ratio of resource outputs to resource inputs, of course, provides an assessment of return on innovation investment [34].

The respondents were asked to express their opinion if the resource associated with an innovation assessment program is hindering their firm from adopting it. Therefore, looking at the graph in Figure 4.12; we can draw conclusion as respondents from all firm sizes tend to be sure that the resource associated with the innovation assessment program is one of a challenge (see Figure 4.12).

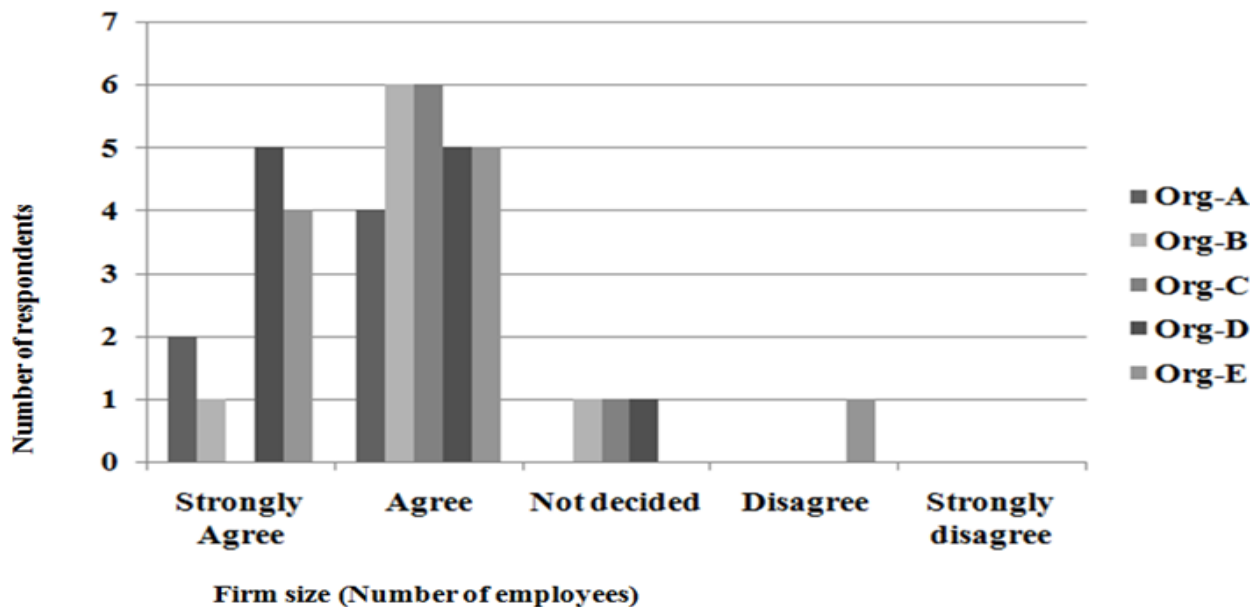


Figure-4.12: Resource constraint

4.3 ANALYSIS OF LITERATURE REVIEW

In the following section we describe the selection results and the characteristics of the selected studies.

4.3.1 PRIMARY STUDIES SELECTION

We executed searching in different database meeting their particular format requirements. We retrieved a total of 150 articles from all databases. We categorize the papers, identify duplicates, sorting and ordering, etc. we rejected duplicate articles. Applying the relevance criteria [23], we rejected 40 articles based on title and abstract. Finally we were looking for and accepted 110 remaining articles as the selected primary studies.

4.3.2 DEFINITIONS OF INNOVATION

From 110 selected primary studies, we identified 26 definitions of innovation. These definitions were found in 26 different studies. Some of studies considered innovation in different terms, i.e. Process, organizational, product, and market innovation, etc. Most of the definitions have a different point of view e.g. Caloghirou et al. [63] defined innovation in knowledge creation perspective as they wrote ‘Innovation can be better understood as a process in which the organization creates and defines problems and then actively develops new knowledge to solve them’. Jong et al. [64] looked at innovation in organizational perspective when they said ‘Innovation behaviour can be defined as all individual actions directed at the generation, introduction and application of beneficial novelty at any organization level’. In chapter 2 of section 2.1, the detailed definitions of innovation found in the literature review are presented.

4.3.3 QUALITY OF PRIMARY STUDIES

It can be seen that most of the studies have a good quality according to criteria’s followed in the study chapter three of section 3.2.3. Most empirical studies discuss about the validity threats (criteria 4). Although most of the studies clearly define the methodology they used, some of the studies did not clearly state the methodology (criteria 3). Only 26 studies formulated their own definitions of innovation or used the existing definitions, which were used as the basis of the studies. The remaining studies did not clearly define innovation or did not have an appropriate definition for the studies (criteria 6).

4.3.4 RESEARCH METHOD ANALYSIS

In this section we classify the primary studies based on research method. The goal of this classification was to see the trend of selected primary studies from the viewpoint of the used research methods. The primary studies were classified based on the research method mentioned in the article. Hence, the categories of the studies are as follows:

- **Survey:** The studies use either questionnaire or interview (or both) to collect data.
- **Case study:** The studies state and use case study to answer research questions.
- **Experiment:** The studies use an experiment to test the hypothesis. And also clearly describe the design of the experiment.
- **Conceptual analysis:** The studies present a theoretical concept without empirical evaluation.
- **No research method specified:** All the studies that do not state clearly the research method used are grouped in this category.

Figure 4.13 shows that 39% of the studies used conceptual analysis and 34% of the studies used survey. Survey is considered as the main instrument to collect quantitative & qualitative data followed by statistical analytic methods to validate the concept. There are some studies that present a theoretical concept but use existing or published data to evaluate the concept. In this study, these studies are considered as non-empirical studies as the researchers just took freely available data and did not collect the data by themselves. However, these studies are marked as ‘conceptual analysis with empirical evaluation’ and treated as subset of this category. There is also a trend that research in innovation assessment used conceptual analysis with empirical evaluation method. 20% of the primary studies used data from existing sources. Only 19% of the studies are pure conceptual analysis. The remaining research method distribution of the studies i.e. for experiment, no research method specified and case study are 2%, 4% and 21 % are respectively

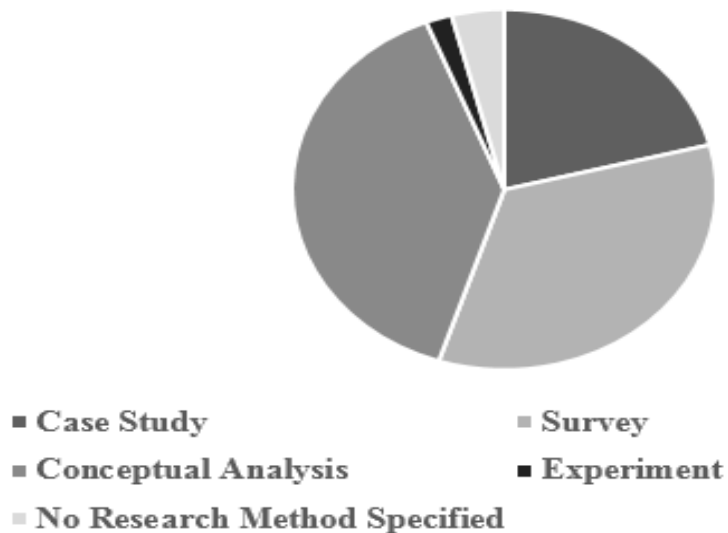


Figure-4.13: Research method distribution of the studies

4.4. ANALYSIS OF INTERVIEW METHOD

During the study, a total of five interviews were conducted. Three interviewees had more industrial experience and remaining two had both academic and industrial experience. All the interviewees were in Addis Ababa and were conducted in face-to-face meetings. In this study, the interview questions are presented in Appendix A. The findings of the interviews are presented in chapter 5.

CHAPTER 5

RESULTS AND FINDINGS

In order to investigate innovation assessment in startups during software development project, we found the results based on the findings of literature review, interviews and questionnaire. The following sections consists of highlighted themes which have been followed by the definition and expressions from respondents, interviewees and by reviewing related literatures.

5.1. DEFINITION OF INNOVATION FOR SOFTWARE STARTUPS

The definitions from the interviews provided us the startup's perspective of innovation. Having interviewed one interviewee from each organization helped to cover different aspects of innovation and increased validity of the findings. Following are the different definitions given by the interviewees based on their perspectives.

