

THE IMPORTANCE OF ITERATION LENGTHS IN AGILE SOFTWARE DEVELOPMENT METHODS:

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university. I further declare that this research has been carried out in full compliance with the ethical research requirements of the School of Computer Science and Statistics

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Abstract

Traditional, monolithic waterfall methodologies for developing software have given way to different types of Incremental and Iterative development over the last twenty years. The reasons for this have been cited as reduction of risk, better management of evolving user requirements, greater interaction and involvement of users and the ability to develop and deliver software functionality quicker. A group of these methods are classed under “Agile software development”. These methods place emphasis on delivering many, small chunks of software increments through collaboration, cross-functional and self-organising teams, in fixed time intervals usually known as iterations. Organisations that have embraced agile development, have either adopted one of the existing methods, or selected various features or aspects from across existing methods, to create their own agile method suitable to their nature.

One of the salient features in almost all agile methods is the duration, or length of the iteration. As of today, there has been no comprehensive study or research into the various factors that impact the choice of the iteration length for a software development project. Literature does exist around Incremental / Iterative development, Agile methodologies and also on iteration lengths. But there is no single piece of literature that has consolidated all possible factors that influence the choice or determination of the iteration length. This research contends that it is not only important to understand what factors influence the choice of iteration lengths, but also to understand how each of these factors impacts the choice.

In this paper, an attempt is made to gather and explore all possible factors that influence the choice of the iteration length; these factors are organised and classified based on how they impact the choice of the iteration length.

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1 Introduction

1.1 Background

1.1.1 Scope of Research

This research examines the importance of the iteration length within the context of agile software development. The research is based on the gathering of relevant primary and secondary data, and compiling them to answer the following key questions:

- What are the main factors that influence the choice of iteration lengths in agile methods used for software development projects?
- How do these factors influence the choice of iteration lengths?
- Is the iteration length a crucial factor in agile methods?

1.1.2 Relevance and Importance of the Research

Many IT teams across many organisations worldwide are using agile methodologies to develop and deliver software. Currently, there is neither a globally accepted standard iteration length that can be applied to any agile team for any agile software development project or endeavour, nor is there a widely accepted objective procedure to determine what would be the right iteration length for a particular project. Agile software development methodologies have been adapted and are in use in different organisations in many standard and non-standard ways, and it has not been determined if in the current state of practice, the iteration length, as an aspect of agile development, is being most efficiently and beneficially used to deliver software to customers. In order to be able to do this, it is important first, to study all the factors that impact the determination of the iteration length and how each factor impacts this choice.

Research into existing literature in this area, will help to understand what material already exists in relation to factors impacting the iteration lengths. Also, research into the current state of practice of how iteration lengths are currently being determined and used, will help to understand what the perception is in the community of agile practitioners about the use and choice of iteration lengths.

2 Literature Review

2.1 Introduction

This chapter presents a critical review of the available literature that is relevant to the topic of this research. It briefly touches upon Incremental and Iterative development (IID), then focussing in on Agile Software Development Methods in particular, as a group of IID methods, their main principles and their various important aspects. But the main focus of this literature review is the aspect relevant to this dissertation – the iteration length within Agile methods.

A substantial amount of literature has been found in the area of Incremental and Iterative development and in the area of Agile Software Development. But there is relatively less literature in the specific area of the Iteration length. This section has three sub sections, covering these areas.

2.2 What is iterative and incremental development?

2.2.1 The Iteration

Berente et al. (2005) assert that an iteration itself is an inherent aspect to “systems analysis and design methodologies and practices”. Iterations exist both in traditional and the new “iterative” methodologies; therefore the difference between the traditional methodologies and the iterative methodologies shouldn’t lie simply in the presence of iterations.

In their research, Berente et al. (2005) endeavour to define an iteration accurately within the context of systems design and software development. They contend that within this context, an iteration means much more than “mere repetition”. The word rather “implies an objective and the progression towards that objective” (Berente et al., 2005).

The authors examine advantages of the iterative approach such as:

- The advantage of a trial and error approach to learning and arriving at a final product)
- Quicker development
- Realistic validation of user requirements

They also examine empirical impacts such as:

- Supporting mutual learning between users and developers
- Improving user related outcomes

- Improving design process, etc.

They analyse and discuss the defining and differentiating aspect of “iterative methods” as compared to traditional methods and conclude that the anticipation of the need for, and proactively seeking, new information is the key difference. This happens by way of “earlier visibility of iterations” to users, thereby relinquishing the control of the development process to a certain extent to the user, very early. This process exposes many assumptions implicit in the design by making a visible product that can be demonstrated or experienced. The authors assert, that an iteration is a multi-dimensional concept within the context of software development and the specific activities that “iterations enable or constrain”, determine the improved outcome.

(Berente et al., 2005).

2.2.2 On the strategy of using increments and iterations

Aydin et al. (2004) researched on how agile methods are adapted in practice, using a case study of an IT department in one of the leading financial institutions in Europe. This department had chosen Dynamic Systems Development (DSDM) as an agile method for all their projects. The authors focussed on the incremental-iterative development strategy and listed five variants that could possibly be adapted:

- The linear DSDM: One increment without iteration
- The one-pass DSDM: One increment with several iterations
- The hybrid DSDM: Many increments, with zero or more iterations
- The Full DSDM: Many increments with many iterations
- The Phased DSDM: Many increments without iterations

(Aydin et al., 2004)

Following the study, the authors conclude that the hybrid development strategy is most appropriate and flexible. The authors say that “having iterations means that some stages and corresponding activities need to be repeated through incorporating continuous feedback from the user” (Aydin et al., 2004); this implies that the length and frequency of the iterations determine the nature and intensity of the feedback from the user.

2.2.3 *Iterative and Incremental development and their advantages*

The primary emphasis in iterative and incremental development is the breaking down of a software system into its constituent parts, each being demonstrable independently to the user to elicit feedback and gaining certain advantages from this increased interaction.

Dalcher et al. (2003) say that “Incremental approaches encompass various ways of producing a sequence of parts of a system, while iterative approaches involve a diversity of ways of producing parts of a system trying them out, and feeding them back user experience to the production of new or revised parts.....incremental delivery is inherently iterative, in that user feedback is used in producing later parts.”

Osorio et al. (2011) say that moving from waterfall to iterative development methodology has advantages. Their paper focussed on Rational Unified Process, which is a type of Iterative development method.

The advantages are – there is a positive impact on project execution control as it provides a smaller control unit; risks are addressed in early iterations, thereby increasing predictability of project execution; value can be delivered earlier and more frequently; the increased customer feedback helps the development team to match the customer expectations better.

It has been acknowledged that the use of Iterative and Incremental development methodologies to produce software has become popular in the recent years.

A paper by Oddur et al. (2004), introduced “a quantitative analytical framework for modelling effort-boxed development in order to uncover....the potential leverage that can be derived from incremental delivery in....projects” (Oddur et al. 2004).

In this, they cite many instances of “IS development failures and their adverse impacts...In 1991, 31.1% of the US software projects were cancelled, while 52.7% were completed late, over budget (cost 189% of their original budget), and lacked essential functionality. Only 16.2% of projects completed on time and within budget...” (Oddur et al., 2004).

They maintain that Iterative and incremental development solve these problems:

“Incremental and iterative development approaches have long been recognised as effective in reducing the risk of failure in such situations as they entail a more controlled approach to development....The approach is underpinned by the assumption that it is possible to isolate meaningful subsets that can be developed, tested and implemented independently...The staggered release philosophy allows for learning and feedback to

alter some of the customer requirements in subsequent versions. Incremental approaches are particularly useful when there is an inability to fully specify the required product or to fully formulate the set of expectations under some budgetary control” (Oddur et al., 2004).

2.2.4 Disadvantages of Iterative and Incremental development

Osorio et al. (2011) say that moving from waterfall to iterative development methodology has certain disadvantages: dealing with frequent feedback from the customer can be seen as an overhead in project management and execution; the method cannot be used “off the shelf” – it needs to be customized for the organisation’s environment. This customizing is complex and expensive (Osorio et al., 2011).

2.3 Agile Software Development methods

2.3.1 Agile methods and their advantages

Many new software development methods were created and improved upon as a reaction to disadvantages found in traditional methods. These methods are commonly placed under the umbrella of “Agile methods” (Cohen et al., 2004).

Most of these Agile methods incorporate Iterative and Incremental Development (IID) methods and share a single philosophy, summarised in the Agile Manifesto.

The authors of the Agile Manifesto were “sympathetic to the need for an alternative to documentation driven, heavyweight software development processes” (Highsmith, 2001). “Deliver quickly. Change quickly. Change often” (Highsmith et. al. 2000), is the essence of being Agile.

The Agile Manifesto, created in February 2001 (Beck et al., 2001) emphasises that the creators of the manifesto “...value:

- Individuals and interaction is to be valued over process and tools,
- Working software over comprehensive documentation,
- Customer collaboration over contract negotiation,
- Responding to change over following a plan

That is, while there is a value in the items on the right, we value the items on the left more.” (Beck et al., 2001)

Therefore, the difference between Agile methods and Traditional methods is in the emphasis of the above new values in software development.

2.3.2 *Disadvantages and challenges of Agile methods*

Duechting et al. (2007), researched on the extent of the inclusion of Usability Engineering in agile methods to ensure that software products created are highly usable. They studied Scrum and Extreme Programming (XP) and concluded that both methods are deficient in handling “User-Centred” requirements. This deficiency is attributed to the exploration phases in both methods before the start of development iterations, which are short and usually do not exceed the span of a single iteration; it is also attributed to the vague definition of the customer role in these methods that could lead to the real end users not participating in the team (Duechting et al. 2007). Since these features are common across most agile methods, it is possible that unless the methods are tailored or modified to cover these deficiencies, they can turn up as an issue upon using agile methods.

Coram et al. (2005) discuss the impact of agile methods on software project management and identify three areas of impact: People, Process and Project. They conclude that

“Agile Methods are not appropriate for all projects. A project manager must consider the characteristics of the project to ensure that an Agile Method is appropriate. The impact on the people, the process, and the project must all be considered. For example, if a team of largely junior members is applied to a project that has very well understood requirements, and a mature software process is already in place in the organizations, there are three characteristics that argue against applying Agile Methods as a whole.” (Coram et al 2005)

Lindvall et al. (2002) gathered substantial empirical experience of the usage of agile methods. Some of the lessons gained are as follows:

- The bigger the size of the team, the more difficult it is to implement agile methods.
- General development experience is more important than experience in Agile methods
- Safety-critical projects can be conducted using Agile methods provided the key performance requirements are made explicitly clear early and proper levels of testing are planned.
- Three most important success factors for Agile methods are culture, competent people and strong communication

...Lindvall et al. (2002)

2.4 Iteration length – an important aspect of Agile methods

Most Agile methods incorporate an incremental / iterative development process, where a working, usable feature is released for the users at the end of each iteration or increment.

This individual segment within a development project is crucial as it determines the size and the nature of the features being developed, the tightness of schedule, and the visibility of the process to the end user.

The existing literature clearly shows that Agile software development methods are steadily gaining more importance. Also, the iteration length is shown to be an important controlling aspect in most Agile software development methods. The focus of this paper is the iteration length and the factors that control the choice and determination of the iteration length.

In order to provide a proper context and framework to this research, a detailed review of the existing literature was examined, for any references to, or in depth studies revolving around, iteration lengths. The same has been presented below.

It was found at the time of this exercise that though substantial material exists in the area of Iterative and Incremental development, iterations and Agile methods, there has been relatively less written to date specifically on the iteration length.

Most papers examined, hint at the importance of iteration lengths, and only one paper has a detailed study on the iteration length. Therefore, though not all sub-sections below deal with papers explicitly concerned with the iteration length, they are nevertheless mentioned as they came under the radar of the investigation done:

2.4.1 Granularity, visibility, control and the iteration length

Berente et al. (2005), in their research on iterations in systems analysis and design, recommend that “Rather than asking whether an organization should adopt iterative development, it is more salient for organizations to ask what level of granularity, visibility, and control over iteration are appropriate at different times and for different purposes of the design”.

It can be concluded from the above that the granularity, visibility and control over the iteration are all chiefly governed by the length of the iteration, as the duration of time determines the trade-off between the levels of control, the visibility to users, and the granularity of specification of requirements. Therefore, it can be said that deciding on an appropriate iteration length is an important task for an organisation embarking on using an agile approach.

