Behavioral Competences of Agile Project Managers

A Case Study of R&D Projects in the Swedish Biotechnology Sector

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Projects that work in complex, uncertain, and dynamic environments, such as research and development (R&D) projects, require a different approach to project management. New approaches have been developed in the last decades as a response to traditional project management to address the uniqueness of the project characteristics. In the mid-1990s, Agile Project Management (APM) was introduced which aimed to address projects that face high levels of complexity and uncertainty. APM aims to develop innovative and complex products that face a constant changing environment.

APM enables a project manager to cope with the challenges presented by R&D projects by delivering customer value through innovative products and a leadership-collaboration management style, which would require certain competences. Traditional PM has focused on the importance of technical competences for successful PM. However, in the last decades two more set of competences have gained importance, contextual and behavioral competences. Several studies have demonstrated the importance of behavioral competences for project managers dealing with highly complex and uncertain projects. Competences such as leadership, communication, flexibility, and creativity have been identified as essential behavioral competences for project managers in turbulent project environments.

This study aims to show what behavioral competences are needed for an agile project manager engaged in R&D projects in the Swedish biotechnology sector. In this way, the research will extend the existing evidence of APM and behavioral competences to a new industry, due to the limited focus of the current research on software development agile projects. The methodology of the study follows a qualitative strategy and a case study design that focuses on the biotechnology sector in the Umeå region. The study achieves an intensive examination of the behavioral competences through a semi-structured interviews method with respondents from five organizations, which represent different segments of the sector.

The findings of the research study show that organizations in the biotechnology sector in Sweden use APM to deliver R&D projects. These organizations follow the APM characteristics to address complexity, uncertainty, and dynamism in R&D projects. In addition, the findings present evidence that behavioral competences are highly important for agile project managers in the biotechnology sector, and considered as the most important competences. Furthermore, the biotechnology sector acknowledges the importance of four competences: creativity, communication, flexibility, and leadership. The four identified behavioral competences allow an agile project manager to enable APM characteristics such as iterative and adaptive life cycles, change management, flexible planning, people orientation, collaborative leadership style, small and self-organized teams, tacit knowledge, and informal communication. The findings suggest that by enabling these characteristics, an agile project manager is able to deliver customer value through innovation and leadership-collaboration management style, hence, successfully addressing the characteristics of a biotechnology R&D project in Sweden.
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Table of Contents

Summary ........................................................................................................................................... i
Acknowledgment ................................................................................................................................. ii
List of Figures ..................................................................................................................................... vi
List of Tables ...................................................................................................................................... vi
List of abbreviations ........................................................................................................................... vi

1. Introduction ................................................................................................................................. 1
   1.1. Traditional Project Management .......................................................................................... 1
       1.1.1. Definition of Traditional Project Management ........................................................... 1
       1.1.2. Traditional PM Process ............................................................................................. 2
       1.1.3. Strengths and Weaknesses of Traditional PM .......................................................... 2
   1.2. R&D Projects in the Biotechnology Sector in Sweden ....................................................... 3
   1.3. R&D Projects and Agile Project Management .................................................................... 5
   1.4. Research Question .............................................................................................................. 6
   1.5. Research Objectives ........................................................................................................... 7
   1.6. Limitations .......................................................................................................................... 7
   1.7. Research Disposition ........................................................................................................... 7

2. Theoretical Methodology ............................................................................................................. 9
   2.1. Preconceptions ..................................................................................................................... 9
   2.2. Methodological Framework ............................................................................................... 10
   2.3. Research Philosophy .......................................................................................................... 10
   2.4. Research Approach ............................................................................................................ 11
   2.5. Theoretical Framework ....................................................................................................... 12
       2.5.1. Acquisition of the Literature ..................................................................................... 12
       2.5.2. Eligibility Criteria ..................................................................................................... 12

3. Theoretical Frame of Reference ................................................................................................. 14
   3.1. Agile Project Management ................................................................................................. 14
       3.1.1. The Concept of Agile Project Management ............................................................... 14
       3.1.2. Phases of APM ........................................................................................................... 16
       3.1.3. Strengths and Weaknesses of APM .......................................................................... 18
   3.2. Choosing an Appropriate PM Approach ............................................................................. 19
   3.3. APM in R&D projects ........................................................................................................ 20
   3.4. Behavioral Competences of Agile Project Managers ......................................................... 21
       3.4.1. The Role of the Project Manager ............................................................................... 21
3.4.2. Competences of Project Managers ...................................................... 22
3.4.3. Technical and Contextual Competences .............................................. 24
3.4.4. Behavioral Competences ..................................................................... 26
3.4.5. Behavioral Competences for Agile Project Managers in Complex and Innovative Projects .......................................................... 27

4. Empirical Methodology ........................................................................... 30
4.1. Research Strategy .................................................................................. 30
4.2. Research Design .................................................................................... 30
4.3. Data Collection ...................................................................................... 31
4.4. Sample .................................................................................................. 33
  4.4.1. Principles of Sample Selection .......................................................... 33
  4.4.2. Company Sample Criteria ................................................................. 33
  4.4.3. Interviewee Sample Criteria ............................................................... 34
  4.4.4. Selected Companies and Interviewees ............................................... 35
  4.4.5. Non-response Analysis ..................................................................... 35
4.5. Interview Guide ...................................................................................... 36
4.6. Interview Procedures ............................................................................ 37
4.7. Interview Limitations ............................................................................ 38
4.8. Data Analysis ......................................................................................... 38
4.9. Ethical Considerations ........................................................................... 38

5. Data Presentation and Analysis ................................................................. 40
5.1. Case Presentation: Umeå Biotechnology Sector ...................................... 40
  5.1.1. Companies’ Background .................................................................. 40
  5.1.2. Respondents’ Background ................................................................. 41
5.2. Project Management .............................................................................. 42
  5.2.1. Projects and the Project Manager’s Role .......................................... 43
  5.2.2. Project Management Approach ....................................................... 47
5.3. Competences ........................................................................................ 52
5.4. Essential Behavioral Competences ....................................................... 54
  5.4.1. Flexibility ......................................................................................... 54
  5.4.2. Leadership ....................................................................................... 56
  5.4.3. Communication .............................................................................. 57
  5.4.4. Creativity ......................................................................................... 58

6. Discussion of Findings ............................................................................. 60
6.1. Agile Project Manager’s Competences .................................................. 60
6.2. Essential Behavioral Competences ................................................................. 61
6.3. Revised Theoretical Framework .................................................................... 64

7. Conclusion ............................................................................................................. 66
7.1. Summary of Findings ....................................................................................... 66
7.2. Theoretical and Practical Contribution .............................................................. 68
7.3. Societal and Ethical Implications .................................................................... 68
7.4. Recommendations for Practitioners ................................................................. 69
7.5. Recommendations for Further Research ............................................................ 69

8. Truth Criteria ......................................................................................................... 71
8.1. Credibility / Internal Validity ............................................................................ 71
8.2. Transferability / External Validity .................................................................... 71
8.3. Dependability / Reliability ............................................................................... 72
8.4. Conformability .................................................................................................. 72
8.5. Authenticity ....................................................................................................... 72

9. References ............................................................................................................. 73
Appendices .................................................................................................................. 80
Appendix 1: Interview Guide ...................................................................................... 81
Appendix 2: Interview Details ..................................................................................... 82
Appendix 3: Template Format ..................................................................................... 83
List of Figures

Figure 1. Traditional PM Process ................................................................. 2
Figure 2. Sweden’s top life science regions ................................................. 4
Figure 3. The methodological framework .................................................. 10
Figure 4. The APM phases ...................................................................... 16
Figure 5. The eye of Competence ............................................................. 24
Figure 6. Theoretical Framework Diagram .............................................. 29
Figure 7. Theoretical Framework Diagram Revisited .............................. 65

List of Tables

Table 1. Traditional PM and APM ............................................................. 20
Table 2. Respondent presentation ............................................................. 35
Table 3. Project characteristics ............................................................... 43
Table 4. Project management approach ................................................... 49
Table 5. The workplace environment of biotechnology R&D projects .......... 50
Table 6. APM principles in biotechnology R&D projects .......................... 51
Table 7. APM characteristics in biotechnology R&D projects .................. 52
Table 8. Flexibility Importance Scale ....................................................... 55
Table 9. Leadership Importance Scale ..................................................... 57
Table 10. Communication Importance Scale ........................................... 58
Table 11. Creativity Importance Scale ..................................................... 59

List of abbreviations

APM Agile Project Management
CEO Chief Executive Officer
CRO Contract Research Organization
EU European Union
IPMA International Project Management Association
IT Information Technology
PM Project Management
PMI Project Management Institute
R&D Research and Development
SEK Swedish Krona
UBI Umeå Biotech Incubator
1. Introduction

This study aims to show what behavioral competences are needed for an agile project manager engaged in R&D projects in the biotechnology sector in Sweden. The methodology of the study is to conduct a case study analysis of the biotechnology sector in the Umeå region, in order to achieve an intensive examination of the behavioral competences. This is done through semi-structured interviews with respondents from five organizations, which represent different segments of the sector. In the following sections, traditional Project Management (PM) will be explored to have a deep understanding on how different projects, for example R&D projects, require different approaches to PM. In addition, the biotechnology sector in Sweden will be explored to state its characteristics to fit a different approach of PM. Finally, the research question, research objectives and limitations will be stated.

1.1. Traditional Project Management

1.1.1. Definition of Traditional Project Management

Traditional PM has evolved from a discipline which was mainly used by the defense and engineering industry in the 1950’s (Cooke-Davies & Arzymanow, 2003, p. 478) to a discipline widely recognized and used by other industries like information & technology, manufacturing, finance, marketing, pharmaceuticals, petrochemicals, etc. (Golini et al., 2014, p. 3; Mir & Pinnington 2014, p. 202; Too & Weaver, 2014, 1382). Studies have shown that organizations with a higher PM maturity, which is the level of development of the PM within an organization, can have more successful results in terms of business benefits (Mir & Pinnington, 2014, p. 202) than those with lower project management maturity (Cooke-Davies & Arzymanow, 2003, p. 478; Golini et al., 2014, p. 3). Traditional PM argues that in order to achieve benefits, an organization needs to comply with common practices, guidelines (Golini et al., 2014, p. 3; PMI, 2013) and standards, which are seen as building blocks for modern organizations (Ahlemann et al., 2009, p.292).

Traditional PM has been defined by the project management bodies of knowledge, the Project Management Institute (PMI) and the Association of Project Management, and several authors with a focus on time, cost, and quality (Atkinson, 1999; Munns & Bjeirmi, 1996). The common definition is that traditional PM is a set of tools, techniques, and methodologies to effectively direct resources for achieving the project requirements and objectives without affecting the routine operations of an organization within the time, cost, and quality constraints (APM, p. 12, 2012; Atkinson, 1999, p. 337; Munns & Bjeirmi, 1996, p.81; PMI, p. 5, 2013). However, Atkinson (1999, p. 338) argues that considering this limited set of criteria have resulted in the high percentage of project failure in different industries. According to the PMI (2013, p. 6) and the Association of Project Management (2012, p. 12) the core components of traditional PM are: showing the need for the project and justification, identifying requirements, addressing stakeholders’ needs and expectations; planning; communication with project stakeholders, controlling and managing scope, quality, schedule, budget, resources and risks; developing and deploying project plan; and leading project team. In addition, Too & Weaver (2014, p. 1389) state that traditional PM must include clear objectives and goals from the initiation of the project. In consequence, the project
management bodies of knowledge have developed a wide range of standards. These standards aim to harmonize PM terminology, describe the functional decomposition of PM, show process descriptions, and develop organizational models (Ahlemann et al., 2009, pp. 292-293).

1.1.2. Traditional PM Process

Traditional PM considers a five stages linear process to manage a project (PMI, 2013, p.50). The stages are: initiation, planning, executing, monitoring and controlling, and closing (PMI, 2013, p. 5), as shown in Figure 1. A project manager would go through each phase one by one, without many overlaps between them. This process aims to ensure an effective management for the application of tools and methodologies to successfully deliver a project.

However, this process could be rigid due to lack of overlap between phases, and a high emphasis on planning and control and monitoring. Munns & Bjeirmi (1996, p. 82) agree that in order to effectively manage a project, there needs to be a high emphasis on planning activities. However, for projects with higher levels of complexity and uncertainty where the requirements cannot be fully specified, it might not be possible to plan in advance in only one stage and move to executing stage. (Ahern et al., 2013, p. 1374). PMI (2013, p. 6) proposes that for these kind of projects a progressive approach to planning should be used. This means that the planning stage would develop continuously as more detailed information and more specific forecasts become available. However, the proposed approach is not flexible enough for projects that face rapid changing environments.

In addition, the control and monitoring stage focuses on constantly bringing activities in line to a plan. It has been argued that excessive control and monitoring can negatively impact the productivity of a project, reduce creativity, and reduce project team’s morale (Collyer & Warren, 2009, pp. 355-361). In consequence, there could be a higher risk of failure (Ahern et al., 2013, p. 1374; Collyer & Warren, 2009, p. 360) if traditional PM is used across all industries as the PMI (2013, p. 48) proposes.

1.1.3. Strengths and Weaknesses of Traditional PM

Traditional PM has evolved in the last few decades as a well-recognized discipline used globally and across several industries (Cooke-Davies & Arzymanow, 2003, p. 471; Svejvig & Andersen, 2014, p. 1) which gives reliability to the methods and tools used by this approach. One of the main strengths of traditional PM is that it emphasizes the need for clear goals and objectives from its initial phase (Munns & Bjeirmi, 1996, p. 82; Too & Weaver,
This gives a clear direction to the project team on what exactly it is needed to deliver. Additionally, traditional PM has developed a largely accepted set of methods, tools, standards, and guidelines that claim certain universality (Association of Project Management, 2012; Ahlemann et al., 2009, p. 292; PMI, 2013).

However, if projects are seen as unique, a “universal” and cross industry approach will not fit all projects (Ahlemann et al., 2009, p. 294). In addition, there is a high level of project failure across the industries, which show that traditional PM might not be the best fit for every project (Collyer & Warren, 2009, p. 358; Koskela & Howell, 2002, p. 293). The cost of implementing PM is very high for an organization, in consequence, finding the right fit for the uniqueness of a project is essential (Grau, 2013, p. 10). Different contexts, where projects present specific characteristics as high complexity, uncertainty and dynamism, need different approaches to PM (Ahlemann et al., 2009, p. 294; Golini et al. 2014).

Ahern et al. (2013, p. 1371) state that there is a need for more extensive research on complex projects in the mainstream PM literature due to their specific characteristics. Traditional PM treats complex projects as if they were just complicated projects that could still be managed, planned, and controlled in the conventional way with the same set of tools, methodologies, techniques and competences. Traditional PM treats knowledge as something pre-existent which is a weakness for the approach. Traditional PM can fail on dealing with “unknown knowns” due to its assumption that all knowledge is already there when executing (Ahern et al., 2013, p. 1373). Therefore, for complex and uncertain projects knowledge is essential through the project lifecycle to discover hidden factors and build tacit knowledge (Polanyi, 1974, p. 22). The needed approach should embrace knowledge creation for these projects.

Traditional PM focuses on planning and control, which is positive when all knowledge has been obtained from before. However, planning and control systems can be risky for projects that have not been completely specified in advance (Ahern et al., 2013, p. 1374). These projects would need an open and flexible planning and control in order to adapt to changes, and a total planning approach would be ineffective (Ahern et al., 2013, p. 1379; Mir & Pinnington, 2014, p. 210). “Events arise at faster rates than is practical to re-plan” (Collyer & Warren, 2009, p. 358) which makes traditional PM counterproductive because it would discourage changes. Following the traditional control of bringing all activities to follow the plan in a dynamic, complex and uncertain project would not be suitable due to the higher level of changes required (Collyer & Warren, 2009, p. 355). Due to the uniqueness of a project, it can be seen that traditional PM is not suitable for every project in every industry as it is suggested by mainstream literature. Different approaches that can embrace change to cope with the high levels of uncertainty and complexity are needed.

### 1.2. R&D Projects in the Biotechnology Sector in Sweden

The biotechnology sector can be considered as one of the new adapters of PM in the last decades (Golini et al., 2014, p. 3; Mir & Pinnington 2014, p. 202; Too & Weaver, 2014, 1382). Biotechnology exploits biological processes, organisms, cells and/or cellular components to develop new technologies and products used in different sectors such as research, agriculture, food, medicine, etc. (Nature, n.d.) . In 2013, this sector represented €28 billion for European Union’s (EU) economy. The EU and the sector leaders have
launched several initiatives in the last few years to trigger growth and enable a more competitive market for the products within this sector (BIO-TIC, 2014). In 2014, €3.7 billion from a public-private partnership were invested for developing Europe’s biotechnology sector. Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science states that the initiatives and policies launched by the EU are enabling Europe to be a leader in the sector because of the huge potential in attracting investments all around the world (European Commission, 2014). It has been forecasted that by 2030 the sector will represent €52 billion for the region (BIO-TIC, 2014).

The biotechnology sector, as part of the life science industry in Sweden, is considered an important foundation for long-term innovation for the society with important economic and political significance (VINNOVA, 2011, p. 6). According to a report from the Swedish Governmental Agency for Innovation Systems (VINNOVA, 2011, p. 5) there are around 32,000 employees in the life science industry in Sweden. The life science industry is composed of three sectors: pharmaceutical, medical technology and biotechnology. The biotechnology sector contains companies “developing the application of science and technology to living organisms” (VINNOVA, 2011, pp. 7-8). This sector consists of eleven segments: drug discovery/development, drug delivery, in vitro diagnostics, biotech medical technology, Contract Research Organizations (CRO), bio-production, biotech tools and suppliers, agro-biotechnology, environmental biotechnology, food related biotechnology, and industrial biotechnology. The biotechnology sector has around 16,200 employees in 285 companies in the country, dominated by R&D employees (VINNOVA, 2011, pp.14, 19). VINNOVA (2011, p. 5) establishes four companies’ sizes: micro (1-10 employees), small (11-50 employees), medium (51-250 employees), and large (over 250 employees). Most of the organizations in Sweden fall in micro, small and medium-sized companies. The governmental agency states that in Sweden there are 5 life science regions where most of the companies are concentrated. The Umeå region is the fourth of the list and it represents the 4% of all companies in the country (VINNOVA, 2011, pp.14), see Figure 2. According to Horn Forlag AS (2014, pp.130-131), the Umeå region has become a main source of companies which are international leaders within the biotechnology sector. The region excels in research & development of projects related to infectious diseases, new antibiotics, med-tech & diagnostics, plant & forest biotechnology, metabolic diseases, and neurodegenerative diseases. There is a strong and systematic interplay of research and commerce which has allowed growth and innovation. Since 2005, there has been a 150% growth on number of companies based in Umeå, employing around 3000 people. There is a wide variety of

![Figure 2. Sweden’s top life science regions. Source: VINNOVA. Life science companies in Sweden- including a comparison with Denmark, 2011. Reprinted with permission](image)
companies from start-up companies to very mature international organizations. The Swedish working culture in these organizations is a positive factor for the biotechnology sector to cope with the challenges that R&D projects face. For this reason, the authors have chosen this geographical area as an interesting region for exploration.

According to the Swedish Institute (2014), a governmental organization responsible for promoting Sweden around the world, the working culture in Sweden is characterized by a unique balance of team interactions and individual orientation. Collaboration, respect and personal responsibility are important factors in the Swedish working culture. Flat hierarchies are predominant in the country’s culture (Swedish Institute, 2014). It is very common for an employee to provide his/her comments directly to the organization’s executives (Porter, 2014). Communication is highly embraced by Swedes in the workplace because having an environment where information flows effectively is highly important for them (Business Culture, n.d.). The communication tends to be informal, where colleagues can address each other in a casual way (Porter, 2014). Feedback is considered essential for an effective communication process, and leaders would constantly require for feedback from their employees. This enables a more efficient and effective decision-making process, where managers will consider the different point of views to take a group-wide agreed decision (Swedish Institute, 2014). According to Porter (2014), the Swedish culture is highly influenced by a ‘lagom’ mentality. Porter (2014) defines the word ‘lagom’ as “enough, sufficient, adequate, just right.” In the Swedish working culture, employers and employees usually focus on executing exactly what is needed, but in the most efficient and effective way (Porter, 2014). Team work, individual responsibility, collaboration, respect, flat hierarchies, effective communication, constant feedback, consensus decision-making, and the ‘lagom’ mentality are characteristics that enable the Swedish working culture to easily adapt to simple, creative, and flexible processes.

1.3. R&D Projects and Agile Project Management

In general, projects are considered a vehicle for bringing innovation into organizations, and R&D projects are focused on delivering novelty (Lenfle, 2008, p. 469). R&D projects are highly complex due to the lack of knowledge in advance on how to develop or discover the final outcome; there is a need for exploration of the market and technology characterized by experimentation and uncertainty. In consequence, these projects have a need of a combination of experts’ capabilities and flexibility to adapt to changes and feedback through the different phases (Lenfle, 2008, p. 471). The challenges of the projects are to face issues as developing cost-effective production solutions, adapting to international regulations, quality, and safety requirements, plus ability to continuous changes from customer requirements (VINNOVA, 2011, p. 8). In addition, projects require both expertise within the different science disciplines, process technology, and knowledge of a variety of industries, which increase the complexity of the task (VINNOVA, 2011, p. 9). Even though the claims for universality of Traditional PM, different characteristics of projects, like R&D projects present, require different approaches towards PM to ensure effectiveness and efficiency in the process (Golini et al., 2014, p. 2) The new approach cannot take knowledge as a pre-given factor, as traditional PM does, but being able to develop it constantly and adapt to it. A new approach to PM for R&D projects could require a less structured and non-linear process adaptable for feedback and cope with change (Ahern et al., 2013, p. 1375).
In the mid-1990s, a new PM approach called Agile Project Management (APM) was introduced (Laanti et al., 2011, p. 276). APM aims to address projects that face high levels of complexity and uncertainty (Fernandez & Fernandez, 2008, p.10). APM aims to develop innovative and complex products that face a constant changing environment (Conforto & Amaral, 2010, p.73). In contrast to traditional PM, the APM is based on the characteristics of flexibility and simplicity. In general, APM is a relatively new field of study, which has mainly focused on software development (i.e. Information Technology industry). There are other fields and industries using this new approach, but there is a lack of literature in those specific fields. The biotechnology sector is a potential field that uses R&D projects, which characteristics can be addressed by APM. In addition, the Swedish working culture characteristics (e.g., team work, individual responsibility, collaboration) as described in the previous section are similar to APM characteristics. This makes it easier for Swedish biotechnology organizations to adopt the APM approach when managing R&D projects.