- It is to identify and create something new, which generates revenue. It starts from an idea and turns that into a product to create value to the industry. It could be a combination of existing things which are used in a new area. It doesn't mean always creating new things rather adopting existing technology or product in a different manner [INT_E].
- It comes from identifying and understanding existing and unfulfilled needs and fulfilling them in new ways of developing projects with advantageous time and resource usage [INT_A].
- When always thinking about innovation, first thing that comes to mind was invention, new products, but it has wider meanings. It is really to change something or make something in a better way. So it can be both something you can adapting it and do in a better way [INT_B].
- Innovation generally means something that creates value and is introduced to the market. Value can be as perceived by the user, customer or the producer [INT_C]
- Innovation is adding value. Value can be to customer, user experience, extent to which the user can use to fulfil the intended purpose and internal value (the way of developing products) etc. It is also introduction of a new product to the market[INT_D]

Now we focus on perception of innovation based on the definitions by questionnaire respondents, interviewees and literature review. While defining innovation, one interviewee [INT_A] point out the purposefulness of innovation. It must be targeted towards identifying and understanding existing and unfulfilled needs and fulfilling them in new ways with time, cost or usage advantage. He also stated that commercialization is an important requirement for something to qualify as innovation.

Another interviewee [INT_B] described innovation as first thing that comes to mind is invention and new products but innovation has broader meanings. It means changing something or making something in a better way. He further emphasized the nature of innovations (in this case process and product innovations) when He said ‘It can be both something you can touch and a better way of doing things’. He did not mention the importance of commercialization as criteria to define innovation as He said ‘Sure if you are working in an organization you want to make money’.

One interviewee [INT_ C] also highlighted that ‘Innovation is adding value, and value could be customer value, user experience, internal value etc.’ According to his idea, innovation means ‘delivering something that creates new value, the value could be perceived by customer, user or producer’. He highlighted the importance of commercialization for innovation. It can be noted here that there is some congruence between all of these definitions. The results of the systematic review and interviews are also consistent on dimension of novelty of innovation. Anything that is new to the organization (firm) qualifies as innovation.

The software development project practitioners (with higher management experience) see innovation at much broader level by using abstract concepts like value creation and need fulfillment. They look at the purpose and goal to define what may be considered as innovation. While the practitioner with research and development management experience talked about concrete innovation types and mostly stressed on new and improved processes and products. Generally there is an agreement that for something to be considered innovation, commercialization is very important. This is also consistent with the view of innovation found in the literature review. Commercialization which means introduction of products to market and implementation of processes, organizational and marketing methods in actual use is an important feature of innovation [20]. Identifying a comprehensive innovation definition is important as in questionnaire we found that lack of a consistent innovation definition is considered one of a challenge in innovation assessment (see Figure 4.5). This is also consistent with the findings of the survey where respondents gave different definitions focusing on different aspects. One software development practitioner mentioned how the perception of innovation differs across the departments of the same organization [INT- A].

Therefore, among the definitions given or used by the primary studies in this literature review, we analyzed each definition for coverage against the identified aspects of innovation from different viewpoints and forms of innovation. Two definitions of innovation by Crossan et al. [94] and Organization for Economic Co-operation and Development (OECD) Oslo manual [20] located out. According to OECD [20] “innovation

is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations''. According to Crossan et al. [94] "Innovation is: production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome''. This thesis uses the definition of innovation from Crossan et al. [94] for its comprehensive coverage of the identified aspects of innovation in literatures, questionnaire and interviews.

5.2 IMPORTANCE OF INNOVATION ASSESSMENT

The interviewees were asked about the importance of innovation assessment, presence or absence of innovation assessment if they were used or not. The following are some of the responses:

- Never thought of assessing innovation itself, rather we should go for assessing the climate for innovation. We introduced a program in the organization where employees could spend some time working on an idea of their choice and then we followed the time spent on it [INT_ A].
- Innovation assessment is not done possibly because of the lack of skills, tradition and understanding why it should be done [INT_ B].
- We can assess by the number of incoming ideas from employees and external body; the processing and conversion of ideas and concepts to products. However, assessing innovation is difficult because the important issue is getting the quality of ideas not just the number [INT_ E].
- It is better to be part of the business goals for employees to be creative and we need to measure this by number of ideas filled, but till now we didn't follow such mechanism. Number of ideas is a very simple assess of innovation to find right way of qualities of ideas for any software development project [INT_ C].

Even though, startups have no any assessment framework and what interviewees thought should be assessed but there was agreement on importance of innovation assessment. Similarly, the respondents of questionnaire regardless of their roles in the organization agreed that innovation assessment is important.

Findings from literatures also indicates that innovation assessment considered important in software industry. Thus we can conclude that although there is a growing consensus on importance of innovation assessment in industry but the practice is still lagging behind. In the following section we described some of the challenges inhibiting the innovation assessment practice.

5.3. CHALLENGES IN ASSESSMENT OF INNOVATION IN SOFTWARE STARTUPS

The following section discusses the challenges of innovation assessment in software startups and the extent to which this study alleviates them.

5.3.1. LACK OF AWARENESS ABOUT THE IMPORTANCE OF INNOVATION

As most respondents from firms agree that the importance of innovation is not well-known in startups. Hence, they should recognize and aware about it while developing innovative software projects. The importance of innovation assessment is presented in section 5.2.

5.3.2. LACK OF UNIFORM DEFINITION OF INNOVATION

This issue has been identified in the systematic review, interview and questionnaire. Definition is fundamental as it affects the assessment process and helps provide a common understanding. This improves communication and understandability between different stakeholders involved in innovation assessment. With the comprehensive definition (as it covers all the aspects identified in the literature review, questionnaire and the interviews) identified in Section 5.1 proposed for use in software startup organizations we hope to address this issue.

5.3.3. LACK OF GUIDELINES AND FRAMEWORK FOR INNOVATION ASSESSMENT

Since there is no agreement on what innovation is, there is also no agreement on what guidelines and framework should be used. One interviewee [INT _A] mentioned that there is no consensus as to what constitutes innovation within the same software organization. Moreover, innovation is a broader term and some aspects might be difficult to assess. Even if the guidelines have been defined, the next issue is whether they are reliable and give information about the innovativeness of the organization during development of projects.

Although, we found only one innovation assessment framework that is proposed in software development project within startup context (refer Section 4.2.3), the existence of such frameworks has been recognized in software startups. Based on the questionnaire results, we found that no innovation assessment framework have been used in their software organization. Hence, there is no standard guidelines and framework to assess innovation, it is subject to the organization. We think that any assessment framework based on organizations need can be used. Some of the aspects that were missing were a comprehensive innovation definition, framework and guidelines for innovation assessment. By contributing in these types of aspects

we hope to improve the innovation practice (an example scenario of use of the proposed framework given in Section 5.4).

5.3.4. LACK OF INNOVATION CULTURE

As most of the respondents agree that innovation is highly dependent on organization culture and it is one of the challenge. Hence, leaders should responsible for building a culture for innovation. Working on innovation culture has many features like focusing on rewards to innovative employees. Hence, Startups should have the proper innovation culture, and reward systems to push innovation during development of software projects.

5.3.5. LACK OF INNOVATION STRATEGY

To understand the state of practice in industry it was important to see if innovation is acknowledged at the top level. Having clear mention of innovation in the organizational strategy is one such indication.

- The organization strategy does not mention innovation strategy. However, it is indirect and understood that to achieve the strategic objective we need to be innovative [INT_ E].
- NO, we didn't have a focus on innovation in our strategy [INT_ A].
- It is not very clear what it means for the direction of the organization. Perhaps, it still means that no dedicated base research would be conducted in innovation in our organization [IN _B].
- Innovation strategy is the direction that we have to follow to be innovative. So, we have an internal strategy but we didn't exercise widely [INT-C].

As most respondents agree that in startups there in a lack of formulated innovation strategy. Hence, they should define an innovation strategy internally in their organization during development of their software development projects. The lack of a clearly formal innovation strategy is a common problem across organizations in every startup industry. According to most interviewees an innovation strategy should not only answer the “what” question, it must answer the “how” and create linkages between innovation process, expected results and the core business plan of the organization [INT_A, INT_C and INT_D]. Developing an innovation strategy is not a difficult task. Hence, startups should follow a formal innovation strategy, whatever they are doing during innovative software development projects.

5.3.6. LACK OF STRONG LEADERSHIP

As most of respondents tend to agree upon this issue that, there is a lack of strong leadership which hinders the innovation assessment (see Figure 4.9). Strong leadership is very important for innovation [28] during managing of innovative ideas. Hence, Software startups must put in place executive level positions responsible for innovation while developing software projects.

5.3.7. LACK OF COMPETENCY

As stated most respondents (See Figure 4.10) this is one of the challenges in startups during development of innovative software projects. Startups are inexperienced in compare with other well-established organizations or large organizations. Hence one of the challenges that they facing for their assessment is lack of skill [9] which could have negative influence on their assessment and making decision regarding their idea of software development. Hence, senior managers should give consultant services to their employees.