2.4.2 *Iteration lengths recommended by common Agile methods*

Cohen et al. (2004) list the common Agile methods and their respective recommended iteration lengths:

- Extreme Programming (XP): Two weeks
- Scrum: Four weeks
- Crystal Methods: Up to four months
- Feature Driven Development: Up to two weeks
- Lean Development: Not directly addressed
- Dynamic Systems Development Method: Not directly addressed

2.4.3 *Literature found on selecting the right iteration lengths and the factors that impact this decision*

Fowler (2003) says in his paper on using Agile for Offshore development that the iteration length would need to be a minimum of two weeks due to communication overheads. This suggests that geographical distribution of teams using agile methods would impact the iteration length.

Paasivaara (2005 pp 80-173) refers to the collaboration process needed to be used in inter-organisational software product development. She says that when multiple organisations or subcontractors are working to deliver a software product, synchronization of the main milestones is important irrespective of whether a single development process is being used or not. Nevertheless, if they are using iterative processes, then it would be preferable if the length of the iterations is similar.

Buslovič et al. (2012) considered drivers towards adoption of Agile methods and drivers to move towards greater outsourcing of software development. They observe that there are contradictions between the two trends. For example, the agile values of greater emphasis on individuals and interactions over processes and tools, customer collaboration over contract negotiation and responding to change over following a plan, seem to be at odds with the need for comprehensive contracts, the limitation of physical distance that can prevent frequent interaction with the customer and limit the ability to conduct stand-up meetings, etc. (Buslovič et al. 2012)

This suggests in general, that implementation of aspects of agile processes can face limitations due to the very nature of outsourcing. The choice of iteration lengths, being one of the aspects, can also therefore be limited due to the level of outsourcing.

Shalloway (2011) says in an article about the rationale for a maximum iteration length of not more than 30 days for Scrum, that the reasons for this are that it:

- Facilitates quick feedback
- Provides an enforced view of reality (End of iteration visibility where it can be objectively determined, what worked, what didn't and progress and failures can be measured)
- Removes delays

Brodwall (2013), in an article "What is The Right Iteration Length?" says there are two main opposing forces that need to be balanced in deciding on the right iteration length:

- Opportunities to learn and improve are directly proportional to the number of iterations, which means shorter iterations provide more opportunities in the same period of time
- Every iteration has overheads of iteration reviews, retrospectives and planning, which means these overheads will dominate shorter iterations

The right iteration length can be arrived at by balancing the two forces

(Brodwall 2013)

Keith (2008) suggests the following factors are to be considered in determining the right iteration length:

- Customer feedback
- Experience of the team
- The overheads of reviews and planning
- Ability to plan the iteration
 - This is directly dependent on the uncertainty of requirements
- Balanced intensity
 - This relates to maturity of the team and the ability of the team to pick a balance between too long and too short iterations

Cohn (2006), one of the founders of the Scrum Alliance has written an article "Selecting the Right Iteration Length", where he includes the following factors, among others, that should be considered to select an iteration length:

- Overall Length of the release
- Amount of uncertainty in:
 - Customer or user needs

- Ability of the team
- Technical aspects of the project
- Stability of priorities
- The overhead of iterating

Berczuk (2007) performed a case study of a team in a paper on the role of agile principles in success with a distributed Scrum team. He observes that the team started with the default iteration length of four weeks. But to respond better to frequent customer requests during the sprint, the Scrum Master negotiated with the product owners to reduce the iteration length. The team as a result decided to change the sprint length to two weeks. This suggests that the frequency of feedback required to customers could dictate the iteration length

Waters (2007) Digital Technology Director at Guardian News and Media and award winning blogger says....“A team with immature processes will find the intensity of Scrum and the overhead of Sprint Planning, Testing, Deployment and Review quite onerous for a short Sprint cycle. Whereas teams with very mature processes (for example automated testing, automated deployment, and teams who’ve become very quick at Sprint Planning), a short cycle might be very comfortable.”... (Waters 2007).

Waters suggests that having automated development processes can be a factor impacting iteration lengths.

2.4.4 On estimation of the appropriate iteration length in agile development by simulation

Shiohama et. al. (2012) published a research paper, on determining the appropriate iteration length, which was the only paper that was examined within the scope of this literature review that dealt with iteration length in great detail.

In this paper, the authors propose a new methodology to estimate an appropriate iteration length by conducting a simulation based on project constraints. They also investigate the relationship between the iteration length and project constraints.

The authors performed two case studies with the following results:

Case study 1 results indicated the following:

- When the complexity of a project is higher, smaller, frequent iterations reduce the progress.

- Small scope within a single iteration reduces productivity in high a complexity project.
- There exists an optimal length of iteration that results in the lowest cost

Case study 2 results indicated the following:

- Progress is constant for a certain band of iteration lengths and then dips on either side (either too small or too large).
- Cost tends to linearly decrease with increase in iteration length.
- Therefore the use of the highest iteration length without compromising on progress leads to most optimum one selected for project
- Progress per cost reflects the previous points, where in, the metric steadily increases as the iteration length is increased, until the point where the iteration length is long enough to have only two iterations in the project, at which point it begins to dip.

The authors also studied the relationship between the project constraints and iteration length. For this, they chose two specific constraints – Variety and Complexity. The other parameters were fixed as:

- Development term: 60 days
- Developers: 0.25, 1, 1, 1, 2.5 (five people)
- Number of requirements: 30

The authors' observations were as follows:

A. Focusing on Variety independent of Complexity:

A higher variety tends to decrease the optimum iteration length and a lower variety tends to increase the optimum iteration length. This could be due to the increased cost of frequently changing requirements for higher iteration lengths

B. Focusing on Complexity independent of Variety:

A higher complexity tends to increase the iteration length. A shorter iteration length reduces the scope and in the case of complex projects, the relationships between requirements are high, leading increase of integration cost.

The authors' endeavour in this paper has been a very good attempt to quantitatively measure the effectiveness of the iteration length in an Agile software development effort, and also to measure the relationship of the iteration length to other constraints of a project / development effort.

2.5 Conclusive remarks on the Literature Review

2.5.1 Remarks on the literature reviewed

It can be seen from the above literature review that some material has been produced both within academia and in popular literature revolving around the iteration length.

The academic material is seen to cover the relationship between the iteration length and the level of granularity, visibility and control required, recommended iteration lengths as per the founders and proponents of the popular agile methods in use today, and the factors that impact the choice of the iteration length. One paper is seen to have done an in depth simulation to determine the factors to be considered to choose the optimum iteration length. This paper lists such factors as complexity of the system (high dependences between requirements) and variety – the probability that requirements will change (or degree of uncertainty of requirements).

Popular literature has also seen proponents writing articles on what they believe are factors impacting the choice of the iteration lengths and how to go about selecting the right iteration length. The various factors suggested are: the frequency of feedback required for customers, the overall length of the release or duration of the project, overheads of the iteration, the geographical distribution of the team, the dependency on outsourcing of the software development and technical complexity of the IT application / ecosystem.

However, the existing literature does not reflect what is actually being done in practice. How are agile teams in reality choosing iteration lengths? What, according to the community of agile practitioners, are the factors impacting iteration lengths, in their experience? What would the opinion around iteration lengths be from agile practitioners with varying degree of experience, or with different agile methods experience?

2.5.2 Conceptual framework for the research based on the literature reviewed

This research focusses on finding out what the community of agile practitioners are doing in relation to choosing iteration lengths. Specifically, it focusses on the factors that impact the iteration length, and whether they limit, or increase flexibility in the choice of iteration lengths. The intention of this research is to gather the opinions and thoughts of the community of agile practitioners on the above, and compare this with what has been written in the existing literature.

Agile methods are used to develop and deliver software, within the context of a project. The key aspect of a software development project is the team delivering the project.

Therefore the research intends to gather relevant information from the agile community, within the context of an agile software development project.

To provide a clear focus to this research, an exhaustive list of factors has been selected, which are believed to impact the choice of iteration lengths. Most of these have been picked up from the existing literature mentioned above, and some of them have been added by the researcher based on his own experience and understanding of software development. The factors are as follows:

Factors mentioned in the existing literature:

- Size of the project team:
- Technical capability of the team
- Experience in agile methods
- Geographical distribution of the team
- Degree of uncertainty of user requirements
- Complexity of the IT application / ecosystem
- Dependency on outsourcing for software development
- Duration of the overall project
- Iteration overheads such as planning, reviews and retrospectives
- Frequency of customer feedback required
- Presence or absence of automated building, testing and deployment of software

The researcher believes that all the above factors can either limit or provide greater flexibility in the choice of iteration lengths, depending on which direction these factors move in their respective scales.

For example, a smaller project team should necessarily compel the team to increase the iteration length, to accomplish the same tasks. But a larger team has the flexibility to either retain the current iteration length or choose a smaller iteration length.

Similarly if the degree of uncertainty of user requirements increases, the team would be forced to shorten the iteration lengths so that smaller features are worked on and feedback is received more frequently, changes in requirements are handled with greater dexterity and there is a lower probability of these changes interrupting an iteration. On the other hand, a decrease in the uncertainty of requirements doesn't necessarily force the team to lengthen the iteration, but provides the flexibility to do so.

Similar arguments have been used for each of the factors listed above.

Factors included based on the researcher's own understanding:

- Use of fourth generation languages:
 - Researcher's reasons: It is understood that fourth generation languages allow for much quicker development of software and therefore cause the iteration length to be shorter. The researcher has included this factor to find out what agile practitioners think is the impact of the use of 4GLs.
- Use of project management tools
 - Researcher's reasons: Project management tools exist for Agile methods, which can be expected to aid in carrying out agile development and therefore impact the iteration length. The researcher has included this factor to find out if the use of these tools directly impacts the iteration length according to the agile community.
- Sharing of team resources amongst multiple projects
 - Researcher's reasons: The researcher believes that a team might be forced to increase the iteration length to stagger its releases with the releases of other teams using the some of the same developers. The researcher has included this factor to find out what the agile community think about the impact of this factor.

It is the intention of the researcher in this paper, to postulate certain hypotheses and find out if they can be conclusively verified by the combination of information collected from existing literature and that gathered from the agile community. The hypotheses seek to answer the following questions:

1. What are the main factors that influence the choice of iteration lengths in agile methods used for software development projects?
2. How do these factors influence the choice of iteration lengths?
3. Is the iteration length a crucial factor in agile methods?

The following hypotheses have been written, to be used as the basis for interpretation of the results, corresponding to the above questions:

1. There are certain key factors that influence the choice of a particular iteration length in software development projects delivered using agile methods as listed below:
 - Size of the agile project team:
 - Technical capability of the team
 - Experience in agile methods

- Geographical distribution of the team
 - Degree of uncertainty of user requirements
 - Complexity of the IT application / ecosystem
 - Dependency on outsourcing for software development
 - Duration of the overall project
 - Iteration overheads such as planning, reviews and retrospectives
 - Frequency of customer feedback required
 - Presence or absence of automated building, testing and deployment of software
 - Use of fourth generation languages:
 - Use of project management tools
 - Sharing of team resources amongst multiple projects
2. These factors tend to either reduce or increase the flexibility in the choice of iteration lengths depending on their increase or decrease, or presence or absence.
 3. The iteration length is a crucial factor in the use of agile methods

The approach to the research will be a deductive approach, but with an interpretivist philosophy. Further details about the philosophy, approach, strategy, choice of methods, etc., are explained in detail in the next chapter. The guidelines for this elaboration have been taken from Saunders et al (2009), who have recommended a layered approach to research.

3 Methodology and Fieldwork

3.1 Introduction

This chapter highlights the methodology that has been chosen to conduct the necessary research for this dissertation. It explains the underlying philosophical basis for adopting this methodology. It also touches upon other methodologies and why this one was chosen over the others.

3.2 Research Methodologies

3.2.1 *Philosophies:*

According to Saunders et al. (2009:109), there are three major ways of thinking about research philosophy.

Ontology: This is to do with the researcher's perspective of the way in which the world works. There are two philosophical positions that can be identified from an ontological point of view. Objectivism is the belief is that social entities exist in reality outside of and independent of social actors. Subjectivism is the belief is that social entities are formed from perceptions and consequent actions of social actors and their existence and structure is therefore relative to the social actors.

Epistemology: This is to do with what is considered to be acceptable knowledge in a field of study. There are three philosophical positions that can be identified from the epistemological point of view. Positivism is the belief that knowledge is gathered by observations of external phenomena, rather than intuitive or introspective sources, leading to objective laws or generalisations. Realism is the belief that objects do exist independent of our knowledge of their existence through our mind. Interpretivism is the belief that knowledge is subject to interpretations and viewpoints of individual social actors.

Axiology: This is to do with the crucial role played by the values of the researcher itself, and the importance of being aware of the impact of these values on the research.

According to Orlikowski and Baroudi (pp. 4-5, 1991), there are three categories of underlying philosophical assumptions: Positivist, Interpretive and Critical. Of these, it was found through a study of 155 papers published across prominent IS journals, that 96.8% of them used Positivism as their epistemology.