Traditional PM has extensive research on project manager’s competences. In several studies, researchers have stated the importance of behavioral competences (Clarke, 2010; Stevenson & Starkweather, 2010) for successful project management (Brière et al., 2014, p. 2). The Project Management Institute (PMI) has classified project manager’s competences in 3 segments: performance, knowledge, and interpersonal (PMI, 2013, p. 17). Within the interpersonal section, the PMI considers: leadership, team building, motivation, communication, influencing, decision making, political and cultural awareness, negotiation, trust building, conflict management, and coaching (PMI, 2013, p. 613). The International Project Management Association (IPMA) also considers three groups of competences which cluster 46 competences: technical, professional behavior, and relations with the project’s context (IPMA, 2006). Traditional PM accepts that there might be additional competences for effective management (PMI, 2013, p.613).

Using APM would require project managers to emphasize certain competences to ensure the right implementation of the approach. The project manager would have to be able to continually reduce “complexity by transforming expectations, understand interdependencies for better integration”, handle unknown knowns and frame the problem to be solved in order to facilitate the project team with the necessary support (Ahern et al., 2013, p. 1373) in R&D projects. Collyer & Warren (2009, p. 362) argue that dynamic project in environments with high uncertainty benefit from having project managers with behavioral competences. Therefore, project managers using an APM approach would require certain behavioral competences in order to be able to manage complex and innovative projects. Currently, there is a lack of research conducted for project managers using APM approach in other sectors besides the software development industry. Hence, there is a literature gap on behavioral competences of agile project managers managing R&D projects in a different industry.

1.4. Research Question

Projects with higher levels of complexity and uncertainty, as R&D projects in the biotechnology sector, require a different approach to PM. As shown before, APM would require project managers to emphasize certain competences to manage projects. Therefore, this thesis seeks to answer the following research question:
What are the essential behavioral competences for an agile project manager engaged in R&D projects in the Swedish biotechnology sector?

1.5. Research Objectives

The aim of the thesis is to identify the essential behavioral competences needed for an agile project manager engaged in R&D projects in the Swedish biotechnology sector. The objectives include:

- Explore the adoption of APM in complex and innovative projects.
- Identify the behavioral competences of a project manager engaged in complex and innovative projects and the potential behavioral characteristics of agile project managers.
- Explore the use of agile project management in the R&D of biotechnology sector.
- Provide evidence of the identified essential behavioral competences that agile project managers need to possess in order to deliver a successful R&D project.

1.6. Limitations

This research study will explore the behavioral competences of agile project managers engaged in R&D projects in the Swedish biotechnology sector with participant organizations from the Umeå region. Due to the small sample size, the findings may be relevant to other companies in the rest of Sweden, however, the study and its results will not represent all organizations in the national or global biotechnology sector.

1.7. Research Disposition

Chapter 1 - Introduction: The introductory chapter has explored traditional (PM) to have a deep understanding on how different projects require different approaches to PM, for example R&D projects. In addition, the biotechnology sector in Sweden has been explored to state its characteristics to fit a different approach of PM. Finally, the research question, research objectives and limitations have been presented.

Chapter 2 - Theoretical Methodology: The chapter presents the methodological pathway that the authors have chosen in this study. It will explain the author’s preconceptions, research philosophy, approach, and theories, which influenced this research study.

Chapter 3 - Theoretical Frame of Reference: This chapter aims to establish the theoretical frame of reference. The first part will explain the APM theory. The concept, the phases, strengths and weaknesses, and the appropriateness of both project management approaches will be presented. The second part will explore the competences theory. This section will elaborate first on the existing competences of a project manager, and then the set of competences that are needed for agile project managers according to the APM characteristics.

Chapter 4 - Empirical Methodology: This chapter presents the empirical part of the methodological pathway. It will explore the various research strategies, research designs,
data collection methods and data analysis methods. Simultaneously it will argue in favor of the chosen research strategy, design, data collection method and data analysis method. In addition, it will discuss the ethical considerations and the actions taken against breaching the ethical principles of research.

**Chapter 5 - Data Presentation and Analysis:** This chapter presents and analyzes the empirical findings on the Umeå biotechnology sector case study. The case study will be presented to give a global perspective on the object of study. The empirical data will be presented and analyzed following the five themes developed in the template: introduction, project management, competences, essential behavioral competences, and conclusions. All the information presented in this chapter was obtained through the semi-structured interviews conducted to eight practitioners in the Umeå biotechnology sector: three business coaches, two project managers, one R&D manager, and two Chief Executive Officers (CEO).

**Chapter 6 - Discussion of Findings:** This chapter discusses the findings from the study in relation to the agile project management and the competences theories. It aims to discover the use of APM approach and the use of the essential behavioral competences by agile project managers in the biotechnology R&D projects. The first section will explore the use of APM principles and characteristics in the biotechnology R&D projects. The second section will discuss if the identified essential behavioral competences are needed for agile project managers when managing R&D projects in the biotechnology sector in Sweden.

**Chapter 7 - Conclusions:** This chapter summarizes the findings of the research that aim to answer the research question. The research objectives will be revisited in order to assess whether or not the objectives of the study have been achieved. The contribution and significance of the thesis in the theoretical and practical context will be discussed. Also, potential societal and ethical implications derived from the findings will be presented. In addition, recommendations for practitioners and recommendations for further research will be suggested.

**Chapter 8 - Truth Criteria:** This chapter aims to present an assessment of the validity and reliability of the thesis. Since validity and reliability are more appropriate for quantitative studies, the study will be evaluated with an alternative criteria for qualitative research. The qualitative criteria consists of two main criteria: trustworthiness and authenticity. The trustworthiness criteria parallel to the quantitative research criteria, whereas authenticity evaluates only qualitative studies. In addition, this chapter will discuss the limitations of the research study.
2. Theoretical Methodology

The chapter will present the methodological pathway that the authors have chosen in this study. It will explain the author’s preconceptions, research philosophy, approach, and theories, which influenced this research study.

2.1. Preconceptions

Preconceptions are the assumptions and the motivation of the authors regarding the topic of this thesis. There are various determinants of the preconceptions of the authors, for instance, educational background, cultural background, and previous work and life experiences. These determinants contributed to the author’s choice of the research topic and the methodology to address the research question. The authors are aware of their preconceptions and have taken a critical and neutral stance towards the literature of the topic, especially on the differences of traditional project management and APM approaches. In other words, the authors have chosen to study a gap in the APM literature, but this choice does not mean that the authors prefer agile over traditional approach, or vice versa. The authors believe that PM approaches are context-dependent. This means that one PM approach is better than the other depending on the particular project context. Moreover, the APM literature is new and mostly descriptive. Researchers explain the APM approach based on the values and principles that emerged from ‘the Agile Manifesto’ (Beck et al., 2001). Therefore, the authors of the thesis believe that the fundamentals of APM are best explained by its pioneers – those who participated in ‘the Agile Manifesto’ and first published books on APM.

The authors study the Master in Strategic Project Management programme at Umeå University. In this programme, the authors have studied project management generally and the traditional approach specifically, with less focus on the agile approach. They shared the same desire to explore more on the new approaches of project management, which suggest a different way of achieving solutions when facing a turbulent environment. Moreover, the authors have a similar educational background. During the Bachelor studies, one of the authors has studied Management and Marketing at the Harding University, Arkansas, U.S.A. The other author has studied Management and Information Technology at the Rochester Institute of Technology, New York, U.S.A. The authors have a mutual interest in new approaches of project management, as the agile approach, and competences to be a leader that adapts to different situations. Also, they prefer to explore on the ways of managing the complexity and uncertainty of innovative projects, such as product development and research and development projects. In addition, the authors come from a developing country, but both of them have worked in organizations that are based in a developed country. One of the authors has worked in the biggest multinational retail corporation and the other in a social networking service company, both in the management level. This made the authors familiar with the cultures of the developed countries and played a role in the decision to conduct the research study in Sweden. Besides the social sciences, Sweden also focuses in the development of life sciences, especially biotechnology. These characteristics of Sweden contributed further to the author’s decision to explore competences of leaders needed in innovative projects, as R&D, in the biotechnology sector.
2.2. Methodological Framework

The methodological framework is the way of conducting research, starting from the philosophy of the researcher to the ways of collecting, analysing, and interpreting data. This methodological framework is best explained through the research ‘onion’ developed by Mark Saunders, Philip Lewis and Adrian Thornhill (Saunders et al., 2009, p.108). In Figure 3, the methodological framework is presented as a research ‘onion’. The research ‘onion’ explains the layers of the methodology. It contains the research philosophies, approaches, strategies, designs, and empirical methods (containing data collection and analysis techniques). The research philosophy and approach are explained in this chapter, whereas research strategy, research design, and empirical method are elaborated in chapter 4 - Empirical methodology.

![Figure 3. The methodological framework](image)

2.3. Research Philosophy

Research philosophy is the way researchers develop knowledge in a particular field (Saunders et al., 2009, p.107). It contains assumptions on how researchers view the world; assumptions that determine the path of the methodology (Saunders et al., 2009, p.108). The different research philosophies are classified into three categories: ontology, which is how researchers see the reality or world; epistemology, which is concerned with what can be considered as acceptable knowledge (Long et al., 2000, p.190); and axiology, which looks at the role of the researcher’s values (Saunders et al., 2009, p.109).

The aim of the thesis is to find the competences that agile project managers need to manage R&D projects in the biotechnology sector. The authors seek to answer the research question based on the assumptions of their philosophical stance. The authors believe that project manager’s competences are developed by the managers themselves and that it is the project manager’s responsibility to perform competences that are needed for managing highly complex, uncertain, and innovative projects as R&D projects. Also, agile project managers need to be aware and adapt their competences on the context in which that project is executed. In this case, managers need to identify and develop competences for handling R&D projects in the biotechnology sector. However, project managers need to continually work on their competences in order to be able to handle emergent situations. In other words, there is no
standard list of competences that managers can apply in all contexts. In the literature, the ontological stance where social phenomena (i.e. competences) are developed from the perceptions or actions of the social actor (i.e. project manager) in a continual process, is referred to as constructionism (Bryman & Bell, 2011, p.22; Saunders et al., 2009, p.111). The world of a constructionist is viewed as socially constructed (Morgan & Smircich, 1980, p.497).

Moreover, the authors view the world in a subjective way, as they are concerned with interpreting the meaning of project managers, executives, and business coaches (units of analysis) on the competences that agile project managers should possess when managing R&D projects. The different opinions of project managers, executives and business coaches are meaningful when the researcher aims to identify competences that affect all sides in a particular context. The authors can best interpret subjective meanings when the unit of analysis has the possibility to express their opinion, which can be done in a qualitative manner – through interviews. In that way, the authors can enter into the subject’s world and understand their perception about project manager’s competences. In the literature, the epistemological stance where a researcher aims to extract the subjective meaning or knowledge of social action, is referred to as interpretivism (Bryman & Bell, 2011, p.17). The subjective view of knowledge is based on the individual’s experience (Long et al., 2000, p.190).

In addition, the authors value the research topic as they are interested in what are the competences needed for agile managers managing R&D projects. They intend to understand whether the same competences used by traditional managers are applicable to agile project managers and if those competences are context specific. Furthermore, the authors value the aim of the study as they believe that these findings can improve them in their future career. The authors are value-bounded with the research and intend through a small sample, semi-structured interviews, and a qualitative gathering and analysing of data, to extract this value. The role of the author’s values played throughout the research process, in the literature, is referred to as axiology (Saunders et al., 2009, p.116). The philosophical stance of the authors is in line throughout the different categories. The authors have a subjectivist view with an ontological stance of constructionism, epistemological stance of interpretivism, and a value-bounded axiological stance.

2.4. Research Approach

The research approach is the way of using theory in a particular research. In this research, the theories of agile project management and the competences of project managers are used as a starting point. There is an extensive literature on the competences of project managers. Therefore, instead of generating a new theory, the authors will focus on providing evidence about a particular area of the theoretical framework. The approach that takes a proposition or hypothesis from an existing theory, in order to verify or reject it, is known as deduction (Bryman & Bell, 2001, p.11; Saunders et al., 2009, p.124). Even though not testing a hypothesis with quantifiable data, the authors will use a deductive approach to prove whether the identified essential behavioural competences are applicable for agile project managers that manage R&D projects in the Swedish biotechnology sector. This will be done in a qualitative manner. The deductive approach is not in line with the constructivism and
interpretivism stances and the qualitative method; however, this does not mean that they are incompatible. As Saunders et al. (2009, p.124) state, there can be combinations of different philosophies with different approaches. Also, in the literature it is argued that there is the possibility to use a deduction approach with a qualitative method (Hyde, 2000, p.82), which is the most suitable method for interpreting the subjective meaning of individuals (Bryman & Bell, 2011, p.27). The chosen research method will be explained in chapter 4 Empirical Methodology.

2.5. Theoretical Framework

2.5.1. Acquisition of the Literature

The theoretical frame of reference involves the essential theories used in the thesis in order to answer the research question. In the introductory chapter, the authors introduce a general overview of the project management theory. In the theoretical frame of reference, the essential theories are the APM and the competences theories. The authors will explore the characteristics of APM, the phases of APM, and the context where is mostly appropriate. Afterwards, the competences theory is presented. The different types of competences are elaborated and, lastly, the competences of agile project managers are presented.

The literature of this study will be mainly acquired from books and academic articles, including scientific publications, literature reviews, and descriptive articles. Scientific publications are used as they prove empirically the characteristics of a theory. The literature review articles are used as a source that shows the common agreements and disagreements of different researchers and the characteristics of the different approaches of a theory, for example agile and traditional PM. Descriptive articles are used mainly from authors that are pioneers of, for instance, APM. Also, the books used are from authors that placed the foundations of the APM and competences theories. A few relevant articles used throughout the author’s courses in the programme of Strategic Project Management have been used due to their relevance on theories used in this thesis. Several websites that are crucial for the information presented in the thesis are also used.

2.5.2. Eligibility Criteria

The authors, in order to explore the literature of this thesis, used several online databases, which were made available by Umeå University. The databases used in this study are EBSCO Host, with all its sub-databases, Science Direct, ProQuest, Web of Science, Emerald Insights, and Willey Online Library. The key terms used to search for the material were “agile project management”, “agile leader”, “agile methods”, “agile teams”, “agile projects”, “traditional project management”, “R&D projects”, “project manager competences”, “competence types”, and other terms that resulted after the initial search terms. These keywords were used both separately and combined with each other. Many combinations of the terms would display similar results as other combinations. The articles are published in various Journals in the fields of project management, software development, information systems, organizational psychology, social and behavioural sciences, and so forth. In the other side, the books used in the theoretical framework are books from pioneers of the particular theories
and worldwide recognized institutions, such as Project Management Institute, International Project Management Association, and Association for Project Management.

When searching for articles, the authors will read the articles’ abstract in order to determine the ones that are relevant for this study and that will be read further in detail. The literature search is done for APM and competences theories. The sources used for the literature of APM date from 1999 and the ones used for competences date from 1982. There are several books used for different agile methods, which date from 1999, and the first books that note the APM theory mostly date from 2003 onwards, for example Anderson (2003), Highsmith (2004), Chin (2004), Wysocki (2009), and Cobb (2011). Scientific articles date from 2005 and most of them are between 2008-2014, which proves that APM is still in its infancy years and many more publications are expected in the upcoming years. The competences literature dates from 1982, but 90 percent of the articles used are from 2000 onwards. The baseline of project management competences theory is set by the IPMA Competence Baseline version 3.0 (IPMA, 2006), which is also used as the basis of project manager’s competences in this thesis. However, there will also be used articles that are published earlier than the abovementioned dates, especially for general project management since its literature is more mature. Also, the authors will not use secondary references in order to avoid any misinterpretations. An exception is when researchers have referred to their own previous work; in that case, the authors consider the information reliable as researchers cannot misinterpret their own work.

In addition, the authors have used several websites that provide essential information for the theories used and for industry knowledge. The Agile Manifesto website (Beck et al., 2001) is used as it represents the foundations of APM values and principles. Also, reports from organizations are used that present information on R&D and biotechnology sector. For instance, the VINNOVA (2011) website is used as it provides reports with information on the life sciences industry in general. These sources are usually found through Google search as online databases do not provide information on different websites. Some of the website are cited in the various articles on the theories used due to their importance in the field, for example, the Agile Manifesto website.
3. Theoretical Frame of Reference

This chapter aims to establish the theoretical frame of reference. The first part will explain the APM theory. The concept, the phases, strengths and weaknesses, and the appropriateness of both project management approaches will be presented. The second part will explore the competences theory. This section will elaborate first on the existing competences of a project manager, and then the set of competences that are needed for agile project managers according to the APM characteristics.

3.1. Agile Project Management

Agile Project Management (APM) has emerged as a new approach of project management that aims to address projects that face high levels of complexity and uncertainty (Chin, 2004, p.13; Fernandez & Fernandez, 2008, p.10). APM aims to develop innovative and complex products that face a constant changing environment (Conforto & Amaral, 2010, p.73).

3.1.1. The Concept of Agile Project Management

APM has been defined by several authors and project management institutions. First, the term ‘agility’ will be defined, and then the APM approach. There is no universally accepted definition of agility in the literature as many authors define it in different ways, except for a few authors that define it in the project management context. Agility is the ability to be flexible and responsive (Chow & Cao, 2008, p.962) when it comes to cope with or adapt to changes (Anderson, 2003, p.293; Highsmith, 2004, p.16; Qumer & Henderson-Sellers, 2008, p.281). Furthermore, Qumer & Henderson-Sellers (2008, p.281) claim that for a method to be agile, besides flexible and responsive, it needs to be speedy, lean, and learning. According to Qumer & Henderson-Sellers (2008, p.281), flexible is being ready to adapt to changes and responsive is to react to those changes, yet an agile method should also be able to cut the time and cost and improve quality (i.e. lean), provide short product versions through iterative development (i.e. speedy), and encourage iterative reflections on team performance and product development (i.e. learning).

Highsmith (2004), defines APM as “a set of values, principles, and practices that assist project teams in coming to grips with this challenging environment” (2004, p. 16). This means that projects operate in fluctuating environments where change is inevitable (Williams, 2005, p.502). Confrorto et al. (2014, p.22) claim that the goal of APM is to provide a modest project management process that is more flexible and iterative with the purpose of attaining high levels of performance and innovation. The Association for Project Management, defines agile as “a family of development methodologies where requirements and solutions are developed iteratively and incrementally throughout the life cycle” (2012, p.233). In the other side, the Project Management Institute (PMI, 2013, p.527) refers to agile methods as adaptive life cycles, which is a project life cycle approach that facilitates change and requires a high level of stakeholder participation. In other words, the agile approach is a family of methods that focus on iterative and adaptive development.
The APM literature, even though it is still considered a new field of study, dates back since the mid-1990s when the first agile methods were introduced (Laanti et al. 2011, p.276). The APM approach has emerged from software development industry (Bose, 2008, p.620). The software development process has led to unsuccessful or even abandoned software projects (Chow & Cao, 2008, p.961). Several researchers developed different software development methods that are part of the agile methods family, including: extreme programming (XP) (Beck, 1999), Scrum (Schwaber & Beedle, 2001; Schwaber, 2004), Lean Software Development (Poppendieck & Poppendieck, 2003), Crystal (Cockburn, 2004), Feature Driven Development (FDD developed by Jeff DeLuca) (Palmer & Felsing, 2002), Adaptive Software Development (Highsmith, 2000), and Dynamic System Development Method (DSDM developed by Dane Faulkner) (Stapleton, 1997). The mostly used method is XP and Scrum (Hoda et al., 2010, p.75). XP focuses on development practices, whereas Scrum focuses more on project management and the development process (Dybå & Dingsøyr, 2008, p.835). In general, the agile methods are based on iterative development that provide short releases of product features with simple design, which are continually reviewed by the customer, with the purpose of attaining business value through each cycle (Hoda et al., 2010, p.75; Ramesh et al., 2010, p.449). In this way, the project effectively responds to a fast-moving and competitive market (Ramesh et al., 2010, p.450).

Moreover, in 2001, the founders of the software development methods were grouped together to create the fundamentals of the values and principles of agile software development, called ‘the Agile Manifesto’ (Beck et al., 2001). Therefore, in the Agile Manifesto, the authors agreed that all the agile software development methods will be based on the following core values: “Individuals and interactions over processes and tools; Working software over comprehensive documentation; Customer collaboration over contract negotiation; Responding to change over following a plan” (Beck et al., 2001, para.1). The founders of the Agile Manifesto argue that they value the items in the right, but they value the items in the left more (Beck et al., 2001). For example, processes and tools are important, but individuals and interactions are more important. Highsmith (2004, pp. 8-9) adapted the values of agile software development in to the APM approach. The values remain the same except for the second value, in which the term ‘software’ is replaced with the term ‘product’ in order for the value to be adaptable in other industries.

Additionally to the values, the authors of the Agile Manifesto established twelve principles of agile development. Highsmith (2004, p.27) adapted the twelve principles in to the APM approach and summarized them in to two groups: customer value through innovative products and leadership-collaboration management style. The first group consists of principles that focus on the customer, for instance: deliver customer value; employ iterative, feature-based delivery; and champion technical excellence. The second group includes leadership features as: encourage exploration; build adaptive and self-organizing teams; and simplify. Since the development of the values and principles of agile methods, many researches and books have been published on APM (Chin 2004; Cobb 2011; Cohen 2010; Cohn 2005; Highsmith 2004; Schwaber 2004; Wysocki 2009). Many books on APM are based on the software development context; however, it is argued that APM tools and techniques can be used and are adaptable in projects of other industries, which face an environment that requires constant change (Conforto et al., 2014, p.22).
3.1.2. Phases of APM

APM, same as the traditional PM, has established phases of a project life cycle. APM has two types of life cycle models: Iterative and Adaptive life cycle (Wysocki, 2009, pp.330-331). The iterative life cycle consists of project phases that repeat several times – a process known as iteration – with a feedback circle at the end of each iteration (Fernandez & Fernandez, 2008, p.12; Wysocki, 2009, p.390). The adaptive life cycle is similar to the iterative life cycle, but “each iteration's feedback adjusts the next iteration so that a solution will be converged upon” (Fernandez & Fernandez, 2008, p.12). In iterative life cycle, the solution is partially known, but not in depth (Wysocki, 2009, p.405). In the adaptive life cycle the solution is unknown; it misses both depth and breadth (Wysocki, 2009, p.405). The adaptive life cycle fits more for innovative projects where the solution or product is unknown until is actually invented.