5.3.8. LACK OF PROPER PROCESS

Interviewees were asked if they had a defined set of activities related to innovation. Actually according to all the interview response they didn't use any well-known or formal innovation process. Here are the responses we received regarding the innovation process and its description in some of the firms.

- No we didn't follow formal innovation process. Even though, there is no formal innovation process the interviewer agree that "any employee can contribute an idea to the ideas submission database, which is then evaluated by the manager and selected ideas are passed and if found useful taken up for software product development" for the proposed innovative software development. Employees must rewarded financially and recognized for each idea contribution [INT_ D].
- Every employee of the organization once the process is developed should achieve the strategic objectives. Any employee having an innovative idea has to generate an idea for the organization for further review of his/her idea by the firm .For external innovation, we collaborate with other startup organizations, universities and try to send out the message that we are open for collaboration to support development of the ideas into software products [INT_ E].
- There is no defined process for innovation, usually the new ideas for software product developments come from mainly chief executive officer and occasionally from employees [INT_ B].
- The software development team, is purposely placed innovation to build innovative software concepts used during project development process [INT_ A].

As most respondents from all firms tend to agree upon this issue that there is no proper process that is startups following to innovation assessment of software development projects (see Figure 4.11). Most respondents mentioned there is no any process to be followed by them.

5.3.9. RESOURCE CONSTRAINT

The respondents were asked to express their opinion if the resource associated with an innovation assessment program is hindering their firm from adopting it. Therefore, looking at the graph in Figure 4.12 we can draw conclusion as respondents from all firm sizes tend to be sure that the resource associated with the innovation assessment program is one of a challenge. According to [9] resource constraints such as time, capital and human resource are the main challenges in innovation assessment during development of software projects.

5.4. PROPOSED FRAMEWORK

Using different perspectives of innovation; the key features for innovation assessment identified by the literature review and survey, we developed an innovation assessment framework, as shown in Figure 5.2. It provides the perspective that help to assess the software startup organizations capability for innovation through idea generation.

Innovation is a process that can be managed and improved. Formalizing innovation process improves business value. While people are critical, harnessing the innovative potential of an organization requires process [28]. Innovation is a nonlinear evolving process [45] [85] that needs to be managed and guided [85]. It is how a firm produces innovation output from innovation inputs [84] [85] [86].

Innovation process has been divided into five main phases [28], having these gates or benchmarking points helps in assessments and does not in any way suggest or dictate that the process is as simplistic to have five sequential steps. Innovation is an iterative process [77]. The process of innovation usually is not linear, the majority of innovations go through the process of problem identification and idea generation, idea evaluation, development, first use and commercialization [97]. In this process idea generation or adoption, development of products, and introduction of products to marketplace and implementation of processes in organization are the major activities [68] [75] [71] [74]. Process view interlinks the resource and leadership view. It focuses on a process that accepts a large number of ideas and systematically selects the most promising ideas by managers for further development of software innovative projects. Also, concentrate on minimizing the development time of those selected innovative software projects for further development [34]. Organizations should put and plan to achieve the innovation goals in the business strategy. The

innovation strategy starts right below the organization's strategy, taking growth targets and business goals from the business planning process to drive acquisition, IT, and product strategies. The innovation strategy should include high-level goals, high level areas to be funded for innovation and in turn should drive new ideas. The strategy may also call out new innovation approaches or processes [28]. In this study, we propose a new innovation process; by depicting on a flow of innovation stages. Hence, the startups should follow the following iterative innovation assessment steps to be innovative in the software market. In the following sections, the viewpoints of innovation and their importance that lead to creation of this assessment process are discussed.

Step 1: In the first step ideas are generated. In this process, organizations engage employees, customers, and partners in an innovation community to capture and share new ideas. In this step, the goal is to generate ideas that will drive new business value. To generate the ideas in this process the innovators should work with the customers, get closer to them, what they desire, how they will make their lives better, and how your product will displace something. One of the difficulties organizations face in this process is generating the right kind of ideas.

Step 2: The second process, takes the output of the first process to the next level. In this process, organizations develop ideas-as individuals or as teams to increase their quality and value. Soliciting and capturing ideas is not enough. Early feedback allows great ideas to be improved upon and issues to be raised so they can be resolved.

Step 3: Simply discussing ideas is not enough. In this step, it is important to be able to organize and merge ideas and take them to the next step in order to turn ideas into money/value. Organizations should take thousands of candidate ideas and turn them into a more reasonable number that you can evaluate.

Step 4: This process takes the input from the previous processes and executes a formal project to further develop the idea or commercialize it.

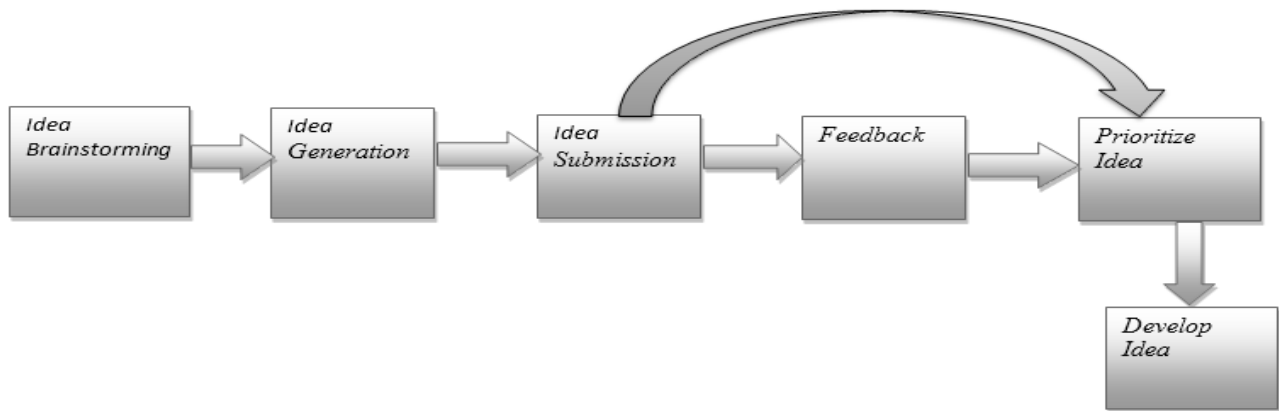


Figure -5.1: Innovation process

The following is the proposed framework that startups will used to assess their innovativeness while developing their software projects.