But, by 1995, it was seen that increasingly in IS journals, publications that use interpretivism have been allowed (Walsham, 1995).

3.2.2 *The Pragmatic philosophy:*

In spite of the opposing positions of the various philosophies discussed above, it has been seen very often, that any one of the individual stances may not be sufficient to address the research question completely.

Pragmatism is the belief that the choice of epistemology, ontology and axiology adopted depend mainly on the research question itself and no one position can be argued to be the best.

Tashakkori and Teddlie (1998) say that it would be better for a researcher to view the adopted philosophy as a continuum between opposing epistemologies, rather than restrict to one particular epistemology. They contend that pragmatism is intuitively appealing, as it bypasses the need for debating over concepts of truth and reality, which they believe, are pointless. They placed emphasis on the researcher's choice of study, choice of methods and choice of using results to bring about positive consequences within the researcher's value system (Tashakkori and Teddlie 1998).

3.2.3 *Research Approaches:*

The approach and design of a research is highly dependent on the position of theory within the context of the research (Saunders et al., 2009). Based on whether the research begins with a fully formed theory, or whether a theory is formed as a result of the research, there are two approaches:

Deductive approach is where the theory is developed up front, and then tested by the research. The main emphasis is on:

- Scientific principles
- Moving from theory to data
- Causality
- Collection of quantitative data
- Structured approach
- Researcher independence

Inductive approach is where the data is collected, analysed and based on the results of the analysis, the theory is developed. The main emphasis is on:

- Gaining an understanding of the meaning humans attach to events
- Close understanding of the research context
- Collection of qualitative data

- Impact of the researcher as part of the research process
- Flexible structure

Once again, there is scope to combine the above approaches, and is also considered advantageous (Saunders et al., 2009:127). A research could be primarily deductive, with a few aspects of inductive research included due to their relevance. For example, the research could strive to be highly researcher independent, gather quantitative data and analyse to crystallize and generalise concepts, but also include an acknowledgement of the human interpretations, the researcher's personal values and their impact on the research.

3.2.4 *Research Strategies:*

The strategy to be adopted for a research depends very much on the research question, the way it has been structured and posed (Saunders et al., 2009). Also, the epistemological and ontological considerations will influence the specific quantitative and qualitative strategies selected (Bryman, 2004).

According to Robson (2002), the different types of research studies could be classified as:

Exploratory:

- To find out what is happening, particularly in little-understood situations
- To seek new insights
- To ask questions
- To assess phenomena in a new light
- To generate ideas and hypotheses for future research
- Almost exclusively of flexible design

Descriptive:

- To portray an accurate profile of persons, events or situations
- Request extensive previous knowledge of the situation etc. to be researched or described, so that you know appropriate aspects on which to gather information
- May be of flexible and/or fixed design

Explanatory:

- Seeks an explanation of a situation or problem, traditionally but not necessarily in the form of causal relationships
- To explain patterns relating to the phenomenon being researched

- To identify relationships between aspects of the phenomenon
- May be of flexible and/or fixed design

Emancipatory:

- To create opportunities and the will to engage in social action
- Almost exclusively of flexible design

(Robson 2002)

Within these different types of studies, there are various strategies that can be used to conduct the research. Galliers (1991), has listed fourteen, Alavi and Carlson (1992) have a hierarchical taxonomy of three levels and eighteen categories.

The following strategies are some of the more commonly used:

- Experiments – The main purpose is to study causal links (Hakim, 2000)
- Surveys – Allow for a collection of a large amount of data in an economical way (Saunders et al., 2009)
- Case Studies – Empirical investigation of a particular phenomenon within its real life context using multiple sources of evidence (Robson, 2002)
- Action research – Coghlan and Brannick (2005) outline four broad characteristics:
 - Research in action rather than research about action
 - Active involvement of members in the situation of concern
 - Action and knowledge are joined (change with knowledge generation)
 - Sequence of events leading to a solution or objective
- Grounded theory – Emphasis on developing and building theory to predict and explain behaviour (Goulding, 2002)

3.2.5 *Data collection methods:*

Data or information collected can be classified as primary or secondary data (Saunders et al., 2009:256). Primary data is new data collected specifically for the purpose of the research whereas secondary data is existing data already previously collected and re-used for possible re-analysis.

Data collection methods can be mainly divided into two types:

Quantitative: Collection, generation and / or analysis of numeric data.

Qualitative: Generation or use of non-numeric data

Many researchers recommend combining quantitative and qualitative methods, in order to gather data in a holistic manner, as the data do not exist in isolation from one another. Tashakkori and Teddlie (2003) use the generic term research design that encompasses both methods and thereby prevent compartmentalising them.

Curran and Blackburn (2001) say that there is an increasing advocacy towards the use of both quantitative and qualitative techniques and also the use of primary and secondary data.

3.2.6 Time Horizons:

Typically, research can be of two types.

Research can be cross-sectional, which takes place over a short span of time and considers the phenomenon at a particular instance or period in time (snapshot perspective).

Research can be longitudinal, which takes place over a considerable period of time and the phenomenon, and any change to it, is considered over this period of time (diary perspective)

3.3 Research Methodology used for this research

3.3.1 Researcher's view (Ontology):

The researcher of this dissertation believes that all observable phenomena are overarched by the human ability and limitation of perception. Yet, within this limitation, there are phenomena that can be studied as being completely external and independent of social actors and independent of interpretations; there are also phenomena that can be explained differently based on interpretations influenced by social conditioning; thirdly, there are phenomena that are impacted by the observer of the phenomena. Answering a research question needs to take all of this into consideration.

3.3.2 Knowledge source (Epistemology):

In spite of the dominance of positivism till recently (Orlikowski and Baroudi, pp. 4-5, 1991), because the question of the importance of the iteration length in Agile methods, involves capturing data relating to human factors, such as their subject matter experience, their background, their personal views, etc., it involves a certain degree of interpretation of their perception, and their points of view. Consequently, there is a need to consider an interpretivist philosophy in conducting this research.

Nevertheless this research also needs to be unbiased and objective and the information gathered should be measurable; thus the conclusions sit on a foundation of quantifiable parameters; impacts can be linked to changes in parameters and measured.

Therefore, in this research, a pragmatic approach has been adopted, respecting the relevance of all different paradigms.

The decision to use a survey is very objective, and the survey questions are designed to return unambiguous and measurable responses as much as is possible. But there are some questions that would need responses based on personal experience. Also, even the quantifiable data gathered from the questions, would need to be interpreted within the context of the participant's subjective view point.

3.3.3 Approach:

Since an interpretivist philosophy is being considered in this research, the approach being taken is to find the answers to three main questions. These questions are directed towards the community of agile practitioners, defined as the set of individuals that includes programmers, project managers, programme managers, QA engineers, business analysts and other such individuals and members of a team who uses agile methods to execute and deliver software development projects:

4. What are the main factors that influence the choice of iteration lengths in agile methods used for software development projects?
5. How do these factors influence the choice of iteration lengths?
6. Is the iteration length a crucial factor in agile methods?

In any case, the following hypotheses have been written, to be used as the basis for interpretation of the results, corresponding to the above questions:

4. There are certain key factors that influence the choice of a particular iteration length in software development projects delivered using agile methods.
5. Some of the factors tend to reduce the flexibility while others tend to increase the flexibility in the choice of iteration lengths.
6. The iteration length is a crucial factor in the use of agile methods

It is considered possible that the responses could be subject to the research participants' experience in and understanding of agile methods. Therefore, even though hypotheses have been written down for this research, it is considered that a generalisation might not necessarily be arrived at. Rather, it is hoped that since the survey is targeted at the

community of professionals who practice agile methods, not only might the above questions be answered, but some new insights might also be derived.

The approach is therefore a deductive approach, where certain assumptions have been made and these have been tested.

3.3.4 Data collection:

Following from the above choices of ontology, epistemology and approach, an appropriate method of data collection is arrived at.

Guba and Lincoln (1994) note that:

“Both qualitative and quantitative methods may be appropriately used with any research paradigm. Questions of method are secondary to questions of paradigm....”

Focus has been shifting towards mixed methods of research (Chen and Hirschheim, 2004) even though positivism is still the prominent methodology in IS.

Computer studies have quantitative approach as their most prevalent methodologies (Kaplan & Duchon p.573, 1988). Close ended survey questions yield limited answers to allow for collecting, deducing and comparing quantitative information and thereby test existing theories or practices.

Open ended survey questions, requesting comments, explanations, etc. allow for extraction of information that aids in understanding the meaning and context of the phenomena and the contributing events and processes (Kaplan & Maxwell p.31, 1994).

This research employs a survey that has a balanced mix of both quantitative and qualitative data collection questions. This facilitates challenging or fortifying current assumptions of iteration lengths (quantitative) and also to generate new conclusions of the framework and context within which decisions are made on the iteration length, including the positing of exceptional cases (qualitative).

3.3.5 Research Strategy

The primary source of data for the research will be derived from the experience and knowledge of IT professionals who have worked in Agile environments and / or used Agile methodologies. It is intended that information from individual IT professionals and communities of IT professionals be gathered, collated and analysed to generate new ideas, patterns or frameworks.

The survey is composed of questions that revolve around the relevant history and experience, and around the current usage of Agile methods, including the length of iterations, the environments they are working in or have worked in. These pieces of information will then be correlated to generate relationships and patterns between each other. From this, the factors influencing the iteration length will be determined and assigned relevant weightages.

Existing literature serves as the secondary source of data. This secondary source is to be mainly used to:

- a. Validate results extracted from the primary data
- b. Identify gaps between recommendations and suggestions in literature and the actual practice.
- c. Identify the reason for these gaps

3.4 Survey Population

Several factors were considered to determine who should be included as participants of the survey for this research.

The most obvious group of participants are developers and programmers who actively use agile methods and are part of agile teams. This group of participants would have a wealth of relevant information related to their experience in the area of agile, their use of iterations, of iteration lengths, etc.

The second group of participants are IT project managers, programme managers, IT managers, etc., who either have used agile methods in managing projects, managing programmes of projects, or have implemented or promoted agile methods to be used in their teams or organisations. This group of participants would be able to provide information from a different perspective, with exposure to impacts of decisions made on iteration lengths across teams, to an IT department as a whole, and to an organisation as a whole.

The third group of participants are other IT personnel holding roles such as QA Engineers, Business Analysts, System / Application architects and Operational Excellence Engineers. This group might not necessarily be using agile methods for development, but their involvement with agile teams can be considered justification for including them in the group.

The fourth group of participants are non-IT, business users or customers who have interacted with agile teams and have worked closely with or even possibly been part of an

agile team as primary product owners. This group of participants can provide an insight into the factors impacting iteration lengths having their origin in strategic, administrative and business considerations.

3.5 Survey Tool

The survey tool chosen to be used is an online tool called “SoGoSurvey”. The professional option provided by this tool was selected for the purposes of this research. It allows for conditional branching, close ended questions types such as, including radio buttons, drop down boxes, check boxes, multi-select boxes, etc. and open ended question types such as text boxes of various formats.

This tool also allows for the generation of certain reports from the data gathered and allows or efficient management of the survey data.

3.6 Survey design and content

3.6.1 Initial filters:

Since the survey is designed to gather information from IT professionals who have used agile methods, it consists of filtering questions in the very beginning of the survey, used to eliminate responses from any IT professional not part of the above group. These questions confirm:

- Whether the participant has used agile methods – if no, the survey ends
- Whether the participant has used iteration lengths – this is because methods such as Kanban do not use iteration lengths. If the answer to this question is no, then the following third question is posed:
- Does the participant wish to continue to participate in the survey, which is related to iteration lengths?

The above questions act as effective filters to ensure that all responses are from professionals with some experience in using agile methods and iterations.

3.6.2 Selection of questions:

Every question considered, was evaluated to see if it did generate meaningful and quantifiable responses that could be correlated with other information to form relevant conclusions. For example, there was initially a question in relation to the culture of the organisation:

Does the culture of the organisation impact the choice of the iteration length?

- Yes
- No

But it was found that the above question does not address how the culture impacts and why there is an impact, if at all. To do this, there was a need for classifying cultures, justify the classification used and then compose relevant questions to gather the relevant information. Also, on further investigation, it was found that the topic of agile methods and organisation cultures is a vast topic and papers have been dedicated to this topic. It was therefore decided that including any question in relation to organisational culture was of no use. This question was therefore eliminated.

Similar deliberations were made for every question and some questions were simplified or combined into a single question, to minimize the time taken of the participant.

3.6.3 *Ordering of questions:*

The first question was the only mandatory question, requesting consent of the participant. Without this consent, the survey would not proceed.

The following three questions were filtering questions, designed to eliminate any participant not in the targeted group of professionals

The following six questions focus on gathering relevant information about the participant, which could then be correlated with the other questions.