Moreover, the iterative and adaptive life cycles, both contain several phases through each iteration. Highsmith (2004, p.18) develops the framework of the APM, which consists of five phases: Envision, Speculate, Explore, Adapt, and Close. Each phase is dependent on particular practices, tools and techniques that contribute to their successful completion. In Figure 4, the APM phases are shown as inspired by Highsmith’s framework. APM is based on an adaptive and iterative life cycle (Wysocki, 2009, pp.330-331) with an iterative development of the requirements of the product (Association of Project Management, 2012, p.233); therefore, the phases speculate, explore, and adapt imply iterative evolution (Highsmith, 2004, p.84). In other words, the three phases undergo through several iterations or cycles until the final product is developed. Furthermore, Highsmith (2004, p.22) highlights that the APM framework is not the “universal best practice”, but it works for a particular type of problem, project, or organization, with a particular manager style and team culture.

According to Highsmith (2004, pp.80-81), the Envision phase aims to deliver a product vision and project scope that covers what is to be delivered, who is to be involved, and how the work is to be done. The product vision should be clear and concise as it will not change throughout the project. This is contrary to the scope and requirements as they will be changed. Furthermore, the Speculate phase is about hypothesizing based on limited information. It includes a plan on feature-based releases, milestones, and iterations that aim to achieve the product vision. APM recognizes planning but in a turbulent environment, where plans are the means of embracing change. This is because customer’s requirements change, the team changes, a new feature is invented, or other reasons. Williams (2005, p.504) claims that planning cannot be fully prepared due to the incomplete information or influences of the external environment. Scope and requirements are roughly defined at this phase as they are

![Figure 4. The APM phases](image-url)
defined in detail at the beginning of each iteration (Stare, 2014, p.302). Cobb (2011, p.49) highlights ‘just-in-time’ planning, which is planning limited to only getting the project started. As Highsmith (2004, pp.80-83) states, the Explore phase involves developing the intended product features and aiming to continually reduce the uncertainty and risk of the project. The activities of this phase include delivering features by handling the workload and technical and risk mitigation practices, forming a collaborative environment with self-organized teams and stakeholders that are facilitated by the project manager, and handling the interaction between the team and key stakeholders.

The Adapt phase, according to Highsmith (2004, pp.80-84), aims to monitor the results of the iteration, the team’s performance, and the current situation in order to check if they are according to the iteration’s plan. It is the last phase of each iteration until the final iteration is instigated. Control and tests are done in order to detect corrections and changes of features that need to be adapted to the next iteration (Ramesh et al., 2010, p.460). This process is done with the involved stakeholders. The customer provides feedback after each iteration until the final product is developed (Bosch & Bosch-Sijtsema, 2011, p.880; Petersen & Wohlin, 2009, p.1487); this enables for the requirements to change (Bose, 2008, p.620). Upon customer request, a product version can be released after each iteration or periodically (Highsmith, 2004, pp.140-142). The Close phase, as Highsmith (2004, p.231) states, is about recognizing the end point of the project, passing the learnings for future projects through the project retrospective, and celebrating with the team and customers. The project might also end because resources are completely used, where there will still be a product but with a few features not integrated (Wysocki, 2009, p.395).

Moreover, throughout these phases, the project team and the customer play an important role. The project manager provides team autonomy and empowers members to be involved in decision making (Lee & Xia, 2010, p.102; Tessem, 2014, p.885; Williams, 2005, p.504). Team members need to be experienced (Bose, 2008, p.628), cross-functional and self-organized who take responsibility in decision making (Cobb, 2011, p.48; Hoda et al., 2013, p.441; Lee & Xia, 2010, p.104; Stare, 2014, p.303). They encourage interdependent work, communication, coordination, and collaboration in order to achieve their goals (Browaeys & Fisser 2012, p. 214; Cobb, 2011, p.48; Mishra & Mishra, 2009, p.451). Usually, agile teams are of a small size (Bose, 2008, p.620) as it increases control and transparency (Petersen & Wohlin, 2009, p.1487). A collaborative environment is enabled with direct communication (face-to-face) between team members, which facilitates learning and understanding (Petersen & Wohlin, 2009, p.1487) and trust among each other (Bose, 2008, p.628). A face-to-face communication is also efficient to effectively transfer ideas between the team members and the customer (Ramesh et al., 2010, p.455).

Throughout the project, every problem is shared with the customer and the customer plays an active role in helping to solve the problems (Cobb, 2011, p.49). In agile projects, there is a continuous customer involvement (Bosch & Bosch-Sijtsema, 2011, p.880; Stare, 2014, p.303). They define the project requirements and the product design (Bose, 2008, p.620), and they provide feedback through each iteration (Petersen & Wohlin, 2009, p.1487). This direct communication between the team members and the customer contributes to the small amount of documentation needed (Petersen & Wohlin, 2009, p.1487). Team members participate in the decision making process in each phase (Drury-Grogan & O’Dwyer, 2013, p.1099). They
cooperate with customers to define project requirements at the beginning of each iteration (Ramesh et al., 2010, p.450; Stare, 2014, p.301). Project requirements are analyzed in the initial phase, however, they are advanced during the development process as requirements always evolve due to changes in the business setting (Ramesh et al., 2010, p.451). As requirements change, the need for detailed documentation is reduced and teams only keep moderate documentation (Bose, 2008, p.620). Requirements are usually prioritized in order to first implement the features that deliver business value for the customer (Cobb, 2011, p.54; Ramesh et al., 2010, p.451). This prioritization is also updated during the development process (Cobb, 2011, p.54; Ramesh et al., 2010, p.451).

3.1.3. Strengths and Weaknesses of APM

APM emerged as a new approach to respond to the needs of innovative and complex projects. However, APM as an approach has its strengths and weaknesses. The main strength of APM is the flexibility of the approach as it offers the opportunity to adapt to changes that can occur to the project from the turbulent environment (Anderson, 2003, p.293; Highsmith, 2004, p.16; Qumer & Henderson-Sellers, 2008, p.281). Also, the approach is flexible in the PM processes as it suggests that agile practices, tools and techniques do not have to be followed strictly, but they can be adjusted to the project’s context (Hoda et al., 2010, p.86; Wysocki, 2009, p.312). There are practices that are context-independent, as the iterative development, retrospectives, testing, and customer reviews; but there are also practices that are context-dependent, which can be adapted to the context (Hoda et al., 2010, p.86). In other words, it does not assume a “one-size-fits-all” approach (Wysocki, 2009, p.312). Another strength of agile approach is that architectures, requirements, and plans are developed iteratively throughout the life cycles, which means that any missed critical requirement can be added into the project in the next iteration (Highsmith, 2004, p.18). The risk of missing a critical requirement is more fatal for the traditional approach as the building of the product comes much later in the project, causing the project to face high costs and delayed project from a potential change in architecture of the project (Highsmith, 2004, p.18).

Furthermore, Wysocki (2009, pp.330-331) addresses the strengths of the two agile life cycles – the iterative and the adaptive life cycles. The iterative life cycle strengths include: the client reviews a release of the product within a short time period and provides feedback for improvement, scope changes can be implemented after each iteration, and it can be adapted to changes from the business environment (Wysocki, 2009, p.396). Similarly, adaptive life cycle strengths are the opportunity to not waste time on a complete project plan which is expected to change over time, to avoid the formal process of scope change requests, to not waste time on planning uncertainty, and to provide business value for the customer by adding features and requirements after each iteration (Wysocki, 2009, p.410). Additionally, Highsmith (2004, p.213) states that the agile approach can save money with an early termination of the project, if the team after a few iterations identifies that the project is not making any progress. This can be avoided if the project has a good vision and continual feedback.

The agile approach is a new approach that has its weaknesses. Wysocki (2009, p. 396) states that both iterative and adaptive life cycle requires more client active involvement and ownership than a linear life cycle in order for the agile project to be successfully completed.
The lack of client involvement can cause problems for the project team (Hoda et al. 2011, p.533). Agile projects require co-located teams to manage change, but if the project team is distributed, then there is a need for high management effort and a good communication plan (Wysocki, 2009, p.397). Also, shared decision making can be challenging at times as various obstacles can arise within the team, such as conflicting priorities, unwillingness to commit to decisions, lack of participation in decision making, lack of empowerment, lack of implementation, lack of ownership, and other potential obstacles (Drury et al., 2012, pp.1248-1250; Moe et al., 2012, pp.860-864). Another weakness considered is the fact that the final product is not defined at the beginning of the project, therefore, it is not possible to identify what will be delivered in the end of the project (Wysocki, 2009, p.411).

3.2. Choosing an Appropriate PM Approach

The traditional and agile approaches have several differences as the latter emerged mainly as a response to the weaknesses of the former. With the emergence of APM, organizations have the option to choose the appropriate PM approach to manage projects. The traditional and agile approaches both have their strengths and weaknesses and both apply to different situations. Therefore, an organization shall choose a traditional or APM approach based on the evaluation of the environment in which the project will operate (see Table 1 for a summary of Traditional PM and APM).

The traditional PM is appropriate for projects that are simple, linear, and predictable with clear objectives and goals from the beginning of the project (Too & Weaver, 2014, p. 1389) and well documented user requirements and features (Fernandez & Fernandez, 2008, p.15; Wysocki, 2009, pp.342-344). It follows a linear life cycle which assumes perfect information about the goal and the product; in other words it assumes that there is no uncertainty (Wysocki, 2009, p.343). Traditional PM focuses on planning and control, which emphasizes optimization and efficient execution of project activities during the project life cycle (Munns & Bjeirimi 1996, p. 82). It assumes a stable environment in which change is controlled, meaning there are only a few scope changes expected (Wysocki, 2009, p.344). Customers are not expected to be heavily involved in the project, meaning their role is passive and reactive (Wysocki, 2009, p.317). The traditional project manager follows a command and control style of managing the project (Fernandez & Fernandez, 2008, p.10). Team members are specialized, but they do not necessarily need to be the most skilled and to be co-located (Wysocki, 2009, p.350). Teams are usually large in size (Wysocki, 2009, p.394). Also, in traditional PM, knowledge is usually documented or explicit (Wysocki, 2009, p.310).

APM is appropriate for projects that need an iterative development of features and requirements over the project life cycle (Hoda et al., 2010, p.75) with the purpose of reducing the level of uncertainty that agile projects face due to the turbulent environment (Chin, 2004, p.13; Fernandez & Fernandez, 2008, p.15). Agile projects, in essence, are complex and innovative that face a constantly changing environment (Conforto & Amaral, 2010, p.73). APM follows an iterative and adaptive life cycle (Wysocki, 2009, p.384). The agile approach is flexible and responsive (Chow & Cao, 2008, p.962), meaning it adjusts easily to changes in the requirements (Fernandez & Fernandez, 2008, p.15). Customer role is critical as they are expected to be involved daily in the development process (Bosch & Bosch-Sijtsema, 2011, p.880). Customer’s feedback and iterative development enables changes in
requirements to be easily adapted (Petersen & Wohlin, 2009, p.1487). The agile project manager follows a leadership and collaboration style (Highsmith, 2004, p.58). The agile team members need to be self-organized, experienced, and preferably working together in the same location in order to collaborate and have a direct communication, which mainly is informal (Hoda et al., 2010, p.83; Hoda et al., 2013, p.441; Lee & Xia, 2010, p.104; Stare, 2014, p.303). Agile methods work better with teams that are small in size (Bose, 2008, p.620; Chin, 2004, p.88; Wysocki, 2009, p.394) and this increases project control and transparency (Petersen & Wohlin, 2009, p.1487). Additionally, knowledge in APM is tacit, which is shared among the team members (Wysocki, 2009, p. 310)

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<th>Fundamental assumptions</th>
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<th>APM</th>
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<td>Projects are simple, linear, and predictable with clearly defined objectives and goals and with well documented requirements. It assumes a predictable and certain future due to possessing perfect information.</td>
<td>Agile projects are complex and innovative that require iterative development of goals, features and requirements over the life cycle with the purpose of reducing the level of uncertainty that agile projects face due to the turbulent environment.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PM Life Cycle</th>
<th>Linear life cycle (product release at the end of the project)</th>
<th>Iterative and Adaptive life cycles (product can be released after each iteration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment/context assumption</td>
<td>Stable (change is controlled)</td>
<td>Turbulent (change is embraced)</td>
</tr>
<tr>
<td>Planning</td>
<td>Rigid (done in the beginning of the project)</td>
<td>Flexible (done continuously throughout the development process)</td>
</tr>
<tr>
<td>Control</td>
<td>Process oriented</td>
<td>People oriented</td>
</tr>
<tr>
<td>Management style</td>
<td>Command and Control</td>
<td>Leadership and collaboration</td>
</tr>
<tr>
<td>Team Role assignment</td>
<td>Specialized individuals, not necessarily the most skilled and co-located</td>
<td>Self-organizing teams – experienced members and preferably co-located</td>
</tr>
<tr>
<td>Team Size</td>
<td>Large</td>
<td>Small</td>
</tr>
<tr>
<td>Knowledge Management</td>
<td>Explicit</td>
<td>Tacit</td>
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<tr>
<td>Customer’s role</td>
<td>Important</td>
<td>Critical</td>
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<tr>
<td>Communication</td>
<td>Formal</td>
<td>Informal</td>
</tr>
</tbody>
</table>

**Table 1. Traditional PM and APM**

### 3.3. APM in R&D projects

The R&D projects are complex and innovative, which face high levels of uncertainty and constant change (Pirola-Merlo, 2010, p.1076). The R&D projects context requires a new approach to successfully cope with uncertainty. The APM approach handles R&D projects as it is flexible when it comes to adapt to changes that emerge from the turbulent environment.
APM’s practices, tools and techniques can be adapted to other types of projects, which face an environment that requires constant change (Conforto et al., 2014, p.22). It applies to projects that face a high level of uncertainty and complexity (Fernandez & Fernandez, 2008, p.10), which aim to develop innovative products (Conforto & Amaral, 2010, p.73). The types of projects with these characteristics, besides software development, are new product development, process development, and R&D projects in various industries (Wysocki, 2009, p.414).

In a recent study, Conforto et al. (2014, pp.26-31) aimed to find APM enablers or indicators in 19 companies of different industries, which were not aware of the APM approach, by surveying professionals from project management, product development and R&D area. The responses resulted in companies possessing or using many APM enablers, for example: the project’s manager and team experience, the project team size (up to 12 members), high level of customer involvement (half of the companies), and the new product development process formalization level (Conforto et al., 2014, pp.26-31). These APM enablers show the potential of new product development and R&D projects in applying APM approach.

Moreover, the components of R&D projects are developed in a series of cycles, which is similar to the iterative development process of agile approach (Pirola-Merlo, 2010, p.1076). The team climate or environment of R&D projects is characterized with a vision – members share common objectives; participative safety – where individuals feel safe to participate in discussions and decision making; task orientation – work done with technical excellence; and support for innovation (Pirola-Merlo, 2010, p.1076). These team characteristics are identical in agile project teams. Additionally, R&D projects face various challenges due to their uncertain environment, such as, “planning for uncertain outcomes, balancing flexibility with reliability and accountability, balancing decision quality against decision speed, and timing scope freeze during rapid change” (Collyer & Warren, 2009, p. 356). These challenges are exactly what APM practices aim to address. Therefore, based on the similar characteristics of R&D projects and APM approach, it can be argued that the two can match in practice.

3.4. Behavioral Competences of Agile Project Managers
3.4.1. The Role of the Project Manager

A project manager is assigned by an organization to lead, motivate and coordinate the responsible team for reaching the project objectives (Association of Project Management, 2012, p. 49; PMI, 2013, p. 16). The project manager has to work closely with the different stakeholders to satisfy task needs, team needs, and individual needs (PMI, 2013, p. 17). Uncertainty, complexity and dynamism are factors that affect R&D projects and require project managers to have certain skills and competences (El-Sabaa, 2001, p. 1; Thomas & Mengel, 2008, p.304).

In order to address the challenges that an R&D project presents, a project manager with the right mix of competences is needed to enable a successful outcome (Association of Project Management, 2012, p. 49; Crawford, 2005, p. 7). The role of a project manager consists of “50 percent strategy and understanding of dynamic environment, 40 percent management, and only 10 percent technical applications” (Alam et al., 2010, p. 497). This is supported by
Edum-Fotwe & McCaffer (2000, p. 113) who claim that in projects with higher levels of complexity and uncertainty the “new project manager” should play three roles: strategist, manager, and production engineer. As a strategist, the project manager needs to provide the required innovation and vision which would involve a long and short-term perspective. The project manager becomes the link between strategy and the team (PMI, 2013, p.17). As a manager, the project manager will perform the general business activities to manage the project, as traditional project management suggests. Finally, as a production engineer, the project manager will make sure of the technicalities of the product. In consequence, these three roles to be performed by the new project manager in a complex, uncertain and dynamic environment require certain competences to influence the eventual outcome of the project (Stevenson & Starkweather, 2010, p. 664). By recognizing which behaviors or skills are essential, an organization could be able to identify a superior project manager (Cheng et al., 2005, p. 27).

3.4.2. Competences of Project Managers

There is not a common definition for competence in literature. Boyatzis (1982, p. 11) defines competence as “an underlying characteristic of a person [which includes] motives, traits, skills, aspects of one’s self-image or social role, or a body of knowledge which he or she uses.” Crawford (2005, pp. 8-9) presents a comparison on the UK and USA perspectives of the definition. The former supports Boyatzis (1982) definition, while the latter adds that these characteristics are referenced to a specific job or situation. In addition, these characteristics would drive superior job performance (Deist & Winterton, 2005, p. 29). Cheng et al. (2005, p. 26) states that “competency is not only an attribute of a jobholder, but also an attribute of the job itself.” Due to the uniqueness of projects, competences cannot be the same for all managers in every project (Jalocha et al., 2014, p.250). Competences will depend on the characteristics and especial requirements of the project, and on the organization (Crawford, 2005, p.11; Crawford & Nahmias, 2010, p. 407; Jalocha et al. 2014, p. 250). Crawford (2005, p. 11) questions the one size fits all approach of traditional project management taken on competences.

Deist & Winterton (2005, p.30) recognize that a holistic approach to competences is needed to enable the right combination of knowledge, skills, and capabilities for superior performance. For a long time, traditional project management has established standards that focus on the “know how” and “know what” in order to address competences. This has caused a major focus on technical and project management skills, leaving to the side other important competences as human/behavioral competences (Pant & Baroundi, 2008, p. 135; Thomas & Mengel, 2008, p. 305). The Project Management Institute (PMI, 2013) and the Association of Project Management (2012) have become a “quasi-standard” for project manager competences, however they have overlooked the approach to human activities. The focus has been on rational, linear and analytical competences, without considering more flexible alternatives with relational and improvisational perspectives. These human or behavioral competences have been underrepresented in the theory (Alam et al., 2010, p. 497; Thomas & Mengel, 2008, p. 306). Although the competences acknowledge by traditional project management are important, there is a need to go beyond them for successful and effective management of complex, uncertain and dynamic projects (Edum-Fotwe & McCaffer 2000, p. 112; Jalacho et al., 2014, p. 250). Following Deist & Winterton (2005) proposition of a
more holistic approach, project managers require a combination of cognitive, technical and behavioral competences for successful management (Alam et al., 2010, p. 496; IMPA, 2006; Pant & Baroundi, 2008, p. 124).

Focusing only on traditional competences could lead to project managers being resilient to change and uncertainty (Thomas & Mengel, 2008, pp. 305-307). In contrast, it has been stated that by developing integrative competencies, an organization could ensure efficiency and effectiveness for a project (Edum-Fotwe & McCaffer, 2000, p. 123). This has increased the interest on which competences, additionally to technical competences, does a project manager needs (Crawford, 2005, p.7). In the past few years, organizations have acknowledge that it is people who undertake projects and therefore having a solid combination of human and technical skills is key for success (Pant & Baroundi, 2008, pp. 124-126). Several authors, including studies from Cheng et al. (2005), Crawford & Nahamias (2010), Dulewicz & Higgs (2003), and Jalocha et al. (2014), have suggested through their research that the International Project Management Association (IPMA) Competence Baseline encompasses a good level of mixture for the necessary competences. Dulewicz & Higgs (2003) suggest three categories of competences: intellectual, managerial, and emotional. These are reflected and developed in the IPMA Competence Baseline (Jalacho et al., 2014, p. 252). Following Dulewicz & Higgs (2003) study, Müller & Turner (2007, p. 27) concluded that these competences could be considered in a broad range of projects due to their adaptability.

The IPMA Competence Baseline, known as IBC version 3, acknowledges that project managers are currently working in very fast changing environment affected with higher levels of complexity, uncertainty, and dynamism (IPMA, 2006, p. V). In addition, it is recognized the need for higher emphasis on behavioral competences, while keeping relevance on technical and conceptual competences. Behavioral competences are seen as an essential addition to complement the other competences. In consequence, the IPMA has developed a three range competence framework: technical competences, contextual competences, and behavioral competences. The framework is composed of forty-six competences distributed among the three ranges. This framework is represented in the “eye of competence,” as it can be seen in Figure 5. The eye of competence illustrates an effective combination of competences needed by a project manager when assessing a situation (IPMA, 2006, p. VII), as supported by Cheng et al. (2005), Crawford & Nahamias (2010), Dulewicz & Higgs (2003), and Jalocha et al. (2014). The IPMA framework also recognizes that there is room for additional competences due to contextual or cultural factors (IPMA, 2006, p. 10). This holistic approach which has been claimed to fit complex projects, as R&D projects, will be used to assess certain competences in projects managed through APM due to its extensive acceptance by researchers and practitioners.
APM’s aim is to develop innovative and complex products in constant changing environments (Conforto & Amaral, 2010, p. 73) which would require a holistic approach to competences for an agile project manager. Change is inevitable in R&D projects managed through APM (Williams, 2005, p. 502), in consequence, an agile project manager needs to rapidly adapt to it. This challenging environment requires more than the traditional technical competences and project management competences. Highsmith (2004, p. 27) emphasizes two APM principles to be delivered: customer value through innovative products and leadership-collaboration management style. The former consists on delivering customer value; employing iterative, feature-based delivery; and mastering technical excellence. The latter includes: encouraging exploration; building adaptive and self-organizing teams; and simplifying. In order to deliver the mentioned principles, an agile project manager would require a combination of technical competences, contextual competences, and essentially behavioural competences (Edum-Fotwe & McCaffer, 2000, p. 112). As presented before, behavioral competences have been left to a second stage by many researchers and bodies of knowledge. However, in the last decade their importance has been recognized by organizations, bodies of knowledge, and researchers. For these reasons and the characteristics of R&D projects managed through APM, the technical and contextual competences will be shortly explored in the next section. Finally, the behavioral competences will be explored, especially those which are essential for delivering successful APM according to the literature.