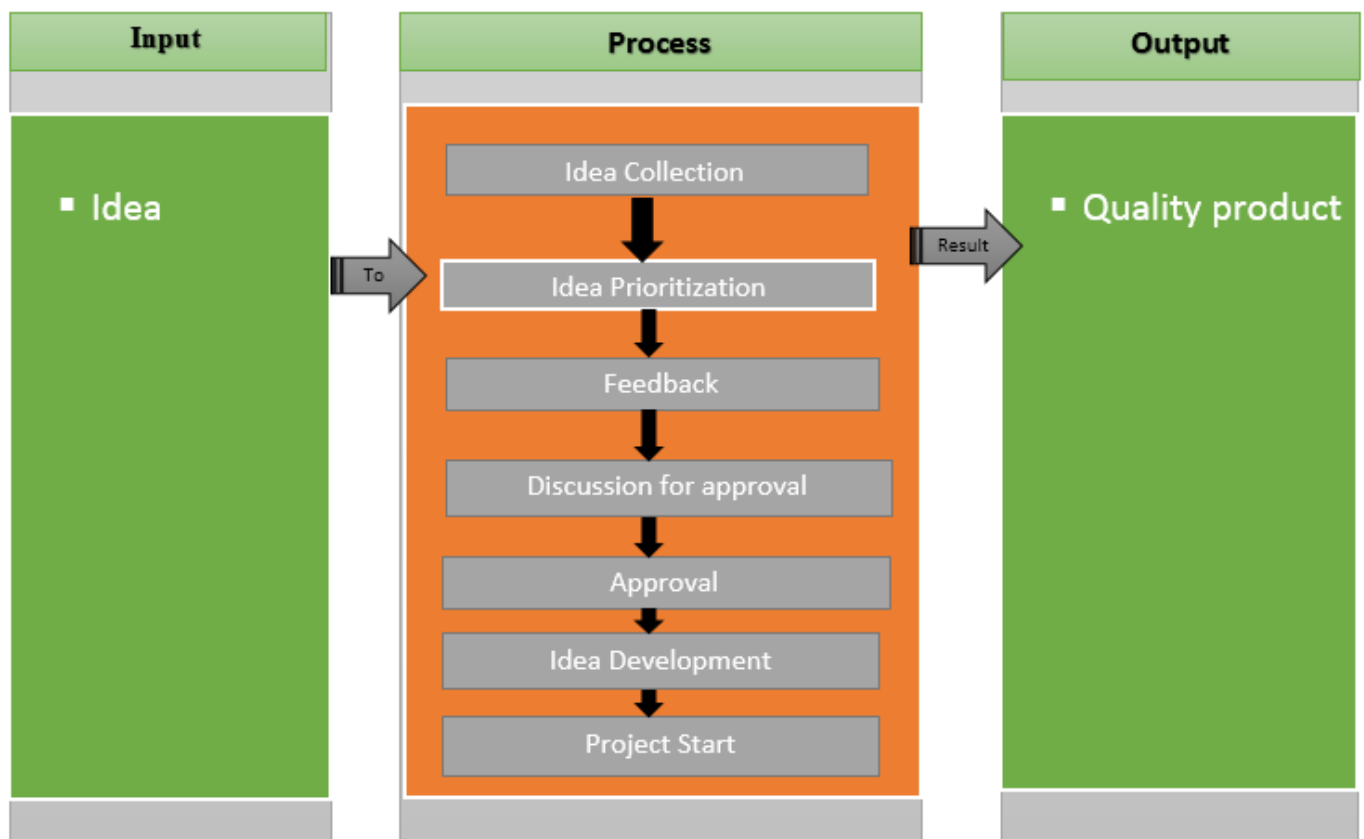


Figure-5.2: Proposed framework

5.4.4 HOW THE PROPOSED FRAMEWORK WORKS

Employees of the startups give ideas on projects which is going to be developed. They should submit their ideas (idea collection). The submitted ideas going to be prioritized by executives or managers of the startups to select innovative ideas. Then feedback is given by the employees. Based on the given feedback and discussions the ideas approved by the manager. Next is the idea development to start the project to get refined quality product with customer satisfaction (refer figure 5.2).

For software startup organizations that are just beginning to develop an innovation assessment; the following are the assessment mechanisms that they should follow during development of innovative software projects:

View Point	Description
Process view	▪ Number of ideas submitted by employees in the past months/years ▪ Ratio of successful ideas to ideas submitted ▪ Number of started and finished innovative software projects ▪ Amount of average time from idea submission to idea developed (accepted).

Table-5.1: How the proposed framework works

5.4.5 PURPOSE OF THE FRAMEWORK

This framework has benefits for software startup industry. It has the following contributions:

- It serves as a starting point for innovation assessment by prescribing innovation process.
- It serves as the basis for future research e.g. to study the effect of various perceptions on innovation assessment in software startups.
- It will provide a common perspective to startups involved in innovation assessment.

5.5 VALIDATION OF THE RESULTS

Most of the interviewees' expressed a positive feedback for the proposed framework about the innovation assessment from different perspectives as shown in figure 5.2. However, there were some critical issues and a concern raised by interviewee's which are discussed below (In sections 5.5.1, 5.5.2 and 5.5.3). In this study

the validity has been increased in the following mentioned process. The major research methods used for this study which are interviews, review of literatures and questionnaire have been identified and are discussed below to show the research degree of validity.

5.5.1 INTERVIEW

Although interview is useful to collect historical information, it also has threats to validity. The presence of interviewers may bias the responses [4]. The bias might be also caused by the unequal articulated and perceptive by all interviewees [4]. Therefore, for each organization, one interviewee is interviewed. Most of the interviewees were at managerial level. Each interview lasted between 30-40 minutes in their offices due to the constraints of time. To validate the framework and gain valuable feedback we conducted face-to-face meeting with the interviewees. This enabled a better and more effective presentation of ideas and arguments while conducting the interview. However, due to the constraints of time and limited contacts we were constrained the interviews in Addis Ababa only. Thus, to reduce the threat to generalization of results [60], we tried to get a mix of representatives from each software organization in Addis Ababa. Experts with software development experience and understanding of the topic of the study were interviewed for effective validation. This also proved useful to validate the completeness of the model [23]. However we think that the study might be affected by the high motivation of the interviewees as they were all interested in the topic. All of startups said that we need to be innovative. Although various critical points and discussions were raised during interviews but the motivation an interest of interviewees in the area may have resulted in biased results [60].

To minimize the threat of evaluation apprehension [60] where respondents may overstate the positive aspects [87], in both interviews and surveys participants were guaranteed anonymity and that the results will be only used by the researchers for this study. Moreover, the decision to use three research methods was to supplement the techniques and improve the ability to generalize the findings of this study. For example to understand the challenges of innovation, we looked for challenges in the literature, indirect questions in survey and open ended questions in interviews. Disturbance and interruptions can affect the results [87]. To minimize this threat, interviewees were requested for appointments well in advance and they choose the time of interview on their convenience and availability. The interviews were conducted with closed doors and there were no interruptions or disturbances during the time of interviews. During the course of the experiment the subjects should not be allowed to communicate with each other as it may affect the results

[87]. In this study, to minimize this threat the interview was conducted by selecting one interviewee from each different organization.

5.5.2 REVIEW OF LITERATURES

As defined by [62] innovation is a very generic term and has been discussed almost in all domains, including software engineering. We found that studies of innovation in software domain were not only published in software engineering journals but also in many other relevant fields for example; Management, health, economics and finance, etc. To minimize the probability of missing relevant studies, we took the following steps as suggested by [23]:

- (1) To cover literature from other important fields like health, management, economics and finance etc., we did not restrict the literature review to software related databases.
- (2) To consider quality articles in this study, mostly journal publications were included in the study.
- (3) For better coverage, we performed manual search for literatures [57].

5.5.3 QUESTIONNAIRE

To check the validity of the questionnaire different validity threats were identified. The instrumentation threat which is caused by bad design leads to misunderstanding of the topic under discussion [60]. It was minimized by conducting the questionnaire with a total of 42 employees in five software startup organizations with different roles and responsibilities. The aim of this was to see whether the questions were clear and understandable and to measure the time taken to fill out the questionnaire. We also sent out the questionnaire to our Advisor for approval to ensure the completeness and validity of the questions. We noticed that some of respondents were unwilling to fill in the questionnaire or left it incomplete.

Another threat to validity was the threat of not having a representative sample of target population (which for this survey were the professionals in software industry with different roles) [60]. To minimize this threat we contacted respondents with different roles (software developers, executives, ICT experts, analysts, etc.) working in organizations. The maturation threat caused by the participants change in behaviour with the progression of time can distort the results [60]. This happens if subjects acquire new knowledge during the process or become detached. However, with a questionnaire which was open only for two weeks we think we were able to minimize this threat. As the respondents may develop their understanding while filling in the questionnaire, different type of questions for example, open ended and closed ended questions were used.

Interruption and disturbance during the participation may influence the results of the study [129]. However, as this was an online questionnaire this threat was beyond the control of the reviewers. Exposing the hypothesis may affect the way the survey respondents answer the questions [87]. Therefore, to minimize this threat only general information about the intent and introduction of the study was given. Also the questions were phrased in a neutral manner e.g. the questions about challenges of innovation, were indirect statements rather than using the keywords to hide the findings of the review which we were being confirmed. Drop out from the study (once they have started to participate) may affect the representative sample and thus the results [87]. This study has this threat as 8% of respondents in the survey did not complete it. However, we think that we still got enough representation in each organization for results to be still valid by the remaining respondents. To capture the expectations on challenges facing in innovation assessment from respondents and exploring new ideas and also for increasing reliability of the results, different locations and different positions has been selected [4]. Identified respondents were in different startups. Hence, these selected respondents have independence on bringing their opinions and experiences in their answers.

5.6 FEEDBACK ABOUT THE PROPOSED FRAMEWORK

At the end we explain most of the interview that presented the framework in detail to get feedback from interviewees and some of employees of the organization. Interviewees were asked about the correctness, completeness and usefulness of the framework. The following are some of the critical comments given by the interviewees about the framework:

- There are some organizations whose business aim is not to make only software products but they do also similar research. Hence, the framework needs some modification by considering from this perspective [INT_ E].
- This framework is generic and is the different way of describing innovation software project and does cover the related concepts. For it to be used, the organizations really needs a integrating of this generic model to the existing structure of the organization; for example, with their website. Also the organization needs to understand their own context first. They need their own framework which everyone not only agrees to but also represents the reality of the future software development business projects [INT _A].
- First you need to investigate the current practices and see what is missing and what can be improved and the consequences of the framework for the organization. And see what we already have and perhaps some of the aspects are already in place [INT_ B].
- Process development is a very important aspect in the performance assessment [INT_ C].

CHAPTER 6

CONCLUSION, RECOMMENDATION AND FUTURE WORK

6.1 CONCLUSION

The main aim of this study was to find challenges and solutions in innovation assessments among software startups by assessing it from different perspectives. For conducting of this research, an assessment framework has been designed by using in-depth interview, systematic literature review and questionnaire method. The Questionnaires and interviews are designed with consideration of related literatures regarding software innovation assessment. Data collection process has been conducted by face-to-face interviews which applied to five interviewees from different software startup organizations. This could highlight the challenges and solutions during innovation assessment which organizations were using for their innovations.