The remainder of the questions focus on gathering the views of the participant on the area of the research.

All questions, barring the final one, were designed to gather quantifiable information, in the form of multiple choice radio buttons, check lists and Likert scales. The final question was open ended, requesting the participant to provide his or her reasons for their opinion on whether or not the iteration length was a crucial aspect of agile software development methods. This question followed on from the question below:

Do you believe that the iteration / sprint length is a crucial aspect of agile software development methods?

- Yes
- No

3.7 Testing the Survey

3.7.1 Initial pilot survey:

An initial pilot survey was conducted where in the participants were a few, selected and known individuals who were agile practitioners. This pilot was very important because it brought to light certain flaws in the survey questions and helped re-design the survey to be much clearer and less ambiguous.

The result of the pilot was that questions where there were ambiguous choices were modified to ensure all choices were clear. For questions where there was potential to specify "Other", non-standard answers, an extra option called "Other, please specify" was added. Certain questions were found to be not relevant and were eliminated.

3.7.2 Finalising the survey questions:

The modified survey questions were then submitted to the research supervisor for guidance, with whose help, they were repeatedly whetted, and brought to their final shape. The questions went through nine versions of change in total. The number of survey questions was brought down from a highest of 30 questions to the final number of 18 questions.

3.8 Limitations of the Research Approach

With any research, there are certain limitations that can be encountered, and these need to be acknowledged. Doing so helps the researcher minimize the impact of these limitations.

This research uses an interpretivist philosophy, and inherent in this philosophy is an element of subjectivity in the analysis of results received. The opinion and relative and subjective experience of the participants has a high influence on the responses. There is also the risk of what is known as "Confirmation bias", which is a tendency to favour information that confirms the researcher's beliefs.

The online survey was designed to reach out to as many targeted individuals as possible, across the globe. The aim was to receive responses from around 100 participants, but due to the paucity of time, the survey needed to be closed at 74 responses. Of these, 17 responses will not be considered since the participants did not have any experience in agile methods or iteration lengths and were filtered out before any of the important questions were addressed. Therefore the final set of 57 responses is brings certain limitations in the conclusions that can be derived.

For the open ended question in the end, though the individual responses can be analysed and commented upon, it is not possible to measure them. This limitation has been considered and accepted as necessary, as the response to this question is important. Since the total number of responses to be dealt with is 57, it would not be an enormous effort to take a few sample responses at random for this question and make relevant deductions.

3.9 Research Ethics

Ethical considerations are an important part of any research, where there is primary data being gathered, as it involves interaction with other people and their exposure directly or indirectly to thoughts, opinions and questions that they might not necessarily be comfortable with. This interaction and exposure has implications and impacts and no matter how minimal or subtle they maybe, they have to be considered. If a survey or an interview expects a participant to be a representative of an organisation, then it is an ethical duty to ensure that consent has been received from the organisation for this representation. If the participant is representing himself or herself as an individual, it is an ethical duty to keep the participant fully informed of the background, purpose and the nature of the survey or interview and to also receive his or her consent.

Robson (2002) emphasises that the ethical and psychological consequences for the participants should be considered.

Since this research is conducted within the context of the final year dissertation of a course offered by Trinity College Dublin, the approval of the ethics committee of the college was necessary before proceeding with gathering of the primary data.

Since the primary data collection was to be done through an online survey, directed towards individuals in the community of IT practitioners either using or in some way involved with teams using agile methods for software development.

As these individuals were being approached not as representatives of any organisation, but as individual professionals, the first question in the survey contained sufficient details of the research including the details of the researcher, the background of the research, the Procedure of the study, details of publication and a declaration of consent, which was to be accepted and affirmed by the participant that he or she agreed to participate in the survey. All questions, including this first one went through the approval process of Trinity College Dublin's Research Ethics committee and were duly approved with no changes requested.

3.10 Conclusion

Using the layered approach to research, explained by Saunders et al (2009), via the research process onion, this research can be said to have used the following approach in the six layers:

Layer	Adopted method
Research Philosophy	Interpretevism
Research Approach	Deductive
Research Strategy	Survey
Research Choice	Multiple Methods Technique
Time Horizon	Cross-sectional
Data Collection Methods	Survey, Literature review

TABLE 3-1 Summary of Adopted Research Methodology

A quantitative and qualitative analysis of the data obtained from the survey and the literature review have been done to obtain the findings. These are explored in the next section.

4 Findings and Analysis

4.1 Introduction

The online survey was made available between 10th of August 2013 and the 16th of September 2013, a little more than five weeks. The survey received a total of 74 responses, out of which 57 responses were fully completed responses. The 17 incomplete responses were as a result of the survey filter design.

The survey was targeted at a very large community of agile practitioners who would be active online. The online groups where this survey was posted were:

Name of group	Site	Number of members (approx.)
Agile and Lean Software Development	Linked In	45,297
Agile Project Management Group	Linked In	19,612
PMI Credentialed PMPs Group	Linked In	71,664
Chief Information Officer (CIO) Network	Linked In	84,150
Developers	Facebook	5,500
Lean Agile group	Facebook	2,000
Agile66	Facebook	1,500
HanoiScrum Exchange	Facebook	400
Agile Eastern Europe	Facebook	240
Welcome to programming	Facebook	200
Agile & DevOps SG	Facebook	150
Agile Academy	Facebook	40
Agile & DevOps Europe	Facebook	10
Waterloo Agile Lean	Facebook	8
Agile & Lean events UK	Facebook	5
TOTAL		230,776

TABLE 4-1 Listing of all online groups to the members of which the survey was sent

Compared to the total number of potential participants, the actual number of participants of 74 is only 0.032% of the total target group. The number of participants who finished the survey, 57, is even smaller. This is acknowledged as a limitation of this research, as during the time when the survey was active, the researcher was unable to obtain more responses.

The above results can be compared the above with contemporary surveys conducted on the population of agile practitioners by reputed organisations. Three surveys have been chosen, out of which two were conducted by large IT corporations and one was conducted as part of a research paper by associate professors in the University of Colorado:

Survey conducted	Conducted by	Year	Total no. of responses
Agile State of the Art Survey	Ambler, S. (2011) Chief Methodologist for IT, IBM	November 2011	168
The seventh annual "State of Agile Development" survey	Version One (2012)	November 2012	4048
Survey of Early Adopters of Agile SW Development	Vijayasathy, L. et al. (2008)	2008	98

Interesting and meaningful conclusions can still be arrived at by analysing the responses of the participants, and comparing the responses against information that is available in the existing literature. It is important to ascertain whether the responses match with what is said in the existing literature, and if yes, how closely they match, if not where is the difference.

The results of the survey were analysed using a combination of the following tools:

- IBM SPSS tool
- The reporting functionality of the survey tool (SogoSurvey)
- Statistical calculator available from StatPac Inc.
- Microsoft Excel.

4.2 Re-formatting and cleaning the data for easier analysis

The data from the survey was re-formatted so that string responses like "Yes" or "No" and other such standard string responses were converted into numeric variables in SPSS to be able to better analyse them.

Data gathered from questions where there was an “Other” option was manually classified and grouped to enable evaluation.

Data gathered from the only free format question in the survey was assigned and grouped into main themes that these responses came under.

4.3 Structure of the survey

The survey was organised into four sections:

1. The first section consisted of only one question, which was also the only mandatory question of the survey. This was the question containing the relevant information about the research along with a declaration of consent by the participant. All participants agreed to providing consent and answered “Yes” to this question.
2. The second section consisted of three questions that ensured that the participants had the relevant background and experience necessary. If they were not involved in using agile methods, the survey would end. If they were involved in agile methods, but had not used iterations, they were given a choice if they still wanted to participate in the survey. This section therefore ensured that all further questions answered, would be from participants who were qualified to provide their opinions on agile methods and iteration lengths. The 17 responses that were incomplete were of those participants who were filtered out based on these questions
3. The third section consisted of five questions to gain specific information about the participant’s experience and background that would be relevant to the research, such as what roles have they performed, what agile methods have they used, how many years of experience did they have in agile, what industry / sector have they worked in, etc.
4. The fourth and the last section consisted of nine questions that gathered the core data required, which was the opinion of the participant on the factors impacting iteration lengths and the importance of iteration lengths.

4.4 Survey participants distribution

The following distribution chart shows the spread of participants across the various roles. Please notice that the individual percentages exceed 100% as many participants have performed multiple roles in their experience

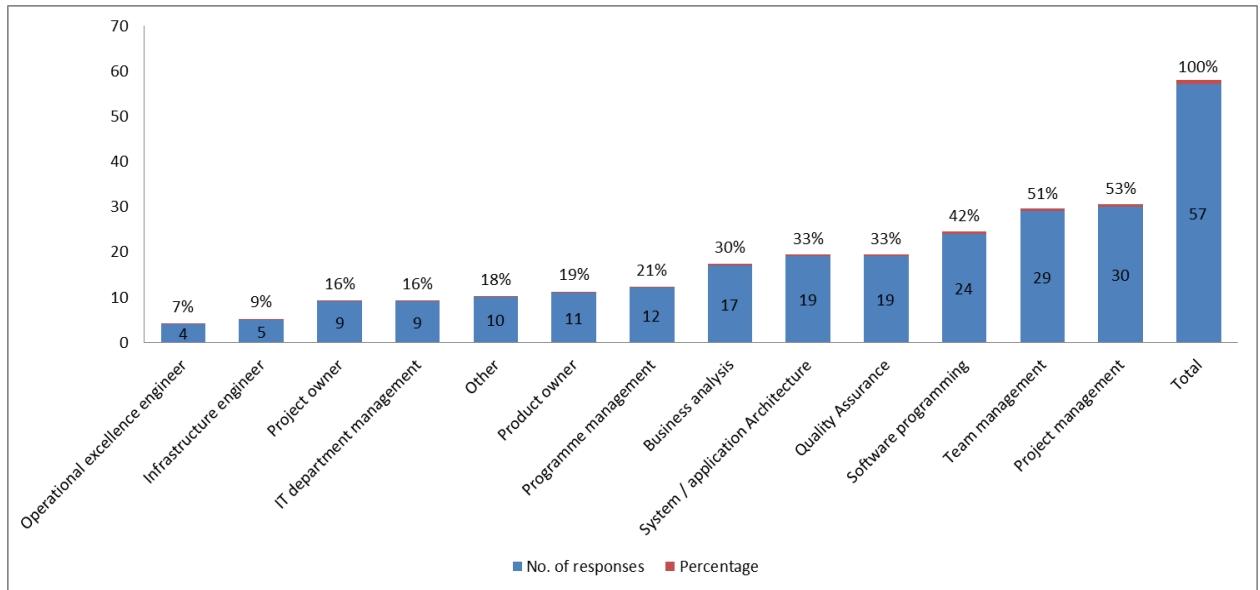


FIGURE 4-1 Distribution of participants across roles - x: roles, y: count and percentages

The above chart shows that most of the participants have performed the following three roles, which are key roles in the context of the use of agile methods:

- Project Management
- Team management
- Software programming

The 18% of participants were in the “Other” category and were distributed as:

Distribution of responses for "Other" category	
Response	No. of responses
Scrum Master, Process Consultant, Agile Coach	1
Scrum Master	5
Coach	1
Did not answer	1
Tester	1
consultant of the project	1

TABLE 4-2 Distribution of responses for "Other" category

The above table also shows that the most frequent response in the “Other” category was “Scrum Master”, which is the equivalent of a Project manager / team leader role in agile environments. This is very similar to the distribution of participants in figure 4.1 where project manager was the most frequent role performed by the participants.

Further, the participants varied in their experience in agile methods between Less than one year and Greater than ten years. The distribution of the participants by experience is shown below:

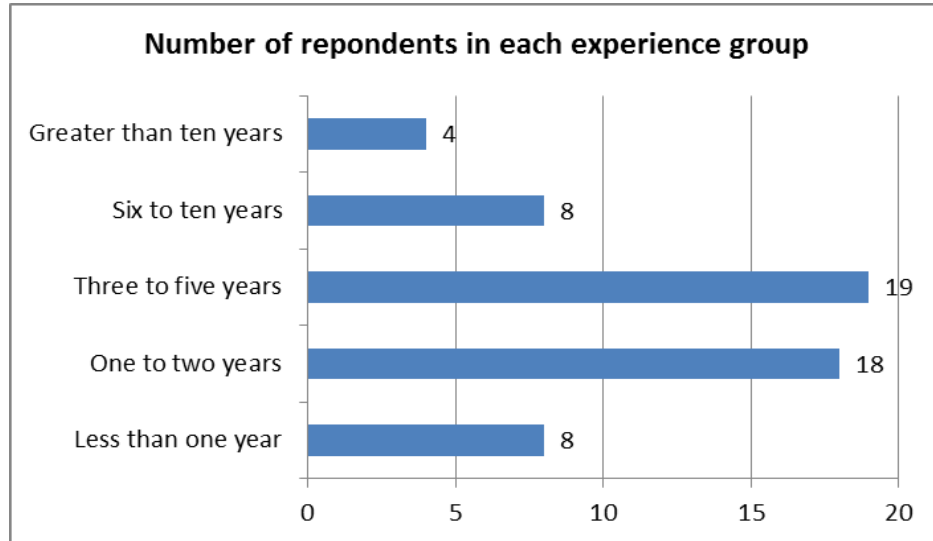


FIGURE 4-2 Distribution of participants across the spectrum of experience in Agile methods

The above distribution is reasonably representative of the distribution in the population of agile practitioners.