3.4.3. Technical and Contextual Competences

Technical competences involve a project manager to understand and apply effectively methods, processes, procedures and techniques relevant to an activity (El-Sabaa, 2001, p. 2). According to the IPMA, this range of competences fully describe the fundamental project management elements of content and they are referred as the “solid” elements (IPMA, 2006, p.9). These competences are more industry specific (Stevenson & Starkweather, 2010, p. 664). For example, the technical competences needed for a manager in R&D project in the biotechnology sector would be different from the ones needed in the automotive industry. The IPMA Competence Baseline presents 20 technical competences: project management success; interested parties; project requirements and objectives; risk and opportunity; quality;
project organization; teamwork; problem resolution; project structures; scope and deliverables; time and project phases; resources; cost and finance; procurement and contract; changes; control and reports; information and documentation; communication; start-up; and close-out (IPMA, 2006, p.38). These competences have traditionally been suggested as key competences by the bodies of knowledge like the Project Management Institute (PMI, 2013) and the Association of Project Management (2012). A project manager needs relevant expertise on the technical competences for successful management (El-Sabaa, 2001, p. 2; Thomas & Mengel, 2008, p.308). Zielinski (2005, p.22) says that a decade ago, an organization would have ranked technical competences as key for success. However, organizations recognize now the need for a combination and emphasis on other competences. In a study executed by El-Sabaa (2001) where project manager practitioners were questioned on the relevance of technical competences, it was concluded that they are the least essential to project managers in comparison to behavioral and contextual competences.

The traditional approach presented by the bodies of knowledge, the Project Management Institute and the Association of Project Management, has focused on technical competences for project manager training as essential to the position (Alam et al., 2010, p.497; Zielinski, 2005, p.18). Thomas & Mengel (2008, p.311) argue that project managers need more than the traditional approach toward competences that the certification institutions have stated. In addition, the authors add that by only focusing on these competences, a project manager would not be fully prepared to manage complex projects. Several authors have recognized the importance of technical competences in managing a project (El-Sabaa, 2001; Thomas & Mengel, 2008), however, when projects become more complex, uncertain and dynamic, project managers would require more than technical skills (Pant & Baroundi, 2008, p.124). The IPMA presents the second range of competences which is contextual competence to complement the technical ones.

Contextual competence is the ability of a project manager to see the big picture of the project (El-Sabaa, 2001, p. 2). According to the IPMA (2006, p.9), this range describes the competences related to the context of the project. These competences allow a project manager to identify interdependencies and relationships among the different actors. Also, how the project’s relation is to the organization. The project manager should be able to act in regards of these relationships for the benefit of the project and the organization. (Brière et al., 2014, in press; El-Sabaa, 2001, p. 2). This can be done by sensing the organization as a whole and its relation with the situation (El-Sabaa, 2001, p. 2). Gillard (2009, p.725) suggests that these competences are key for avoiding project manager’s failing. The IPMA Competence Baseline presents 11 contextual competences: project orientation; program orientation; portfolio orientation; project, programme, and portfolio implementation; permanent organization; business; systems, products and technology; personnel management; health, security safety and environment; finance; and legal (IPMA, 2006, p.125). These competences provides clarity of project goals and a clear vision (El-Sabaa, 2001, p. 2). According to El-Sabaa’s (2001) research, contextual competences are considered as second essential project manager competences from the practitioners’ perspective; under behavioral competences. Due to a major focus on technical competences in the past, project managers have given contextual competences less importance. In consequence, affecting their ability to fit project plans to corporate strategy (Gillard, 2009, p.725).
3.4.4. Behavioral Competences

Organizations have seen the need for emphasizing behavioral competences due to their positive effect on complex, uncertain, and dynamic projects (Zielinski, 2005, p. 22). Currently, there is more interest on behavioral competences for project managers and its association to successful project management (Fisher, 2011, p.994). A behavioral or human competence is the ability of an individual to “work effectively as a group member and to build a cooperative effort within the team he leads.” (El-Sabaa, 2001, p. 2). According to the IPMA (2006, p.9), this range of competences covers the project manager's attitudes and skills. A project manager with a high level of behavioral competences is sensitive to its environment and to rapidly cope with changes around him (El-Sabaa, 2001, p. 2). Project managers who are involved in projects with higher levels of change require higher levels of interpersonal skills, different from the traditional PM approach to be direct and fully rational (Crawford & Nahmias, 2010, p. 406). Crawford & Nahmias (2010, 406) state that there is enough evidence that projects with higher levels of change and uncertainty can fail due to lack of human skills. El-Sabaa (2001, p.2) claims that human or behavioral competences have the greatest influence on project management, while technical skills have the least. This is supported by Loo’s (2003, p. 30) research on Canadian organizations and the positive impact of behavioral competences in effective management. These competences have been called the missing link for project success (Pant & Baroundi, 2008, p. 125).

The IPMA Competence Baseline presents 15 behavioral competences which also have been supported by several researchers. These are as follow: leadership (Kerzner, 1987; Thomas & Mengel, 2008); engagement and motivation (Brandel, 2006); self-control (Thomas & Mengel, 2008); assertiveness; relaxation (DiVincenzo, 2006); openness; creativity (Kerzner, 1987; Thomas & Mengel, 2008); results orientation (Kerzner, 1987); efficiency; consultation; negotiation (Black, 2006); conflict and crisis; reliability (Kerzner, 1987); values appreciation (Thomas & Mengel, 2008); and ethics (IPMA, 2006, p.83). However, there are a few competences that have been identified as key behavioral competences by several researchers but have not been included in the IPMA Competence Baseline. In their research Dainty et al. (2005) and Belzer (2001) have identified flexibility as a key behavioral competence and critical for success. In addition, communication has been identified as a key behavioral competence (Association of Project Management, 2012; Crawford & Nahmias, 2010, p.407). However, this competence has been classified as a technical competence by the IPMA Competence Baseline. Several authors agree on the importance of communication as a human or behavioral skill (Pant & Baroundi, 2008, p.125; Belzer, 2001; Edum-Fotwe & McCaffer, 2000, p.114; El-Sabaa, 2011, p.2). Research studies from Belzer (2001), Crawford & Nahmias (2010), Dainty et al. (2005), Edum-Fotwe & McCaffer (2000), El-Sabaa (2011), Kerzner (1987), Pant & Baroundi (2008), and Thomas & Mengel (2008) have identified leadership, creativity, flexibility, and communication as essential behavioral competences for managing complex and dynamic projects. In the next section, these four behavioral competences will be explored to understand their importance for agile project managers.
3.4.5. Behavioral Competences for Agile Project Managers in Complex and Innovative Projects

Leadership has become an essential competence for agile project managers (Alam et al, 2010, p. 497). This competence involves setting a direction through establishing a vision of the future, aligning people by communicating the vision, and motivating and engaging them to achieve the set goals and objectives (Edum-Fotwe & McCaffer, 2000, p. 114). Leadership is the ability of getting the job done through others (PMI, 2013, 513). A project manager should possess this competence through the whole project lifecycle, in particular when facing changes (IPMA, 2006, p.86). Integrating leadership to the other set of project management competences, technical and contextual competences, enables project management success (Pant & Baroundi, 2008, p.124). Thomas & Mengel (2008, p. 308) demonstrate in their study that highly complex and uncertain environments call for the inclusion of leadership competences into project managers’ profiles. A project manager needs to provide leadership at different levels: project leadership, technical leadership, and team leadership (Edum-Fotwe & McCaffer, 2000, p. 113). Fisher (2011, p. 1000) suggests that project managers in complex environments need to adapt their leadership to the specific situation. Stevenson & Starkweather (2010, p. 667) executed a study to measure the critical competences for project IT projects, and they concluded that leadership is the most important one according to the practitioners interviewed. Furthermore, Cheng et al. (2005, p.29) identifies leadership in the top of the necessary critical competences for an agile project manager. The agile project manager who possesses a leadership competence can direct and influence the team towards achieving the vision of the project (Highsmith, 2004, p.58; IPMA, 2006, p.86). This competences would allow the agile project manager to provide immediate and constructive feedback to the team members (Association of Project Management, 2012, p.68), which is essential in APM. In turn, leadership contributes heavily in the success of the agile project (Highsmith, 2004, p.57).

Creativity is “the ability to think and act in original and imaginative ways” (IPMA, 2006, p.100). The project manager also exploits on the creativity of the team members and the overall organization (IPMA, 2006, p.100). This competence enables project managers to approach problems and find solutions. A project manager would use different perspectives, tools, methods, knowledge and experience to solve issues. An effective project manager would encourage creativity among his team members to find the best solutions (Fisher, 2011, p.995). Moreover, with creativity competence, agile project managers can transform complex issues into solutions (Joiner & Josephs, 2007, p.40).

The flexibility competence has been identified as a missing link for successful APM (Pant & Baroundi, 2008; Belzer, 2001). This competence enables a project manager to work dynamically and rapidly respond in a changing environment to cope with change (Thomas & Mengel, 2008, p. 308). Cheng et al. (2005, p.32) suggest that a project manager should remain flexible and adaptable to solve the problems in hand. Fernandez & Fernandez (2010, p.15) suggest that flexibility gives an advantage to project managers in complex environments. In their research, Dainty et al. (2005) suggest that this competence should be added by the bodies of knowledge to their frameworks. Agile project managers work in environments where change is inevitable and needs to be embraced. In consequence, possessing the
flexibility competence would allow them to adjust constantly to emerging challenges (Fernandez & Fernandez, 2010, p. 10).

Communication involves the exchange of information between the agile project manager and all other parties involved in the project (Edum-Fotwe & McCaffer, 2000, p.114; IPMA, 2006, p.76). Effective communication enables openness, increases performance, improves relationships, and creates mutual trust among the team (PMI, 2013, p.515). Belzer (2001) includes communication as a competence in the “missing link” cluster of competences for project management success. This competence is considered to be strategic for project management success (Zielinski, 2005, p.18). Communication involves many dimensions which would require writing, oral, and listening skills (Edum-Fotwe & McCaffer, 2000, p.114). This behavioral competence would be primarily used “to engage stakeholders, sell change, enlist champions, facilitate political diffusion and manage stakeholder expectations” (Crawford & Nahmias, 2010, p.407). El-Sabaa (2001, p.2) and Zielinski (2005, p.21) rank communications as one of the most essential behavioral competences. In APM, communication is a key competence as the project manager should be able to effectively interact with the team members and the customer, in order to keep their commitment at the highest level (Ramesh et al., 2010, p.455).

APM would require certain behavioral competences, combined with the technical and contextual competences (Edum-Fotwe & McCaffer, 2000, p. 112). The traditional project managers focus more on technical competences as the traditional approach requires more emphasis on process of project management (El-Sabaa, 2001, p. 2; Thomas & Mengel, 2008, p.308). However, the agile project managers focus more on behavioral competences as the agile approach highlights more the importance of people orientation rather than processes and tools (Beck et al., 2001; Highsmith, 2004, p.9). As stated in the APM literature, an agile project manager needs to deliver two main principles: customer value through innovative products (customer value, feature based delivery, and champion technical excellence) and leadership-collaboration management style (encourage exploration, build adaptive & self-organizing teams, and simplicity) (Highsmith, 2004, p.27). In order to deliver both principles, an agile project manager should be able to manage the APM characteristics: iterative & adaptive lifecycles, turbulent environment, flexible planning, people oriented control, leadership & collaboration management style, small & self-organizing teams, tacit development of knowledge, high customer involvement, and informal communication; see Table 1. In consequence, in the behavioral competences literature, there have been identified four essential competences which would enable APM characteristics and deliver the APM principles: leadership, creativity, flexibility, and communication (Belzer, 2001; Crawford & Nahmias, 2010; Dainty et al., 2005; Kerzner, 1987; Thomas & Mengel, 2008). See Figure 6 for the derived theoretical framework diagram.
Due to the focus of APM in the software development industry, there is no research done on behavioral competences in other industries. In consequence, APM research could be expanded to other industries (Conforto et al., 2014; Fernandez & Fernandez, 2008). Therefore, the aim of this research study is to provide evidence whether these essential behavioral competences: leadership, communication, flexibility and creativity, of agile project managers apply in managing R&D projects in the biotechnology sector in Sweden.
4. Empirical Methodology

This chapter presents the empirical part of the methodological pathway. It will explore the research strategies, research designs, data collection and data analysis methods. Simultaneously, it will argue in favor of the chosen research strategy, design, data collection method, and data analysis method. In addition, it will discuss the ethical considerations and the actions taken against breaching the ethical principles of research.

4.1. Research Strategy

A research strategy can be quantitative, qualitative, or both. A quantitative research strategy entails a high concern on measurement of variables, causality, generalization of findings, and replication of the research study (Bryman & Bell, 2011, pp.163-165). A qualitative research strategy is concerned with enabling researchers to explore the social characteristics of a study in detail (Schensul, 2012, p. 69). For choosing the research strategy, whether to be quantitative, qualitative, or both, the authors focused on the assumptions of the objects to be studied (Long et al., 2000, p.190). The research orientation regarding ontological, epistemological, and methodological considerations drove the authors to choose a qualitative approach. The presented research philosophy is based on subjectivity, with a constructivist ontological consideration and an interpretivist epistemological consideration. From these assumptions, a qualitative approach fits the research because it enables high subjectivity (Long et al., 2000, p.190) to understand the social characteristics of the research study in detail through its emphasis on words rather than collection and analysis of numeric data (Bryman & Bell, 2011, p.386). In contrast, the quantitative approach would not be able to satisfy the subjectivity of the research process. In addition, the research study does not aim to measure any variable, find cause and effect among variables, generalize the findings to other social contexts, or replicate the exact research study. Although a qualitative approach has been associated with inductive researches, it has been stated that it can also fit a deductive approach (Morgan & Smircich, 1980, p.498). Through a qualitative approach, the focus is on understanding the social context by interpreting the participants’ points of view (Bryman & Bell, 2011, p.486).

4.2. Research Design

The research design will provide a framework for the data collection and analysis. Bryman & Bell (2011, pp.45-67) present four research designs: experimental design, cross-sectional design, longitudinal design, and case study design. In order to choose a research design, it is needed to set the priority of the research process. Bryman & Bell (2011, p.40) state that when choosing a research design, the choice should prioritize one of the following four research dimensions: presenting interdependencies between variables, generalizing research results, understanding behavior in its specific social context, and having temporal understanding of a phenomena. This thesis focuses on examining what are the behavioral competences for an agile project manager engaged in R&D projects in the Swedish biotechnology sector. The study is based on the assumption that project management approaches are context dependent. This means that companies in the biotechnology sector need to be deeply examined in order to assess if the behavioral competences listed in the theoretical framework apply as essential
or not in the industry-specific context. The priority would be then to understand the behavior in its specific social context. An experimental research design creates the limitation of controlling organizational behavior in a social context (Bryman & Bell, 2011, p.45). This research design would not deliver the research dimension. A cross-sectional design enables the collection of data on more than one case and at a single point in time to detect patterns of association” (Bryman & Bell, 2011, p.53). However, this research study does not aim to state causality among variables, but it aims to understand behaviors in a specific social context. The longitudinal design enables a researcher to find changes in a research study by surveying a sample for more than one occasion (Bryman & Bell, 2011, p.58). This research design requires a longer time frame to be executed, which collides with the scope of this research study. In consequence, it has been decided to take a case study design to approach the study. A case study design will allow the detailed and intensive exploration of a single case due to its focus on the complexity and particularity of the chosen case (Bryman & Bell, 2011, p.59). Case study design is considered as one of the best ways to link qualitative data to theory testing (Bryman & Bell, 2011, pp.60-61; Eisenhardt & Graebner, 2007, p.25). This research design aims to provide an in-depth interpretation of the particularity of the situation. The case study design will provide this study with the ability of understanding complex inter-relationships, presenting a lived reality, and facilitate the exploration of the unexpected and unusual characteristics (Hodkinson & Hodkinson, 2001, pp.2-5).

As presented previously, 4% of the biotechnology companies in Sweden are located in the Umeå region (VINNOVA, 2011, pp.14). This makes Umeå the fourth most important region in the life science industry, and one of the most important in the biotechnology sector. The study will entail a detailed and intensive analysis of Umeå biotechnology sector as a single location. This will enable the understanding of complexities and particularities of the region’s organizations (Bryman & Bell, 2011, p.59) regarding behavioral competences. Due to the rapid growth of the biotechnology sector in Umeå, this case is expected to deliver greatest learning in comparison to other regions. The type of case chosen for this study is a representative case which seeks to “explore a case that exemplifies an everyday situation or form of organization” (Bryman & Bell, 2011, p. 62) in Sweden.

However, the case study design presents some limitations. First, there can be too much data to be analyzed from the interviewees, and some of the information could not be taken into consideration. This will be addressed by designing a more specific interview guide to avoid data overflow. Secondly, representation of the whole Umeå population can be a limitation. Umeå has approximately 65 biotechnology companies (Biotech Umeå, n.d.). This will be addressed by contacting the majority of the organizations to obtain a representative percentage of participants from the total population.

4.3. **Data Collection**

An interpretative approach will allow the authors to understand and analyze the input of the participants to this research. The main objective is to determine communalities and/or differences between the essential behavioral competences presented in the literature and the ones perceived by the practitioners in the sector. Through a qualitative strategy, the data collection could be done by three methods: ethnography and participant observation; focus groups; and interviewing (Bryman & Bell, 2011). The first method, ethnography and
Participant observation entails for a researcher to immerse into a group to observe, listen and ask questions to understand their behaviors and interactions for an extended period of time (Bryman & Bell, 2011, p.426). This method does not fit this study for two reasons. First, the study has to be conducted in a relative short period which would not allow the immersion in a group for an extended period of time. Secondly, the biotechnology sector works with products where keeping the knowledge as secret is very important. In consequence, having access to the project management groups would not be possible do to secrecy considerations. The second method is focus groups. A focus group entails interviewing more than one interviewee at the same time and location. The aim is to understand how these individuals discuss a theme as a group and assess their responses to it. The method allows understanding the interactions among the group (Bryman & Bell, 2011, p.502). This method has several limitations for this research study, hence, will not be used. The interest of the study is to understand the individual perspectives, and not the interactions and reactions regarding the themes to be assessed. In addition, the focus groups can create discomfort among the participants due to the topics in question, in consequence the answers might be biased by the group’s pressures (Bryman & Bell, 2011, p.516). The last method considered was the interviewing method, which was chosen for this study. The data collection will be conducted using a semi-structured interviewing method due to the flexibility that it provides. The method allows emphasis on “generality in the formulation of research ideas and on the interviewee’s perspective” (Bryman & Bell, 2011, p.466). This method will enable a better understanding of the interviewee’s point of view on behavioral competences for agile project managers in the Swedish biotechnology sector. Semi-structured interviews will allow rich and detailed responses that will enable the aimed deep exploration of the topic (Bryman & Bell, 2011, p. 467). An interview guide has been developed with specific topics but with more general questions to be covered with the interviewees (see section 4.4. Interview guide design). The questions asked can vary depending on the context of the interview.

Furthermore, in the semi-structured interview method can be used three types of questions: open, probing, and specific and closed questions (Saunders et al., 2009, pp.337-339). Open questions give the opportunity to elaborate or describe a particular situation. Probing questions are similar to open questions but with a particular focus. Specific and closed questions are usually used in structured interviews, but they can be used in semi-structured interviews in order to obtain a specific information (Saunders et al., 2009, pp.337-339). In this study, all of these types of questions were used. Especially, two types of closed questions were used: rating and ranking questions. Rating questions were used in order to gain the opinion of each respondent regarding each essential behavioral competence: flexibility, leadership, communication, and creativity. The rating that the respondents could provide was from 1 to 5 (1- very low importance; 2- low importance; 3- important; 4- high importance; 5- very high importance). Additionally, there was only one ranking question that asked respondents to rank the four essential behavioral competences based on their importance. It is important to note that the rating and ranking questions were used only to confirm that the subjective meaning of each respondent regarding the four behavioral competences is interpreted correctly. They were not used to quantify the study.
4.4. Sample
4.4.1. Principles of Sample Selection

In this thesis, the authors aim to answer the research question using a qualitative method of collecting data, which is through interviews. Sampling in qualitative research is usually non-probabilistic, meaning researchers select samples based on their subjective judgment (Saunders et al., 2009, p.233). The respondents are selected based on their knowledge on new approaches to project management, such as agile, and their participation in R&D projects. They are selected in a non-random basis. Therefore, in this thesis, the authors use a purposive sampling, which is a non-probabilistic sampling where participants are selected based on their relevance to the research question (Bryman & Bell, 2011, p.442; Teddlie & Yu, 2007, p.77). Purposive sampling is usually used with a small sample size and a case study that is insightful with information (Saunders et al., 2009, p.237). Moreover, there are several purposive sampling strategies: extreme case, heterogeneous, homogeneous, critical case, and typical case sampling (Saunders et al., 2009, pp. 239-240). In this study, a heterogeneous strategy will be followed in order to have variation in the sample with the purpose of having different points of view when explaining the key themes that emerged from the literature. Therefore, the unit of analysis in this study is project managers, executives, and business coaches. In this way, the study will contain the different perspectives of the unit of analysis on the behavioral competences that an agile project manager should have when managing R&D projects.

4.4.2. Company Sample Criteria

The company sample criteria are the criteria that organizations need to match against. The organizations are not the unit of analysis of the study; they are the entities in which the unit of analysis operates. It is important that the unit of analysis comes from organizations that match the following criteria:

Criterion 1: Organizations operating in the biotechnology sector in Umeå, Sweden
Agile project management has been explored mainly in the software development industry. However, it is argued that APM practices can be used and are adaptable in projects of other industries, which face an environment that requires constant change (Conforto et al., 2014, p.22). The research question of the thesis is posed in the biotechnology sector context, therefore, organizations participating in this study must operate within the biotechnology sector. Moreover, the case study of the thesis focuses only in biotechnology companies that operate in Umeå, Sweden.

Criterion 2: The organization has been or is engaged in R&D projects
In its literature, the agile approach of project management is mainly explored in the software development projects. The new approaches of project management, such as agile approach, are also used in other types of projects. For instance: new product development, process development, and R&D projects (Wysocki, 2009, p.414). In this thesis, the research question seeks to explore the behavioral competences of agile project managers that manage R&D projects. Therefore, the second criterion for organizations in this study is to have executed or to execute R&D projects.
Criterion 3: Organizations use new approaches of project management

Organizations in the biotechnology sector that are engaged in R&D projects certainly use project management practices to manage the projects. R&D projects are highly complex and uncertain due to the lack of knowledge in advance on how to develop or discover the final outcome. They require a different approach of PM rather than a traditional one. The new approach of PM for R&D projects could require a less structured and non-linear process adaptable for feedback and cope with change (Ahern et al., 2013, p. 1375). R&D characteristics can be addressed with APM. The APM is suitable for R&D as the planning of the project is done continually throughout the projects, the requirements of the project change due to the high level of uncertainty, changes are adapted in the project rather than prevented, and customer involvement and feedback is encouraged to succeed with the project. Therefore, the aim is to select organizations that use the principles and characteristics of the APM approach, in order to be able to respond to changes from the environment in which the organizations operate. It is not required for organizations to use agile methods, as XP, Scrum, or any other, as they are mainly suitable for software development.

4.4.3. Interviewee Sample Criteria

The interviewee sample criteria are the criteria used to select respondents who will participate in the study. The respondents are the unit of analysis of this study. They are executives, project managers, and business coaches. The subjective meaning of their responses will be the results of this study. Therefore, based on the scope of the study, the following criteria are used to select the interviewees:

Criterion 1: English speaking
The interviewee has to be able to speak fluently the English language. Since the authors of this thesis do not understand the Swedish language, it is required that the respondent speaks English. The respondent’s English level should be understandable for the authors. This is important for the authors as they need to be able to analyze and interpret correctly the information provided by the respondents.

Criterion 2: Participated or participates in R&D projects related to biotechnology
The respondent should be part of an R&D projects, whether that is a project manager, project team member, project sponsor, or project owner. The period of the respondent being part of the R&D project is not significant. It can be that the respondent has participated before or participates now in an R&D project. It is important that the R&D project, in which the respondent participates or participated, is executed in the biotechnology sector.

Criterion 3: Aware of or engaged in agile approach of project management
The agile approach of PM is mostly suitable for managing R&D projects, especially its complexity and uncertainty. With an agile approach, changes of requirements are easily managed and feedback is adapted to the project. R&D projects have been usually managed using new approaches of project management that are more flexible and adaptable to changes. Moreover, the aim of the research question is to explore the behavioral competences of agile project managers in R&D projects. Therefore, the respondents of the study should be aware of or engaged in agile approach of project management. They should be engaged in using APM principles and characteristics when managing the project. It is not required
from the respondents to use agile methods, such as XP, Scrum, or any other, as they are mainly suitable for software development.

4.4.4. Selected Companies and Interviewees

The qualitative study of this thesis contains interviews with respondents from several biotechnology companies in Umeå. There are 39 companies that matched the company criteria. However, when companies were contacted in order to participate in this study, only five companies responded positively. From the five companies, eight individuals were available to participate, which resulted in eight interviews. The authors of the thesis introduced the topic and the interviewee criteria to the respondents and all of them were qualified and confirmed to participate in the study. Eight companies rejected the request to participate because they were new in the sector. The companies that did not respond to the request are discussed in the next section. Table 2 shows the respondents name, position, and company.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Position</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pia Keyser</td>
<td>Business coach</td>
<td>Umeå Biotech Incubator</td>
</tr>
<tr>
<td>Thomas Edlund</td>
<td>Chief Executive Officer</td>
<td>Betagenon</td>
</tr>
<tr>
<td>Emil Byström</td>
<td>Chief Executive Officer</td>
<td>Nordic ChemQuest</td>
</tr>
<tr>
<td>Respondent 4</td>
<td>Project Manager</td>
<td>Umeå Biotech Incubator</td>
</tr>
<tr>
<td>Respondent 5</td>
<td>Business coach</td>
<td>Umeå Biotech Incubator</td>
</tr>
<tr>
<td>Kjell Öberg</td>
<td>Business coach</td>
<td>Uminova Innovation</td>
</tr>
<tr>
<td>Göran Aronsson</td>
<td>R&amp;D Manager</td>
<td>Nordic Biomarker</td>
</tr>
<tr>
<td>Bo Hammarström</td>
<td>Project Manager and</td>
<td>Uminova Innovation</td>
</tr>
<tr>
<td></td>
<td>Business coach</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Respondent presentation

4.4.5. Non-response Analysis

The sample of biotechnology companies is large, but only five companies responded positively and eight negatively. The other 26 companies did not respond to the request to participate in this study. The primary method to approach companies was through e-mails. The second method was by calling the companies or visiting them in person. With the second method, 13 companies responded. The authors believe that several reasons contributed to the non-response high rate. Time is a very scarce resource for biotechnology companies as R&D projects are complex and difficult to complete. The project team members usually are researchers in the company and also researchers in the universities. The amount of work for biotechnology researchers is very high, especially during the academic period, which is from September until May. Another reason is that many companies are new or start-up companies in the biotech sector and they do not feel comfortable to provide any information that could potentially bring risks to their business idea. Moreover, the high rate of non-response companies caused a lower number of interviews than intended for this study. The authors believe that a higher rate of participating companies could have resulted with a richer data display of the Umeå context. Due to the qualitative nature of the study, the findings cannot be generalizable neither for Umeå, nor for Sweden. However, the companies that participate
in the study provide insightful information and good view of the reality of R&D projects in biotech companies in Umeå.

4.5. Interview Guide

In this study, a qualitative semi-structured interview method will be used to collect data. This method allows more control in the interviewing process due to its flexibility. The method will enable an in-depth collection of data from the participants without compromising quality. The interview process will be based on a pre-established interview guide (see Appendix 1). This guide consists on standard themes that will cover a number of topics which will give depth to the answers. For each topic, it has been considered several essential questions, but depending on the context of the interview some follow up questions will be added to enable an in-depth collection of data. The guide is divided in 5 key themes: Introduction, Project Management, Competences, Essential Behavioral Competences, and Conclusion. The interview guide template can be found in Appendix 1.

Theme 1 - Introduction
First, a general introduction to the study will be presented to the interviewee. In addition, the research question and the research objectives will be stated. This theme will focus on two topics: the interviewee and the company. The first topic will be covered by collecting background information regarding the interviewee: name, position, years of experience, etc. Also, key details from the company will be collected, such as company name, company objectives, sector, size, key clients, etc.

Theme 2 - Project Management
This theme aims to collect data regarding projects, project manager, and project management approach. These three topics will enable a corroboration on how the complexity, uncertainty and dynamism of projects interact with the role of project manager and the approach to address projects. Within the projects topic, the aim is to collect information regarding the factors that the interviewee considers that affect or increase the complexity and uncertainty of a project. In addition, questions regarding project characteristics, such as budget, team size, time, stakeholders, will be asked. The role and responsibilities of the project managers in the organizations will be covered. Finally, the project management approach will be covered by addressing the project management process in the organization, the adaptability of the project management process, the project life cycle, change management, hierarchical structure, customer role, knowledge, team characteristics, decision making process, and communication.

Theme 3 - Competences
The interviewer will give a short explanation of the three categories of competences that have been identified in the theoretical framework: technical, contextual, and behavioral. This theme will cover the three sets of competences. The interviewee will be asked to mention which technical, contextual, and behavioral competences are needed in their project context. In addition, the interviewee will be asked to state the benefits and importance of possessing those competences. Finally, the aim is to collect information regarding which set of competences (technical, contextual, or behavioral) dominates the sector and understand the importance of the others.
**Theme 4 - Essential behavioral competences**

In the theoretical framework, it has been concluded that there are four essential behavioral competences for an agile project manager. The competences are flexibility, leadership, communication and creativity. The interviewee will be asked details on how they perceive each competence to be important in their context. In addition, the interviewee will be asked to explain in which situations the competences is essential for a better outcome. The interviewee will also be asked to scale each competence from 1 to 5 (1 being very low important and 5 very high important). This will be done with the four competences. Finally, the interviewee will be asked to rank the four competences in order of importance for their organization.

**Theme 5 - Conclusion**

The final theme will address concluding remarks that either the interviewee or the interviewer have. The interviewee will have the opportunity of sharing any additional information or experience that feels it is beneficial for the study. Finally, the interview will be closed and the interviewee will receive information on how the findings will be sent to him/her for corroboration in order to address the credibility limitation.

**4.6. Interview Procedures**

In this study, the interview process was executed on a one-to-one basis, meaning every respondent was interviewed personally (Saunders et al., 2009, p. 321). In all of the interviews, the authors and the participant interacted directly in a ‘face to face’ interview. This allowed the authors to best interpret the respondent’s answers as they were able to observe the participant’s body language and gestures. The authors were able to detect when the respondents did not fully understand the questions and therefore explain the question with more simple words. The interviews followed the themes from the interview guide. All of the themes were covered in each interview. Both of the authors participated in all interviews and asked the questions in a pre-agreed order. Also, follow up questions were asked whenever an interesting information was provided. The authors felt that there is no need to conduct any pilot interview to test the interview guide. However, the interview guide was sent by e-mail to the respondents several days before the interview date.

The interviews were conducted based on the interviewee’s preferences. Every interview was conducted on the time, date, and location that best suited the interviewee’s schedule. All of the interviews were completed in the respondent’s work office. The respondents were informed that the interviews could last from 30 to 45 minutes. The interviews length varied from 31 to 64 minutes. Also, with the interviewee’s permission, the interviews were recorded using a voice recorder device. This was done with the purpose of listening the interview repeatedly when analyzing and categorizing the information into the template (see section 4.8. - Data Analysis). The interview details can be found in Appendix 2.
### 4.7. Interview Limitations

In addition, the interview process presents a few limitations. The first limitation is that English is not the mother-tongue of any of the interviewees. Their mother-tongue is Swedish. However, they all mastered English to a high level which enabled us to perform the interview smoothly. In the cases were an interviewee would be confused with the language used in a question, the question would be repeated with more simple words. Also, if the interviewee’s answer was not understandable, they would be asked to repeat their answer or elaborate on the answer. However, in the majority of the interviews this was not the case. Another limitation is the time that the respondents had for the interview. The respondents were informed that the interviews length can vary mainly based on their responses. Some respondents asked for the interview to last less than 45 minutes, therefore, their limited time could have caused the respondents to give shorter answers. Nonetheless, the authors managed to ask all the foreseen questions from the interview guide and the respondents provided insightful answers in all of the questions. Lastly, respondents’ experience and beliefs can lead to biased answers. In order to overcome this limitation, the authors ensured more than one interview with two organizations. Also, in order to reduce the biasness, the authors interviewed respondents from five different organizations that have different positions, experiences, and thus perspectives regarding the aim of the study.

### 4.8. Data Analysis

The data analysis process of the study will be conducted by following a general strategy and an analytic technique. According to Yin (2014, pp.136-142), there are four general strategies for analyzing data: relying on theoretical propositions, working the data from the “ground up”, developing a case description, and examining plausible rival explanations. Developing a case description “is to organize your case study according to some descriptive framework” (Yin, 2014, p.139). In this study, the authors will follow the strategy of developing a case description. This means that the case study will be organized by following the theoretical framework diagram as described in Figure 6 (see section 3.4.4.). Moreover, the qualitative data of the study will be analyzed following the analytic technique of template analysis. A template is a list of categories (Saunders et al., 2009, p.505), which is utilized based on the themes that emerged from the theoretical framework. The categories are created from the topics covered in the semi-structured interviews. The raw data from the semi-structured interviews will be categorized into the categories and the main themes of the template. The following chapter – Chapter 5 Empirical data presentation – will be developed based on the themes of the template and it will cover the different categories of each theme. The template format can be found in Appendix 3.

### 4.9. Ethical Considerations

The research process is subjected to ethical considerations, hence considering ethical principles when conducting the research is highly important (Saunders et al., 2009, p.168). Ethics is defined as the “appropriateness of your behavior in relation to the rights of those who become the subject of your work, or are affected by it” (Saunders et al., pp.183-184). Bryman & Bell (2011, p.128-136) summarized four areas where a research study may
transgress ethical principles: harm to participants; lack of informed consent; invasion of privacy; and deception. Harm to participants entails physical, self-esteem, stress, and future development harm. Lack of informed consent entails disguised or covert observation where the researcher’s identity is not disclosed and the participant is being observed without consent. Invasion of privacy is the degree on which the researcher invades the participant’s privacy by asking disguised questions that normally the participant would reject answering. Finally, deception is presenting the research to the participants as something other what it really is. This study aims to ensure that ethical principles are respected, hence, the following actions will be taken:

- Fully disclosing information. All the organizations participating in this study have been fully informed regarding the nature and objectives of the study. This was done in two steps. First, the organization was contacted via email to introduce the researchers, the study, the research question, research objectives, participation criteria, and request for collaboration. After the company would accept, the company would be contacted via phone to agree on details. Here again, any doubts were solved. In addition, the interview guide was sent to the interviewee several days before the interview. Before starting the interview, the interviewee was given a short presentation on the research study and time to clarify any questions. Finally, the interviewee was asked for consent to record the interview and to use his or her name in the study. This action enables the avoidance of lack of informed consent, invasion of privacy, and deception.

- Offering the option of being anonymous. Both the organizations and the interviewees in this study have been offered the option of being anonymous in the study. When contacting the organizations which accepted to collaborate, it was asked if the organization’s name could be used in the study. All organizations stated that there was no issue regarding this. In the case of the participants, when conducting the interview they were given the option of being anonymous. From eight participants, only two chose this option. For this reason, the name of the participants have been coded as Respondent 1 to 8, in order to avoid mentioning their names through the analysis and discussion. In addition, the names of both participants who chose to be anonymous have been deleted from the study. This action enables the avoidance of harm to participants, lack of informed consent, and invasion of privacy.

- No covert methods. Participants received the interview guide several days before the interview so they could be familiar with the topics. During the interview, the questions were fully aligned to the themes previously submitted to the participants. If a participant did not feel comfortable answering any of the questions, the interviewers did not try at any point to covert the question or push for an answer. This action enables the avoidance of invasion of privacy.

- Presenting data as it is. In order to avoid harm to participants, the data collected from the interviews was placed in a template divided by themes as the ones in the interview guide. The templates were submitted to the interviewees in order to corroborate that the information in the templates was the one they provided. After this, the data was used for the discussion section maintaining alignment to the original source.
5. Data Presentation and Analysis

This chapter presents and analyzes the empirical findings on the Umeå biotechnology sector case study. In the following sections, first the case study will be presented to give a global perspective on the object of study. Then, the empirical data will be presented and analyzed following the five themes developed in the template: introduction, project management, competences, essential behavioral competences, and conclusions (see Appendix 3). All the information presented in this chapter was obtained through the semi-structured interviews conducted with eight practitioners in the Umeå biotechnology sector: three business coaches, two project managers, one R&D manager, and two Chief Executive Officers (CEO).

5.1. Case Presentation: Umeå Biotechnology Sector

The majority of organizations in the Umeå biotechnology sector are micro (1-10 employees) and small (11-50) size and focus on R&D. The projects in these organizations vary among the following different segments: drug discovery/development, drug delivery, in vitro diagnostics, biotech medical technology, CR (contract research), bio-production, biotech tools and suppliers, agro-biotechnology, environmental biotechnology, food related biotechnology, and industrial biotechnology. For the case study, five organizations from the 39 which matched the company’s criteria accepted to participate. These organizations are all micro and small size. In addition, all of them are involved in R&D projects covering the following segments: drug discovery/development, drug delivery, in vitro diagnostics, biotech medical technology, and biotech tools and suppliers. These projects are highly complex and uncertain, hence, requiring a different approach than traditional project management emphasizing some behavioral competences is needed. The companies use APM, which is a more flexible approach. This approach makes it easier for project managers to adapt changes that come from the turbulent sector environment to their projects. They follow the principles and characteristics of APM. In the following sub-sections, the five companies and the eight participants will be introduced.

5.1.1. Companies’ Background

**Umeå Biotech Incubator (UBI)** – A micro sized organization with seven employees founded in 2004. It is a business incubator which supports innovative biotechnology ideas in the Umeå and Northern regions to spread growth in the region. The majority of projects are in drug discovery/development, in vitro diagnostic, and medical technology. Currently, there are 16 ongoing projects. UBI’s average customers are either an established university professor with several years of research experience, or a young postdoctoral individual. Initially, UBI helps their customers to understand if there is a market need for their product or service. If the project is accepted, a business coach is assigned to the project in order to advice through the whole project life cycle. The average length of a project is between two and three years. UBI offers facilities with specially equipped laboratories for biotechnology development, financing for verifying a business idea before starting a company, and business development competences for start-up biotechnology companies.
Betagenon – A micro sized organization with six employees founded in 2004. It is a drug discovery/development company focused on developing AMP-activated protein kinase (AMPK) activator compounds. This product aims to lead to treatment of chronic energy balance diseases. Currently, they are focused on one R&D project, the AMPK activator compound O304, which is currently in Phase I clinical trials. In drug discovery/development, research projects have several phases of clinical research: Phase I, Phase II, and Phase III. The phases of clinical research last for many years, for example Phase I up to 15 years, therefore, each Phase is considered as a separate project. The company’s main potential customers are large pharmaceutical companies.

Nordic ChemQuest AB – A small sized organization with 15 employees founded in 2007. It has its roots in academic research at Umeå University. It focuses in material science and mass transport phenomena for developing innovative products that improve productivity. The company’s projects are mainly biotechnology tools. Nordic ChemQuest’s main customers are small and large academic institutions and pharmaceuticals. The SpinChem is their most successful product. This product constitutes a new concept for enhanced mass transfer in heterogeneous reactions and better use of solid reagents, for example immobilized enzymes. Currently, the company is the process of developing several other products.

Uminova Innovation – A small sized organization with around 15 employees founded in 2003. As a business incubator, it contributes to commercializing business ideas. It is financed by Umeå municipality, Umeå University, the region of Västerbotten, Västerbotten County Council, and European Union (EU) structural funds. It offers infrastructure, business and personal support, and solid business networks. The organization runs projects to strengthen Umeå and Västerbotten as a life science region. Compared to other incubators, they follow the entrepreneurs and business ideas longer. Its focus is on biotechnology medical technology projects. Uminova Innovation’s main customers are university researchers with a business idea.

Nordic Biomarker – A micro sized organization with 9 employees founded in 2007. In 2013, it was ranked number 34 as Sweden’s fastest growing technology company. The company focuses on developing, manufacturing, and marketing hemostasis reagents. These reagents enable to diagnose coagulation disorders in the blood vessels. Nordic Biomarker’s R&D projects are based on drug discovery/development, drug delivery and in vitro diagnostics. Currently, the company has developed 6 successful products. The most successful product is used in hospitals for the diagnosis of thrombosis. The company’s main customers are hospitals’ distributors who manage reagents packages mainly in Europe, China and Turkey.

5.1.2. Respondents’ Background

Respondent 1: Pia Keyser – A business coach with three and a half years of experience at Umeå Biotech Incubator. She also works part time as a project manager for another life science organization. In addition, Pia has experience as Chief Scientific Officer at a biotechnology company.

Respondent 2: Thomas Edlund – Thomas has a Ph.D. in Bio-chemistry. He is the Chief Executive Officer at Betagenon. In addition, he is a professor in Molecular Genetics at the
University of Umeå. He has 10 years of experience at Betagenon, from which six as CEO. Also, he has experience in other biotechnology companies as a co-founder of Symbicom AB and Uman Genomics AB. He has served at the scientific advisory board of Ontogeny Inc. Cambridge, USA. He is part of the Swedish Royal Academy of Sciences and has been honored by numerous national and international awards.

Respondent 3: Emil Byström – Emil has a Ph.D. in Chemistry. He is the Chief Executive Officer and Product Manager at Nordic ChemQuest AB. He has four years of experience in the current position. Previous to that, he was the Project and Product manager for Nordic ChemQuest for three years. The most successful project to deliver was the development of the SpinChem, the current most successful product for the company.

Respondent 4 (Anonymous) – Respondent 4 is a project manager at Umeå Biotech Incubator. Respondent 4 has one and half year experience as a project manager. This anonymous respondent will be addressed as a ‘he’ during the research study.

Respondent 5 (Anonymous) – Respondent 5 has one and a half year experience as a business coach at Umeå Biotech Incubator. This anonymous respondent will be addressed as a ‘he’ during the research study.

Respondent 6: Kjell Öberg – Kjell is a business coach at Uminova Innovation since 2003. Kjell has experience as a business owner, CEO, and business consultant in many organizations, mainly in medical technology companies.

Respondent 7: Göran Aronsson - Göran has a Ph.D. in biochemistry. He has seven years of experience as R&D manager and VP of Marketing at Nordic Biomarker. In addition, several years of work experience as an R&D manager and general manager for other biotechnology companies.

Respondent 8: Bo Hammarström – Bo has more than 25 year experience in Umeå biotechnology sector dealing with R&D projects. He is an experienced venture capitalist who has been investing in biotechnology companies in Umeå since 1998. Currently, he is a shareholder in several biotechnology start-up companies in Umeå. Additionally, he is a member of the board of three biotechnology companies. Also, 20% of his time is dedicated as a business coach and project manager for Uminova Innovations. He has been cooperating with them since 2003.

5.2. Project Management

The aim of the project management theme is to present the findings on the topics of projects, project manager’s role, and project management approach. It contains detailed information on respondent’s engagement in projects and project management approach, in which the authors will explore the use of the APM theory – its principles and characteristics – in the biotechnology sector.
5.2.1. Projects and the Project Manager’s Role

The projects and the project manager categories contain information on several sub-categories, including: respondents’ number of projects, their role in the projects, their opinion on the factors that contribute to the complexity and uncertainty of R&D projects, their decision making authority in the project, the project characteristics, and their opinion on the role and responsibilities of the project manager. The variation in the position of the respondents – project manager, chief executive officer, R&D manager, and business coach – has provided different perspectives on these sub-categories. Table 3 summarizes the number of projects in which the respondents participate and the project characteristics in terms of budget, team members, and project life period.

<table>
<thead>
<tr>
<th>No. of Projects</th>
<th>Project characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 7</td>
<td>1 million SEK 3 in average 2 years</td>
</tr>
<tr>
<td>R2 1</td>
<td>1 million SEK 6 + workers from CROs 10 years +</td>
</tr>
<tr>
<td>R3 20</td>
<td>N/A 4 in average 1 year</td>
</tr>
<tr>
<td>R4 1</td>
<td>1 million SEK 5 1 and ½ +</td>
</tr>
<tr>
<td>R5 10</td>
<td>1 million SEK 3 in average 2 years</td>
</tr>
<tr>
<td>R6 10</td>
<td>N/A Small teams N/A</td>
</tr>
<tr>
<td>R7 5</td>
<td>2 million SEK Small teams 3-4 years</td>
</tr>
<tr>
<td>R8 3</td>
<td>N/A Small teams N/A</td>
</tr>
</tbody>
</table>

*Table 3: Project characteristics*

Start-up projects are very common at UBI as it offers various services to project leaders to develop their biotechnology idea. Respondent 1 & 5, business coaches at UBI, advise 7 and 10 projects, respectively. According to Respondent 1 & 5, projects that participate in the UBI are small as they are start-up projects. Usually, there are three team members on average. UBI offers 1 million SEK to start-up projects that are accepted in the incubator and also the opportunity to stay for two years in the incubator’s facilities. The business coaches are involved in the different phases of the project within the incubator, for example: idea development, pre-incubation, verification I, verification II, and accelerator phase. The main role of the business coach is to assess if the idea has potential for entering into the market. The business coaches participate in finding small budgets to support early stages, patent guidance, planning, and budgeting. The goal is to add value to the project management process. Also, they organize meetings once a week to check the progress of the project. Strategic meetings take place two to four times a year in which the business coach and the project manager go through the activity plan and the budget in detail. In these strategic meetings, the project managers, in accordance with the business coaches, have the authority to make decisions on changing the activity plan and the requirements of the project. The business coaches also travel to meetings and congresses to meet with potential investors who are willing to invest in the project ideas at UBI.

Furthermore, Respondent 1 states that R&D projects that are in UBI face two factors of complexity, for example: strong product regulations and technical knowledge. Before a drug is allowed into the market, it needs to be tested in different ways, such as, in vitro, animals, and humans. Respondent 5 adds as a factor of complexity that the biotechnology sector is a
fast moving market, in which ideas need to be developed at the right time. Also, when projects move into further stages, they need more funding. In the recent years, finding funds for the projects has become harder (Respondent 5). According to Respondent 1, R&D projects face high levels of uncertainty as they have many steps to complete the project, and after each step it becomes costlier to quit the project. It is a very costly process. Respondent 5 complements that during the project life cycle there can be new discoveries that can change the whole orientation of the project, which increases both uncertainty and complexity of the project.

Respondent 4 manages his first start-up R&D project at UBI. Respondent 4 has five members in the project team. The project has been ongoing for one year and a half. Respondent 4 describes the roles and responsibilities of the project manager as managing the project in many ways with the help of the business coaches. This is because Respondent 4 is a project manager for the first time. The biggest responsibility is to maintain contact with the customers, who are potential participants in the project. Decision making is done collaboratively with the team, especially in major decisions, but the project manager takes the final decision. Respondent 4 claims that the difficulty to take the project idea from the scientific world and apply it in the business world increases its complexity. Also, Respondent 4 is a scientific researcher therefore it is hard for him to present the product to the business world. Therefore, Respondent 4 needs the help provided by UBI in order to put the product into the market.

Moreover, Respondent 6 is a business coach and Respondent 8 is a business coach and a project manager at Uminova Innovation. Both respondents have long experiences in R&D projects in the biotechnology sector. Respondent 6 & 8 advise ten and three projects, respectively. All of the projects in which they participate have small teams. Uminova Innovation does not provide funding for the projects, but the projects do have an unlimited period of stay at the incubator. Respondent 6, depending at the stage in which the projects are, advises the project managers in technical, market, and customer activities that take the project forward. It helps them verify the market needs in order to discover if the project is viable. Respondent 8 also helps project managers to see if there is a market need for the product and if the product is in the right market. He takes a more strategic participation in projects. Respondent 8 tries to get the customer involved in order to adapt the product to their needs in earlier stages. He participates in goal and objective setting of the projects. His biggest contribution is keeping the projects focused on the objectives with positive cash flow. The failure of many biotechnology projects and companies is that they do not focus on what is their aim in the market, hence, wasting resources. Respondent 8 claims that project managers should have enough authority to take decisions regarding how to come to the different solutions. However, decisions regarding if the project should be initiated or closed are the responsibility of the people in executive positions.

Respondent 6 states that the regulatory pathway makes R&D projects really complex. Life science patents are important in order to get the product in the market. Patent protection is needed to protect the project. Besides, patent protection is key for financing. There are many markets that specialize in copying products, and the project manager cannot afford to lose the knowledge (Respondent 8). Respondent 8 highlights that biotechnology R&D projects deal with the biological system. It is never certain how an activity will work and experiments
can show unexpected results. The testing process is long, and it can change from testing in vitro to testing in animals. There is a lot of uncertainty in the final product and how it will work. Also, the sector is extremely regulated by the government. Projects take a lot of time to be developed. The customers are usually large pharmaceutical companies, and they are very difficult to deal with. The project managers need to provide a lot of backup proof that the product is good enough to get the customers interested. Project managers often do not know what the customer wants or needs, and time cannot be bought with more resources. Also, the biological experiments cannot be accelerated.

Respondent 2, a CEO, states that their only Phase I clinical research project has been ongoing for the last 10 years with a 1 million SEK per year invested. The project has six employees and also outsources work to Contract Research Organizations (CROs), which have around 50 workers. Respondent 2 is the head of the company, but he is engaged daily in the laboratory work. Also, he advises the project manager daily. Respondent 2 claims if a traditional PM approach is taken, projects have the tendency to fail. This is why his company manages the project differently. The organization is not linear and decision making is done with the group as every team members’ input is important. Decision making is based on the team members’ experience. Also, the project is complex due to the biological nature of the project. For example, a simple bacteria is much more complex than any computer to develop.

Respondent 3, a CEO, manages around 20 projects. The projects have around four team members and last approximately one year. Respondent 3 is the leader of all the projects and focuses on stakeholder management, personnel management, finance, legal, and marketing. He is involved in the product development phases and market analysis. Also, he proposes new projects for the pipeline or the portfolio of the company. Respondent 4 believes that the complexity of R&D projects is triggered by the uncertainty in research findings. This can lead to many different solutions. It is a rapidly changing environment, highly dynamic. This presents a challenge for the project manager as he needs to adapt to those changes without impacting the results. Also, most products being developed are new in the market and there is nothing similar to compare, thus, complexity increases. All the knowledge needed will have to be build up through experimenting and expertise in the area. New technology is also another factor of complexity. Finally, there are many disciplines involved that increase the complexity of the projects: design, manufacturing, chemistry, physics, biology, and business.

Respondent 7, an R&D manager, manages five projects in the company. The projects have small teams and last from three to four years in average. In each project, around 2 million SEK are invested; 1.5 million for the budget of the project and 0.5 million for external services. The reason for outsourcing work as external services is the lack of expertise in certain areas. As an R&D manager, the level of involvement in the projects is not on a daily technical basis, but on a global strategic perspective. He is responsible for writing the R&D plans, and deciding which project from the pipeline will get done. He follows the progress of the five projects, but the project managers are the ones directly responsible. Respondent 7 claims that uncertainty is affected by the product itself. Products in R&D are not certain if they will succeed in the market. These products have gone through market analysis, but due to the nature of the sector, they might fail to be successful for the customers. Also, there is technical uncertainty. There might be technical solutions that will not work as expected. There are projects on hold because of the technical uncertainty. Furthermore, regulations
increase the complexity of the project, especially at the end of the project when coping with marketing, packaging, labeling, and documentation regulations. There is also technical complexity. Usually these projects have no point of reference in the market, something to compare to, that increases the complexity. Also, innovation increases complexity as developing features differently makes the process harder.

In addition, the roles and responsibilities of the project manager vary depending on the context. For example, the project managers that manage start-up projects in the incubators can have different roles than project managers managing projects in established companies. The project managers of start-up projects usually have the help of the business coaches from the incubators. Respondent 5 states that the project manager should drive the project forward, maintain the team engaged and motivated, be open to learn, and manage a team with different competences in order to provide the best solutions. Respondent 1 claims that the project manager should also keep track on the budget and spend it according to the budget plan. The project manager is on top of the project, but he or she also needs to report to the business coach on weekly basis in order to check that everything is going smoothly. In these complex projects, there is the need to change the project plan over time, and the project manager should manage changes in accordance with the business coach. Furthermore, Respondent 6 & 8 state that, in new projects, the researcher is usually the project manager, who comes with the project idea and who knows the technique and patents required for the project. Respondent 6 claims that the project manager needs to be fully involved in the beginning in order for the project idea to succeed. Later, when the project is more mature, then another project leader can be assigned who has skills that are needed for the business world. The project manager should be aware of the struggles that projects are facing, such as financing, team building, patents, and others. Respondent 8 highlights that a project manager should be market oriented, and not focus only on the product. Creativity allows a project manager to be successful in the biotechnology competitive market (Respondent 2).

In micro and small companies, Respondent 8 claims that the project manager is also the managing director or the CEO of the company. In consequence, the project manager has to manage the biotechnology techniques and all the business oriented parts. The project manager needs to be very competent on the project environment. In addition, he or she needs to be aware of financing, marketing, and legal (patent) procedures. The project manager is responsible to deliver a product or service which is needed in the market with a positive cash flow in a certain period of time. The project manager should not spend too much time in the technical side. As Respondent 3 claims, they have 100 percent of the responsibility to move the project forward, but also responsible for major decision and the iron triangle: budget, time, and quality. Respondent 7 highlights the importance of the project manager understanding the different stakeholders, especially the customers. The project manager needs to visualize in the long term how the product will create value for all stakeholders and how it will succeed in the market. Additionally, he or she needs to manage the project in the global level, ensure the availability of the resources, engage and motivate the team to complete the work, and document the project. Without documentation it appears as the project never existed. People will forget many details when looking at the projects many years later. There needs to be a summary of the whole process and not just documentation of the experiments.
5.2.2. Project Management Approach

The project management approach category contains the following sub-categories: project management process and approach, project life cycle, change management, hierarchical structure of projects, client involvement and feedback, teams, and communication style.

Respondents 2, 6, & 8 criticize the traditional approach of project management and emphasize that biotechnology R&D projects usually fail under the traditional approach. According to Respondent 2, the reason that many large pharmaceutical companies fail is the use of traditional project management approach. Respondent 8 states that most of the R&D projects in Umeå come from ideas developed at one of the universities. In those cases, projects follow a more traditional project management approach. This is due to the scientific background of the people involved in developing the ideas. When these projects become a potential business idea, some continue with a traditional approach and in many cases it appears to be a mistake. Being rigid in planning and control can lead to failure. It delays the adaptability of a product that the customer wants. Respondent 6 & 8 claim that Uminova Innovation encourages project managers to use agile approach of project management in order to succeed in the turbulent environment. A flexible approach is needed to be able to adapt to changes in the project.

Similarly, Respondent 1 states that at UBI scientists come and want to develop their idea but are not familiar with project management. The business coach helps these project managers to follow their plan, to spend the funds as planned, and to connect them with clients and future investors. From project managers it is required to prepare a project plan for two years in detail, but the plan is a subject to change as it is re-written many times. Respondent 5 says that there are periodic meetings to access the project results and if there is the need to change the project plan, then it will be changed. Thus, it is followed a project management approach that embraces change. The project manager will have to adapt the resources to the new direction and continue. In other words, requirements of the project are continuously assessed in order to consider if there is the need to change or evolve them. Respondent 4 confirms that in the beginning the plan is done for the whole project, but then it changes as other requirements emerge and need to be included in the plan. Verification studies are executed in order to know if a requirement is viable before proceeding further.

Respondent 2 highlights that changes in his company can happen basically three times a week. Respondent 3 has daily meetings with the team to address issues and define actions to solve them. There is an iterative or cyclic development of the work. Furthermore, Respondent 7 notes that the company does not have a formal expressed project management approach. However, he manages projects in a flexible and adaptable way. The projects change continually. Changes are documented in order to learn from them. In the earlier phases of the project, the approach is more agile. At the end, when following the regulatory stages, there is the need to be more traditional and strict. The whole process is divided in two: Research and Development. The research part is more agile than the development part (Respondent 7).

Moreover, the project life cycle in R&D projects at UBI is adaptive. According to Respondent 1, project requirements are adapted to the project and thus the plan is re-written. This is done especially after the client feedback. Customer’s interest and input is very
important as they will invest in the projects, therefore, the project plan adapts to the customer’s needs. Respondent 5 highlights the five stages that a project undergoes in the incubator. The idea stage assesses if the project idea is feasible. The pre-incubator stage analyzes the market. Stages Verify I and II are the execution phases. Finally, the accelerator stage is when the project reaches the higher levels of funding. In each stage, there is a ‘go and stop’ criteria in order to adapt the life cycles. Respondent 4, the project manager of a start-up project, states that the goal is to do everything time and cost effective, but requirements that need to be changed are changed. The change management process is done by discussing the changes with the team during the meetings. Also, big changes are discussed with the business coach in order to assess if the change should be implemented. Additionally, Respondent 6 & 8 claim that projects should follow a ‘learn-and-adapt’ process with an adaptive life cycle. Respondent 6 says that if a linear life cycle is followed, then the project can be very costly when it takes a wrong turn. In early phase projects, for example Phase I clinical research, it is easier to manage changes. If the information is valid then the change is implemented. In later stages of clinical research, there are regulatory procedures to follow on how to correspond to the market.

The companies of Respondent 2, 3 & 7 follow an adaptive life cycle. Respondent 7 claims that changes are adapted while the project is developed. They are managed usually by informal discussions. The results of the changes are revised and every week there is a team meeting where issues are discussed. All of the changes are documented. Furthermore, the team of Respondent 3 uses iterations in order to adapt to changes. They focus on developing prototypes and test them. If the prototypes work, then the work is moved in to the next stage. Changes are addressed as a team in the daily meetings. Actions are defined and taken. In the afternoon, there will be a ‘follow up’ meeting to present the results of those changes. In addition, Respondent 2 claims that changes are managed and implemented through a rapid decision making with the team. In the company of Respondent 2, changes need to be adapted by the following week.

Customer involvement is a sub-category in which respondents have different answers depending on the project context. Most project types are drug discovery/development, drug delivery, in vitro diagnostics, biotech medical technology, and biotech tools and suppliers. Respondent 6 states that customers usually give a lot of feedback to different tool development projects. However, if a project is in an early phase clinical research (Phase I, II, or III), in the case of drug development, then the customer is not involved with the project until it reaches its maturity and the time to be introduced in the market. In the company of Respondent 2, the project is in Phase I clinical trials. In this case, the customers are not involved at the project at all because of patents; the project idea needs to remain secret. Therefore, customers need to be involved only at the later stages of clinical development, after Phase III, when the product is also tested in humans and is ready for the market.

Respondent 1 & 5 claim that at UBI customer input is very important as they invest in projects. Their feedback is considered to change the project plan in order to deliver a product that the future customer wants. Respondent 1 highlights the need for more customer involvement, possibly in the advisory board. In that way, the customer’s experience and knowledge could be used more often. The business coaches go often to partner meetings to discuss and present the project ideas to customers in order to get their input and possibly their
investment. Most customers have scouts around Sweden, who are looking for project ideas in order to invest in them. Respondent 4 says that before initiating the project idea, a customer need analysis was made by interviewing people from clinics in order to hear their opinion on the project. The customer’s needs and demands were gathered in order to analyze what is important for him or her. The product needs to be user friendly. Also, contact is kept with the customers over time. The project of Respondent 4 aims to develop a prognostic tool, meaning it is a biotechnology tools project.

Respondent 3 states that customer feedback is highly important when developing biotechnology tools. The company is involved in conferences where clients can be approached and therefore invite them directly to test a product. The feedback is analyzed, and if needed, the changes in the product are adapted. The company works closely with customers to understand what they need and want. In addition, feedback enhances the company’s ideas and enables them to gain a competitive advantage. Respondent 7, who is in charge of developing diagnostic tools, claims that the customer is involved in the process, but more in the later phase of the project when there are prototypes developed. These prototypes can be tested by the customers in their environments. Their feedback can be used to adapt it to the prototype. Or a different solution can be offered to the customer, in which the customer adapts their systems and instruments to the solution. Additionally, Respondent 8 highlights that companies need to understand how to cooperate with the customer as their feedback is important when developing a product. However, the products should have a patent before talking to any customer, especially start-up companies. Small companies cannot afford legal processes against large companies that have a lot of resources. There is the need to establish good development agreements with the customers involved. Involving customers allows the project leaders to see new alternatives for the solutions required by the customers.

Table 4 summarizes the project management process, the project life cycle, change management, and customer involvement in respondents’ projects. All of the respondents apply a flexible PM process, meaning an agile approach of PM. All respondents apply an adaptive life cycle. Changes are managed usually together with the teams in the meetings. Customer involvement is periodically done by all participants, except in drug development. Additionally, Respondent 6 & 8 are marked with the * symbol for change management and customer involvement as they consult various types of projects and take various perspectives depending on the project context.

<table>
<thead>
<tr>
<th></th>
<th>Flexible PM process</th>
<th>Adaptive life cycle</th>
<th>Change management through team meetings</th>
<th>Customer involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>R2</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>R3</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>R4</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>R5</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>R6</td>
<td>√</td>
<td>√</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>R7</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>R8</td>
<td>√</td>
<td>√</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Table 4. Project management approach
The workplace environment of R&D projects has similar characteristics among the different companies. The hierarchical structure of R&D projects is usually flat, according to all respondents. Project teams are usually small and all team members participate in the decision making process, which contributes to the flatness of the project hierarchy. As Respondent 3 states, the project manager becomes a facilitator where he or she encourages the team to participate when important decisions are made. Decisions of initiating or closing a project are usually taken by executives (Respondent 7). Moreover, all respondents say that teams are small, usually two to five researchers. All respondents claim that team members are highly experienced in their field of expertise and their contribution to the decision making is very important. Furthermore, Respondent 2, 3, 7, & 8 claim that teams work in the same location, that is where the company is located. Respondents 1, 4, 5, & 6, who advise and work at the UBI and Uminova Innovation incubators, claim that researchers mainly do the laboratory work in the incubators’ facilities, but some research is also done in the universities’ offices since these researchers are also professors at universities. This means that teams mainly work in the same location, but sometimes they work in distributed locations as well. Additionally, for all respondents, the communication between the project manager and the team members is usually informal. Only Respondent 6 claims that communication can be both, formal and informal, depending on the situation. Table 5 summarizes the workplace environment of biotechnology R&D projects by confirming the hierarchical structure, teams size, teams experience, teams participation in the decision making (DM) process, teams location, and the overall projects communication style. Respondent 1, 4, 5 & 6 are marked with the * symbol for co-located as the project teams work in different locations at some stages of the project. Also, Respondent 6 is marked with the * symbol as his organization uses both informal and formal communication.

<table>
<thead>
<tr>
<th>Flat hierarchical structure</th>
<th>Small Size</th>
<th>Highly Experienced</th>
<th>Participate in DM</th>
<th>Co-located</th>
<th>Informal Communication style</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>R2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>R3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>R4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>R5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>R6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>R7</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>R8</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 5. The workplace environment of biotechnology R&D projects

Based on the findings of the data, it can be observed that biotechnology R&D projects follow the principles and characteristics of APM approach. This approach is based on six main principles. Highsmith (2004, p.27) categorized these six principles in two groups: customer value through innovative products and leadership-collaboration management style. The first group consists of principles that focus on the customer: deliver customer value; employ iterative, feature-based delivery; and champion technical excellence. The second group includes leadership features as: encourage exploration; build adaptive and self-organizing teams; and simplify.
The findings show that all respondents highlight the importance of listening to the customer’s needs. The first principle is to deliver customer value. This is achieved through developing a product that is needed in the market. The second principle is to employ iterative, feature-based delivery. All respondents claim that R&D projects in the biotechnology sector face high levels of uncertainty, thus, emphasizing the work in iterations to build knowledge. Each experiment or prototype can be an iteration in itself. If the experiment fails, another experiment is planned and executed. If the experiment displays the desired results, then the next experiment is planned and executed until the final solution is reached. The third principle is to champion technical excellence. All respondents state that the project manager and the team members are highly experienced and know the technicalities of the project. The project manager understands how the product should work and therefore is able to present the value that the product can bring to the customers.

Furthermore, project managers need to adapt a leadership-collaboration management style. As the fourth principles suggests, project managers need to encourage exploration. Working in a constantly-changing environment is difficult for team members, thus, the agile project manager needs to encourage team members to cope with changes. All respondents claim that the project manager needs to encourage team members in difficult situations and drive them forward in order to succeed. The fifth principle is building adaptive and self-organizing teams. Respondents claim that team members in R&D projects are highly experienced. They know what is needed to be done in order to complete the project, therefore, they mostly self-organize their work. Team members quickly adapt to changes that come from the experiments. The last principle encourages project managers to simplify the work. Based on the findings, the R&D project managers keep the work simple and do not introduce many PM processes to the project team. Team members complete their work by simply developing features through experiments and testing if they work. Table 6 summarizes the use of APM principles in R&D projects in the biotechnology sector.

<table>
<thead>
<tr>
<th>APM principle</th>
<th>Biotech R&amp;D projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer value through innovative products</td>
<td>Deliver customer value</td>
</tr>
<tr>
<td></td>
<td>Employ iterative, feature-based delivery</td>
</tr>
<tr>
<td></td>
<td>Champion technical excellence</td>
</tr>
<tr>
<td>Leadership-collaboration management style</td>
<td>Encourage exploration</td>
</tr>
<tr>
<td></td>
<td>Build adaptive and self-organizing teams</td>
</tr>
<tr>
<td></td>
<td>Simplify</td>
</tr>
</tbody>
</table>

Table 6. APM principles in biotechnology R&D projects

Following the findings of the data, the use of APM characteristics can be observed in biotechnology R&D projects. From the findings, all respondents claim that R&D projects in biotechnology are highly complex and innovative as the aim of the project is to develop a product that does not exist and is needed in the market. They claim that these projects face high level of uncertainty, hence, working with iterative development in order to build knowledge about the solution. Table 7, an adaptation of Table 1, summarizes the use of APM in biotechnology R&D projects by matching the APM characteristics to the study’s context.
Only customer’s role is marked with the * symbol as in biotechnology R&D projects the customer is not involved daily but periodically. Nonetheless, customer role is seen as very important as customer’s feedback is implemented in order to develop a product that is needed in the market.

<table>
<thead>
<tr>
<th>APM characteristics</th>
<th>Biotech R&amp;D projects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fundamental assumptions</strong></td>
<td></td>
</tr>
<tr>
<td>Agile projects are complex and innovative that</td>
<td>√</td>
</tr>
<tr>
<td>require iterative development of goals,</td>
<td></td>
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<tr>
<td>features and requirements over the life</td>
<td></td>
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<tr>
<td>cycle with the purpose of reducing the level</td>
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<tr>
<td>of uncertainty that agile projects face</td>
<td></td>
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<tr>
<td>due to the turbulent environment.</td>
<td></td>
</tr>
<tr>
<td><strong>PM Life Cycle</strong></td>
<td></td>
</tr>
<tr>
<td>Iterative and Adaptive life cycles (product</td>
<td>√</td>
</tr>
<tr>
<td>can be released after each iteration)</td>
<td></td>
</tr>
<tr>
<td><strong>Environment/context assumption</strong></td>
<td></td>
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<tr>
<td>Turbulent (change is embraced)</td>
<td>√</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td></td>
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<tr>
<td>Flexible (done continuously throughout the</td>
<td>√</td>
</tr>
<tr>
<td>development process)</td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
</tr>
<tr>
<td>People oriented</td>
<td>√</td>
</tr>
<tr>
<td><strong>Management style</strong></td>
<td></td>
</tr>
<tr>
<td>Leadership and collaboration</td>
<td>√</td>
</tr>
<tr>
<td><strong>Team Role assignment</strong></td>
<td></td>
</tr>
<tr>
<td>Self-organizing teams – experienced members</td>
<td>√</td>
</tr>
<tr>
<td>and preferably co-located</td>
<td></td>
</tr>
<tr>
<td><strong>Team Size</strong></td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td>√</td>
</tr>
<tr>
<td><strong>Knowledge Management</strong></td>
<td></td>
</tr>
<tr>
<td>Tacit</td>
<td>√</td>
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<tr>
<td><strong>Customer’s role</strong></td>
<td>Critical  *</td>
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<tr>
<td><strong>Communication</strong></td>
<td>Informal</td>
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Table 7. APM characteristics in biotechnology R&D projects

Based on the use of APM characteristics and principles in the biotechnology R&D projects it can be said that biotechnology R&D project managers are agile project managers. Hereafter, biotechnology R&D project managers and agile project managers will be used interchangeably.

5.3. Competences

The competences theme explores the three main types of competences as identified from the competences literature: technical, contextual, and behavioral competences. The category is named competences as well, whereas the sub-categories are the three types of competences.

Technical competences are considered very important for project managers according to all of the respondents. As Respondent 1 claims, project leaders need to have high technical skills and have to be experts in their idea. It depends on the project context in order to know which technical skills are needed. Project leaders are usually researchers, thus, their expertise is technical. Respondent 5 & 7 support that project managers need to have a scientific and
technical background in order to understand the product and translate it to different stakeholders. Respondent 5 elaborates on the fact that the project manager needs to convince stakeholders for the need of the product in the market. If the project manager does not have the technical competences, then he or she needs someone in the team who is experienced in this field. This claim is supported also by Respondent 4 & 6. But, if a researcher is a project manager at the same time, then he or she has the technical skills and knows about the technicalities and regulatory patents.

Respondent 3 claims that a competence is a combination of education and experience. Thus, in his organization, all team members have at least a Master degree in Chemistry and two members have a Ph.D. in Chemistry. Experience varies from 10 to 30 years. Respondent 7 states the same criteria that a team member should have at least a Master or a Ph.D. in Chemistry. Also, his organization provides internal training to foster technical competences that are more special for the products they develop. Respondent 2 names several technical skills needed in drug development: to be a molecular biologist, to know how to do experiments with animals, and to know physiology of animals in order to understand how the animals behave. Furthermore, Respondent 8 argues that the importance and the need for technical competences for project managers depends on the size of the organization. In micro organizations, the technical competences are more needed because the project manager would need to focus more on technical activities. The project manager needs to deal with almost everything related to the project. In larger organizations, a project manager will also need the technical competences to understand the product or service.

The importance of contextual competences for project managers depends on the project context. Respondent 2, who works on Phase I clinical research project, says that contextual competences are only needed later when the product advances to later stages. However, there is the need for the project manager, or at least a team member, to know intellectual property rights. Respondent 1 & 5, who are business coaches at UBI, claim that project managers come in the incubator with low contextual competences. They claim that project manager over time learn these competences in the incubator. The contextual skills are important as project managers need to see the business side of the project, especially when they meet the investors. Project managers need to be able to sell the idea to the investors. Respondent 5 says that contextual competences are fostered in project managers through several educational activities. Project managers in the incubator learn contextual competences as: finance, legal, personnel management, project management, and business. Respondent 4 supports that UBI has contributed in developing his or her contextual competences, especially by giving legal advice and a network of potential customers.

Respondent 8 claims that all the project oriented competences are needed throughout the project. Respondent 3, 6, & 8 claim that financing competence is very important for a project manager if he or she is involved in the funding activities. According to Respondent 8, resources are limited, thus, a project manager needs to focus the finances on the important activities. Respondent 3 & 6 say that project managers need the business competence in order to understand the customer and the market environment. Respondent 3 & 8 argue that the legal competence is highly important due to patents and secrecy agreements that need to be involved. Respondent 7 also claims that a project manager needs to be aware of the organizations environment, the market environment, legal factors, and others.
Moreover, behavioral competences are seen as the most important competences, compared to technical and contextual competences. Respondent 1 claims that project leaders need to have social skills in order to interact with people from different fields. Also, for Respondent 4, communication is an important behavioral competence in order to communicate with people that have different backgrounds. The project manager has to establish an effective communication for a better understanding of what the project manager and the team need from each other. Respondent 6 claims that communication enables a team to go in the same direction towards reaching the established goal. Respondent 2 argues that project managers need to be able to collaborate, to have open discussion, and to be able to accept criticism. In other words, to be open minded and understand when they are wrong. According to Respondent 1, they need to be humble to understand that they do not know everything.

Furthermore, according to Respondent 5, project manager are very dependent on other people in order to reach project success. The project manager needs to communicate the importance of the team to the team members. In this way, the project manager will lead the team to success. Thus, leadership is needed as a competence. Respondent 7 claims that the project manager has to be able to maintain an environment where every individual can feel and be successful. Respondent 3 further argues that competences such as consultation, reliability, ethics, engagement and motivation, relaxation, appreciation, conflict and crisis, openness and self-control are important in general for project managers. He adds that for his company behavioral competences are important but not vital. This is because the members of the company have worked together for a long time and their interaction is excellent. Additionally, for Respondent 8, behavioral competences are the most important of all. The project manager needs the human side of competences in order to achieve the goals. He recognizes that it is very important to engage and motivate the team members, and also to foster flexibility in the team in order for them to be open, efficient, creative, and create value for the project.

5.4. Essential Behavioral Competences

The essential behavioral competences theme explores the four main behavioral competences as identified from the competences literature: flexibility, leadership, communication, and creativity. This section will present the empirical data and analyze the importance of these competences for a project manager in the biotechnology sector.

5.4.1. Flexibility

A project manager needs to be very flexible (Respondent 1, 4 & 8). Respondent 3 claims that a project manager has to be 100% flexible. It is an essential competence because many project requirements will change from what it was planned at the beginning of the project (Respondent 1). Respondent 5 adds that in fact, there are many unexpected events that could happen in the process, and if a project manager tries to stick to the initial plan and ideas, the project has a higher chance of failing. R&D projects in the biotechnology sector tend to continuously change, and very rapidly (Respondent 3 & 7). Respondent 3 highlights that a project in R&D can change directions unexpectedly. Respondent 8 states that there is a need for understanding the market and adapting the product or service to it. Respondents 7 & 8 say that the biotechnology sector is a sector of many changes, and a project manager needs
this competence in order to deliver the best outcomes. Respondent 1 & 2 highlight that flexibility enables change by allowing the project manager to be adaptable. The importance of flexibility comes into play because it enables a project manager to be very open-minded, to be able to change depending on the context, and understand what is needed to be changed in the project (Respondent 4). Respondent 8 states that in order to be flexible, a project manager needs to listen to the different stakeholders. A project must be flexible, otherwise it is very hard to reach the goals (Respondent 5). Respondent 8 highlights that flexibility allows a project manager to reallocate resources in the most effective way. It allows different alternatives to be considered to reach the goals. Not being flexible in an R&D project can cost you a lot of financial resources. In R&D projects, Respondent 7 states that flexibility is more needed in the research part than in the development part. However, the project manager needs to be clear that he or she cannot run into all directions and ideas (Respondent 8).

Respondent 3 states that the project manager always needs a small percentage of inflexibility in order to drive the project idea to the end. Respondent 6 claims that the project manager cannot be too flexible to change directions every day, but he or she needs to listen and be able to adapt to new information. However, this information needs to be carefully assessed to state its validity. A project manager needs to be careful to not end up in a loop by changing all the time and never reaching an end. Therefore, a project manager needs to be flexible and take action quickly to adapt, but only when he or she has valid information. Flexibility allows a project manager to balance between giving up to early or too late. Respondent 3 & 7 state that this competence can impact a project by saving a lot of money and time by terminating activities if they deviate from the project goals.

Respondents 2, 3 & 5 highlight that flexibility is the most important competence for a project manager in the biotechnology sector. Overall, the competence is scaled as very high important by four respondents (Respondents 2, 3, 5, & 8), while the other four scaled it as high important (Respondents 1, 4, 6, & 7), see Table 8. When compared to creativity, communication and leadership, flexibility is ranked as the third most important and essential behavioral competence for agile project managers in the biotechnology sector.

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<th>Flexibility Scale</th>
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*Table 8. Flexibility Importance Scale*
5.4.2. Leadership

Respondent 8 states that leadership is always needed in R&D projects. Respondent 5 claims that leadership is important in the biotechnology sector, considering that most of R&D projects are developed and managed by teams with a scientific background and no experience in business. Leadership allows a project manager to push the project forward and take the necessary strategic decisions to deliver a product or service wanted in the market (Respondent 3). Respondent 2 states that leadership is important even in small companies as someone has to make fast decisions. In addition, someone has to realize when decisions are wrong and be able to change into the right direction. Respondent 1 says that project managers need to be leaders in the sense of accepting that he or she will not have all the knowledge, hence, that they are very dependent on other team members as well. Respondent 8 expresses that there are many leadership styles, and some work better than others in R&D context. Respondent 1 says that a commanding and control leadership approach cannot be used when managing R&D project, hence, another type of leadership is needed in this field. A project manager should be more of a facilitator in the team than a commander (Respondent 3). This would facilitate an integrative decision making process. Respondent 5 states that leadership can be developed throughout the project management process. Respondent 8 claims that it is essential for a project manager to listen to his or her personnel and create an open dialogue.

Respondents 5 & 7 state that leadership is important because a project manager needs to keep the project team engaged and motivated. Respondent 8 adds that by engaging and motivating a team, a project manager can achieve the established goals. Respondents 7 & 8 state that a project manager needs to create an environment where the project team wants to follow him or her vision. Respondent 4, a project manager, states that leadership enables a project manager to show confidence on what he or she is doing in order for the project team to trust and follow. The team members should feel that the leader knows what he or she is doing. Respondent 5 claims that through leadership, a project team gets convinced on the abilities and capabilities that a project manager possess to successfully deliver a project. Respondent 6 & 7 highlight that it is hard to separate leadership from communication, creativity, and flexibility, because leadership is the sum of the three competences. Therefore, the project manager needs to have the four competences to be a good leader (Respondent 6).

Respondents 5 & 7 state that leadership is less important in some contexts. Respondents 3 & 7, from an executive perspective, express that when organizations have small teams, especially in the case of start-up organization, this competence might become less important. Respondent 3 supports that being an effective leader in smaller groups is easier, decreasing the importance of the competence. Smaller organizations can take decisions as a consensus and without escalating decisions at many organizational levels. Also, Respondent 5 says leadership is less important in the initial stages of a project. There is a higher need for leadership in later stages when the complexity and uncertainty increases due to constant changes. Overall, Respondents 6 & 8 consider leadership as a very high important competence. Especially for Respondent 6 leadership is the sum of the other three competences, Respondents 2, 4 & 7 scale leadership as high important. Finally, Respondents 1 & 5 scale the competence as important, while only Respondent 3 sees leadership as a low important competence; see Table 9. When compared to the other three behavioral competences, leadership is ranked as the least important and essential of the four. This is due
to the understanding that to be an effective leader, a project manager requires the other three behavioral competences. Only Respondent 6 ranks this competence as the most important and essential.

Table 9. Leadership Importance Scale

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<th>Leadership Scale</th>
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5.4.3. Communication

Respondent 7 states that communication is extremely important in R&D projects. Respondent 1 says that R&D projects in the biotechnology sector require a team that consists of individuals with different expertise background. Hence, a project manager needs to have good communication skills to talk with different professionals and align them to follow the same goals. Respondent 2 adds that this requires a project manager to be open-minded and be able to talk to people. Project managers need to be direct and say exactly what it is needed to be done. A project manager needs to be open to take criticism and deliver constructive criticism. Respondent 8 says communication is not only about speaking, but it is also about listening. External and internal communication is very important, as a project manager needs to listen to customers and the project team.

Respondent 3 & 5 say that communication enables a project manager to express the project vision and objectives to the different stakeholders involved with the project. Respondent 5 states that communication enables alignment among the different stakeholders. Respondent 3 claims that through an effective communication, a project manager can provide constant feedback to him or her team, and also receive it from the different stakeholders. In small organization communication is more important when dealing with external stakeholders, for example customers or investors. Respondent 4 agrees on the importance of communication regarding stakeholder management. However, regardless of the size of the organization, the project manager needs to get the most out of people and needs to understand what they need and/or want. In small organizations, Respondent 3 states that within the group it is not that important due to the size of the team. In the case of medium or large organization, the respondent clarifies that communication could play a more important role. Respondent 4 & 5 add that the project manager has to clearly transmit what it is expected from the project team. Respondent 7 says that a project manager has to speak to others and understand them. The team needs a common goal and to understand it. Effective communication brings people on board (Respondent 5). Respondent 6 says that there cannot be any misunderstanding among the project team regarding goals and objectives. Everybody should have clear goals.
and agenda. Therefore, effective communication is necessary for the correct implementation of a project.

Overall, most of the respondents consider communication as a very high important competence for a project manager (Respondents 4, 5, 6, 7, & 8). Respondents 1 & 3 scale the competence as high important. Only respondent 2 states that communication is only important; see Table 10. When compared to the other three competences, communication is the second most important and essential behavioral competence of the four. However, Respondents 6, 7, & 8 rank it as the most important and essential competence arguing that a project manager needs to listen in order to be a leader, creative, and flexible. A project manager cannot understand the problem and come back with solutions without effective communication.

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<th>Communication Scale</th>
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<td>1 (Very Low importance)</td>
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*Table 10. Communication Importance Scale*

5.4.4. Creativity

Respondent 1 & 3 say that creativity is the most important competence, as project managers need to be creative in all aspects. In the biotechnology sector, project managers are usually science experts, but they also need to be creative to make people work together, and to find funds and other resources. Respondent 2 claims that creativity is the most essential competence as it is all about being creative in this sector. Respondent 4 states that the project manager needs to be creative at all times in order to achieve the best results. Respondent 5 adds that a high level of creativity can define the best outcome. Respondent 3 highlights that creativity is the competence that drives a company to success. The project manager has to be creative enough to achieve the objectives with limited resources. Micro and small companies have achieved great results with small budgets, only if they have been creative enough. Respondent 3 & 5 share that a project manager needs to find alternatives and solutions, in order to reach his or her project objectives. In R&D projects, especially in product development, the project manager is responsible for creating products or services that the customer does not really know they need. It is all about living and working outside the box. Respondent 4 states that creativity enables effectiveness and efficiency in a project.

Respondent 6 says that project managers are continuously finding new information in the market. The project manager needs to be creative enough in order to find the best solution or
alternative to cope with the changes that the market requires. Creativity includes flexibility to quickly adapt and communicate with the project team. In this way, an organization is able to be ahead of the competitors. Respondent 8 states that creativity is very connected to listening to your customer and understanding the problem. With creativity a project manager can find new solutions and alternatives to fulfill the needs of the market. Respondent 7 claims that from an R&D perspective, creativity is very important especially for project managers looking for technical solutions. Overall, creativity is seen as a very high important behavioral competence for project managers (Respondents 1, 2, 3, 4, 6, 7, & 8). Only Respondent 5 rates creativity as high important; see Table 11. When compared to the other three competence, creativity ranks first as the most important and essential behavioral competence. Five respondents rank it as the most essential and important competence in their organization (Respondents 1, 2, 3, 4, & 6).

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<tr>
<th>Creativity Scale</th>
<th>1 (Very Low importance)</th>
<th>2 (Low importance)</th>
<th>3 (Important)</th>
<th>4 (High importance)</th>
<th>5 (Very High importance)</th>
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<td>R1</td>
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*Table 11. Creativity Importance Scale*
6. Discussion of Findings

This chapter discusses the findings from the study in relation to the competences theory. It aims to discuss if the identified essential behavioral competences are needed for agile project managers when managing R&D projects in the biotechnology sector in Sweden. In addition, the theoretical framework diagram will be revised.

6.1. Agile Project Manager’s Competences

The literature supports the importance for a project manager to have relevant expertise on the technical competences for successful management (El-Sabaa, 2001, p. 2; Thomas & Mengel, 2008, p.308). In the biotechnology sector, the research findings show that the importance for technical competences increases due to the scientific and technical background of R&D projects, especially in micro and small organizations. These two sizes of organizations require more technical competences from an agile project manager because he or she needs to be more involved in the technical aspects of the process due to lack of human resources. In consequence, the findings suggest that an agile project manager needs a combination of technical education and technical expertise. Alam et al. (2010, p. 497) claim that a project manager’s technical competences are the least important, and he or she should focus more on behavioral and contextual competences. The research findings suggest that in the biotechnology sector, agile project managers should possess strong technical competences in order to deliver a successful project. However, the findings also show that practitioners in the biotechnology sector acknowledge that behavioral competences are more important for managing a complex and dynamic project than technical or contextual competences, as also presented by E-Sabaa’s (2001) studies on IT projects. Contextual competences are the ability of an agile project manager to see the big picture of the project by sensing his or her environment (El-Sabaa 2001, p. 2). The research study findings confirm that contextual competences enable the agile project manager to understand the project context to be aware of the organization’s environment, market, legal factors, systems, finances, and technicalities. The research findings suggest that by being aware of these factors, an agile project manager is able to identify interdependencies and relationships among the different stakeholders. However, the research findings also show that while contextual competences are important for agile project managers in the biotechnology sector, they are less important than behavioral competences.

According to the prior literature, in order to address the challenges that an R&D project presents, a project manager needs the right mix of competences to enable a successful outcome (Association of Project Management, 2012, p. 49; Crawford, 2005, p. 7). As the IPMA (2006) competence framework presents, a project managers requires technical, contextual, and behavioral competences to deliver a complex and dynamic project. Deist & Winterton (2005, p.30) argue that having the right mix of competences (technical, contextual, and behavioral) would enable the right combination of knowledge, skills, and capabilities. The findings of this study show that an agile project manager in the biotechnology sector requires technical competences to understand the product or service, contextual competences to sense his or her environment, and most importantly, behavioral competences to be able to connect with the project team and the different stakeholders in order to push the project
forward. In addition of supporting Deist & Winterton (2005) studies, the research study findings suggest that behavioral competences are essential for agile project managers engaged in highly complex and dynamic projects. Fisher (2011, p.994) claims that behavioral competences enable successful project management when dealing with complex and dynamic projects. The research findings present that biotechnology organizations are more interested in behavioral competences due to their emphasis on people orientation, which enables an agile project manager to achieve the established goals and successful project management. El-Sabaa (2001) states that behavioral competences enable cooperation, openness, and constructive feedback among the project team. The research findings show that behavioral competences enable an agile project manager to work effectively with the project team through cooperation, open discussion, and constructive criticism. The research findings show that practitioners in the biotechnology sector also acknowledge the importance of competences such as consultation, reliability, ethics, engagement & motivation, relaxation, appreciation, conflict & crisis, and openness & self-control, as presented by IPMA (2006) competences framework. However, the research findings suggest that behavioral competences such as leadership, creativity, flexibility, and communication are essential for an agile project manager in order to enable customer value and leadership-collaboration; both APM group of principles.

6.2. Essential Behavioral Competences

Creativity is defined as “the ability to think and act in original and imaginative ways” (IPMA, 2006, p.100). With the creativity competence, agile project managers can transform complex issues into solutions (Joiner & Josephs, 2007, p.40). From the findings of the study, practitioners in the biotechnology sector consider creativity as the most essential behavioral competence. Practitioners claim that agile project managers continuously find new information in the market; therefore, they need to be creative in order to find the best solution or alternative to cope with the changes from the market. In the literature, creativity enables a project manager to use different perspectives, tools, methods, knowledge and experience to solve issues (Fisher, 2011, p.995). The research findings show that an agile project manager should involve several aspects to be creative: technical solutions, human resources, financial resources, and tools and techniques. R&D project presents high technical complexity, hence, an agile project manager is required to facilitate technical creativity to find the best solutions. In the biotechnology sector, micro and small organizations face challenges regarding limited resources; human and financial. In consequence, an agile project manager needs to have high levels of creativity in order to achieve great results with limited resources. Furthermore, an agile project manager needs to understand which tools, methods, knowledge, and experiences can contribute for developing an efficient alternative to the problem. In the literature, an effective project manager would encourage creativity among his team members to find the best solutions (Fisher, 2011, p.995; IPMA, 2006, p.100). The findings suggest that an agile project manager encourages and exploits the team’s creativity in order to find alternatives for achieving the project goals with limited resources.

In the biotechnology sector, creativity enables an organization to connect with the market and develop products and services that are needed, which allows them to be ahead of other competitors. Practitioners highlight that creativity enables an agile project manager to adapt to iterative and adaptive lifecycles; deal with change; develop flexible planning; use customer
involvement; and create tacit knowledge. The findings of the study confirm creativity as an essential behavioral competence, as suggested in the theoretical framework. Practitioners in the biotechnology sector consider it as the most essential competence. Hence, the study provides evidence that creativity is an essential behavioral competence for agile project manager engaged in R&D projects in the biotechnology sector.

The communication competence involves the exchange of information between the agile project manager and all stakeholders involved in the project (Edum-Fotwe & McCaffer, 2000, p.114; IPMA, 2006, p.76), especially with the project team and the customer (Ramesh et al., 2010, p.455). The research findings show that an agile project manager needs communication to engage with individuals from different fields of expertise and align them to reach a common goal. Furthermore, communication between the agile project manager and the involved stakeholders is usually informal, which enables a faster implementation of changes in the project. In the literature, effective communication enables openness, increases performance, improves relationships, and creates mutual trust among the team (PMI, 2013, p.515). The findings of the study suggest that communication enables an agile project manager to clearly share the vision and objectives of the project, be open for criticism and provide constructive criticism to stakeholders. This enables to enhance relationships among the different stakeholders, improve project performance, and create an environment of mutual trust. Communication is used for engaging stakeholders, encouraging change, directing employees, and managing stakeholder expectations (Crawford & Nahmias, 2010, p.407). The findings support that an agile project manager needs to communicate the project vision to the employees and the clients, encourage change when feedback is received, involve the project team in discussions and decision making processes, and manage customer needs.

Moreover, communication requires writing, oral, and listening skills (Edum-Fotwe & McCaffer, 2000, p.114). From the findings, in the biotechnology sector, the written communication has the tendency to be very informal. Speaking is important for an agile project manager, but listening is the most important skill. An agile project manager needs to listen to the different stakeholders in order to understand what is needed. In the literature, El-Sabaa (2001, p.2) and Zielinski (2005, p.21) rank communications as one of the most essential behavioral competences. From the findings of the study, communication is considered as the second most essential competence, after creativity. Communication is needed for the effective and efficient completion of the project. The findings suggest that it allows agile project managers engaged in R&D projects to deal with change; be people oriented; be involved with the customer; keep communication informal; enable leadership and collaboration; engage with small and self-organized teams; and built and transfer tacit knowledge. In the biotechnology sector, the communication competence is considered essential for agile project managers, as the theoretical framework suggests. Hence, the study provides evidence that communication is an essential behavioral competence for agile project manager engaged in R&D projects in the biotechnology sector.

Thomas & Mengel (2008, p.308) state that the flexibility competence enables a project manager to work dynamically and respond rapidly in a changing environment to cope with change. The research findings show that R&D projects in the biotechnology sector work in a highly changing environment where a project can change directions several times in a short period of time due to the market requirements or R&D findings. Hence, flexibility is found
to be an essential behavioral competence in the biotechnology sector as it enables change in order to adapt resources and the project plan when needed. In addition, Fernandez & Fernandez (2010, p.15) suggest that flexibility gives an advantage to project managers in complex environments because it allows them to adjust constantly to emerging challenges. The research findings confirm that flexibility enables an agile project manager to be adaptable and open-minded to understand and cope with the complex requirements. Practitioners in the biotechnology sector state that in order to be flexible, an agile project manager must be open to his or her context, especially understanding the market and listening to the different stakeholders. Cheng et al. (2005, p.32) suggest that a project manager should remain flexible and adaptable to solve the problems in hand. The research findings suggest that one of the major problems faced by agile project managers in micro and small organization is working with limited resources. Hence, an agile project manager in this sector needs to find alternative to solve the problems in hand with limited resources (financial and people). However, the findings also suggest that an agile project manager needs some level of inflexibility in order to drive an idea to the end. At the end, an agile project manager cannot run into all directions and ideas. Belzer (2001) and Pant & Baroundi (2008) identify the flexibility competence as a missing link for successfully managing complex and innovative projects, such as R&D projects. The research findings suggest that biotechnology practitioners consider this competence as highly important because it allows an agile project manager to cope with the changing environment, work with iterative and adaptive lifecycles, enable flexible planning, involve customers, effectively work with small and self-organized teams, and build tacit knowledge. Biotechnology practitioners see flexibility as the third most essential competences when compared to creativity, communication, and leadership. The research findings show that the suggested characteristics enabled by flexibility are essential for delivering the APM principles in the biotechnology sector.

The leadership competence involves setting a direction through establishing a vision of the future, aligning people by communicating the vision, and motivating and engaging people to achieve the set goals and objectives (Edum-Fotwe & McCaffer, 2000, p. 114). The agile project manager who possesses a leadership competence can direct and influence the team towards achieving the vision of the project (Highsmith, 2004, p.58). The research findings show that leadership enables an agile project manager to set a direction through establishing a project vision and aligning the project team and other stakeholders to this vision. Also, the research findings shows that leadership enables an agile project manager to engage and motivate a project team to achieve the proposed goals. In addition, the findings suggest that practitioners in the biotechnology sector see leadership as an enabler to share confidence and trust to his or her team. Furthermore, Thomas & Mengel (2008, p. 308) demonstrate in their study that highly complex and uncertain environments call for the inclusion of leadership competence into project managers’ profiles. The research findings show that leadership is needed in R&D biotechnology projects due to their complex and uncertain environments. This competence allows an agile project manager to push the project forward and take the necessary strategic decision in a rapid changing environment. Literature states that a project manager should possess this competence throughout the whole project lifecycle (IPMA, 2006, p.86). However, the research findings suggest that in the biotechnology sector, leadership is needed more in the later stages of the project lifecycle where the project faces higher levels of complexity and uncertainty due to the high influence of the market and regulations. In addition, Fisher (2011, p.1000) claims that a project manager needs to adapt
his or her leadership style to specific situations. The research findings suggest that agile project managers should adapt their leadership style to be more of a facilitator for the project team in order to create an open dialogue and enable an integrative decision making process. The findings show that a command and control leadership style would not fit the situation where biotechnology R&D projects work. Studies presented by Cheng et al. (2005) and Stevenson & Starkweather (2010) claim that leadership is the most important and essential behavioral competence. However, the research findings suggest that in micro and small size biotechnology organizations, leadership is considered as the least important of the four behavioral competences presented due to the low number of team members. This finding does not state that leadership is not essential or important, but when compared to the other three identified behavioral competences, it is ranked as the fourth important. Practitioners in the biotechnology sector do acknowledge leadership as a top behavioral competence due to its significance on enabling an agile project manager to deal with change, be people oriented, facilitate customer involvement, develop collaboration, engage in small & self-organized teams, and built tacit knowledge. The research findings show that the suggested characteristics enabled by leadership are essential for delivering the APM principles in the biotechnology sector.

6.3. Revised Theoretical Framework

R&D biotechnology projects managed through APM principles aim to cope with the challenges presented by the sector. Through this research study, it can be seen that micro and small biotechnology organizations aim to deliver the two groups of APM principles: customer value through innovative products and leadership-collaboration management style. In order to deliver them, organizations follow certain APM characteristics. Organizations in the biotechnology sector use an adaptive lifecycle in order to cope with the rapid changes of the market. R&D projects in the biotechnology sector work in a rapid-changing environment, hence, micro and small organizations encourage the project management team to embrace and cope with changes. In order to adapt to changes, the R&D projects follow a flexible approach to planning, where requirements evolve throughout the project. In addition, organization in the biotechnology sector focus on their team members to ensure they have the right set of competences and capabilities to execute their work. These organizations require leaders who build a collaborative environment where the team’s perspective is involved for decisions. The agile project manager becomes a facilitator in the project team. This is important due to the small size of the teams, hence, the agile project manager needs to allow them to self-organize for achieving the best results. R&D biotechnology projects deal with innovative products and services which have not been developed before, thus, knowledge is tacit and needs to be developed throughout the project. Customer involvement is very important, however, it cannot be done in a daily basis due to the nature of the projects. Organizations involve the customers in a periodic basis and take the necessary legal steps (secrecy and development agreements) to get them involved. Finally, micro and small biotechnology organizations use an informal communication approach to simplify the process.

For enabling the APM characteristics presented above, an agile project manager requires certain behavioral competences, combined with the technical and contextual competences to deliver complex and uncertain projects. In consequence, this study has presented evidence
regarding four behavioral competences which have been considered important and essential in other industries. The research study suggests that creativity, communication, flexibility, and leadership are essential for agile project managers engaged in R&D projects in the biotechnology sector in order to enable APM characteristics and deliver APM principles. Therefore, this provides proof for revising the theoretical framework diagram in Figure 7. The theoretical framework diagram derived from the competences theory and the APM theory from the software development industry is also applicable in the biotechnology sector with a minor revision in one APM characteristic. In the biotechnology sector, customer involvement is done periodically and not daily.
7. Conclusion

This chapter will summarize the findings of the research that aim to answer the research question. The research objectives will be revisited in order to assess if the objectives of the study have been achieved. The contribution and significance of the thesis in the theoretical and practical context will be discussed. Also, potential societal and ethical implications derived from the findings will be presented. In addition, recommendations for practitioners and recommendations for further research will be suggested.

7.1. Summary of Findings

This thesis aimed to identify the essential behavioral competences needed for an agile project manager engaged in R&D projects in the Swedish biotechnology sector. The main research objective consists of four parts. The first part is to explore the appropriateness of agile project management for complex and innovative projects. R&D projects are highly uncertain, complex, and innovative that face frequent changes to project requirements. APM is a new approach that is more flexible for managing changes that originate from the turbulent environment in which the project operates. In the literature, APM has been identified as the best approach to manage R&D projects. Hence, the first part of the objective is achieved with an extensive literature review.

Moreover, the second part of the objective is to identify the behavioral competences of a project manager engaged in complex and innovative projects and the potential characteristics of agile project manager. In the literature, competences are categorized into technical, contextual, and behavioral competences. The behavioral competences that a project manager needs are identified. Also, in the APM literature, the characteristics that define an agile project manager are studied and identified, primarily in the software development industry. Therefore, it has been identified that the characteristics of an agile project manager match with four essential behavioral competences. In consequence, the essential behavioral competences that an agile project manager needs are flexibility, leadership, communication, and creativity. The second part of the research objective is achieved with an extensive literature review. The second part of the objective sets the base of a particular area of the theoretical framework in which the study aims to provide evidence on the essential behavioral competences of agile project managers in the biotechnology sector.

The third part of the research objective intends to explore the use of APM in R&D projects of the biotechnology. This part of the objective is achieved with a literature research on the biotechnology sector and the workplace culture in Sweden in order to identify the potential use of APM. In addition, it is confirmed by the derived research findings. The findings of the study show that project managers in the biotechnology sector use all APM principles and characteristics when managing R&D projects. An APM characteristic exception is the daily involvement of the customer. In the biotechnology sector, although customer involvement is considered highly important, the customer is involved only periodically.

The final part of the research objective aims to provide evidence on the identified essential behavioral competences that an agile project manager needs when managing R&D projects.
This part of the objective is achieved from the findings of the research derived from the empirical analysis of the collected data. The research findings provide evidence that: creativity, communication, flexibility, and leadership are essential behavioral competences for agile project managers engaged in R&D projects by enabling APM characteristics. All of the four parts of the research objective have been achieved; hence, completing the main research objective.

The main research objective aims to answer the research question. The posed research question for this thesis is as follows: *What are the essential behavioral competences for an agile project manager engaged in R&D projects in the Swedish biotechnology sector?* Based on the findings of the research study, it can be concluded that the research question is answered. After analyzing the empirical data, the findings show that the identified essential behavioral competences—creativity, communication, flexibility, and leadership—are important and needed for agile project managers when managing R&D projects in the biotechnology sector.

The empirical findings of the study consider the creativity competence as the most important in the biotechnology sector. Agile project managers need to be creative in order to find the best solutions. He or she needs to achieve great results with limited resources in the most effective and efficient way. Also, agile project managers need to possess creativity in order to develop products or services that are needed in the market at the right time, which will allow them to be ahead of other competitors. Additionally, practitioners highlighted that creativity is the most essential competence because it enables an agile project manager to adapt to iterative and adaptive life cycles, deal with change, develop flexible planning of requirements, use customer feedback, and create tacit knowledge.

Furthermore, the findings display the need for the communication competence for agile project managers as it involves the exchange of information between the parties involved in the project. The agile project manager should be able to effectively interact with the team members and the customer. Practitioners claim that communication allows an agile project manager to be people oriented, involve the project team, create an environment of mutual trust, build relationships with the different stakeholders, share the project vision with the involved stakeholders, encourage change, and transfer tacit knowledge. An agile project manager needs communication to engage with individuals from different fields of expertise and align them to reach a common goal.

The empirical findings indicate that agile project managers need to possess the flexibility competence in order to be able to cope and respond to changes coming from the fast-changing environment, where a project could basically change direction several times. The biotechnology practitioners consider the flexibility competence as highly important because it allows an agile project manager to cope with the changing environment, work with iterative and adaptive lifecycles, enable flexible planning, involve customers, effectively work with small & self-organized teams, and build tacit knowledge.

Finally, although leadership is seen as the fourth most essential competence of the four behavioral competences in the biotechnology sector, the results of the study show that agile project managers need to possess the leadership competence as it enables them to set a
direction through establishing a project vision, align the project team and other stakeholders to this vision, and engage and motivate the project team to achieve the proposed goals. Practitioners in the biotechnology sector acknowledge that leadership enables an agile project manager to deal with change, be people oriented, facilitate customer involvement, develop collaboration, engage in small & self-organized teams, and built tacit knowledge. Also, practitioners see leadership as the sum of the three other competences: creativity, flexibility and communication.

7.2. Theoretical and Practical Contribution

The current APM and behavioral competences literature provides relevant research studies in the IT and software development industry. Conforto et al. (2014) suggest that APM principles and characteristics can be used in other industries, other that the IT industry. In addition, Fernandez & Fernandez (2008) state the need to explore the APM principles and characteristics in other industries which face a turbulent environment. In the behavioral competences literature, Belzer (2001), Crawford & Nahmias (2010), Dainty et al. (2005), Edum-Fotwe & McCaffer (2000), El-Sabaa (2011), Kerzner (1987), Pant & Baroundi (2008), Thomas & Mengel (2008) and Stevenson & Starkweather (2010) suggest in their studies that leadership, creativity, flexibility, and communication are essential behavioral competences in complex and uncertain projects. The theoretical research contribution that this study provides is the evidence on the four essential behavioral competences needed for agile project managers managing R&D projects in the biotechnology sector in Sweden. Therefore, it provides evidence and contributes in three areas. First, the findings of the study provide evidence that leadership, creativity, flexibility, and communication are considered highly important competences in the biotechnology R&D projects. Second, it provides evidence on the importance of behavioral competences for enabling APM characteristics and principles. Third, it provides knowledge on the use of APM approach in other industries or sectors. In the literature, APM is mainly explored in the software development industry. Hence, it provides evidence that APM characteristics also apply to the biotechnology sector.

The practical research contribution of this study is the in-depth discussion provided about the biotechnology sector in the Umeå region. This study provides evidence on the project management approach used in five different organizations. Project managers, business coaches, and executives from these biotechnology organizations use a more flexible project management approach than the traditional one. The analysis of findings confirms that these practitioners use the characteristics of APM approach for managing R&D projects. Therefore and more specifically, the practical research contribution is the evidence provided on the use of APM approach for successfully managing R&D projects in the biotechnology sector in Umeå.

7.3. Societal and Ethical Implications

The societal and ethical implications can relate to the research process and the results or conclusions of the study. About the research process, the authors have considered the ethical principles of research and they have implemented several actions in order to respect those ethical principles. This is discussed in section 4.8. - Ethical considerations. Regarding the
results or conclusions of the study, the authors could not observe any societal or ethical implications. The topic of the thesis is not related to particular societal or ethical principles, therefore, the findings do not reveal any societal or ethical issues. The findings of this study display the essential behavioral competences needed for agile project managers when managing R&D projects in the biotechnology sector. In contrary to societal implications, the findings can only provide recommendations for practitioners managing R&D projects in the biotechnology sector.

7.4. Recommendations for Practitioners

The findings of the study show that behavioral competences are needed for project manager using APM approach when managing R&D projects in the biotechnology sector. Based on the findings and the suggestions of several experienced practitioners, the authors of this thesis provide recommendations for new practitioners in the biotechnology sector in Umeå. These recommendations are specifically for new practitioners in the Umeå region as the findings cannot be generalizable for other regions of Sweden or the world due to the transferability limitation. Although the findings cannot be generalized, new practitioners from other regions can consider these recommendations by understanding the differences between the regions. The new practitioners in the Umeå region are usually university researchers or professors that have a biotechnology project idea, who want to develop it – a product or a service – and sell it to potential clients. These practitioners are usually project leaders of their idea for the first time. Therefore, the authors of this thesis, provide the following recommendations:

- Develop the communication competence: Practitioners should listen to the feedback of different stakeholders involved in the project. Especially, listen to the input provided by the business coaches, if the project idea is developed in an incubator. Also, listen to the feedback from the potential clients. A successful project will be considered only the one that meets the markets’ needs.
- Develop the leadership competence: For new practitioners, it would be important to take a leadership training course. In this way, the practitioner, who most of the times has a strong scientific background, could be aware of the different leadership styles. In practice, a new practitioner should develop working relationships with the project team in order to create an environment of mutual trust. Engaging and motivating the team should be a goal for the practitioner.
- Develop the flexibility competence: For practitioners it is important to be open minded and accept new ideas from the different stakeholders. The practitioner should be market oriented, and not only product oriented. In this way, the practitioner would be more open to understand the market, and adapt the product or service to it.
- Develop the creativity competence: The practitioner should encourage his or her team to search for alternative solutions in order to reach the established goal through the most effective and efficient way.

7.5. Recommendations for Further Research

The theoretical framework of this thesis covers the APM and the competences theories. The APM theory is relatively new therefore other potential research gaps can be found. The focus
of this thesis is on the project manager who uses APM. The authors of this thesis chose to investigate the behavioral competences of agile project manager in R&D projects in the biotechnology sector. Therefore, one recommendation for further research is to investigate behavioral competences that an agile project manager needs in another type of project instead of R&D projects. Complementary, providing evidence on the behavioral competences that an agile project manager needs in other industries or sectors other than the biotechnology sector or software development industry. Another recommendation is to provide evidence on the essential technical and contextual competences needed for managing R&D projects in the biotechnology sector or in another industry. As previously mentioned, other characteristics of APM, for example: team size, team empowerment for decision making, co-located teams, team experience, customer involvement, PM life cycle, planning process, communication style, and others, can be a subject for further research. There needs to be provided evidence on the use of these characteristics of APM in other industries as well.
8. Truth Criteria

In order to evaluate a business research, three criteria need to be considered: reliability, replication, and validity (Bryman & Bell, 2011, p.41). Reliability is the extent to which the current raw data, data collection techniques, and other techniques will present similar findings if the study is executed by other researchers in another period of time (Saunders et al., 2009, p.600). Replication is the extent to which a research study can be replicated or repeated by other researchers. In order to achieve replication, a researcher must clearly express the procedures in detail that have driven him or her to the findings of the study (Bryman & Bell, 2001, p.41). Validity is considered as the most important criteria where the integrity of the conclusions of a study is assessed. Validity consists of measurement validity, internal validity (causality), external validity (generalizability), and ecological validity (Bryman & Bell, 2011, pp.42-43). However, these three criteria are more applicable to quantitative research studies (Mason, 1996, p.21). Lincoln & Guba (1985, p.219) present an alternative criteria for evaluating qualitative research. The alternative consists of two main criteria: trustworthiness and authenticity. Trustworthiness is formed by four additional criteria, which parallel to the quantitative criteria except for replication. The criteria are as follow: credibility, transferability, dependability, and conformability; which will be explored in the next four sub-sections.

8.1. Credibility / Internal Validity

Credibility assess the trustworthiness of the study by determining the feasibility of the research findings. Credibility is established by demonstrating that the research was carried out following best practices and by ensuring that the findings are in line with the reality of the studied social world. Credibility can be assessed through respondent validation and/or triangulation (Bryman & Bell, 2011, p.396). In this research study, credibility is addressed through a respondent validation technique. With the respondent validation technique, the interviewees receive the final findings to enable corroboration (Bryman & Bell, 2011, p.396). The interviewees are asked to provide feedback in order to assess the credibility of the findings. The biotechnology sector has not been an object of study for the APM research. The aim of this research study is to expand the APM literature in other industries other than the software development industry. Hence, there is not enough secondary data to do a triangulation of the findings of this study.

8.2. Transferability / External Validity

External validity is the extent to which a research study can be generalized (Bryman & Bell, 2011, p.43). This study cannot be generalized to other contexts because it is impossible to repeat the same social phenomena. Therefore, generalizability of the findings is a limitation for this thesis. However, a qualitative research study aims to intensively study the contextual uniqueness and significance of the object of study (Bryman & Bell, 2011, p.398). The aim of this research study is to achieve depth rather than breadth on behavioral competences for agile project managers in the biotechnology sector. The study will interview a relative small group of experts, eight individuals, in the Swedish R&D biotechnology context, which makes it hard to transfer the conclusions to other contexts. However, it is the researchers’ aim to
produce conclusions that can be used as reference for making judgments in other contexts. Lincoln & Guba (1985, p.316) has called this the “thick description” which addresses possible transferability of findings by providing rich and detailed accounts of information.

8.3. Dependability / Reliability

Dependability parallels to reliability which relates to whether the results of a study are repeatable. This is hard to achieve because a social setting cannot be isolated to study it. This can be addressed by adopting a similar social role, if other researchers want to repeat the study (Bryman & Bell, 2011, p.395).

8.4. Conformability

Conformability entails that the researchers act in good faith when doing the research study (Bryman & Bell, 2011, p.398). Although it is recognized by the authors of this study that complete objectivity cannot be achieved, the authors attempt to not let personal values and theoretical inclinations affect the process in order to achieve conformability of findings.

8.5. Authenticity

Authenticity addresses the political impact of the research study by considering the fairness of the study, the ontological authenticity, educative authenticity, catalyst authenticity, and tactical authenticity (Bryman & Bell, 2011, pp.398-399). In order to achieve fairness, a research study should consider different point of views among the individuals of the social setting under study (Bryman & Bell, 2011, p.398). The research study has considered business coaches, project managers, R&D managers, and senior executives to represent the viewpoints of the members of the biotechnology social setting. In order to achieve ontological authenticity, a research study should allow individuals to arrive to a better understanding of the social setting (Bryman & Bell, 2011, p.399). This is achieved through the exploration of R&D projects in the biotechnology sector in Umeå, and how behavioral competences enable project managers to deliver those projects. The findings elaborate on the characteristics of this specific social setting. Educative authenticity is achieved by allowing a better appreciation of the perspectives of members in other social settings (Bryman & Bell, 2011, p.399). This is achieved through establishing a theoretical framework based on research in other industries. The aim of the study was to explore this framework in a different social setting, the biotechnology sector. This research study presents evidence on how the theoretical framework is also presented in the biotechnology sector. Catalyst authenticity is achieved by the research acting as an incentive to change the social circumstances (Bryman & Bell, 2011, p.399). This research studies does not aim to change any social setting, however, the findings presents the importance of behavioral competences for project managers in the biotechnology sector. Therefore, individuals could use the findings to foster these competences for better project outcomes. Finally, tacit authenticity is achieved by providing the necessary steps to take action for change (Bryman & Bell, 2011, p.399). This research study presents the reasons on why the four identified competence are essential for a project manager, however, it is out of the scope of this research to presents the necessary steps to gain these competences.
9. References


Appendices
## Appendix 1: Interview Guide

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<th>Theme</th>
<th>Topic</th>
<th>Details</th>
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<td>Conclusion</td>
<td>Closing question</td>
<td>The essential competence mostly required (Rank the four competences)</td>
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## Appendix 2: Interview Details

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<td>Pia Keyser - Business coach</td>
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<td>Thomas Edlund - CEO</td>
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<td>3</td>
<td>Emil Byström - CEO</td>
<td>Nordic Chemquest</td>
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## Appendix 3: Template Format

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## Theme 4: Essential Behavioral Competences

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