Qualitative data which collected from interviews, questionnaire and systematic literature review analyzed to identify the challenges and solutions facing to startups while developing innovative software projects. Analysis of the data has been conducted by using of conceptual analysis. After analyzing the data through survey and systematic literature review, we found a conceptual framework.

The importance of innovation assessment is not well recognized in software startup industry. Hence, innovation assessment is not a common practice in software startup industry; Some of the major reasons are lack of uniform definition, lack of awareness, lack of guidelines and framework, lack of innovation culture, lack of innovation strategy, lack of strong leadership, lack of competency and lack of proper process to assess innovation. The startups do not assess innovation; this is partly because of the lack of consistent definition of innovation in their organization.

Until today, software industries describe innovation in different ways. They focus on different viewpoints of innovation based on particular perspectives. This difference in views affects how innovation assessment ideas for software development projects are conceived and performed.

This study found that innovation assessment is considered important in software startups for their business during developing software projects. However, it was found that there is a lack of defined innovation process and assessment programs in startups while developing software projects.

Similarly, we found that none of the well-known assessment frameworks have been used to assess innovation during development of innovative software products. This may be caused by lack of comprehensive assessment frameworks. The existing frameworks of innovation assessment do not cover the key process features of innovation. Furthermore, they do not relate which innovation viewpoints can be used to assess the important aspects of innovation.

In this study, our contribution is to identify the important process assessment of innovation and map them into a framework for assessment. The framework encompasses the inputs, processes and outputs for innovation from process point of view. The proposed conceptual framework covers the most common aspects of innovation used in software startup industry. It is one step towards identifying important process viewpoint of innovation to understand the innovation assessment of software startups.

6.2 RECOMMENDATION AND FUTURE WORK

Software startup organizations must give high emphasis on innovation assessment and managers should give awareness to employees by giving training about innovation in order to get better innovative software projects. We recommend that software organizations should integrate and use this framework with their website to develop innovative software projects.

In order to produce high quality software with less cost and less time startups should follow innovation strategy for developing innovative software projects; and they should have an organizational standard about innovation through idea development by creating collaboration and teamwork habits.

Finally, for future work we proposed the following work needs further study.

- Develop innovation assessment tool that represents the innovation assessment of innovative software development process
- Develop and integrate the framework from other innovation perspectives like product, market, technological, etc.
- Integrating software development process with innovation assessment process
- Additional work on validation needs to be undertaken

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APPENDICES

APPENDIX –A: INTERVIEW QUESTIONS

A.1 PRELIMINARY QUESTIONS

Name	
Position	
Years of experience	
Role and responsibility	

A.2 GENERAL QUESTIONS

A.2.1 PERCEPTION ABOUT INNOVATION

- 1) What do you mean by innovation?
- 2) Is innovation considered a strategic objective of your organization?
- 3) What is the Importance of innovation?
- 4) Does your organization have a formal innovation process?
- 5) What aspects of innovation are considered important in your organization?

A.2.2 INNOVATION ASSESSMENT

- 1) Does your organization assess innovation?
- 2) If your answer is **Yes**, how do you assess?
- 3) If the answer is **No**, why is innovation not assessed?
- 4) What are the major issues in assessing innovation?
- 5) Does your organization have a framework or methodology to assess innovation?
- 6) If your answer is **Yes**, could you describe the major steps?
- 7) If **No**, what are the reasons and how do you perform the assessment process?
- 8) What are the challenges that you are facing during assessment of innovations in your organization?

A.3 FINDINGS REVIEW

After the initial questions we presented the major findings and the innovation framework that we have developed from the literature review. Get their comments and feedback about the results.

- 1) Do you think there is an aspect of innovation that is missing in this framework?
- 2) What do you think we can add to this framework to make it usable for software startup industry?

APPENDIX –B: QUESTIONNAIRE QUESTIONS

This questionnaire is designed for the purpose of a research being conducted by master of student in software engineering at Adama Science and Technology University (ASTU), Ethiopia. In this thesis, we are working on innovation assessment to assess the challenges and solutions in software startup organizations during development of their software projects. In this regard, we would like to get response from your organization on what they perceive as innovation and how they assess innovation. We would like to fill out this questionnaire to give us your insight about innovation practices in your organization. The demographic information acquired here will be kept confidential and will only be used for research purpose in this thesis. Thus, your kind cooperation in answering the questions will help the researcher to make analysis of the data and reach a concrete solution, because your frank and unreserved reply would contribute a lot. The researcher would like to thank you in advance for your cooperation.

GENERAL INFORMATION	
Name(optional)	
Sex	☐ Male ☐ Female
Position	
Email(optional)	
Organization name	
Number of employees	
Educational background	Diploma ☐ 1 st Degree ☐ Above 1 st Degree ☐ other:_____
How long have you been working in your current position	☐ Below Five Years ☐ 5-10 years ☐ 10-15 years ☐ Above 15 years

When has the organization been founded	
What is the field of the organization for working	☐ ICT ☐ IT ☐ Software development ☐ Web development ☐ Other, please specify_____.
What are your experiences e.g. Education and Previous work experience	
Have you ever been a founder of organization	☐ Yes ☐ No

B.1 INNOVATION RELATED QUESTIONS

- 1) In your perspective, innovation is defined as_____.
- 2) In your opinion, to be considered as innovation it must be new to (world, industry, market, firm ..., others please specify, why?)

- 3) Do you think innovation assessment is important for your organization?

- ☐ **Yes**
☐ **No**
☐ **I don't know**

- 4) If your answer is **yes**, please describe the reason for your answer briefly.

- 5) Does your organization have clear strategy on innovation?

- ☐ **Yes**
☐ **No**
☐ **I don't know**

6) Does your organization assess innovation?

☐ **Yes**

☐ **No**

☐ **I don't know**

7) If your answer is **yes**, Please briefly explain the reason for your answer.

8) How do you investigate the return of investment (cost/effort/resources, etc.) for your prospective innovative product?

9) What problems/challenges should a framework should cover for innovation assessment and positioning of a novel idea?

10) If there are other challenges that you are facing during assessment of innovations within your organization, please specify and describe here.

11) What Solutions do you think should a framework cover for innovation assessment and positioning of a novel idea?

12) Which of the following do you think are the main challenges for innovation measurement/assessment in your organization?

a) Resource Constraint (capital, time, human resource, etc.)

- ☐ Strongly Agree
- ☐ Agree
- ☐ Not Decided
- ☐ Disagree
- ☐ Strongly Disagree

b) Lack of confidence

- ☐ Strongly Agree
- ☐ Agree
- ☐ Not Decided
- ☐ Disagree
- ☐ Strongly Disagree

c) Scalability Exploration

- ☐ Strongly Agree
- ☐ Agree
- ☐ Not Decided
- ☐ Disagree
- ☐ Strongly Disagree

d) Being Inexperienced

- ☐ Strongly Agree
- ☐ Agree
- ☐ Not Decided
- ☐ Disagree
- ☐ Strongly Disagree

e) Lack of proper process

- ☐ Strongly Agree
- ☐ Agree
- ☐ Not Decided
- ☐ Disagree
- ☐ Strongly Disagree

f) Lack of uniform definition for innovation

☐ Strongly Agree

☐ Agree

☐ Not Decided

☐ Disagree

☐ Strongly Disagree

g) Lack of innovation framework

☐ Strongly Agree

☐ Agree

☐ Not Decided

☐ Disagree

☐ Strongly Disagree

h) Lack of guidelines for innovation

☐ Strongly Agree

☐ Agree

☐ Not Decided

☐ Disagree

☐ Strongly Disagree

i) Lack of proper metrics for innovation

☐ Strongly Agree

☐ Agree

☐ Not Decided

☐ Disagree

☐ Strongly Disagree

13) If you have any other issues on question **No.12**, please Specify here.

14) How do you express innovation from different points of view in your organization?

15) Do the above viewpoints sufficient to successfully assess innovation?

☐ **Yes**

☐ **No** (if you say **NO**, why?)

16) Does your organization use any framework or methodology to assess innovation?

☐ **No**

☐ **Yes** (if **yes**, please can you describe the major steps in the assessment process)?