Focussing in on the three key roles mentioned with the highest frequency of distribution in Figure 4.1 above, the table below compares the distribution of these specific participants across their respective experience in agile methods:

Distribution of key roles across years of experience in agile methods							
Roles	Data points	Less than one year	One to two years	Three to five years	Six to ten years	Greater than ten years	Total
Software programming	No. of responses	3	9	7	4	1	24
	Percentage	12.50%	37.50%	29.17%	16.67%	4.17%	100.00%
Project management	No. of responses	3	8	10	6	3	30
	Percentage	10.00%	26.67%	33.33%	20.00%	10.00%	100.00%
Team management	No. of responses	2	10	7	7	3	29
	Percentage	6.90%	34.48%	24.14%	24.14%	10.34%	100.00%

TABLE 4-3 Distribution of key roles across years of experience in agile methods

The above table shows that the highest number of participants was between one and five years. Comparing this information to other contemporary surveys conducted on agile practitioners, the following can be seen:

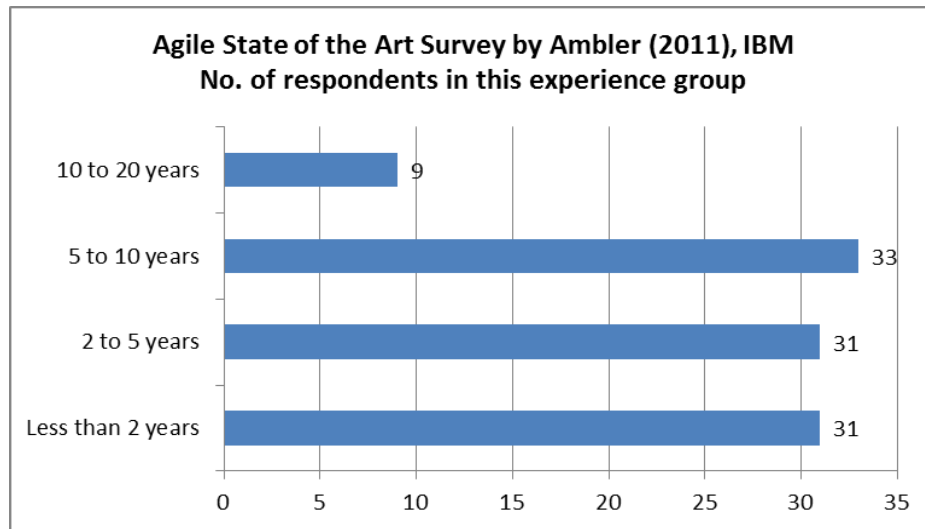


Figure 4-3 Agile State of the Art Survey by Ambler (2011), IBM

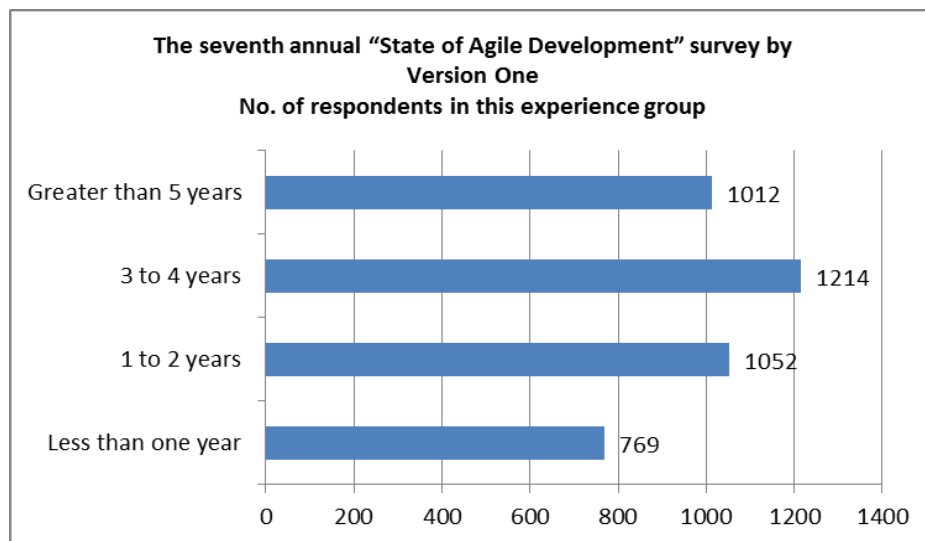


Figure 4-4 The seventh annual "State of Agile Development" survey by Version One (2012)

The above figures were extracted based on the information provided in the respective surveys. In both the surveys above, the experience group between one and five years seems to have the highest frequency (Ambler 2011) and (Version One 2012).

Further, in the Survey of Early Adopters of Agile SW Development, conducted by Vijayasathy et al. (2008), though elaborated data was not available as in the case of the

above two surveys, the researchers did mention that the average experience in agile of the respondents was 3.9 years ... (Vijayasathy et al. 2008).

The above figure is also in line with the distribution arrived at in the other surveys.

4.5 Core Factors identified and used in the survey as impacting iteration length

The core factors that were identified as impacting iteration lengths and for which survey questions were asked are as follows:

- Size of the agile project team:
- Technical capability of the team
- Experience in agile methods
- Geographical distribution of the team
- Degree of uncertainty of user requirements
- Complexity of the IT application / ecosystem
- Dependency on outsourcing for software development
- Duration of the overall project
- Iteration overheads such as planning, reviews and retrospectives
- Frequency of customer feedback required
- Presence or absence of automated building, testing and deployment of software

The next two sections present the results obtained to these questions.

4.6 Factors that limit the choice of the iteration length

The participants were asked to choose the most appropriate option for a set of factors that were hypothesised to impact the iteration length. These factors were worded so as to be considered as limiting factors from the respondent's point of view. The factors and the corresponding options, including cases where the participants did not choose any answer, are represented in the table below.

How do the factors on the left hand side limit the choice of iteration /sprint lengths?								
Please select one of the following options:								
Factors	Compels you to increase the iteration/sprint length		Compels you to decrease the iteration/sprint length		Does not impact the iteration/sprint lengths		Did not choose any answer	
Smaller project team	14	24.56%	9	15.79%	31	54.39%	3	5.26%
Lower technical capability in the team	27	47.37%	10	17.54%	20	35.09%	0	0%
Team less experienced in agile methods	22	38.60%	12	21.05%	23	40.35%	0	0%
Team geographically more distributed	16	28.07%	7	12.28%	34	59.65%	0	0%

Higher degree of uncertainty in the requirements	22	38.60%	17	29.82%	18	31.58%	0	0%
Higher complexity of the IT application / eco-system	25	43.86%	9	15.79%	22	38.60%	1	1.75%
Higher dependency on outsourcing for software development	14	24.56%	12	21.05%	30	52.63%	1	1.75%
Decrease in overall project duration	3	5.26%	25	43.86%	27	47.37%	2	3.51%
Automated building, testing and deployment of software not in use	20	35.09%	4	7.02%	30	52.63%	3	5.26%
Fourth generation languages not in use	9	15.79%	3	5.26%	41	71.93%	4	7.02%
Project management / agile tools not in use	13	22.81%	6	10.53%	35	61.40%	3	5.26%
Team resources shared among multiple projects	28	49.12%	3	5.26%	24	42.11%	2	3.51%
More time spent on iteration planning / review / retrospective meetings or related tasks	16	28.07%	10	17.54%	29	50.88%	2	3.51%
Customer feedback required more frequently	10	17.54%	20	35.09%	26	45.61%	1	1.75%
AVERAGE	17	29.95%	11	18.42%	28	48.87%	2	2.76%

TABLE 4-4 Responses to factors limiting the choice of the iteration lengths

Some of the factors in the above table have been considered individually and their analysis presented one at a time, while a summary has been presented for the others:

4.6.1 Smaller project team:

It is noted that around 55% (more than half) of the participants responded that the above factor did not impact the iteration length, while the remainder of the participants were divided in their opinion as to whether the factor forces an increase or a decrease in the iteration length. To ensure that the result recorded above was not a chance occurrence a null hypothesis needs to be tested for significance.

Null Hypothesis: When a project team becomes smaller, it compels the team to increase the iteration length.

To test the null hypothesis, it is sufficient if we compare the percentage that believed it did not impact and the percentage that believed that it compelled an increase. For this, we employ a one sample t-test, assuming an alpha level (significant p-value) of 0.05. In other words we need to attain 95% or more surety before we can reject the null hypothesis.

Doing a “One sample t-test” between these percentages, we find that:

The t-statistic was significant at the 0.05 alpha level $t(56) = 2.691$, $p = 0.0094$. From this we can conclude that the above result is significant.

Therefore the above null hypothesis can be rejected and we can conclude that most agile practitioners believe that a smaller project team does not impact the iteration length in any way.

Further, investigating the spread of the responses across two experience levels into which the participants have been classified below, it can be seen that out of the 31 participants (54.39%) who responded that the smaller project team did not impact the iteration lengths, 20 (64.52%) of them had greater than or equal to three years of experience. Out of this group one participant had an experience of greater than ten years and five participants had an experience of between six to ten years.

Responses to the factor "Smaller project team" across a split of respondents by experience in Agile methods			
Responses	Less than three years	Greater than or equal to three years	Total
Compels you to increase the iteration/sprint length	7	7	14
Compels you to decrease the iteration/sprint length	5	4	9
Does not impact the iteration/sprint lengths	11	20 (64.52%)	31 (54.39%)
Did not answer	3	0	3
Total	26	31	57

Table 4-5 Split of respondents by experience in Agile methods

Testing to see if this is significant or not using a one sample t-test, we find that:

The t-statistic was not significant at the 0.05 alpha level $t(30) = 1.690$, $p = 0.1015$. From this we can conclude that the above result is not significant.

From this we can conclude that it is significantly probable that the above result was a chance occurrence and that there is no statistical significance in the relationship between the experience of the participants in agile and their response to the above factor.

4.6.2 Lower technical capability in the team:

It can be seen that around 48% of the participants believed that a reduction in the technical capability of the team compels the team to use the longer iteration lengths, whereas 35% of the participants believed that there was no impact.

We need to test whether the statement that: If there is a reduction in the technical capability in the team, the team will be **compelled** to increase the iteration length, which is supported by 48% of the responses, is statistically significant. To prove that this is not a chance occurrence, we will need to postulate a null hypothesis as follows:

Null Hypothesis: When the technical capability of the team is reduced, it does **not** compel the team to increase the iteration length.

We test the significance of the two results – compels to increase the iteration length (47.37%) and does not impact the iteration length (35.09%), using the one sample t-test again and find that:

The t-statistic was not significant at the 0.05 alpha level $t(56) = 1.030$, $p = 0.3072$. From this we can conclude that the above result is not significant.

The p-value above indicates a higher probability than what is required for statistical significance. The above test prevents us from rejecting the null hypothesis and prevents us from concluding that the lower technical capability of the team does compel the team to increase the iteration length. It might be true that the lower technical capability of the team does not compel the team to increase the iteration length, but this cannot be proved.

4.6.3 Team geographically more distributed:

We use a similar hypothesis for the geographical distribution as used for the factor “Smaller project team” and test the significance:

Null Hypothesis: When the geographical distribution of the team increases, it compels the team to increase the iteration length.

The t-statistic was significant at the 0.05 alpha level $t(56) = 2.704$, $p = 0.0091$. From this we can conclude that the above result is significant.

Therefore the above null hypothesis can be rejected and we can conclude that most agile practitioners believe that an increase in the geographical distribution of the team does not impact the iteration length in any way.

4.6.4 Dependency on outsourcing for software development:

Very similar to the **smaller project team** and the **geographical distribution** factors, we notice that around 50% of the participants do not believe that there is any impact on the iteration length due to a higher dependency on outsourcing.

Hypothesising similarly, we find:

Null Hypothesis: A higher dependency on outsourcing for software development compels the team to increase the iteration length.

The t-statistic was significant at the 0.05 alpha level $t(56) = 2.546$, $p = 0.0137$. From this we can conclude that the above result is significant.