APPENDIX –C: SAMPLE CODE

Innovative Software Development Project

[HOME](#) · [Register Project](#) · [Approve Ideas](#) · [Report](#) · [Logout](#)

Register Project

Project_Title

Starting_date yy/mm/dd or yy-mm-dd

Ending_date yy/mm/dd or yy-mm-dd

Project Description

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Innovative Software Development Project

[HOME](#) · [Register Project](#) · [Approve Ideas](#) · [Report](#) · [Logout](#)

Select project id to view ideas submitted

Project Id

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Innovative Software Development Project

[HOME](#)[Register Project](#)[Approve Ideas](#)[Report](#)[Logout](#)

Ideas submitted under project title

Android Tourist Guide System

☐ Android Tourist Guide System should support English and French Languages us user interface

☒ Android Tourist Guide System should support English and Amharic Languages us user interface

☒ Android Tourist Guide System should support English,French and Amharic Languages us user interface

Innovative Software Development Project

[HOME](#)[Register Project](#)[Approve Ideas](#)[Report](#)[Logout](#)

Number of ideas submitted

Number of started and finished projects

Ratio of successful ideas to ideas submitted

Average time from idea submission to developed

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Table:Amount of Average time from idea submission to idea developed (accepted)

Number of accepted idea	2
Average day taken	1
Average time taken	24 hours

[Back](#)

Innovative Software Development Project

[HOME](#) • [Feedback](#) • [View](#) • [Comment](#)

The Selected project id to view
Project Id

Android Tourist Guide System

- Android Tourist Guide System should support English and French Languages us user interface
- Android Tourist Guide System should support English and Amharic Languages us user interface
- Android Tourist Guide System should support English,French and Amharic Languages us user interface

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Innovative Software Development Project

[HOME](#)
[Feedback](#)
[View](#)
[Comment](#)

Ro_No	Project Title	Project ID	Status
1	Android Tourist Guide System	1	ongoing
2	E- Health Online Consultation And Medical Subscription	2	ongoing
3	Mobile Attendance Project	3	ongoing
4	Energy Efficient Cloud Computing Project	4	completed
5	Integrated Finance Management System	5	completed
6	Android Customer Relationship Management System	6	notstarted
7	Wifi Library Book Locator Project	7	started
8	Online Loan Application And Verification System	8	started

Project ID	Idea	Idea_id
1	Android Tourist Guide System should support English and French Languages us user interface	1
1	Android Tourist Guide System should support English and Amharic Languages us user interface	2
1	Android Tourist Guide System should support English,French and Amharic Languages us user interface	3
2	E- Health Online Consultation And Medical Subscription Amharic Language us user interface	4
2	E- Health Online Consultation And Medical Subscription Amharic,Oromia and Tigrina Language us user interface	5

Idea_ID

Emp_ID

YOUR COMMENTS ...

Comment

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Innovative Software Development Project

[Generate New idea](#)
[Feed Back](#)
[Managing ideas](#)

Generate New idea

Emp-FName

Emp-LName

Emp-ID

Project Id

Idea

Your impressive idea...

Copyright © ASTU , Ethiopia. All Rights Reserved 2016, By Kelemework

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
  <title>Project Registration</title>
  <link href="themes/1/js-image-slider.css" rel="stylesheet" type="text/css" />
  <script src="themes/1/js-image-slider.js" type="text/javascript"></script>
  <link rel="stylesheet" type="text/css" href="css/a.css">
  <link rel="stylesheet" type="text/css" href="css/style.css" />
  <script type="text/javascript">
function formValidation()
{
  var letters = /^[A-Za-zA-Za-z]+$/;
  var dateformat = /^(0?[1-9])[12][0-9]3[01])(\|-)(0?[1-9]1[012])(\|-)d{4}$/;

  if( document.myform.project_title.value == "" )
  {
    alert( "Please provide project title!" );
    document.myform.project_title.focus();
    return false;
  }
  if (!document.myform.project_title.value.match(letters))
  {

```

```

        alert( "Please provide project title with letters!" );
document.myform.project_title.focus() ;
return false;
    }
    if( document.myform.start_date.value == "" )
{
    alert( "Please provide start date!" );
document.myform.start_date.focus() ;
return false;
    }
if (!document.myform.start_date.value.match(dateformat))
{
    alert("Invalid date format start date!");
document.myform.start_date.focus();
return false;
}
if(document.myform.start_date.value.match(dateformat))
{
    document.myform.start_date.focus();
//Test which separator is used '/' or '-'
var opera1 = document.myform.start_date.value.split('/');
var opera2 = document.myform.start_date.value.split('-');
lopera1 = opera1.length;
lopera2 = opera2.length;
// Extract the string into month, date and year
if (lopera1>1)
{
    var pdate = document.myform.start_date.value.split('/');
}
else if (lopera2>1)
{
    var pdate = document.myform.start_date.value.split('-');
}
var dd = parseInt(pdate[0]);
var mm = parseInt(pdate[1]);
var yy = parseInt(pdate[2]);
// Create list of days of a month [assume there is no leap year by default]
var ListofDays = [31,28,31,30,31,30,31,31,30,31,30,31];
if (mm==1 || mm>2)
{
    if (dd>ListofDays[mm-1])
    {
        alert("Invalid date format on start date number of days!");
return false;
    }
}
}
if (mm==2)

```

```

{
var lyear = false;
if ( (!yy % 4) && yy % 100) || !(yy % 400))
{
lyear = true;
}
if ((lyear==false) && (dd>=29))
{
alert('Invalid date format on start date!');
return false;
}
if ((lyear==true) && (dd>29))
{
alert('Invalid date format on startdate!');
return false;
}
}
}
}
if( document.myform.end_date.value == "" )
{
alert( "Please provide end date!" );
document.myform.end_date.focus() ;
return false;
}
}
if(document.myform.end_date.value.match(dateformat))
{
document.myform.end_date.focus();
//Test which separator is used '/' or '-'
var opera1 = document.myform.end_date.value.split('/');
var opera2 = document.myform.end_date.value.split('-');
lopera1 = opera1.length;
lopera2 = opera2.length;
// Extract the string into month, date and year
if (lopera1>1)
{
var pdate = document.myform.end_date.value.split('/');
}
else if (lopera2>1)
{
var pdate = document.myform.end_date.value.split('-');
}
var dd = parseInt(pdate[2]);
var mm = parseInt(pdate[1]);
var yy = parseInt(pdate[0]);
// Create list of days of a month [assume there is no leap year by default]
var ListofDays = [31,28,31,30,31,30,31,31,30,31,30,31];
if (mm==1 || mm>2)

```

```

{
if (dd>ListofDays[mm-1])
{
alert("Invalid date format on end date number of days!");
return false;
}
}
if (mm==2)
{
var lyear = false;
if ( (!yy % 4) && yy % 100 || !(yy % 400))
{
lyear = true;
}
if ((lyear==false) && (dd>=29))
{
alert("Invalid date format on end date!");
return false;
}
if ((lyear==true) && (dd>29))
{
alert("Invalid date format on end date!");
return false;
}
}
}
if(!document.myform.end_date.value.match(dateformat))
{
alert("Invalid date format on end date!");
document.myform.end_date.focus();
return false;
}
if( document.myform.objective.value == "" )
{
alert( "Please provide objective!" );
document.myform.objective.focus();
return false;
}
if (!document.myform.objective.value.match(letters))
{
alert( "Please provide objective with letters!" );
document.myform.objective.focus() ;
return false;
}
return true;
}
</script>

```



```

if(!$conn)
{
    die("connection failed".mysql_error());
    header("Location:Register.html");
}
else
{
    mysql_select_db("Innovation_database", $conn);
    $value1="unknown";
    $date_of_system=date('y-m-d');
    if($date_of_system==Date('Y-m-d',strtotime("'.$_POST['start_date'].'")) !! $date_of_system>Date('Y-m-d',strtotime("'.$_POST['start_date'].'")))
    {
        $value1="Started";
        $sq2="INSERT INTO project_information (project_title,Start_date,end_date,objective,status) VALUES
        ($_POST[project_title], $_POST[start_date], $_POST[end_date],$_POST[objective],".$value1.")" ;
    }
    else
    {
        $sq2="INSERT INTO project_information (project_title,Start_date,end_date,objective,status) VALUES
        ($_POST[project_title], $_POST[start_date], $_POST[end_date],$_POST[objective],".$value1.")" ;
    }
    if (!mysql_query($sq2,$conn))
    {
        die('Error: ' . mysql_error());
        header("Location:Register.html");
    }

    header("Location:Register.html");

}
mysql_close($conn);
?>
<html>
<head>
    <title> Idea submission page </title>
    <link href="themes/1/js-image-slider.css" rel="stylesheet" type="text/css" />
    <script src="themes/1/js-image-slider.js" type="text/javascript"></script>
    <link rel="stylesheet" type="text/css" href="css/a.css">
    <link rel="stylesheet" type="text/css" href="css/style.css" />
<script type="text/javascript">
function formValidation() {
    var numbers = /^[0-9]+$/;
    var letters = /^[A-Za-z]+$/;
    var letters2=/^[0-9a-zA-Z]+$/;

```