Therefore the above null hypothesis can be rejected and we can conclude that most agile practitioners believe that an increase in the dependency of outsourcing does not impact the iteration length in any way.

4.6.5 Decrease in Overall project duration:

For this factor, it can be seen that the opinion is equally divided between “compels you to decrease the iteration length” and “does not impact the iteration length”, with percentages of around 45% approximately. Whereas there is a relatively small section of the participants who believed that a decrease in the project duration forces an increase in the iteration length.

It needs to be tested whether this result has occurred by chance and the different response sections are completely independent, or is there statistical significance in this result and the responses are in some way related to one another.

To do this, we need to find out how close is the distribution of respondents observed to what would be expected if there was no relationship between them. This can be done by a **one way Chi-square test**. But the limitation of the Chi-square test is that there should not be a cell value of less than 5 in more than 25% of the cells. In the case of the data for this factor, this is the case. So using the one sample t-test again, we individually test the following relationships:

- between “compels you to increase the iteration length” and “compels you to decrease the iteration length”
 - Result: The p-value is 0.0000, which is highly significant.
- between “compels you to increase the iteration length” and “does not impact the iteration length”
 - Result: The p-value is 0.0000, which is highly significant.
- between “compels you to decrease the iteration length” and “does not impact the iteration length”
 - Result: The p-value is 0.9394, which is not significant.

Therefore, the t-tests enable us to conclude that we can be sure that either one of the following is true: That agile practitioners believe that the decrease in the overall duration of the project does not impact the iteration length and that agile practitioners believe that the factor compels the team to decrease the iteration length. But we cannot conclude

which of them are true due to the non-significance of the result of the relationship between the two.

4.6.6 Summary of results for the remaining results in the table:

- It can be concluded that the following factors do not impact the iteration length:
 - Automated building, testing and deployment of software not in use
 - Fourth generation languages not in use
 - Project management tools not in use
 - More time spent on iteration planning / review / retrospective meetings or related tasks
- It can be seen that the results for the following factors do not pass the significance test
 - Team less experienced in agile methods
 - Higher degree of uncertainty in the requirements
 - Higher complexity of the IT application / eco-system
 - Team resources shared among multiple projects
 - Customer feedback required more frequently

4.7 Factors that increase flexibility in the choice of the iteration length

The participants were asked to choose the most appropriate factors that were hypothesised to impact the iteration length. These factors were worded so as to be considered by the respondents as factors that would increase the flexibility in the choice of the iteration length from the respondent’s point of view. The factors and the corresponding responses are as shown below:

Factors that provide greater flexibility in increasing or decreasing the iteration lengths	“Yes” responses	%
Higher technical capability in the team	30	52.63%
Team more experienced in agile methods	30	52.63%
Automated building, testing and deployment of software in use	25	43.86%
Team resources not shared among multiple projects	24	42.11%
Lower degree of uncertainty in the requirements	24	42.11%
Team geographically less distributed	19	33.33%
Project management / agile tools in use	19	33.33%
Larger project team	18	31.58%
Lower complexity of the IT application / eco-system	18	31.58%
Customer feedback required less frequently	17	29.82%
Increase in overall project duration	16	28.07%
Lower dependency on outsourcing for software development	15	26.32%
Less time spent on iteration planning / review / retrospective meetings or related tasks	13	22.81%

Factors that provide greater flexibility in increasing or decreasing the iteration lengths	"Yes" responses	%
Fourth generation languages in use	9	15.79%
Did not answer	8	10.53%
Change in Project priorities after commencement of sprint	1	1.75%
Product owner's commitment or lack thereof	1	1.75%
Team member's vacation plans can increase the iteration length	1	1.75%
Peopleware - the skill and ability of the team	1	1.75%
None of the above impact the length of iterations	1	1.75%
Nature of development, customer expectations and visibility to customers	1	1.75%

TABLE 4-6 Responses to factors increasing flexibility in the choice of iteration lengths

The corresponding chart is shown below:

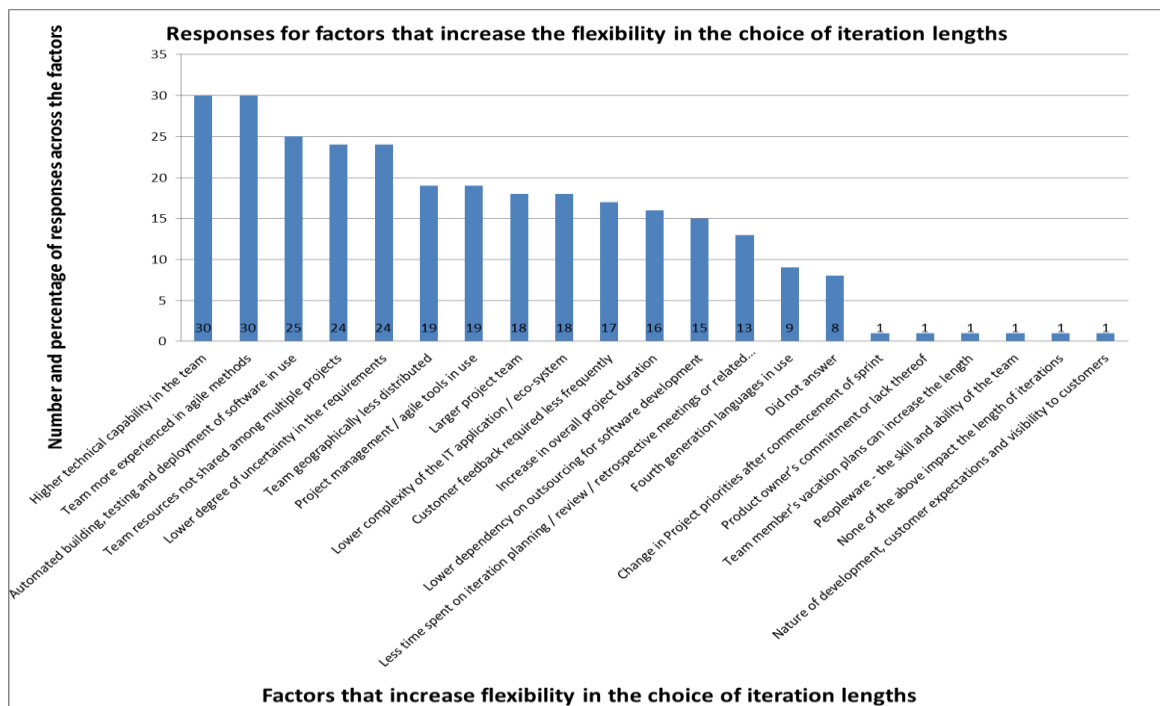


FIGURE 4-5 Distribution of responses across the various factors that increase flexibility in the choice of iteration length

The responses in the above table and chart after the “Did not answer” response were gathered from the “Other” category, where the participants had a chance to type in any other factors they believed increased the flexibility of the iteration length in free format text. These responses were condensed to enable easier reading without changing the content of the response.

The table and the chart show us that the following five factors received a high number of responses from the participants:

1. Higher technical capability in the team
2. Team more experienced in agile methods
3. Automated building, testing and deployment of software in use
4. Team resources not shared among multiple projects
5. Lower degree of uncertainty in the requirements

To investigate this section of respondents who agreed that the above factors increased the flexibility in the choice of the iteration lengths, we examine what roles these respondents have played. Since a respondent could select more than one role, and could also select more than one factor, there are overlaps in the responses. The chart below presents only certain key roles that have made a higher contribution to these responses for the five factors listed above:

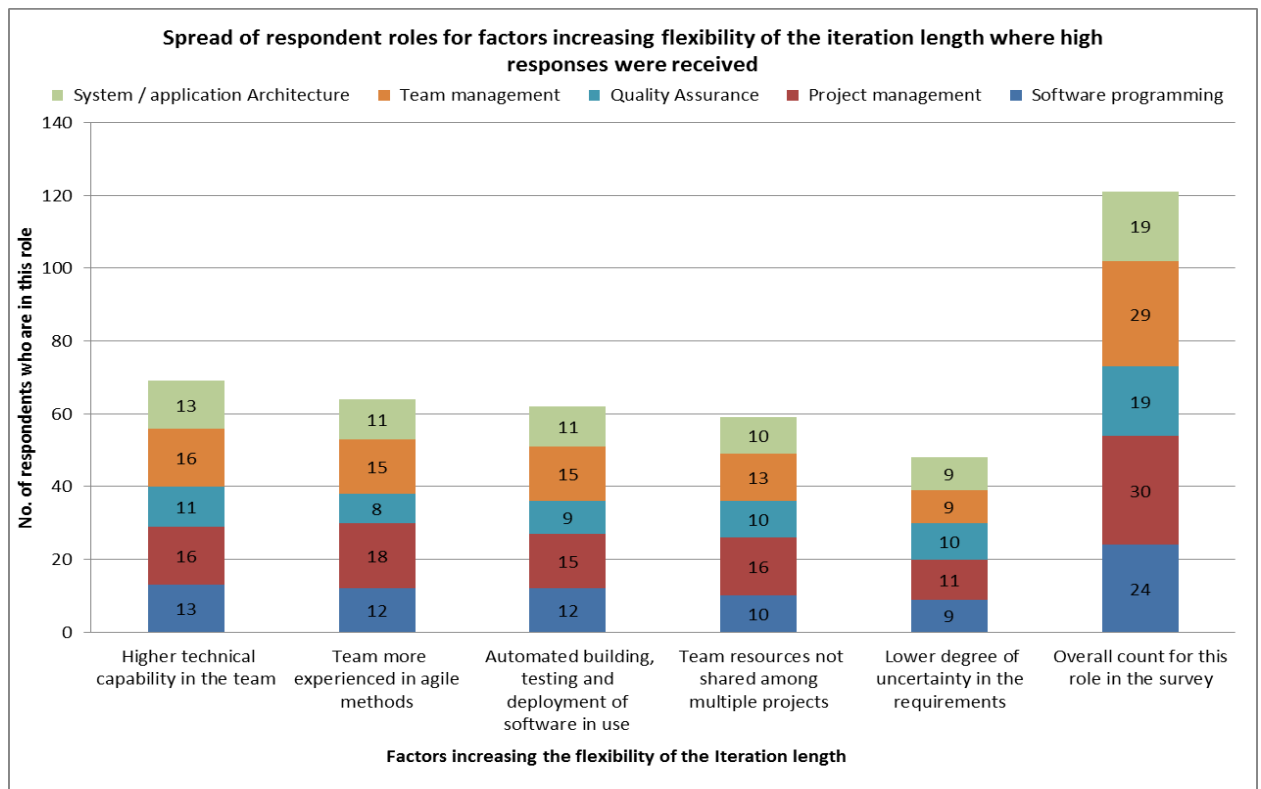


Figure 4-6 Spread of roles for factors where high responses were received

The above chart shows that those are or have been Project managers and Team managers have responded most, followed by Software programmers and System / Application architects.

It is also interesting to note the following the overlap of responses by role:




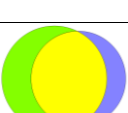
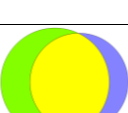
Factor	No. of project manager responses	No. of Team manager responses	Overlap of responses	Distinct count	% overlap of total response count	Venn Diagram
Higher Technical Capability in the team	16	16	13	19	68%	
Team more experienced in agile methods	18	15	12	21	57%	
Automated building, testing and deployment of software in use	15	15	12	18	67%	
Team resources not shared among multiple projects	16	13	10	19	53%	
Lower degree of uncertainty in the requirements	11	9	7	13	54%	

Table 4-7 Table of overlap in responses by role

The above table shows that after identifying the distinct number of responses for each of the above factors, there is a substantial overlap of the respondents for the above factors.

The null hypothesis for this result is that project managers and team managers believe that the above factors increase the flexibility in the choice of the iteration lengths.

On performing a significance test on the two sets of responses using one sample t-tests, we can confirm that none of the above results are significant and there is a high probability that they occurred by chance. Therefore, we reject the null hypothesis and cannot make a conclusion that project managers and team managers believe that the above factors increase the flexibility in the choice of the iteration lengths.

Comparing the result in section 4.6.2 for the limiting factor “Lower technical capability in the team” with that for the “flexibility” factor in this section “Higher technical capability in the team”, we can see that:

- Neither were we able to conclusively prove that lower technical capability in the team compels the team to increase the iteration length

- Nor were we able to conclusively prove that higher technical capability in the team increases flexibility in the choice of the iteration length.

Though both of these facts could be true, we end up being inconclusive because of failure in the respective significance tests.

4.8 Relationship between Industry / Sector and Iteration length

A few questions were directed towards eliciting whether there was a consensus that the Industry or Sector of an organisation had any impact on the iteration length, either directly, or indirectly, by impacting the nature of other IT aspects, which might in turn impact the iteration length. The chart below represents what the overall distribution of responses was:

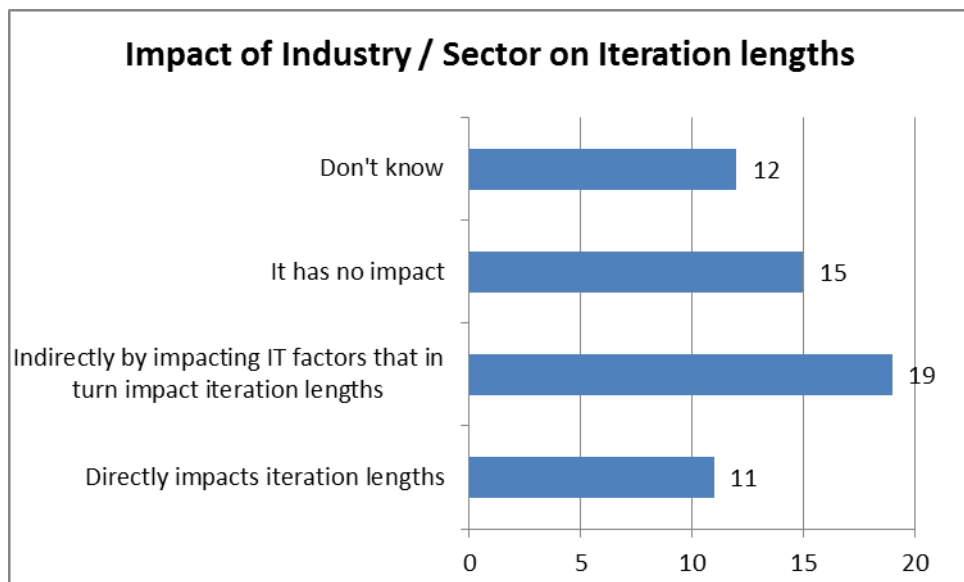


Figure 4-7 Impact of Industry / Sector on Iteration lengths

It can be seen that one third of the opinion was divided between “It impacts IT factors that in turn impact the iteration length” and “Has no impact”. The remainder of the opinion was divided between “Directly impacts and don’t know”

Further, by splitting the responses by categories of experience, we obtain the following:

Responses split across respondents by experience		
Manner of impact	Less than three years	Greater than or equal to three years
Directly impacts iteration lengths	5	6
Indirectly by impacting IT factors that in turn impact iteration lengths	10	9

It has no impact	6	9
Don't know	5	7

Table 4-8 Responses split across respondents by experience

We can see in the above table that responses are quite evenly spread. A one sample t-test performed on the two sets of responses split by experience resulted in a t-statistic that was not significant at the 0.05 alpha level $t(56) = 0.662$, $p = 0.5105$, and therefore the above result is not statistically significant. The null hypothesis that most agile practitioners believe that the industry / sector does not impact the iteration length cannot be rejected.

The respondents were also asked if a particular industry or sector tended to favour shorter or longer iteration lengths, or neither. The table below represents the responses:

Manner of impact of Industry / Sector on Iteration length				
Industry / Sector	Tends to favour shorter iteration/sprint lengths	Tends to favour longer iteration/sprint lengths	Don't know	Did not answer
Pharmaceutical	1	9	20	27
Agriculture	2	3	22	30
Construction	1	4	22	30
Energy	3	6	18	30
Retail	7	4	17	29
Health care	1	8	18	30
Financial services	5	10	15	27
Insurance	4	5	18	30
Telecom	6	7	17	27
Hospitality	3	6	19	29
Aerospace	1	8	17	31
Defence	1	7	19	30
Public sector	2	11	18	26
Average response	3	7	18	29

Table 4-9 Responses for manner of impact of Industry / Sector on Iteration length

The above table shows that most of the respondents either desisted from responding or chose “Did not know” as the answer. In order to test whether this was a chance occurrence or a significant result, we put these results through the Chi-square test as each and every cell in the above table is exclusive and has no overlap. But we need to also incorporate Yate’s correction to the Chi-square test since there are a few results less than 5.

Applying the Chi-square test, we get a Chi-square statistic of 32.176, df (degree of freedom) 36 and a p-value of .6569.

The above probability value, being much higher than the standard of 0.05, leads us to conclude that there was a high probability that this was a chance occurrence and does not represent a significant result. Therefore we are not in a position to make any conclusions as to whether each of the industry or sectors tend to favour a shorter or longer iteration length or do not impact the iteration length.

4.9 The importance of the iteration length – crucial or not

The second last question asked to the participants was: “Do you believe that the iteration / sprint length is a crucial aspect of agile software development methods?”

The responses to this question are presented in the pie chart below:

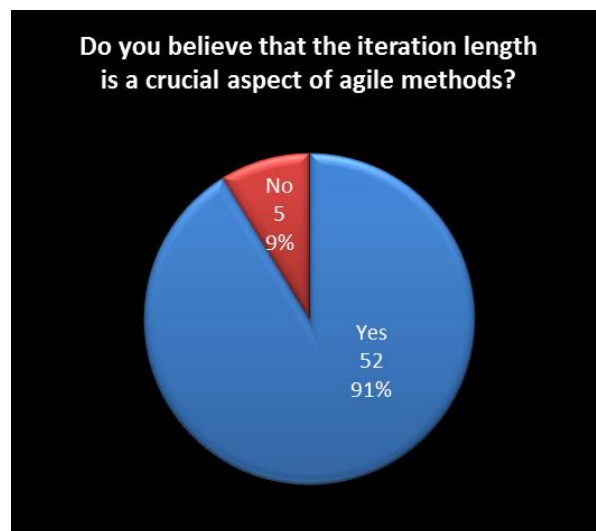


FIGURE 4-8 Distribution of responses to the question “Do you believe that the iteration / sprint length is a crucial aspect of agile software development methods?”

This result seems to suggest that an overwhelming number of respondents believed that the iteration length is a crucial aspect of agile software development methods. Performing a one sample t-test on this result we obtain:

The t-statistic was significant at the 0.05 alpha level $t(56) = 10.816$, $p = 0.0000$. From this we can conclude that the above result is significant.

This allows us to conclude that null hypothesis, that the iteration length is not crucial in agile software development methods can be rejected. We can firmly conclude that the iteration length is crucial in agile software development methods according to agile practitioners.

4.10 Reasons for whether iteration lengths are a crucial aspect or not

The last question was an open ended question, requesting the participants to provide reasons for the above answer. Since this question provided an opportunity for the participants to type in free text of up to 2000 words, there have been many varied responses. These responses have been classified into different themes following an extensive study of them. Further, the responses have been grouped into those for which the respondent answered a “Yes” to the previous question above (or believed that the iteration length is a crucial aspect of agile methods) and those for which the respondent answered a “No” (or believed that the iteration length is not a crucial aspect of agile methods).

Since the number of “No” responses is only five, these have been listed out as is.

4.10.1 Reasons for a “Yes” response:

The table below represents the themes extracted for all participants who believed that the iteration length is a crucial aspect of agile methods. The total number of responses in this group is 52. These themes provide the full gist of the response. The number of responses per theme exceeds the total of 52 as several of these themes were seen in the response of more than one participant:

Sl. No.	Theme	No. of responses
1	No reason / answer provided by participant	20
2	It is important to have an optimum iteration length	8
3	Shorter iteration length is better	8
4	Iteration length enables quicker customer feedback, determines frequency of customer feedback, better tracking, early detection of flaws	6
5	Iteration length helps to provide a milestone, provide motivation to meet targets, set the pace	5
6	The iteration length depends on team ability and experience, also on customer availability	4
7	Iteration lengths should be fixed	3
8	Specific iteration lengths of 2, 3 and 4-5 weeks have been mentioned as ideal or optimum	3
9	Customer expectations are important, pre-iteration planning is important	1
10	Iteration lengths are decided by team and do not depend on the industry	1
11	Iteration length should be carefully chosen based on factors mentioned in the survey	1

Sl. No.	Theme	No. of responses
12	Iteration length impacts development and coding standard, Provides constant pressure	1
13	Iteration length is significant to project planning	1
14	Iteration lengths for us only defines amount of time between formal reviews	1
15	The participant used this answer space to advertise a product	1

TABLE 4-10 Themes for the reason responses where the answer was “Yes”

From the above table, it can be seen that, amongst those participants who have responded to the last question, a significant number of them believe in shorter and fixed iteration lengths between two and five weeks.

Many participants have also mentioned that iteration lengths lend themselves to a number of advantages and benefits such as quicker customer feedback, early detection of flaws, provide milestones and motivation to meet targets, set the pace, provide constant pressure, etc. Some participants focussed on mentioning how iteration lengths should be determined and what they depend on. One participant used this answer space to paste an advertisement of a product.

4.10.2 Reasons for a “No” response:

The table below represents the responses of participants who believed that the iteration length is not a crucial aspect of agile methods. The total number of responses in this group is 5.

Sl. No.	Response	No. of responses
1	Iteration is a kick in the ****, done correctly it can catapult team performance, however regardless of an iteration rate, if tasks are not being accomplished, iteration will have the undesired effect of mistake repetition, over & over & over & over. What I do find extremely interesting is the determination of iteration rates is currently determined by the algorithms designed inherent in the software platforms used, irrelevant of inputted key performance indicators; instead the iteration rate should be based on project tasks attainability. A solution that would allow for better modeling by changing iteration rates would be very beneficial in financial sectors.	1
2	I believe shorter iteration lengths are useful for development, but longer iteration lengths are more useful for deployment and management. The length is not "crucial", but must balance the needs of development and deployment.	1
3	No reason / answer provided by participant	3

TABLE 4-11 Reason responses where the answer was “No”

5 Conclusions and Future work

5.1 Introduction

The focus of this chapter is to discuss and summarise the research findings, insights gained and limitations of this research. Any future work that can be undertaken following this research will be outlined and proposed.

At the outset it needs to be acknowledged that a total of 57 complete responses from the survey was a low number of participation and this inherently limits the extent to which analysis can be done and significant results extracted. Therefore there is scope for future researchers to gain a broader response in the area of the iteration length and arrive at significant conclusions.

5.2 Factors limiting or decreasing the choice of iteration lengths

This research was able to generate the following conclusions for limiting factors:

- A statistically significant population of agile practitioners believe that a smaller project team does not impact the iteration length at all.
- A statistically significant population of agile practitioners believe that an increase in the geographical distribution of the team does not impact the iteration length at all.
 - This conclusion is contrary to what has been said in the existing literature (Fowler 2003), where the suggestion is that off shore teams (geographically more distributed, will need a longer iteration length and therefore implying a relationship between the iteration length and the geographical distribution.
- A statistically significant population of agile practitioners believe that an increase in the dependency of outsourcing does not impact the iteration length at all.
 - This conclusion is also contrary to existing literature (Paasivaara 2005), where the suggestion is that the collaboration that needed when inter-organisational software product development is involved, makes it necessary to tailor the iteration lengths of the respective agile processes used in order to match and synchronize deliveries.

5.3 Factors leading to increasing flexibility in the choice of iteration lengths

This research was able to generate the following conclusions:

The following factors were also found to not impact the iteration lengths at all:

- Automated building, testing and deployment of software not in use.
 - It has been suggested by Waters (2007) that automated testing and deployment signify mature processes and are factors that impact iteration lengths (sprints) very positively, in that shorter iteration lengths are achievable. The conclusion drawn in this research again disagrees with the existing literature.
- More time spent on iteration planning / review / retrospective meetings or related tasks.
 - Considering the overheads of planning, review and retrospectives for an iteration, Brodwall (2013) has suggested that as iteration lengths grow shorter, the relative time taken for the above activities will grow larger and consume greater portions of the iteration. Therefore, in this case again, we are face with a result that does not tie in with what has been said by experts in the state of practice.
- Fourth generation languages not in use
- Project management tools not in use

5.4 Industry / Sector and its impact on the iteration length

This research was not able to generate any significant conclusion in relation to the Industry or sector of the organisation where agile methods are used. On reflection, the researcher believes that there is a chance many respondents might have found a survey question related to this topic difficult to make sense of due to the way the question was phrased. Question 15 (Appendix B) could have been phrased to ask if respondents thought the Industry / Sector in question increased or decreased the level of the factors mentioned. Rather the question asked was whether the Industry / Sector impacted the factor mentioned. Many of the respondents either did not attempt to respond to this question or chose "I don't know". This implies that there is a possibility to achieve better responses in this area by a well formed set of questions, along with an effort to obtain higher number of responses.

5.5 The importance of the iteration length itself

This research was able to draw out the conclusion that a statistically significant population of agile practitioners believe that the iteration length is a crucial aspect of agile software development methods.