```

if( document.myform.Emp_FName.value == "" )
{
    alert( "Please provide Emp_FName!" );
    document.myform.Emp_FName.focus();
    return false;
}
if (!document.myform.Emp_FName.value.match(letters))
{
    alert( "Please provide Emp_FName with letters!" );
    document.myform.Emp_FName.focus() ;
    return false;
}
if( document.myform.Emp_LName.value == "" )
{
    alert( "Please provide Emp_LName!" );
    document.myform.Emp_LName.focus();
    return false;
}
if (!document.myform.Emp_LName.value.match(letters))
{
    alert( "Please provide Emp_LName with letters!" );
    document.myform.Emp_LName.focus() ;
    return false;
}
if( document.myform.Emp_Id.value == "" )
{
    alert( "Please provide Emp_Id!" );
    document.myform.Emp_Id.focus();
    return false;
}
if (!document.myform.Emp_Id.value.match(numbers))
{
    alert( "Please provide Emp_Id with numbers!" );
    document.myform.Emp_Id.focus() ;
    return false;
}
if( document.myform.project_id.value == "selectP_id" )
{
    alert( "Please select project id!" );
    document.myform.project_id.focus();
    return false;
}
if( document.myform.Idea.value == "" )
{
    alert( "Please provide your Idea!" );
    document.myform.Idea.focus();
    return false;
}

```



```

        mysql_select_db("Innovation_database", $conn);
        $result = mysql_query('SELECT employee_id FROM employee where
employee_id='.$_POST['Emp_Id'].')';
        $rows=mysql_fetch_row($result);
        if($rows>0)
        {
            $today=date('Y-m-d');
            $sq2='INSERT INTO idea (project_id, employee_id, idea_note,idea_registration_date) VALUES
('$_POST[project_id]', '$_POST[Emp_Id]', '$_POST[Idea]',"$today.")';
            if (!mysql_query($sq2,$conn))
            {
                die('Error: '. mysql_error());
                header("Location:Generate_new_idea.php");
            }
            header("Location:Generate_new_idea.php");
        }
        else
        {
            echo '<script type="text/javascript">alert("You are not employee");</script>';
            header("Location:Generate_new_idea.php");
        }
    }
    mysql_close($conn);
    ?>
<!DOCTYPE html>
<html>
<head>
    <title>Approve ideas</title>
    <link href="themes/1/js-image-slider.css" rel="stylesheet" type="text/css" />
    <script src="themes/1/js-image-slider.js" type="text/javascript"></script>
    <link rel="stylesheet" type="text/css" href="css/a.css">
    <link rel="stylesheet" type="text/css" href="css/style.css" />
    <script type="text/javascript">
        function formValidation()
        {
            $var=document.myform.project_id.value;
            if($var=="selectP_id")
            {

                alert("pleas select project id");
                document.myform.project_id.focus();
                return false;
            }
        }
    </script>
</head>
<body>

```



```

<br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/>
<br/><br/><br/>
</form>
</fieldset>
</div><!--close content_item-->
</body>
<div id="footer">
    <h1> Copyright &copy; ASTU , Ethiopia. All Rights Reserved 2016, By Kelemework</h1>
</div><!--close footer-->
</div><!--close main-->
</html>
<!DOCTYPE html>
<html>
<head>
    <title>Approve ideas</title>
    <link href="themes/1/js-image-slider.css" rel="stylesheet" type="text/css" />
    <script src="themes/1/js-image-slider.js" type="text/javascript"></script>
    <link rel="stylesheet" type="text/css" href="css/a.css">
    <link rel="stylesheet" type="text/css" href="css/style.css" />
</head>
<body>
<div id="main">
    <div id="site_content">
        <div id="site_heading">
            <h1> Innovative Software Development Project </h1>

        </div><!--close site_heading-->
        <div id="header">
            <div id="menubar">
                <div class="menuoe">

                    <li> <h1><a href="index.html">HOME</a></h1> </li>
                    <li><h1><a href="Register.html" id="current" >Register Project</a></h1></li>
                    <li><h1><a href="#" id="current" style="color: pink">Approve Ideas</a></h1></li>
                        <li><h1><a href="Report.html" id="current">Report</a></h1></li>
                        <li><h1><a href="logout.php" id="current">Logout</a></h1> </li>
                </div><!--close menubar-->
            </div><!--close header-->
            <div id="content">
                <div class="content_item">
                    <fieldset>
                        <legend><h1>Ideas submitted under project title</h1> </legend>
<form align="Center" action="Accept_and_Reject_ideas3.php" method="post" name="myform">
<h1>
<?php
$con = mysql_connect("localhost","root","");
if (!$con)

```



```

</html>
<?php
    $aDoor = $_POST['idea'];
    $conn = mysql_connect("localhost","root","");
    if(empty($aDoor))
    {
        echo("You didn't select any idea.");
        header("Location:Accept_and_Reject_ideas.php");
    }
else
{
    if(!$conn)
    {
        die("connection failed".mysql_error());
        header("Location:Accept_and_Reject_ideas.php");
    }
else
{
    $today=Date('Y-m-d');
    mysql_select_db("Innovation_database", $conn);
    $N = count($aDoor);
    for($i=0; $i < $N; $i++)
    {
        $sq2="UPDATE idea SET status='accepted' , idea_accepted_date='".$today.'" WHERE
        idea_id='".$aDoor[$i]."'";
        if (!mysql_query($sq2,$conn))
        {
            die('Error: ' . mysql_error());
            header("Location:Accept_and_Reject_ideas.php");
        }
        header("Location:Accept_and_Reject_ideas.php");
    }
}
mysql_close($conn);
?>
<!DOCTYPE html>
<html>
<head>
    <title>Commenting Page</title>
    <link href="themes/1/js-image-slider.css" rel="stylesheet" type="text/css" />
    <script src="themes/1/js-image-slider.js" type="text/javascript"></script>
    <link rel="stylesheet" type="text/css" href="css/a.css">
    <link rel="stylesheet" type="text/css" href="css/style.css" />
    <script type="text/javascript">
        function formValidation(){
            var numbers = /^[0-9]+$/;

```

```

var letters = /^[A-Za-z]+$/;
var letters2=/^[0-9a-zA-Z0-9]+$/;

if( document.myform.Idea_id.value == "" )
{
    alert( "Please provide Idea id!" );
    document.myform.Idea_id.focus();
    return false;
}
if (!document.myform.Idea_id.value.match(numbers))
{
    alert( "Please provide Idea_id with numbers!" );
    document.myform.Idea_id.focus() ;
    return false;
}
if( document.myform.emp_id.value == "" )
{
    alert( "Please provide Emp_Id!" );
    document.myform.emp_id.focus();
    return false;
}
if (!document.myform.emp_id.value.match(numbers))
{
    alert( "Please provide Emp_Id with numbers!" );
    document.myform.emp_id.focus() ;
    return false;
}
if( document.myform.comment.value == "" )
{
    alert( "Please provide your comment!" );
    document.myform.comment.focus();
    return false;
}
/*if (!document.myform.comment.value.match(letters2))
{
    alert( "Please provide your comment with letters!" );
    document.myform.comment.focus() ;
    return false;
}*/
}

</script>

</head>
<body onload="document.registration.Idea_id.focus();">
<div id="main">
<div id="site_content">
<div id="site_heading">

```

```

<h1> Innovative Software Development Project </h1>
</div><!--close site_heading-->
<div id="header">
<div id="menubar">
<div class="menusoe">

<li> <h1><a href="index.html">HOME</a> </h1></li>
<li> <h1><a href="#" style="color: pink">Feedback</a></h1> </li>
<li><h1><a href="View.php" id="current">View </a></h1></li>

<li><h1><a href="#" id="current" style="color: pink">Comment</a></h1></li>
</div><!--close menubar-->
</div><!--close header-->
<div id="content">
<div class="content_item">
<fieldset>
<legend></legend>
<h1>
<form align="center" name='myform' action="insert_comment.php" method="post">
<?php
$con = mysql_connect("localhost","root","");
if (!$con)
{
die("Could not connect:". mysql_error());
}
$no=0;
mysql_select_db("Innovation_database", $con);
$result = mysql_query("SELECT project_title,project_id,status FROM project_information");
echo "<table border='1' >
<tr>
<th>Ro_No</th>
<th>Project Title</th>
<th>Project ID</th>
<th>Status</th>
</tr>";
while($row = mysql_fetch_array($result))
{
echo "<tr>";
echo "<td>" . ++$no . "</td>";
echo "<td>" . $row['project_title'] . "</td>";
echo "<td>" . $row['project_id'] . "</td>";
echo "<td>" . $row['status'] . "</td>";
echo "</tr>";
}
//echo "</table>";
$result2 = mysql_query("SELECT project_id,idea_note,idea_id,status FROM idea");
echo "<table border='1' align='center'>

```

```
<tr>
<th>Project ID</th>
<th >Idea </th>
<th >Idea_Id</th>
<th >Status</th>
</tr>;
while($row2 = mysql_fetch_array($result2))
{
echo "<tr>";
echo "<td>" . $row2['project_id'] . "</td>";
echo "<td>" . $row2['idea_note'] . "</td>";
echo "<td bgcolor='pink'>" . $row2['idea_id'] . "</td>";
if($row2['status']!="accepted")
    echo "<td>not accepted</td>";
else
echo "<td>" . $row2['status'] . "</td>";
echo "</tr>";
}
echo "</table>";
mysql_close($con);
?>
<br/><br/>
Idea_ID<input type="text" name="Idea_id"/>&nbsp;&nbsp;&nbsp;<br/><br/>
Emp_ID<input type="text" name="emp_id"/>&nbsp;&nbsp;&nbsp;<br/><br/>
Comment<textarea cols="30" rows="12" name="comment" onclick="this.value="; ">Your comment ...
</textarea>&nbsp;&nbsp;&nbsp;<br/><br/>
<input type="submit" value="Submit" onclick="return formValidation();">
<input type="reset" value="Clear" >&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&~
</form>
</h1>
</fieldset>
</div><!--close content_item-->
</body>
<div id="footer">
    <h1> Copyright &copy; ASTU , Ethiopia. All Rights Reserved 2016, By Kelemework</h1>
</div><!--close footer-->
</div><!--close main-->
</html>
$conn = mysql_connect("localhost","root","");
if(!$conn)
{
        die("connection failed".mysql_error());
        header("Location:Feedback.html");
}
else
{
```

```

mysql_select_db("Innovation_database", $conn);

$sql="INSERT INTO feedback(comment,idea_id,employee_id) VALUES ('$_POST[comment]',
'$_POST[Idea_id]', '$_POST[emp_id]'" ;
if(!mysql_query($sql,$conn))
{
    die('Error: ' . mysql_error());
    header("Location:Feedback.html");
}
header("Location:Feedback.html");
}
mysql_close($conn);
?>
<!doctype html>
<html>
<head>
<title>ideas submitted by employees</title>
</head>
<body>
<h1>
<?php
//include "libchart/libchart.php";
$con = mysql_connect("localhost","root","");
if (!$con)
{
    die("Could not connect:". mysql_error());
}
$vrz=0;
$vry=0;
$vrz=0;
mysql_select_db("Innovation_database", $con);
$result2 = mysql_query("SELECT idea_registration_date FROM idea");
$var=date('dd-mm-yy His');//how to get current date of the system check it
while($row2 = mysql_fetch_array($result2))
{
    if($var-$row2['idea_registration_date']==1)
        $vrz=++$vrz;
    else if ($var-$row2['idea_registration_date']==3)
        $vry=++$vry;
    elseif ($var-$row2['idea_registration_date']==6)
        $vrz=++$vrz;
}
echo "Table: Number of ideas submitted by employees in the past months<br/>";
echo "<table border='1'>";
echo "<tr>";
echo "<td> First month</td>";
echo "<td>".$vrz."</td>";

```

```

echo "</tr>";
echo "<tr>";
echo "<td> Three months</td>";
echo "<td>".$vry."<td>";
echo "</tr>";
echo "<tr>";
echo "<td> Six months</td>";
echo "<td>".$vrz."<td>";
echo "</tr>";
echo "</table>";
?></h1>
<h2><a href="Report.html" id="current" style="color: Green">Back</a></h2>
</body>
</html>
<!doctype html>
<html>
<head>
<title>started and finished projects</title>
</head>
<body>
<h1>
<?php
//include "libchart/libchart.php";
$con = mysql_connect("localhost","root","");
if (!$con)
{
die("Could not connect:". mysql_error());
}
$vrz=0;
$vry=0;
mysql_select_db("Innovation_database", $con);
$result2 = mysql_query("SELECT status,Start_date,end_date FROM project_information");
while($row2 = mysql_fetch_array($result2))
{
if($row2['status']=='started' || $row2['status']=='ongoing')
$vrz=++$vrz;
else if ($row2['status']=="finished" || $row2['status']=="completed" )
$vry=++$vry;
}
echo "Table: Number of started and finished innovative software projects<br/>";
echo "<table border='1'>";
echo "<tr>";
echo "<td>Started</td>";
echo "<td>".$vrz."<td>";
echo "</tr>";
echo "<tr>";
echo "<td> Finished</td>";

```

```

echo "<td>".$vry."<td>";
echo "</tr>";
echo "</table>";
/*$chart = new PieChart(500, 250);

    $dataSet = new XYDataSet();
    $dataSet->addPoint(new Point("Number of project started and ongoing",$vrx ));
    $dataSet->addPoint(new Point("Number of project finished", $vry));

    $chart->setDataSet($dataSet);

    $chart->setTitle("ration");
    $chart->render("generated/demo3.png");
    */
?>
</h1>
<h2><a href="Report.html" id="current" style="color: Green">Back</a></h2>
</body>
</html>
<!doctype html>
<html>
<head>
<title>successful ideas from ideas submitted</title>
</head>
<body >
<h1>
<?php
//include "libchart/libchart.php";

    $con = mysql_connect("localhost","root","");
    if (!$con)
    {
        die("Could not connect:". mysql_error());
    }
    $vrx=0;
    $vry=0;
    mysql_select_db("Innovation_database", $con);
    $result2 = mysql_query("SELECT idea_id FROM idea");
    $num_rows = mysql_num_rows($result2);
    $result3 = mysql_query("SELECT idea_id FROM idea where status='accepted'");
    $num_rows2 = mysql_num_rows($result3);

    echo "Table:Ratio of successful ideas to ideas submitted<br/>";
    echo "<table border='1'>";
    echo "<tr>";
    echo "<td>Total idea submitted</td>";
    echo "<td>".$num_rows."<td>";

```

```

echo "</tr>";
echo "<tr>";
echo "<td> Total accepted idea</td>";
echo "<td>".$num_rows2."<td>";
echo "</tr>";
echo "</table>";
/*var pie = new RGraph.Pie('cvs', [<?php echo $result1; ?>,<?php echo $result2; ?>]);
$chart = new PieChart(500, 250);

    $dataSet = new XYDataSet();
    $dataSet->addPoint(new Point("Number of ideas",$result2 ));
    $dataSet->addPoint(new Point("Number of sccussful ideas", $result3));

    $chart->setDataSet($dataSet);

    $chart->setTitle("ration");
    $chart->render("generated/demo3.png");*/
?></h1>
<h2><a href="Report.html" id="current" style="color: Green">Back</a></h2>
</body>
</html>
<!doctype html>
<html>
<head>
    <title>Average time from idea submission to developed</title>
</head>
<body>
    <h1>
<?php
//include "libchart/libchart.php";

    $con = mysql_connect("localhost","root","");
if (!$con)
{
die("Could not connect:". mysql_error());
}
$i=0;
$sum=0;
mysql_select_db("Innovation_database", $con);
$result2 = mysql_query("SELECT idea_registration_date,idea_accepted_date FROM idea where
status='accepted'");
if($result2)
{
$num_rows = mysql_num_rows($result2);

if ($num_rows>0) {

```

```

while($data=mysql_fetch_array($result2))
{
$registration_date[$i]=$data['idea_registration_date'];
$accepted_date[$i]=$data['idea_accepted_date'];
$cal[$i]=$accepted_date[$i]-$registration_date[$i];
if($cal[$i]==0)
$cal[$i]=1;
$sum=$sum+$cal[$i];
$i++;
}
}
$av=($sum/2);
echo "Table:Amount of Average time from idea submission to idea developed (accepted)<br/>";
echo "<table border='1'>";
echo "<tr>";
echo "<td>Number of accepted idea</td>";
echo "<td>".$num_rows."<td>";
echo "</tr>";
echo "<tr>";
echo "<td>Average day taken</td>";
echo "<td>".$av."<td>";
echo "</tr>";
echo "<tr>";
echo "<td>Average time taken</td>";
echo "<td>".($av*24)." hours</td>";
echo "</tr>";
echo "</table>";
}
else
{
echo '<script type="text/javascript">alert("You are not an employee");</script>';
header("Location:Report.html");
}
/*$chart = new PieChart(500, 250);

$dataSet = new XYDataSet();
$dataSet->addPoint(new Point("Number of ideas",$result2 ));
$dataSet->addPoint(new Point("Number of successful ideas", $result3));

$chart->setDataSet($dataSet);

$chart->setTitle("ration");
$chart->render("generated/demo3.png"); */
?></h1>
<h2><a href="Report.html" id="current" style="color: Green">Back</a></h2>
</body>
</html>

```