Existing literature both academic and popular, contain many references to iteration or sprint lengths within their discussions. The volume of these references on inspection is

sufficient to conclude that the iteration length is an important aspect of agile software development methods, and is a key controlling factor that can be used to influence the success of software development projects.

In addition, we can look at the various themes represented by the response of the respondents to the last question of the survey. This was to provide the reason why they believed that the iteration length was crucial or not. In identifying and classifying the responses within these themes, it was found that individual responses, many times had more than one theme. Therefore the count of responses within these individual themes exceeds much higher than the total number of responses itself. We can gather the following information from these themes:

The total number of responses that believed iteration lengths were crucial was 52 (answered "Yes") and of the remaining 5 answered "No". There were no omissions of this question.

Of the respondents who said "Yes":

- 20 respondents did not specify a reason.
- 22 respondents focussed on the importance of having an optimum, or fixed or short iteration lengths. Some respondents explicitly specified certain lengths between two and five weeks.
- 11 respondents outlined various benefits of iteration lengths such as allowing for regular customer feedback, regular and better tracking, early detection of flaws, providing frequent milestones and serving as a motivation to meet targets, etc.
- Some respondents
- 4 respondents mentioned team ability and experience, and customer availability as factors that impact iteration lengths.

Of the five respondents who said "No":

- Three respondents did not specify a reason.
- The remaining two responses did not express any clear reasons

5.6 What has been achieved in this research

Though few conclusions were reached, and many of these suggested that the factors hypothesised as impacting iteration lengths, did not actually have any impact, these conclusions are significant and throw light on what is the perception in the community of agile practitioners.

In addition to obtaining conclusions, this research provided a platform for a number of agile practitioners to focus on and respond to questions surrounding the factors impacting the iteration length, which it is hoped, will lead to further reflections and discussions by the respondents in this area. This has by no means created a significant difference, but it is believed that significant change sometimes starts with the smallest of steps. Therefore this research can be further taken forward to provide opportunities for greater discussion and synthesis of results in the area of iteration lengths in agile software development.

5.7 Future work suggested

The scope of this research was to seek out the opinion of the agile community to identify factors that impact the choice of iteration lengths and to gather whether iteration length is considered to be an important aspect of agile methods. But this research did not look at the area of whether these individual factors are independent, or whether they influence one another.

Interesting future work that can be done in this area so that the factors used in this research and / or other new factors that might be considered impacting iteration lengths could be studied in depth to determine if these individual factors are interdependent and influence each other in any way. For example it would be reasonable to consider whether there is a relationship between the dependency on outsourcing and geographical distribution of the team.

Another area of focus would be to consider certain Industries or sectors and study the tendency of teams in organisations in these sectors to either favour longer or shorter iteration lengths. For example, the financial sector could tend to have steadier requirements compared to, for instance, retail, which could influence the behaviour of the internal customers of the IT teams (like slower response or feedback) and therefore could in turn influence the software development teams to choose a longer iteration length.

A third area that has not been explored in this research is the area of how the culture of the organisation itself determines various agile practices and aspects. Focussing on the iteration length itself, it could be studied whether the “risk taking” nature of the organisation has a bearing on the ultimate choice of iteration lengths.

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Appendices

Appendix A – Information Sheet for Participants

TITLE OF RESEARCH: The Importance of Iteration Lengths in Agile Software Development Methods

RESEARCHER: Vikas Ram Bhat

CONTACT DETAILS: bhatv@tcd.ie

BACKGROUND OF RESEARCH:

Traditional, monolithic waterfall methods for developing software have given way to different types of Incremental and Iterative methods over the last twenty years for risk reduction, evolving user requirements, greater interaction and involvement of users and the ability to deliver software quicker. Some of these methods come under Agile methods, emphasising on delivering small chunks of software through collaboration, cross-functional and self-organising teams, in fixed time intervals known as iterations.

A salient feature in almost all agile methods is the length of the iteration. The purpose of this research is to answer the question of how important it is to determine the most appropriate iteration length for an agile team within the context of delivering a software system, and whether a procedure for doing so can be developed.

PROCEDURE OF THIS STUDY:

This study is based on an online survey that should take no more than 15 minutes to complete. Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions were responded to.

PUBLICATION:

The analyzed and interpreted data will be completely anonymous and the identity of the participant or their organisation will not be revealed in any way. This data will be used in the completion of a dissertation as part of studies for a MSc. in Management of Information Systems, Trinity College Dublin.

PART 2: Consent form (First question of the survey):

The following appears as the first question of the survey, and based on the response, the survey either terminates or continues forward:

DECLARATION:

- I am 18 years or older and am competent to provide consent.
- I have read, or had read to me this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me.

- I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.
 - I understand that if I make illicit activities known, these will be reported to appropriate authorities.
 - I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.
 - I understand that I may refuse to answer any question and that I may withdraw from completing the survey at any time without penalty.
 - I understand that my participation is fully anonymous and that no personal details about me will be recorded.
 - Since this research involves viewing materials via a computer monitor I understand that if I or anyone in my family has a history of epilepsy then I am proceeding at my own risk.
 - I understand that I cannot name any third parties in any open ended text field of the questionnaire. Any such replies will be made anonymous. In the unlikely event that illicit activity is reported during the study, I will be obliged to report it to the appropriate authorities.
 - Do you accept the above declaration and agree to participate in this survey?
- Yes (If Yes is selected, the survey continues)
- No (If No is selected, the survey terminates)

Appendix B – Survey Questions

* Required Information

page 1
<p>*</p> <p>TITLE OF RESEARCH: The Importance of Iteration Lengths in Agile Software Development Methods</p> <p>RESEARCHER: Vikas Ram Bhat</p> <p>CONTACT DETAILS: bhatv@tcd.ie</p> <p>BACKGROUND OF RESEARCH:</p> <p>Traditional, monolithic waterfall methods for developing software have given way to different types of Incremental and Iterative methods over the last twenty years for risk reduction, evolving user requirements, greater interaction & involvement of users and for quicker delivery of software. Some of these methods come under Agile methods, emphasising on delivering small chunks of software through</p>

collaboration, cross-functional & self-organising teams, in fixed time intervals (iterations / sprints). The specific focus of this research is the iteration/sprint length used in software projects. The intention is to find out what are the factors impacting the choice of iteration/sprint lengths and how these factors impact this choice.

PROCEDURE OF THIS STUDY: This study is based on an online survey that should take no more than 15 minutes to complete. Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions were responded to.

PUBLICATION: The analyzed and interpreted data will be completely anonymous and the identity of the participant or their organisation will not be revealed in any way. This data will be used in the completion of a dissertation as part of studies for a MSc. in Management of Information Systems, Trinity College Dublin.

DECLARATION:

- I am 18 years or older and am competent to provide consent.
 - I have read, or had read to me this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me.
 - I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.
 - I understand that if I make illicit activities known, these will be reported to appropriate authorities.
 - I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.
 - I understand that I may refuse to answer any question and that I may withdraw from completing the survey at any time without penalty.
 - I understand that my participation is fully anonymous and that no personal details about me will be recorded.
 - Since this research involves viewing materials via a computer monitor I understand that if I or anyone in my family has a history of epilepsy then I am proceeding at my own risk.
 - I understand that I cannot name any third parties in any open ended text field of the questionnaire. Any such replies will be made anonymous. In the unlikely event that illicit activity is reported during the study, I will be obliged to report it to the appropriate authorities.
- Do you accept the above declaration and agree to participate in this**

survey? (Select one option)

Yes

Go to Page No. 2

No

Stop, you have finished the survey

page 2

2. Have you been involved in using Agile methods to execute / manage / participate in software development projects? (Select one option)

Yes

Go to Page No. 3

No

Stop, you have finished the survey

If Did Not Answer Then
Go to Page No. 3

page 3

3. Have you used iterations or sprints in your agile software development projects? (Select one option)

Yes

Go to Page No. 5

No

Go to Page No. 4

If Did Not Answer Then
Go to Page No. 4

page 4

4. Would you like to continue to participate in this survey in relation to iteration / sprint lengths? (Select one option)

<input type="radio"/> Yes	Go to Page No. 5
<input type="radio"/> No	Stop, you have finished the survey
	If Did Not Answer Then Go to Page No. 5

page 5

5. What roles / responsibilities have you held so far in your experience within the context of using Agile methods to deliver software development projects? Please select as many as applicable:

- Software programming
- Project management
- Programme management
- Project owner
- Quality Assurance
- Team management
- IT department management
- Business analysis
- System / application Architecture
- Infrastructure engineer
- Operational excellence engineer
- Product owner

Other (please specify) _____

page 6

6. How many years of experience have you had so far working with Agile methods? (Select one option)

- Less than one year
- One to two years
- Three to five years
- Six to ten years
- Greater than ten years

page 7

7. In which sectors / industries has your main experience of agile methods been in so far? Please select as many as applicable:

- Pharmaceutical
- Agriculture
- Construction
- Energy
- Retail
- Health care

<input type="checkbox"/>	Financial services
<input type="checkbox"/>	Insurance
<input type="checkbox"/>	Manufacturing
<input type="checkbox"/>	Telecom
<input type="checkbox"/>	Hospitality
<input type="checkbox"/>	Aerospace
<input type="checkbox"/>	Defense
<input type="checkbox"/>	Public sector
<input type="checkbox"/>	Other (please specify) _____

page 8

8. What agile methodologies have you mainly used in your experience so far? Please select as many as applicable:

- Scrum
- Extreme Programming (XP)
- Feature Driven Development (FDD)
- Kanban
- Lean software development
- Crystal methods

<input type="checkbox"/> Dynamic Systems Development Method (DSDM)
<input type="checkbox"/> Custom or other method (please specify) _____

page 9
9. Is the iteration length used by you dictated by the agile method you use? (Select one option)
<input type="radio"/> Yes
<input type="radio"/> No

page 10
10. Have you worked with fixed or variable length iterations / sprints or both? (Select one option)
<input type="radio"/> Fixed only
<input type="radio"/> Variable only
<input type="radio"/> Both

page 11
11. What fixed iteration or sprint lengths have you most commonly used in your experience so far? Please select as many as applicable:
<input type="checkbox"/> Less than one week

One week
 Two weeks
 Three weeks
 Four weeks
 Five weeks
 Six weeks
 Seven weeks
 Eight weeks
 Other (please specify) _____

page 12

How do the factors on the left hand side limit the choice of iteration /sprint lengths?

12. Please select one of the following options:

	Compels you to increase the iteration/sprint length	Compels you to decrease the iteration/sprint length	Does not impact the iteration/sprint lengths
(a) Smaller project team (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) Lower technical capability in the team (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(c) Team less experienced in agile methods (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

(d) Team geographically more distributed (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(e) Higher degree of uncertainty in the requirements (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(f) Higher complexity of the IT application / eco-system (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(g) Higher dependency on outsourcing for software development (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(h) Decrease in overall project duration (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(i) Automated building, testing and deployment of software not in use (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(j) Fourth generation languages not in use (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(k) Project management / agile tools not in use (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(l) Team resources shared among multiple projects (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(m) More time spent on iteration planning / review / retrospective meetings or related tasks (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(n) Customer feedback required more frequently (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

page 13

13. Which of the following factors provide greater flexibility in increasing or decreasing iteration /sprint lengths? Please select as many as applicable:

- Larger project team
- Higher technical capability in the team
- Team more experienced in agile methods
- Team geographically less distributed
- Lower degree of uncertainty in the requirements
- Lower complexity of the IT application / eco-system
- Lower dependency on outsourcing for software development
- Increase in overall project duration
- Automated building, testing and deployment of software in use
- Fourth generation languages in use
- Project management / agile tools in use
- Team resources not shared among multiple projects
- Less time spent on iteration planning / review / retrospective meetings or related tasks
- Customer feedback required less frequently
- If there are any other factors impacting iteration/sprint lengths, please specify: _____

(i) Telecom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(j) Hospitality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(k) Aerospace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(l) Defense	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(m) Public sector	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

page 16

For each industry / sector listed, please select whether it tends to shorten or lengthen the iteration/sprint length:

16. Select one of the two options:

	Tends to favour longer iteration/sprint lengths	Tends to favour shorter iteration/sprint lengths	Don't know
(a) Pharmaceutical (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) Agriculture (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(c) Construction (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(d) Energy (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(e) Retail (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(f) Health care (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(g) Financial services (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(h) Insurance (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

(i) Telecom (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(j) Hospitality (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(k) Aerospace (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(l) Defense (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(m) Public sector (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

page 17

17. Do you believe that the iteration / sprint length is a crucial aspect of agile software development methods? (Select one option)

Yes

No

18. Please provide your reasons for your answer to the above question:
