



Expertise
and insight
for the future

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Project and Service Management methodologies in IT environments

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PREFACE

I chose this topic for the thesis, because it has been closely related to my work during the past ten years. I have been working as a Project Manager, team leader, and Service Manager in a variety of IT in the organisation and have seen the struggles of managing the related challenges. Another reason I chose the topic, was because the topic is interesting, and the deeper familiarization made during the writing process serves as a learning tool for myself to raise my professional skills.

The biggest challenge in doing the writing was understanding and compiling a large amount of information and putting it into shape I was satisfied with.

During the writing process, I learned a lot about different methodologies, theory and better understood the challenges I have faced in my work in the past. By doing this thesis, I will be able to perform better in my work in the future.

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<p>Change is constant and most IT organisations and IT service providers have adapted to a formalized methodology to manage the related work. Change is important because it enables the businesses to respond and meet the ever-changing needs of customers. This thesis describes the most used methodologies for managing work related to change and their benefits and practical implementation. However, a formalised methodology is not like a ready-made set an organisation can just start using, but more like a guideline which the organisation needs to tailor to suit their need. Processes and culture need to support the methodology to be successful. Co-existence of multiple different supporting methodologies is often required to achieve the best results.</p> <p>A literature review is used to collect data for this thesis, which then describes commonly used Project Management, Agile methodologies, and IT Service Management practices. A traditional Project Management (waterfall) approach divides the activities into a sequence of separately executed steps. It focuses on preparatory planning where factors like budget, scope, and schedule are prominent and change to original plan is not desired. Agile prioritize quick and flexible adaptation to changes, iterative development cycles, collaboration, and commitment to continuous improvement. Both have their benefits and drawbacks.</p> <p>Some organisations and their Project and Service Management characteristics are described in this thesis. Recommendations and guidelines are provided to avoid the most common pitfalls and how to aid in delivering successful projects. Some of the tools that are commonly used to support organisations are described. Many organisations are well on the way to leveraging the methodologies described in this thesis, but some are facing serious challenges. In general, inefficiency in management can have detrimental effects on the organisation's success and losing the competitive advantage. A key finding is that the focus needs to be in providing business value and consistent execution of the selected methodology.</p> <p>Project and Service management in general are broad topic but it is possible to piece together the big picture and define the place of each methodology and formulate recommendations and guidelines for implementation. However, each environment is unique and thus requires processing according to its features. Knowledge of all the intricacies related to Project and Service Management requires years, if not decades, of experience. This work is no substitute for that experience but understanding the key points is vital for success for organisations and their employees.</p>	
Keywords	Project management, PRINCE2, ITIL, Agile, Scrum

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List of Abbreviations

ART	Agile release train (SAFe)
CAB	Change Advisory Board (ITIL)
CapEx	Capital Expenditure Budget
CCB	Change Control Board (PMBOK)
CCTA	UK government Central Computer and Telecommunications Agency
CI	Configuration Item (ITIL)
CMDB	Configuration Management Database (ITIL)
CMS	Configuration Management System (ITIL)
CSI	Continual Service Improvement (ITIL)
DSDM	Dynamic System Development Method (Agile)
IP	Innovation and Planning (SAFe)
IT	Information Technology
ITIL	Information Technology Infrastructure Library
ITSM	Information Technology Service Management (ITIL)
I&A	Inspect and adapt (SAFe)
KPI	Key Performance Indicator (ITIL)
RAD	Rapid Application Development (Agile)
RFC	Request for Change (ITIL)
PI	Program Increment (SAFe)
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMO	Project Management Office (PMBOK)
PMP	Project Management Professional
PRINCE2	PRojects IN Controlled Environments
PSI	Potentially Shippable Increment (SAFe)
RFC	Request for Change (ITIL)
SaaS	Software-as-a-Service
SAFe	Scaled Agile Framework
SLA	Service Level Agreement (ITIL)
SVS	Service Value System (Lean)
TPS	Toyota Production System (Lean)

1 Introduction

Organisations and employees are under constant change. Some form of change can be observed all the time, whether it be a local supermarket where employees are stacking products on the shelves that have been emptied or a newly introduced payment system by a transport company. The mere passage of time contributes to a wide range of changes. Change enables the businesses to improve, to respond, and meet the ever-changing needs of customers. In a book by Anderson and Ackerman Anderson [13 p1] it was noted that continued success requires change. Change always introduces new and exciting opportunities.

In the field of Information Technology (IT), several ways to control change have been developed. Change happens when teams are developing a new product or performing daily IT system maintenance. To manage the change in repeatable and efficient manner, most IT organisations and IT service providers have adapted to utilizing a formalized methodology. A more significant change which usually has some larger impact and requirements, and has a start and an end, is often managed as a project. A set of smaller changes that are performed all the time, are often managed under IT Service Management. Agile methodologies are another approach to manage change in an a more iterative way towards a common, but initially not as clearly defined goal.

For most people, the purpose and deep understanding of the requirements of each methodology is not clear and therefore may cause inefficiency. Many organisations are well on the way of leveraging these methodologies, but some organisations are facing serious challenges related to efficiency with managing the work related to change. Most issues arise from the fact that a formalised methodology is not like a ready-made set an organisation can just start using, but more like a guideline which the organisation needs to tailor to suit their need. Processes and culture need to support the methodology to be successful.

The traditional way of managing projects is the waterfall approach, where project activities are divided into a sequence of separately executed controlled steps, and each step has dependence on the deliverables of the previous step. It focuses on preparatory planning where variables like budget, scope, and schedule are prominent and change to original plan is not desired. There might be also regulatory reasons to implement strong

and effective internal controls which are prominent with waterfall methodologies. Moeller [18 p49] has stated that since the beginning of IT auditing, there has been a need for creating and validating internal controls. A more recent development are the Agile concepts, which give prominence to teamwork, customer collaboration, flexibility and embrace change. Both have their benefits and drawbacks. The most important points of each methodology are described using the literature available about Project Management and Service Management methodologies. Some of the tools that are commonly used to support organisations are also introduced in this thesis.

In addition to the theory, observations and experience are utilized to summarize the key points with practical examples. Based on this, several recommendations, and best practices related to the most common pitfalls to avoid and the ensure success of the project are introduced. Different organisation types which utilize these models in their operations are also described. Inefficiency with the projects can also have a detrimental effect on other areas, which are also described in this thesis.

The introduction of a methodology to an organisation is often done in a situation when an organisation acknowledges that the current way of working is no longer efficient or producing desired results. Drikus [20 p254] has described this scenario as a Task conflict, which is about a disagreement in responsibilities or contents of a task. According to Drikus, “this type of conflict happens naturally in a team and while there is still uncertainty about the benefits of such conflict, it would seem that it can sometimes help a team to find better and improved ways to deal with various tasks”. [20 p254] A thorough comprehension of the purpose and requirements of each methodology needs to be established before it can be implemented. The most typical pitfall to avoid is the partial implementation of a methodology which is caused by lack of understanding the methodology. For example, an organisation can decide to implement an Agile methodology and set up individual teams, and leadership assumes that managing work with a Kanban board alone is enough to be an Agile team. However, this is by no means the case. One of the basic ideas of Scrum is that any member of the team can perform any of the tasks in the sprint. Expertise is often focused on specific individuals and true way of working as a scrum team is not achieved. Another significant problem arises if, for instance, the Product Owner mandated by the is not assigned. The Product Owner has an important role in describing and prioritizing producer characteristics and decision-making. A development team that is devoid of a product owner might not know what they should do.

This thesis is divided into six parts:

- The first section introduces the general background about the methodologies.
- The second section describes the theory and principles for common Project Management methodologies.
- The third section describes different types of organisations which utilize these methodologies.
- The fourth section describes real life scenarios organisations have, practical recommendations and best practices.
- The fifth section describes different tools which are being used to support the work.
- The sixth and final section is about the conclusions.

Project and Service Management in general are a broad topic but is possible to piece together the big picture and define the place of each methodology and formulate recommendations and guidelines for implementation. However, each environment is unique and thus requires processing according to its features. Knowledge of all the intricacies related to Project and Service Management requires years, if not decades, of experience. This work is no substitute for that experience but understanding the key points is vital for success for organisations and their employees.

2 Purpose of methodologies in delivering services and products

There is a long history of managing complex and challenging tasks and work. It is generally agreed that a reproducible and time-tested methodology provides better chance for the success and enhancing the quality of the work. A structured set of processes, tasks and tools provide guidance for successful execution of a project or ongoing task. For sake of clarity, all these frameworks or methodologies are called methodologies in this thesis. A methodology can be generally defined as a collection of methods and principles used to carry out a specific task.

To deliver successful products and services, a careful selection and adaptation of methodology is required. Cobb [22 p19] has noted that organisations need to understand deeply the underlying principles to know how to apply it in the specific business and project settings. Therefore, each relevant methodology needs to be studied and

understood. Each have their benefits and drawbacks, and in many situations the optimal solution is a combination of methodologies which are compatible with each other.

A notable challenge for organisations is finding the balance between the two following competing but equally important necessities:

- Maintaining day to day business operations, often referred to “business as usual”.
- Transforming the current business operations to persist and prosper in the future business changes.

Hinder [5 p30] has explained that implementing a new invoice-processing system will transform the way the finance department works after the project. This is a typical scenario where the change has a significant impact on an organisation. Business as usual on the other hand is “something that is part of an organisation’s normal operations”. [5 p30] Hinder [5 p30] also explains that the tasks in this scenario are done repeatedly. A similar task will be done again and again. Therefore, the outcome of the task is quite predictable.

A methodology helps organisations map out the progression of the individual steps, from beginning to completion. The methodologies discussed in this thesis includes all aspects of the project or task, from required resources and tools to specific processes and tasks. Methodologies provide the following benefits:

- A methodology provides means to perform the task repeatedly with the same quality level.
- A methodology can be taught to individuals.
- Lessons learned are used to improve the methodology.
- A documented methodology increases the likelihood that individuals are aware of their tasks and responsibilities.
- Gives signs of possible problems before they may occur.
- Allows organisations to react to issues proactively and properly when issues occur.

The traditional way of managing projects is the waterfall approach, where project activities are divided into a sequence of separately executed controlled steps, and each step has dependence on the deliverables of the previous step. Waterfall approach focuses on preparatory planning where variables like budget, scope, and schedule are

important. In the waterfall methodology changes to original plan is not desired. Agile concepts prioritize quick and flexible adaptation to changes, collaboration, iterative development cycles, fast releases, and commitment to continuous improvement. Both have their benefits and drawbacks, and characteristics of both approaches are discussed in the next chapters.

2.1 Project Management

Project Management is a discrete area of expertise which was originally identified in the 1950's in the engineering industry. Previously, projects had been managed using task charts and the techniques were not standardized. The Project Management Institute (PMI) was founded in the United States in 1969, and eventually in 1996 published the definitive Guide to the Project Management Body of Knowledge (PMBOK). The PMBOK guide describes the techniques, processes, and knowledge areas for any generic type of project.

Another major Project Management methodology is PRINCE2 (PRojects IN Controlled Environments 2), which according to Hinder [5 pxvi], evolved and was first published in 1989 from a previously used methodology by the United Kingdom's Central Computer and Telecommunications Agency (CCTA). The second revision of the methodology is PRINCE2, which was released in 1996 and the latest update was published in 2017. Today, PRINCE2 is one of the most used and recognized project management methodologies around the world and especially in the UK government where it originated from. According to Hinder [5 pxvi], PRINCE2 has been successfully utilized in many industries like banking, IT, pharmaceuticals, and other technology industries.

In the true meaning of the word, a project can be anything from manufacturing, relocation, or commissioning of a complex product. This thesis focuses on the IT Projects, but a few other examples are listed in Table 1.

Table 1. Types of projects.

Type of Project	Project outcomes (Examples)
Construction	Construction of a house

Code development	Mobile application
Installation of IT hardware	New production servers with networking
Relocation	Office and personnel move into a new location
Product development	Pharmaceutical product
Physics research	Theoretical research to support development of new type of airplane design

Projects can be thought as a container for processes and techniques which are used to introduce change in a controlled manner. A project can be also described as a temporary organisation with an objective of creating products according to a predefined business case. Another definition of a project is a temporary effort undertaken to create a new product or service. Therefore, there are some major differences between handling daily operations and managing the work of a project.

A product, outcome or deliverable can be defined as everything the project must create or change. The deliverables of projects can be diverse, e.g., practical objects or installation and configuration of equipment into an IT datacenter. Projects can also deliver immaterial products like improved brand image or organizational changes. A project creates both management products as well as specialized products. Hinder [5 pxvi] has described several types of features which separates project related tasks from day-to-day operations:

- The purpose of the project is to introduce change.
- A project organisation is working only temporarily. Business as usual continues after the outcome of the project has been delivered. Projects have an agreed beginning and an end.
- A project is cross-functional. Projects include a group of individuals with different skills cooperating temporarily to deliver the agreed change. Projects often cross the normal organizational borders.
- Every project is unique.
- Projects are riskier and may oppose threats and possibilities that are not necessary present in everyday business.

Typical among all the Project Management methodologies is that they concentrate on three most important goals: schedule, budget, and quality. Raydugin [23 p8] has claimed that the following three project objectives are traditionally considered:

- Schedule
- Capital expenditure budget (CapEx)
- Scope, Quality and Performance

A Project is considered successful when it meets the previously agreed schedule, does not exceed the budget, and has the expected level of quality. A key role in a project is a Project Manager who creates and utilizes industry-customized and reusable templates. This enables the project plans to become beneficial and repeatable, with the purpose of improving quality, lowering costs, and minimizing the time to produce the deliverables.

The Project Management methodologies discussed in this thesis, are often classified as waterfall methodologies. A key concept is to divide the activities into a sequence of steps which are executed separately in controlled manner. Each step has dependency on the deliverables of the previous step. Considerable criticism exists towards waterfall Project Management methodologies and argue that the methodologies are outdated. Even though the waterfall methodologies provide clear structure, it can be described as defect of the model, because the end goal is defined too early, and it makes changes and testing along the way difficult. For these reasons, the project can end up with a product which does not meet the customer requirements. Project management is also a demanding discipline and utilizing a methodology does not guarantee project success. It requires experienced Project Managers to handle all the required tasks defined by the methodology. Hinder [5 pxvi] has also claimed that project success is not guaranteed when using PRINCE2 methodology, but chance of project achieving its defined objectives is significantly increased.

However, some reasons still exist where a waterfall model could be preferred. In projects where human life is at stake, like in healthcare, there might not be possibility for iteration so waterfall model can provide more suitable structure. Also, some government projects follow such strict standards and requirements defined by law, that Agile methodology might not be compatible.

2.2 Agile methodologies

Agile methodologies are a widely endorsed philosophy and a set of methodologies to create and release complex products. Agile principles emphasize the discovery of

requirements and solution development through the cooperative endeavor of skilled self-organizing and cross-functional teams and customers. It emphasizes adaptation to any changes in the development work with focus on flexible and continuous progression. Two examples of commonly used Agile methodologies today based on these ideas are Lean and Scrum. PRINCE2 also provides a tailored adaptation to Agile which claims to support project work in organisations with Agile teams.

Pons [21 p542] has referred that conventional project management, like PRINCE2 or PMBOK, demand relatively complete pre-agreed description of deliverables, which can cause issues for new product development. According to Pons [21 p542], changes to deliverables are possible especially when research is needed.

Measey [4 p2] has stated that, Agile ideas emerged in the late 1940's, when Taiichi Ohno, Shigeo Shinko and Eiji Toyoda came up with the 'Toyota Way'. Basis for today's Lean manufacturing methodology originates from the ideas from Toyota Production System (TPS). According to Measey [4 p33], the principal focus of Lean is to improve by solving problems with the intent of providing customer value. Removal of waste throughout the value stream is done systematically. Lean software development also draws heavily from these ideas.

To counter the issues with overregulation and micro-management with the existing waterfall methodologies, like PRINCE2 or PMBOK, many more simplified and straightforward software development methodologies were developed during the 1990's. According to Measey [4 p3], Tom Gilb's Evo and Barry Boehm's Spiral methodologies are examples which heavily influenced the Agile thinking in the early 1990's and eventually evolved into Rapid Application Development (RAD). Another influential 1990's methodology was DSDM, which focused on delivery within projects. Many notable failures to deliver were seen during this time. Measey [4 p3] has stated that the failures happened in teams and organisations who thought that they were developing products based on RAD but were unable to change their management culture, delivery practices and behaviour which led to many failures. This is an important lesson because this is still often seen today.

A group of software developers published the Agile Manifesto in 2001. They described the principles under one collective name and terms of reference. According to Measey [4 p4], this led to the birth of Agile as a concept. The first Scrum book was also published

during the same year by Ken Schwaber and Mike Beedle, which evolved from the concepts of Scrum Agile Process by Takeuchi and Nonaka. The Agile Manifesto makes four statements of values [4 p5]:

- Individuals and interactions over processes and tools.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change over following a plan.

Agile Manifesto [4 p6] also makes a statement about 12 Agile principles, which take a stand on prioritizing customer value, positive response to change, collaboration with stakeholders, team building and interaction.

Common methodologies to manage teams according to the Agile principles and values are Scrum and SAFe. PRINCE2 and ITIL V4 also claim to include Agile principles. These methodologies are described in this thesis.

2.3 IT Service Management

In today's world, many companies are involved in providing a service and a significant portion of these services are digital because the digital environment provides so many opportunities to enrich the services being produced. Cloud services and infrastructure are everywhere and leveraging opportunities of digitalization gives successful organisations a significant competitive advantage.

World is changing so fast that successful companies manage service production and change with an established and predictable model of operating IT Service Management to ensure that change takes place in a controlled manner and new technologies and capabilities are effectively implemented. Thejendra [19 p20] has referred the term IT Service Management as a professional methodology, where an IT department follows a methodology to deliver support for information systems efficiently and reliably, which meets customer's business requirements.

As a service is not necessarily best suited to be managed as a project or something that an Agile team would produce, a practice of IT Service Management has been

established. The ITIL V4 guide [1 p16] claims that ITIL is the world's most widely adopted guideline on IT Service Management (ITSM). Project Management and Agile methodologies are closely related to running various IT services.

3 PRINCE2 Project Management methodology

PRINCE2 is an open Project Management methodology, and it is one of the most widely endorsed methodologies for managing project work. According to Hinder [5 pxvii], PRINCE2 provides organisations with a comprehensive and structured project techniques and principles to guide the team through a waterfall type project. Hinder [5 p29] has stated that purpose of the project in PRINCE2 is to create a temporary organisation that's intent is to deliver products according to a previously agreed Business Case. PRINCE2 is often described as prescriptive, which means that it defines the tasks, responsibilities, and schedule for a project.

3.1 Structure of PRINCE2

Hinder [5 p32] has stated that the main elements which PRINCE2 methodology addresses in the project management context are principles, themes, processes, and the project environment.

- The principles are the main requirements and methods that define the practices on how to manage a PRINCE2 project. If not all seven principles are applied, then it is not a PRINCE2 project.
- The processes provide a step-by-step guidance to manage a project from start to finish. Checklists are provided for each of the seven processes including recommended activities, products, and related responsibilities.
- The themes include descriptions of the points which need to be addressed continuously during the project along with the other ongoing project tasks. Various Project Management disciplines and their necessity requires specific handling in PRINCE which the seven themes address.
- The project environment provides guidance for tailoring PRINCE2 to the project environment. Several types of projects exist, and environments are unique. Projects may be very large or small with only a minimal amount of work.

Each of these elements is discussed in the next sections.

3.1.1 Principles

The seven PRINCE2 principles can be summarized as following.

Continued business justification

Hinder [5 p38] has stated that PRINCE2 project requires a justifiable, documented reason to start it. Throughout the project lifecycle, the justification should also remain relevant. The justification also needs to be documented and approved within a Business Case. Lastly, the project should be ended if the project can no longer be justified.

Learn from experience

In PRINCE2, project members and teams are striving to continuously learn from experience. According to Hinder [5], learning is performed:

- At the start of a project, by reviewing similar and previous projects whether they contain valuable lessons to be learned.[5 p69]
- During the project, by the team continuing with learning and including all lessons in the project documentation.[5 p231]
- At the project closure, when the team passes on the lessons.[5 p243]

In PRINCE2, every team member has a responsibility to proactively look for improvement through the past experiences.

Defined roles and responsibilities

PRINCE2 methodology defines a set of specific project roles and responsibilities. According to Hinder [5 p39], a project team often consists of a mix of cross-functional, full-time, and part-time resources across organisational borders. All project teams should include the following primary stakeholders: Business sponsors, users, and suppliers. To be successful according to PRINCE2, an explicit Project Management team structure should be maintained in projects. This consists of defined and agreed upon roles and responsibilities for the whole project team. Establishing a way to efficiently communicate within the team is also required.

Manage by stages

PRINCE2 methodology divides the project in stages which have their separate control, planning, and monitoring activities. Better control can be achieved with shorter controls, but longer stages reduce the work for senior decision makes. Purpose of a stage is to

provide the decision makers with points of control at relevant times during the project life cycles. PRINCE2 requires that each stage includes:

- An assessment of the project status
- A review of the Business Case validity and project justification
- A decision about continuing or ending the project

Hinder [5 p38] has stated that “there is always a planning horizon, beyond which it is difficult to forecast”. Issues with planning horizon are addressed with:

- Dividing project tasks into multiple parts
- Creating a Project Plan which contains the high-level plans and a more detailed Stage Plan.

According to Hinder [5 p38], the minimum number of management stages in PRINCE2 is two: An initiation stage and one or more management stages. Each stage is described on the section ‘Processes’.

Manage by exception

PRINCE2 methodology mandates that project objectives are set with appropriate limits of tolerance. If a tolerance is exceeded, the exception is escalated to next management level. PRINCE2 describes the relevant governance, accountability, and responsibilities to direct, manage, and deliver the project at each level of the project. According to Hinder [5 p41], the tolerances are set for objectives about schedule, budget, scope, risk, quality, and benefits. Hinder’s [5 p41] opinion is that management by exception reduces the need for managers to allocate time for project activities.

Focus on products

PRINCE2 project focus is on creating the initial product descriptions and delivery of the products in accordance with the requirements. According to Measey [4 p41], the focus in PRINCE2 project is especially on the quality aspects and the outcomes.

Tailor to suit the project environment

A PRINCE2 project elements should be tailored to fit in the environment context. According to Hinder [5 p247], related factors are project size, complexity, importance, and risk. The authors of PRINCE2 claim that the benefit of PRINCE2 is that it is suitable

any type of project setting. PRINCE2 can be utilized for very small projects so long as few critical elements remain.[5 p253]

- The role of Project Executive (to serve as the Project Board) is required.
- The role of a Product Manager is required.
- A Product Initiation Document must be produced during the combined Start Up a Project and Initiating a Project stages.
- There must be at least one working stage and formal closure.
- Controls may be informal with informal reviews and reports (if necessary, these may be verbal).

Very large projects can benefit from using the PRINCE2 methodology to maintain control.

There are three areas that have been intentionally left out of PRINCE2. According to Hinder [5 p39]:

- Aspects which are specific to the industry, are outside the methodology scope
- Detailed techniques are deliberately excluded, because many techniques are already defined which are supported by the elements of PRINCE2. E.g. Critical Path Analysis.
- Leadership skills are out of scope. Even though these skills are essential with the day-to-day activities, it is difficult to be describe them universally.

This emphasizes the principal ideas of PRINCE2, which describes what should be done and why, but not how.

3.1.2 Processes

In PRINCE2, a process is a structured collection of closely related tasks which utilizes resources and capabilities (input) to create a previously agreed outcome (output). A process contains all the activities and other elements that are needed to deliver the products. Different PRINCE2 processes and relation to each other is illustrated in Figure 1.

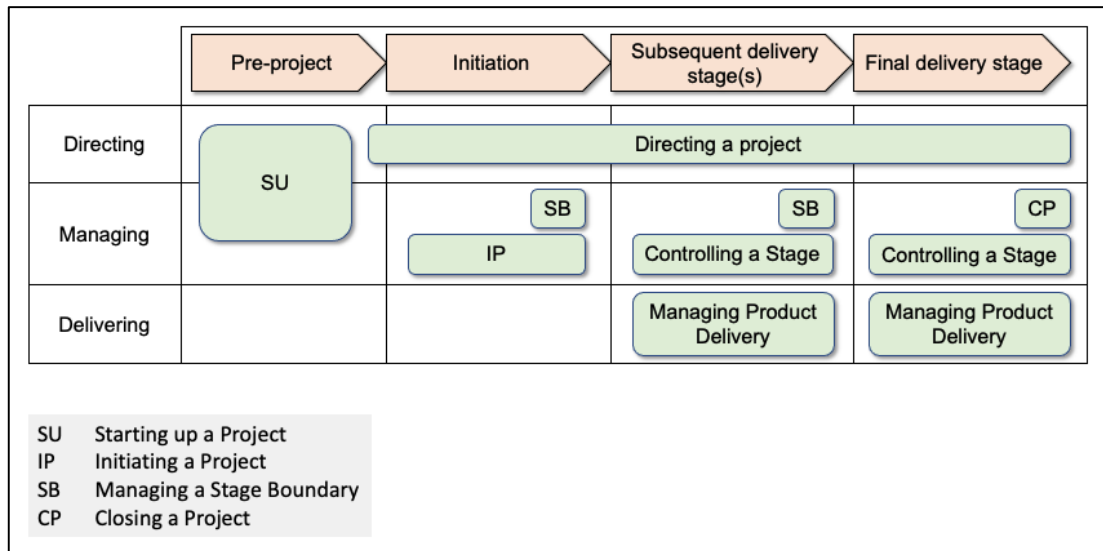


Figure 1. PRINCE2 processes.

Starting up a Project process marks the beginning of the project and the Pre-project stage. It includes activities for the managing and directing levels. Initiation stage continues after Pre-project stage. Managing a Stage Boundary process is utilized after the Controlling a Stage has concluded and transition to subsequent stage is ongoing. Project Closure and Product Delivery are managed during the Final delivery stage.

Starting Up a Project

During the Starting Up a Project process, the requirements for Initiating a Project process are verified. According to Hinder [5 p52], activities during Starting Up a Project stage include:

- Executive and the Project Manager are appointed
- Lessons learned are reviewed from earlier projects
- Project Management team is assigned.
- Business Case is defined.
- Project Brief is created Project Approach is decided
- Initiation stage planning is performed.

Initiating a project

To establish the basis for a successful project, the Initiating a Project process is utilized by the Project Manager and Project Organisation to define, describe, and understand the requirements for producing the project deliverables.

Managing Stage Boundaries

During the Managing the Stage Boundary process, the Project Manager reports the relevant information to Project Board. Project Board reviews and reacts if needed based the status report of the current stage. If there is a deviation to the current plan, according to Hinder [5 p224], an Exception Report is provided to Project Board which may then request that the current stage or project is reconsidered.

Managing Product Delivery

The objective for Managing Product Delivery process is to ensure that the work carried out by the team members is relevant. According to Hinder [5 p220], another objective for this process is ensuring that other stakeholders are aware of the deliverables being produced and what is the expected effort needed, the budget and schedule.

Closing a Project

Closing a Project is the process defined by PRINCE2 which includes the required activities at the project closure. The process activities provide the Project Board with relevant information about the project status for possible project closure. According to Hinder [5 p323], the Closing a Project enables the Project Board to decide whether to authorize the closure of the project and confirm the project deliverables.

3.1.3 Themes

PRINCE2 themes are the elements of Project Management which are required to be performed in parallel to other elements. The authors of PRINCE2 claim that the seven PRINCE2 themes provide additional ways to ensure project success.

Business Case

The Business Case theme describes the potential profitable idea and the development into a meaningful product for the organisation. Business Case also ensures that the project focus remains on the objectives of the organisation.

Organisation

Project members work over organisational borders, so the normal management structures do not serve the purpose. The Organisation theme addresses the organisational aspects of effective project work. Figure 2 illustrates the PRINCE2 organisation.

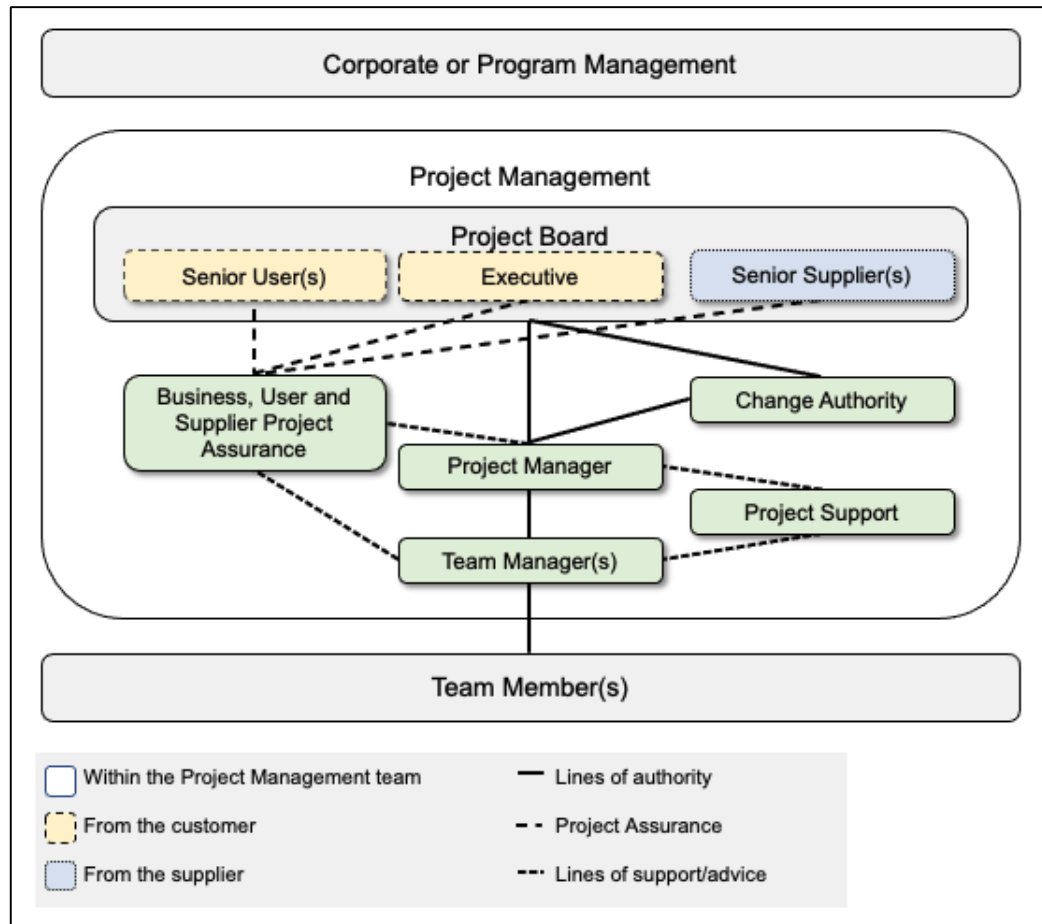


Figure 2. PRINCE2 project organisation.

PRINCE2 defines several groups in the Project Management level. Hinder [5 p56, p63, p50] describes five different groups or people and their responsibilities:

- Project Board is responsible for decisions.
- Project Assurance is responsible for monitoring the project management quality.
- Change Authority is a group who has some delegated change authority from the Project Board.
- Project Manager is the single person managing the daily activities.
- Team Managers are responsible for managing the teams.

Quality

As Hinder [5 p67] describes, quality theme describes the quality aspects of the deliverables and the related management activities for Project Manager.

Plans

PRINCE2 projects advance on step-by-step basis as described by the plans. According to Hinder [5 p67], the PRINCE2 plans are created based on the requirements of the project setting. Plans are a key instrument for control and communication and during the project.

Risk

Project typically introduces additional risks compared to the normal daily operations. Risk theme addresses the risks within the project context and the tools for Project Management.

Change

Change theme addresses the response to unexpected changes to the original project scope during the project. A change might arise from within the project, e.g. as a quality issue, or there might be requirement for change from stakeholders. Hinder [5 p175] lists the following project management products which are used to manage change:

- Configuration Management Strategy
- Configuration Item Records
- Issue Reports
- Issue Register
- Product Status Accounts.

Progress

The Progress theme manages the validity of the current plans. It is used as a basis for making decisions based on the status reports and other metrics. The Progress theme is vital when decisions are made regarding the viability of the project

All the seven themes described are required by PRINCE2 to be utilized. However, consideration is recommended based on the project size and environment.

3.1.4 Project environment

Projects are managed in many types and sizes of environments. Hinder [5 p33] claims that tailoring is recommended, and PRINCE addresses this aspect with the Project environment element.

3.2 PRINCE2 workflow

Pre-project

To project is initialized with the project mandate. Hinder [5 p328] has described that the corporate or program management provides the project mandate, and it contains the project definition and justification. Hinder [5 p43] explains that after project mandate, the Starting Up a Project process validates the viability of the project before full project scoping. Key roles of Executive and Project Manager are also appointed during the process. Project Brief and a Stage Plan are created during the Starting Up a Project to launch the project and Project Management team is appointed. Finally, the Project Board makes a decision whether to continue with the project based on the previous steps.

Initiation stage

At the initiation stage, Project Manager is responsible for creating the Project Initiation Documentation and planning the transition to next stage. According to Hinder [5 p328], the Project Board has the responsibility to decide upon the authorization and continuation the project and its first delivery stage. Project Board reviews and validates the Project Initiation Documentation and decides about continuing with next step.

Subsequent delivery stages

The Project Board authorizes the daily control to the Project Manager on stage-by-stage basis. As explained by Hinder [5 p46], the Project Manager is responsible for:

- Assigning the work items.
- Ensuring the outcomes are being created according to the requirements.
- Obtaining relevant approvals.
- Ensuring that the project is progressing according to the plans and tolerances.
- Keeping all the Project Management logs up to date.
- Keeping the Project Board informed about the project status.

Controlling a Stage describes the tasks to control the work during each stage. Team Managers and team members are responsible for performing the work packages assigned by Project Manager and keep the Project Manager informed about the statuses.

Final Delivery Stage

Purpose of the Final Delivery stage is to close the project in controlled manner. According to Hinder [5 p49], this is achieved by the following activities:

- The deliverables are put in to use and the project ends.
- An assessment is performed to review the project performance.
- The project organisation and resources are disbanded.
- End Project Report is created.

The project closing also includes activities to review the success. The last process which concludes the project is the Closing a Project process.

4 PMBOK Project Management methodology

The basis for Project Management Body of Knowledge (PMBOK) methodology is described in the PMBOK Guide. It is published by American Project Management Institute (PMI). The PMBOK Guide is often characterised as descriptive. The meaning for this is that the methodology defines techniques for Project Management, the inputs and outputs to processes, and knowledge areas, but it does not provide guidance for the usage. PMBOK self-defines as a standard in Project Management, and not as a methodology since PMI itself was approved by the American National Standards Institute (ANSI) to be a standards developer.

A closely related term with PMI and PMBOK is Project Management Professional (PMP) which is a certification designed for project professionals.

Key elements in PMBOK are Process Groups, Knowledge Areas, Tools and Techniques. Process groups and Knowledge areas are discussed in the next chapter.

4.1 Process Groups

PMBOK standard is defined as 47 discrete processes. These processes are grouped as Process Groups. Bell and Orzen [10 p2] describe the processes groups in following manner:

- Initiating Process Group contains the processes for new project definition.
- Planning Process Group contains the processes for scoping the project and other key items
- Executing Process Group includes the processes for performing the planned tasks.
- Monitoring and Controlling Process Group includes the processes related progress reporting and related tasks.
- Closing Process Group includes the processes for project ending.

PMBOK Process groups and Process flow is illustrated in Figure 3.

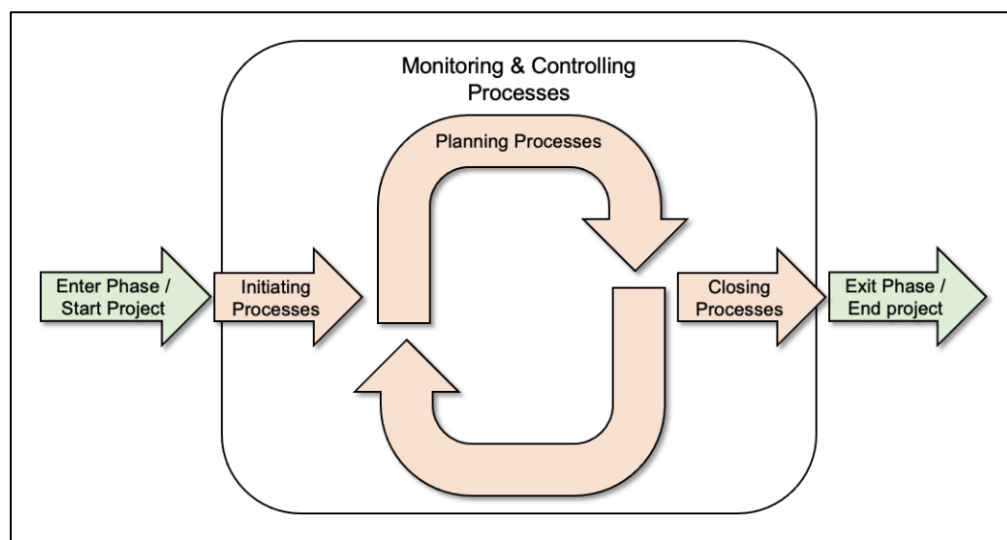


Figure 3. PMBOK Process Groups.

A process is a collection of repeating activities performed in structured and controlled manner. Bell and Orzen [10 p2] define a process in PMBOK as the activities which are developing a pre-specified product, result, or service. They also note that inputs, tools and techniques, and outputs are key aspects of a Process.

4.2 Knowledge Areas

Knowledge Areas group the processes defined in the previous. According to Stackpole Snyder [9 p4], Knowledge Areas are the specific aspects of Project Management which have specific knowledge requirements regarding technique, tooling, inputs, and outputs:

- Project Integration Management contains activities for Project Management Process Groups.
- Project Scope Management contains activities for controlling the relevant scope
- Project Time Management includes activities to control the schedule.
- Project Cost Management includes activities for controlling project costs.
- Project Quality Management includes the processes related to quality.
- Project Human Resource Management includes the activities control project team.
- Project Communications Management includes the activities to control the communication of information regarding the project.
- Project Risk Management includes the activities related to controlling the uncertainty in the project.
- Project Procurement Management includes the procurement related processes.
- Project Stakeholder Management includes the activities to control stakeholders and impact, and their expectations effectively.

This emphasizes the fact that the process details are described within the Knowledge Areas.

4.3 Comparison with PRINCE2

PRINCE2 describes all the stages required to start the project, manage it during the project and finally end the project, in detail. PRINCE2 is characterised as prescriptive, which means that it defines the tasks, responsibilities, and schedule for a project. The PMBOK in the other hand is descriptive in nature. The meaning for this is that the methodology defines techniques for Project Management, the inputs and outputs to processes, and knowledge areas, but it does not provide guidance for the usage.

There are other differences as well. PMBOK includes procurement planning,[9 p147] but PRINCE does not because it assumes that the environment is bound by a contract. PRINCE2 has also intentionally scoped out specialist aspects, detailed techniques, and leadership capability. Differences with roles are listed in Table 2.

Table 2. Comparison between roles in PRINCE2 and PMBOK

PRINCE2 role	PMBOK role
Project Board	Not defined
Executive	Project Sponsor
Senior User	Not defined
Senior Supplier	Not defined
Project Assurance	Not defined
Project Manager	Project Manager
Team Manager	Not defined
Project Support	Project Management Office (PMO)
Change Authority	Change Control Board (CCB)

Both PMBOK and PRINCE2 have significant amount of detail included. Applying them all is unrealistic but the key thing both methodologies recommend is to tailor the methodology to suit the environment.

5 IT Service Management - ITIL

ITIL provides organisations with the relevant principles, practices, and guidance to support IT Service Management across organizational boundaries. It also enables effective decision-making and guideline for day-to-day work. These guidelines are not organisation or technology specific and can be applied on many types of levels to measure and eventually improve the services. ITIL is also a way to present the maturity of an operation.

ITIL also provides a way for professionals to teach, learn and portray knowledge of the model, through formal training and certification. Gallacher and Morris [3 p19] have claimed that ITIL methodology is currently the most well-established framework for Service Management and a significant number of individuals worldwide have taken and passed the ITIL Foundation exam. They also have claimed that it is important for most IT professionals to possess the ITIL Foundation certification and it is often required in job advertisements.

ITIL was originally created by the Central Computing and Telecommunications Agency (CCTA) in the United Kingdom during the 1980's for government agencies to increase quality.

Most used version of ITIL is V3, which is described in the following chapter.

5.1 ITIL V3

ITIL V3 was published in 2011 and as described by Gallacher and Morris [3 p45], it utilizes a set of processes within five service lifecycle stages: Service Strategy, Service Design, Service Transition, Service Operation, and Continual Service Improvement.

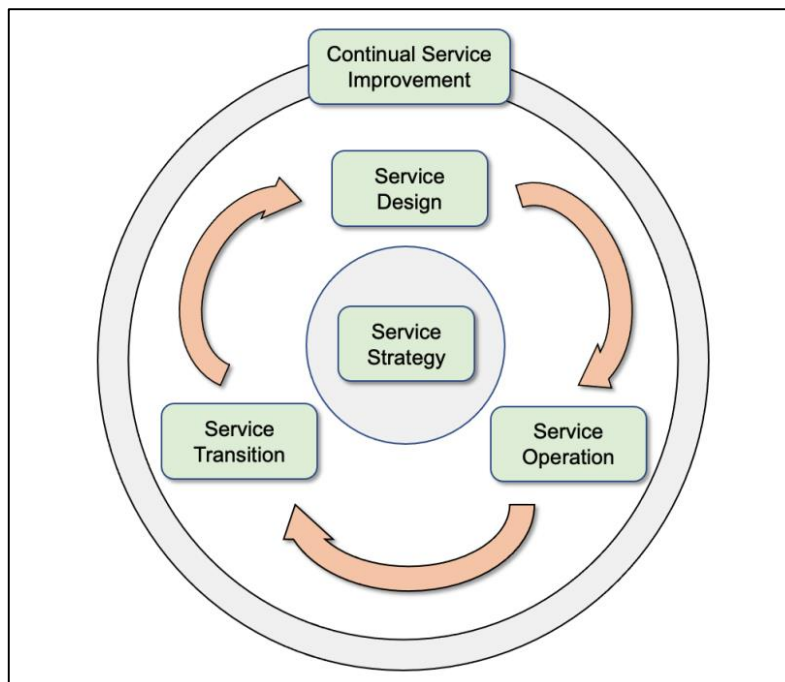


Figure 4. ITIL V3 lifecycle stages.

The five stages of service lifecycle are focused on a specific phase. The five stages and their relation to each other is shown in Figure 4.

5.1.1 Service Strategy

Objective of this lifecycle stage is to plan and decide the strategy to serve the customers. As described by Gallacher and Morris [3 p49], it is essential for organisation to identify the service type and service level which supports the customers and their success best. Also, it is essential to organise properly to deliver the services.

At this lifecycle stage, it is necessary to understand what kind of approach is taken, what kind of services are produced, what kind of value they produce, as well as the formation of a comprehensive service structure. In addition, the documentation of plans for the of the strategy. As described by Gallacher and Morris [3 p 48], service strategy is in the central position within the service lifecycle. The purpose of this lifecycle stage is to determine the Service Management strategy for the entire lifecycle.

5.1.2 Service Design

Service to be provided are outlined during the the Service Design lifecycle stage. The objective is to have the design in accordance with the intended value and the selected strategy. It is not possible to provide services without functional solutions. It is critical for the solutions provided to meet the requirements and work properly. In addition, care must be taken for their management and architecture. A bad design can mean the intended strategy cannot be implemented. Problems which may arise at this stage may be related to technology architecture, technology choices, capacity, security problems, or problems in subsequent development. Not everything can be predicted in advance, so improvement is also needed along the way.

Service Design is the lifecycle stage where organisation needs to plan ahead. Gallagher and Morris [3 p71] have noted that planning is often neglected because there is often a strong need to move forward with minimal planning. However, this might backfire and cause delays later. It is important to control risk accordingly to guarantee success of all stakeholders.

5.1.3 Service Transition

Objective for Service Transition lifecycle stage is to implement the designed IT services. This lifecycle stage controls the service changes and ensures Service Management processes are performed structured and controlled manner. Examples include software or hardware upgrades, bug fixes, new deployments which significantly affects the service provided. At this phase, the business or production organisation accepts the new functionalities.

Gallacher and Morris [3 p141] have summarized the objectives for this lifecycle stage as following:

- Control the service changes properly, regardless of introducing new service or retirement of old ones.
- Control the risk related to the change.
- Deploy to production environments with success.
- Maintain realistic expectations for the services
- Verify that expected business value is achieved after a change is done.
- Maintain high-quality information and knowledge about the services provided.

The most important embodiment of this lifecycle stage is the process for Change Management. For example, transition from Service Design to Service Operation lifecycle stage introduces change. Change Manager leads to activities during the process and collaborates with the Change Advisory Board (CAB). Change Management accurately and in repeatable manner describes and takes in to account the various controls, dependencies, stakeholders, by which changes are made.

Typical CAB meeting agenda might include, but not limited to the following topics, as described by Gallacher and Morris [3 p154]

- Change proposals
- Requests for Change (RFC)
- Pending Changes and progress updates on current Changes
- Change schedule adjustments

- Review of Change failures and Changes without proper authorization
- Proposed upcoming changes

Key Change terminology described by Gallacher and Morris [3 p146, p147, p148, p149] is summarized in Table 3.

Table 3. Change terminology.

Term	Description
Change	Any type of alteration or addition of assets that potentially have any type of impact on the services.
Request for Change (RFC)	A proposal for a modification of a configuration item. The proposal holds all the details of the change. Other types of records are used to control the actual change.
Change Record	Documentation of the details of the change being performed.
Standard Change	A standard change is a type of change which has been previously authorized due to being well understood and often done repeatedly.
Emergency Change	A type of change used to prevent or resolve a high-priority issue with significant impact. Often has a priority over other changes with lower impact
Normal Change	A Change which is not Standard or Emergency Change, which requires creation of RFC, authorization for change and the actual change coordination, implementation, and closure.

Change management is often one of the most well-defined processes in an IT organisation which has adapted to ITIL V3. The reason for this is that a failure at this stage is often reflected in immediate business impacts, so organisations are typically well prepared to manage change.

5.1.4 Service Operation

Purpose of this lifecycle stage is to ensure that IT services are being delivered properly and efficiently as in accordance with the service agreement. Service Operation lifecycle stage contains the tasks the IT service is supposed to perform under the normal operational phase. E.g., resolving support requests, handling installations, and performing other routine tasks. These tasks must be performed in accordance with the Service Level Agreement (SLA). Other tasks included in this process include monitoring, availability management, capacity management, and reporting. Gallagher and Morris [3 p177] have explained, that the purpose of the Service Operation lifecycle phase is to

deliver the service as agreed on in the Service Level Agreement (SLA). The key processes of the Service Operation lifecycle stage explained by Gallacher and Morris [3 p194, p217, p223, p220] are summarized in Table 4.

Table 4. Key processes within Service Operation lifecycle stage.

Process	Description
Incident management	An incident is an issue with an IT service, related to e.g., availability or quality.
Problem management	A problem is a more significant issue that is causing single or multiple incidents. Problem management provides structured methods to investigate and resolve the root causes of the issues.
Event management	An event is an occurrence of any state change or message received and observed that has some relevance to the service. An event can be an informational about user logging in or a log message indicating a system error.
Access management	Access request is needed to gain access to a resource which is only granted for individuals who have the authorization and denied from others.
Request fulfillment	Handling of Service requests which may include any type of user request, e.g., resetting a password or installing a software.

To be more specific, purpose of the Incident Management is to resolve an issue and restore the normal operational state interruption, but without necessary understanding the underlying cause for the interruption or preventing it from reoccurring. An Incident has different attributes: category, priority, impact, and urgency. Problem Management process includes the activities related to documenting, investigating, identifying, and eliminating the underlying cause of the Incident and prevent it from recurring. This process is an important part of the service operations process. Often, these also have a significant impact on the success of overall service delivery. Objective of Problem Management is to find a workaround or a permanent solution to problems.

5.1.5 Continual Service Improvement

To improve the services, ITIL V3 introduces the Continual Service Improvement (CSI) concept. It is not a separate process but an integral part of the other lifecycle stages and constantly involved in other activities. Improving services is in everyone's interest. For the customer this is reflected in a quality service that develops and generates added value. For the service provider, this means that the business will succeed, new

opportunities for new services will emerge, and the services will be able to be provided cheaper and with higher quality.

Gallagher and Morris [3 p228] have summarized that the objective for of Continual Service Improvement lifecycle stage is to maintain and improve the service performance and value to respond to customer requirements. Continuous improvement can be approached, for example, with the following questions: what we do with our vision, where are we now, where do we want to go, how do we get there. To answer these questions, Gallacher and Morris [3 p231] have explained that various methods can be utilized, from measurable metrics to current state analyses.

Development targets are recorded in the CSI register which can include the e.g., size, timing, metrics, and rationale for the improvement. All improvements should include ways for measurement. According to Gallacher and Morris [3 p233], a method ITIL promotes for continual improvement, is the Deming cycle described in steps which is summarized in Table 5.

Table 5. Deming cycle.

Step	Description
Plan	Outline the steps for developing the improvement.
Do	Perform the improvement and record status to the CS.
Check	Verify that the improvement is being utilized.
Act	Perform the relevant measurements and act proactively if required

CSI also includes techniques for implementing the improvements. According to Gallacher and Morris [3 p237], this lifecycle stage includes all required techniques to identify and define improvements as well as implementing them.

5.2 ITIL V4

The beginning for ITIL V4 was in 2019 with the publication of ITIL Foundation book. This introduces dramatic shift for ITIL V3 processes to other concepts. ITIL V4 has significant emphasis on reducing complexity and providing straightforward solutions. However, the

five ITIL V3 lifecycle stages and 26 processes are still valid after the release of ITIL 4 and are still used widely. ITIL V4 is based on two key concepts, which are the four dimensions model and Service Value System (SVS).

Compared to the distinct ITIL V3 processes, ITIL V4 instead describes 34 practices. The practices provide organisations more flexibility to implement tailored ITIL processes, to support their environment-specific requirements. This idea is similar to ideas in Lean which is discussed in Chapter 9 of this thesis. The major differences with ITIL V3 are listed in Table 6.

Table 6. Differences between ITIL V4 and V3

ITIL V4	ITIL V3
Service Value System	Service Lifecycle
7 Principles	9 Principles
34 Practices	26 Processes
Four Dimensions of Service Management <ul style="list-style-type: none"> • Organisations & People • Information & Technology • Partners & Suppliers • Value Streams & Processes 	Four P's of Service Design <ul style="list-style-type: none"> • People • Partners • Products • Processes

Each of these differences is discussed in the next chapters.

5.2.1 Four dimensions model

AXELOS [1 p19] has outlined the four key dimensions with the ITIL V4:

- Organisations and people
- Information and technology
- Partners and suppliers
- Value streams and processes.

The four dimensions' purpose is to ensure that a balance of importance between each dimension is maintained. Also, AXELOS [1 p43] has emphasized the considerations about the impact of external factors on the four dimensions.

Various external factors are continuously affecting the four dimensions and the variables are constantly changing along the way. AXELOS [1 p43] has also argued that the Service Value System needs to be assessed from the viewpoint of all dimensions. If done inadequately, it can result in mediocre performance and low-quality products. Each dimension is explained next in detail.

Organisations and people

The operating model has significant impact upon the people and the organisations in ITIL V4. A key message from AXELOS [1 p34] has been that the organisations today are continuing to be more complex as the time passes, so the alignment of processes, responsibilities, and ways of sharing information to support the operating model is becoming more critical.

A fundamental concept in ITIL V4 affecting organisations is value. ITIL defines value as the benefits, usability, and importance of something. Instead of the traditional way of service provider unilaterally providing the service for the customer, the customer also participates in the production of the value. This is a major shift from the previous way of thinking. AXELOS [1 p21] has claimed that organisations who have adapted to ITIL V4 acknowledge that value is generated together cooperatively with the providers of the service and customers. Service providers cannot work on the value on their own but need to proactively engage in service relationships where close collaboration is embraced to materialize any achievable and potential service value chain benefits. In ITIL V4, Service Management involves a wide variety of stakeholders, each with a defined role. ITIL V4 defines following groups of stakeholders and the value they are receiving. AXELOS [1 p24] has defined the roles in six categories which are listed in Table 7.

Table 7. ITIL V4 roles.

Stakeholder	Value for the stakeholder
Customer	Receives the generated benefits Financial aspects of the service are optimal

Service provider	Economic benefit Development opportunities for Business Reputation increases
Employees of the Service provider	Salary Professional skills increase Purposeful tasks with possible benefits to the society
Society and community	Jobs Tax income Possible benefits of the service to the society
Shareholders	Profits Trust for continuing business success

Other key definitions provided by AXELOS [1 p26] with the ITIL V4 dimensions are products and services. These are further divided as the goods, resource accesses, actions with service, relationships with the service and outcomes.

Information and technology

Information and technology dimension is related to the technologies used to support the Service Value System. This includes workflow management systems, knowledge bases, inventory systems, communication systems and analytical tools. The benefit it produces is the information which is generated from the service. AXELOS [1 p35], has described that this dimension addresses the technical aspects and sharing of information supporting the service operations.

Partners and suppliers

The partners and suppliers dimension has been designed to address the collaboration between all stakeholders that are contributing during any of phases of service operations, e.g., implementations or support. According to AXELOS [1 p39], all related agreements and contractual relationships are also addressed in this dimension.

ITIL V4 defines this dimension because almost all organisations are in some way dependent on other organisations and services. Often these relationships are defined by agreements which may be strict or less formal. Many organisations acknowledge that it is better to focus on their main area of business and procure some services from external suppliers due to cost efficiency or quality benefits.

Value streams and processes

Value streams are simply the set of tasks that construct the flow which is generating the desired value. AXELOS [1 p41] has described value stream as a series of tasks that the provider uses to develop and services or products to customers.

5.2.2 Service value system

Service Value System (SVS) aims to describe and enable close collaboration and interlinked process model throughout the organisation. Ideally an ecosystem is formed where all stakeholder benefit from each other. Purpose of SVS is to provide a flexible model for delivering and continuously developing services like DevOps. The main idea behind DevOps is to integrate software development (Dev) and IT operations (Ops) with a set of practices. The key idea is to respond adapt quickly to changing requirements from stakeholders. The Service Value system is displayed in Figure 5.

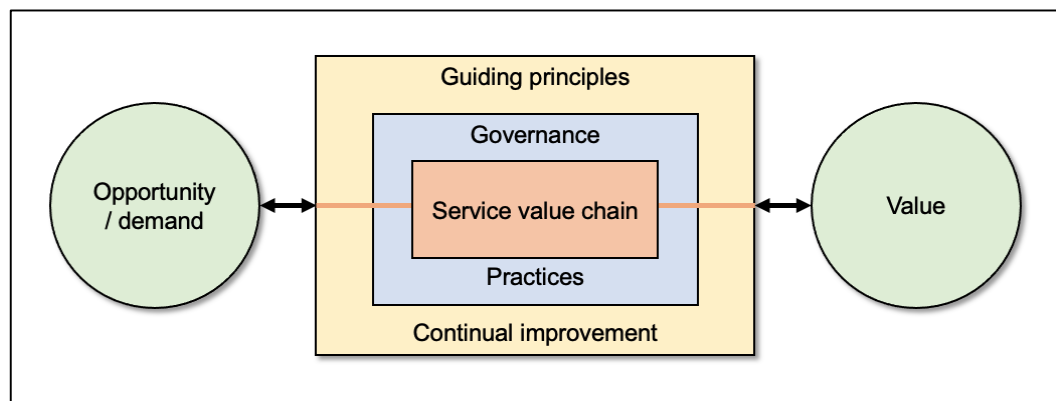


Figure 5. ITIL V4 Service Value System workflow.[3]

The Service Value System (SVS) portrays a way of different parts of the service provider collaborating to facilitate value creation. The SVS in ITIL V4 consists of:

- Guiding principles
- Governance
- Service value chain
- Continual improvement
- Practices.

All these elements are discussed next in detail.

Guiding principles

The guiding principles defined by ITIL V4 contain similarities with Agile methodologies. For example, iterative progression with a feedback is recommended. In addition, ITIL V4 directs the teams to leverage existing work if possible. In this way, there is no need to spend resources on developing a new one. In addition, it encourages collaboration for optimization and automation. According to AXELOS [1 p46], the guiding principles provides organisations with guidance on how the organisation is supposed to be reacting in changing environment regardless of any situation.

Governance

AXELOS [1 p64] defines that a governing body with the overall accountability exists within all organisations. Examples of people or persons who perform related activities include board of directors and executive officers. These groups or persons are accountable for the compliance within the organisations. Governance can be provided with following three activities: Evaluate, direct and monitor. In practice, therefore, the organisation must constantly evaluate its strategies as well as direct based on the evaluating. In addition, the suitable metrics must be in available.

Service value chain

The six service value chain activities defined by ITIL V4 embody the phases an organisation undergoes during the value creation. The activities are:

- Plan
- Improve
- Engage
- Design and transition
- Obtain/build
- Deliver and support.

The service value chain generates output via series of process steps triggered by an input. According to AXELOS [1 p65], the inputs can be coming from an external source outside the Service value chain. All the six activities are interacting between others and providing different impulses for each other. The activities are performed using different combinations of practices defined by the methodology.

Continual improvement

The continuous development model follows very much the ITIL V3 model, described earlier in this thesis.

Practices

Practices are methods which are utilized in parallel with all the four dimensions of ITIL V4. AXELOS [1 p78] defines Practices as a collection of methods and techniques within the organisation which have been developed to support the work or objective being performed.

6 Agile methodologies – Scrum

Scrum is a work management methodology which provides methods and techniques for Agile teams in value generation activities. It advocates adaptive ways to develop solutions for complex issues problems. Pries and Quigley [24 p1] have noted that Scrum focus is on the needs from the business during a product development lifecycle. Scrum mandates the appointment of a Scrum Master for the Scrum team, who is an individual responsible for facilitating efficient collaborative cyclical development circumstances for other members in the Scrum team. The basic operation model in the Scrum team is:

- A Product Owner is responsible for prioritizing the work related to the complex product being developed. Priorities are stored Product Backlog in the form of ordered feature list.
- The Scrum Team develops the selected items cooperatively into a representable Increment. The development work is done during a Sprint.
- The Scrum Team and stakeholders are responsible for checking the results and required changes for the for the next Sprint.
- The cycle is starts from beginning.

An objective of Scrum is to be straightforward and easy to understand. The Scrum methodology has been intentionally left partial with the purpose of defining only the aspects that are required to fulfil the requirements of the theory. Main idea is that collaborative work increases overall team creativity and productivity compared to people working individually. Scrum emphasizes working relationships and collaboration instead of providing guidance about techniques. However, many types of working methods can

be utilized when practicing Scrum but Scrum quickly reveals any inefficiency with management practices or circumstance, while enabling opportunities for improvement.

6.1 Scrum History

Harvard Business Review published an article 'The New Product Development Game' by Hirotaka Takeuchi and Ikujiro Nonaka in 1986 and described Scrum for the first time. According to Viscardi [8 p36], the article mentioned the term Scrum when discussing about product development. According to Viscardi [8 p36], the main argument was that product delivery speed and flexibility must be improved to be able to compete in the market. To achieve this, the focus should extend also farther than just scoping, scheduling, and budgeting. They proposed a comprehensive approach where the idea was to work as an interacting team, adapting to changing conditions and passing the development ideas between each other, as it is done in rugby, where the team is working together towards a joint objective. While working towards the objective the rugby team adapts to changing conditions and passes the ball between team members.

Scrum was first used by Jeff Sutherland and formalized by Ken Schwaber in 1995.[8 p36] Sutherland and Schwaber also published the definitive Scrum Guide which describes the key concepts and elements of Scrum. The Scrum Guide is a compact, well thought guide and definition of Scrum.

6.2 Scrum Theory

Main concept behind Scrum theory is its foundation on Lean values and learning from experience, also known as empiricism. Schwaber and Sutherland [7 p 3] argue that empiricism is the method how knowledge is accumulated, and the right decisions are possible based on the experience and evidence. The idea with Lean values is to incorporate reduction of waste on keeping the focus on important things. To control risk and predictability, Scrum utilizes an iterative approach to development. In contrast to waterfall projects and to avoid lack of information about what is being developed, according to Viscardi [8 p43], Scrum aims to provide predesignated occasions when the evidence-based status of the development can be reviewed and replanned if needed.

Scrum consists of four events that are utilized to review the development status continually and adjust the work when needed. These events occur within a Sprint and carry out the main evidence-based principles of Scrum which are transparency, inspection, and adaptation. These principles provide tangible visibility to the development status.

6.3 Scrum Values

Scrum employs five values which, according to Schwaber and Sutherland [7 p4], depends on participating team members being competent at them.

- Commitment signifies the commitment of the team members to common objectives while working as a collaborative team.
- Focus signifies the priority of achieving the goals with the highest level of quality.
- Openness signifies that the team discusses the development and issues freely.
- Respect signifies that the team values their colleagues.
- Courage signifies ability to make bold decisions and embracing exploration of complex issues as they arise.

These values guide and influence the work and of Scrum Team during their daily activities. Based on the arguments by Schwaber and Sutherland [7 p4], the Scrum values reinforce and support the essential Scrum foundations of empiricism, learning from experience and focusing on creating value.

6.4 Scrum Team

The most basic collaborative working unit in Scrum is the Scrum Team. The Scrum Guide [7 p5] defines Scrum Team members as one Scrum Master, one Product Owner, and Developers. They work together towards a common Product Goal, without having any other formal roles within the organisation. They are an efficient team of people who possess the necessary skillset to achieve the Product Goal, organize and decide about their work independently without any external management.

A notable characteristic about a Scrum Team is that they are relatively small number of people, usually less than 10. However, the team is able develop substantial work during

a Sprint because of great potential of share information between team members efficiently. If team needs to grow larger, Schwaber and Sutherland [7 p5] advice to divide the team to multiple teams with same objectives.

The Scrum Team mandates for several responsibilities related to the development. According to Schwaber and Sutherland, [7 p5] they are responsible for development tasks, collaborating with stakeholders, verification of increments and all other activities which are required. They are being trusted to provide the results with their work and the organisation around them supports it.

6.4.1 Developers

In Scrum methodology, developers need to have broad skills to do the development work needed. According to Scrum Guide [7 p5], developers are responsible for:

- Deciding how Sprint Goal is achieved, in the form of Sprint Backlog.
- Focusing on quality by establishing and maintaining the Definition of Done.
- Adjusting the work continuously to achieve the Sprint Goal.
- Acting professionally and expecting same from other team members.

Developers are the people who are responsible and committed to creating the actual shippable increments in the Sprint.

6.4.2 Product Owner

The Product Owner is the single person who is accountable for the Product reaching its full potential and value. According to Schwaber and Sutherland [7 p5], Product Owner collaborates with Scrum Team to achieve these results by utilizing their development effort. The Product Owner maintains the Product Backlog which is used to order work from the Scrum Team. According to Schwaber and Sutherland [7 p6], the responsibilities of Product Owner includes:

- Provide description of the Product Goal in the Product Backlog
- Develop and keep Team members informed about Product Backlog Items
- Sorting Product Backlog items.
- Making sure that the Product Backlog is clear and acknowledged.

It is important to note that for Product Owners to succeed, the whole organisation beyond Scrum Team must respect their decisions. The Product Owner can be a representative for other stakeholders within the organisation, so according to Schwaber and Sutherland [7 p6] they are also available to be influenced by other on the contents of Product Goal. Schwaber and Sutherland [7 p6] claim that Product Backlog clearly portrays the decisions of Product Owner and are available for review in the Sprint Review in form of Increment.

6.4.3 Scrum Master

The Scrum Master is a key role who is accountable for laying out the foundations for the team to work according to Scrum principles. According to Scrum Guide [7 p6], Scrum Master assists and serves the team and other stakeholders in the organisation on utilizing the Scrum principles. Several activities exist for Scrum Masters to help with upholding the principle with the Scrum Team:

- Scrum Master helps the Scrum Team in establishing efficient self-organisation and utilization of different skills within the team.
- Scrum Master coaches the Scrum Team to concentrate on the important Increments and quality aspects.
- Scrum Master eliminates obstacles that are affecting the Scrum Team's work.
- Scrum Master upholds the overall good atmosphere and schedule in the Scrum events.

The Scrum Master also assists and coaches the Product Owner. According to Scrum Guide [7 p7], The Scrum Master is responsible for following activities:

- Scrum Master aids on how to utilize different tactics when defining Product Goal and managing Product Backlog.
- Scrum Master coaches the Scrum Team with instilling knowledge about importance of Product Backlog item quality.
- Facilitation of efficient and timely cooperation between stakeholders.

The Scrum Master has also responsibilities towards to organisation surrounding the Scrum Team. According to Scrum Guide [7 p7], The Scrum Master is responsible for the following activities:

- Scrum Master coaches the organisation about Scrum principles.

- Scrum Master plans and supports the organisation with their Scrum introduction.
- Scrum Master assists inexperienced individuals in their Scrum journey and the evidence-based principles.
- Scrum Master eliminates obstacles between stakeholders and developers.

To summarize, Scrum Master is accountable that Scrum principles and activities are performed as intended.

6.5 Scrum Events

The various Scrum events are included and performed during a Sprint. The Sprint includes carefully considered events that promote continuous possibilities for review and opportunity to adjust the work based on the Scrum values. The purpose of these predefined events is to focus on the delivering the increment and eliminating any unnecessary meeting.

6.5.1 The Sprint

Sprints are the fundamental recurring cycles of work in Scrum. According to Scrum Guide [7 p7], the Sprint includes all the activities that are required to complete the Product Goal. To achieve consistency and routine, duration of Sprints is always the same, for example one month. Sprints are consecutive so a new Sprint begins after previous has been ended. There are several of other characteristics for Sprint defined by the Scrum Guide [7 p7]:

- Sprint Goal remains the same during a Sprint
- Quality remains the same or increases.
- The Product Backlog can be adjusted when required.
- Product Owner can adjust the Scope with the Team if needed.

The Scrum sprint flow is shown in Figure 6.

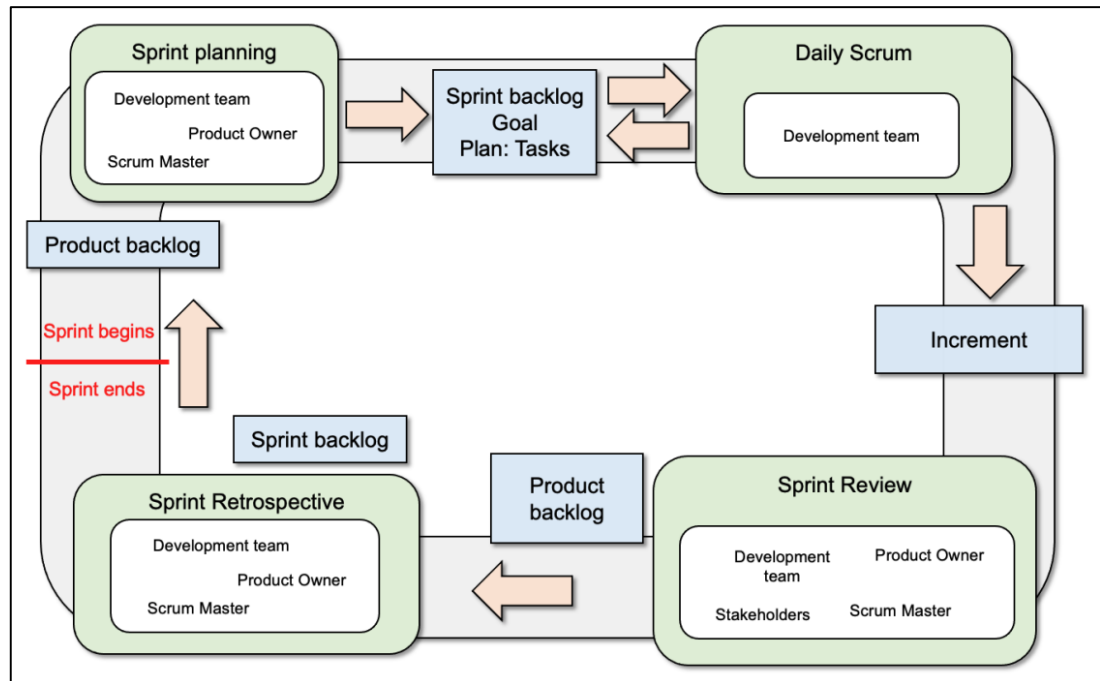


Figure 6. Scrum sprint flow.

The main idea with Sprint is that the continuous reviews and adjustments enable predictable results to reach the Product Goal which can be inspected in every Sprint. According to Schwaber and Sutherland [7 p7], shorter planning horizon also reduces risk of challenges becoming too complex or Sprint Goal becoming irrelevant, in which case the Sprint could be ended. Product owner can authorize ending of the Sprint.[7 p8] Common for most of the events is that they are timeboxed, meaning that the event lengths is restricted to certain time.

6.5.2 Sprint Planning

A Sprint begins with Sprint Planning event, performed by the Scrum Team. According to Scrum Guide [7 p8], Sprint Planning addresses the following topics:

- The Product Owner initiates the planning by suggesting improvements to the product. The Sprint Goal is the defined in collaboration between Product Owner and Scrum Team. The value is communicated to stakeholders.
- The Scrum Team decides which of the proposed Product Backlog items are included in the Sprint.

- To meet the Definition of Done, the developers plan and decide independently how to develop an Increment.

To complete the agreed tasks, different techniques are used. Experience from previous Sprints also helps the team plan the work forward.

6.5.3 Daily Scrum

The development team holds a 15-minute Daily Scrum meeting every day at the same time to discuss the development status, next actions, and possible issues. Daily Scrum is an opportunity for the Scrum Team to review the status against the Sprint Goal and adjust accordingly. The Scrum Guide [7 p9] has claimed that Daily Scrum is an effective event to promote productive collaboration, keeping individuals informed about the progress and recognizing possible issues. Developers often meet in additional sessions during the day to discuss specific topics further.

6.5.4 Sprint Review

In the Sprint Review event, the Scrum Team shows the results of the development work and interacts with other stakeholders and adjust the plans accordingly. According to Scrum Guide [7 p9], Sprint Review is also an opportunity to agree upon next actions and modify the Product Backlog based on the empirical experiences gathered during the Sprint.

6.5.5 Sprint Retrospective

In the Sprint Retrospective, the Scrum team collaborates to analyse the Sprint success against the Definition of Done and performance of working techniques. According to Scrum Guide [7 p10], the Scrum Team also interacts to learn from positive experiences and areas of improvement. The Sprint Retrospective is the last event in a Sprint.

6.6 Scrum Artifacts

To provide the essential information and portray the value and work, several Scrum Artifacts have been defined. According to Scrum Guide [7 p10], the Artifacts provide the team with measurable representation of progress information and promote commitment. The Scrum Guide [7 p10] defines the following Scrum Artifacts.

- Product Goal is defined to measure the progress of Product Backlog
- Sprint Goal is defined to measure the progress of Sprint Backlog
- Definition of Done is defined to measure the progress of the Increment

According to the Scrum Guide [7 p10], purpose of these commitments is to enhance the impact of evidence-based approach and adoption of Scrum values.

Product Backlog

The complete list of features that the product should be and look like, is documented in the Product Backlog. Scrum Guide [7 p10] describe it as a constantly evolving list of enhancements to the product owned by the Product Owner. Work originates only from Product Backlog which is prioritized by Product Owner. Product Backlog items that can be done during a Sprint needs to fit in to a single Sprint. If not, further refinement or breaking down for the items is needed.

Product Goal

The Product Goal is a description of the product that is used as an objective by the Scrum team as basis for all short-term planning and commitment. The Product Goal describes the product, the features, and capabilities in clear manner for developers so they can plan their work accordingly. The Product Backlog contains the Product Goal and a list of Product Backlog items that build up the actual product.

Sprint Backlog

The Sprint Backlog contains the following items [7 p11]:

- Sprint Goal, which is the common Sprint objective
- Product Backlog items, which the team develops during the Sprint
- A plan on how to deliver the Increment.

The Sprint Backlog is owned by the Development Team and according to Schwaber and Sutherland [7 p11], its purpose is to be a straightforward and accurate portrayal of work that needs to be completed to reach the Sprint Goal. The Scrum Guide does not specifically define how it should be visualized, but often a Scrum board is used. Scrum board is very similar to a Kanban Board which originates from Lean practices. Scrum board is often a physical board in the room where the Daily Scrum is held. Scrum board contains the individual tasks and user stories and their status. An individual user story

describes a feature of the product. A typical, but simplified example of a Scrum Board during a Sprint is illustrated in Figure 7.

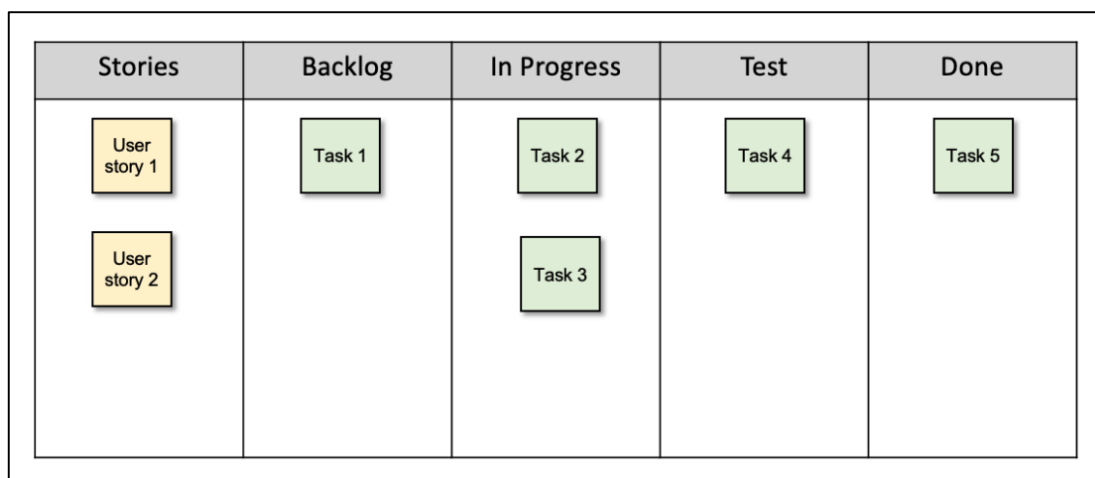


Figure 7. An example of a simple Scrum board.

A physical board has the advantage that anyone walking by can make a quick assessment on where the team is in the iteration. However, many tools, like Atlassian Jira, also provide this function integrated in the work management tool.

Sprint Goal

The Scrum Team is encouraged to work together and focus as a team towards a joint goal by defining the Sprint Goal. According to Scrum Guide [7 p11], it also decreases any room for inconsistency.

Increment

An Increment is the fundamental increase in value towards the Product Goal. Viscardi [8 p56] has described an Increment as the collection of work items that construct the deliverables the team has developed during the Sprint. The completed Increment is inspected and accepted in Sprint Review. The Scrum Guide [7 p12] notes that a valid Increment contains only work that matches the Definition of Done.

Definition of Done

The Scrum Guide [7 p12] defines Definition of Done as a clearly documented list of features or quality criteria which an Increment needs to reach to be accepted for release. The purpose of Definition of Done is enable visibility between all team members and stakeholders on the work that builds up the Increment. It is critical that the entire Scrum

Team has collectively agreed upon the contents of Definition of Done. A Product Backlog item cannot be released if it does not meet the Definition of Done criteria and therefore it is reinstated to Product Backlog.

7 Agile methodologies – SAFe

Scrum and other lightweight Agile methodologies are well established in software development but focus on team level work management, so organisations have started to look for alternatives beyond team-level. Cooke [25 p52] has noted that this seen in large IT organisations which are increasingly looking into methodologies to support scaling beyond single Agile teams up to multiple teams with hundreds of developers who share same common long-term objective. The Scaled Agile Framework (SAFe) is a methodology to address this demand. It draws from the experiences of the authors who found Scrum to be incomplete to provide solutions for these issues. SAFe one of the emerging methodologies with a collection guidelines and workflow patterns to assist organisations in scaling beyond individual teams and leveraging Lean and Agile principles and values.

Measey [4 p158] has stated that SAFe is not a completely new type of methodology, but incorporates several well-established principles and processes originating from other Agile methodologies. It also adds some own concepts to address the practicalities and techniques on all organisational levels. SAFe emphasizes the importance of mid-level planning cycles after three or more sprints. The main intent is to provide stability and enable long-term planning and predictability over work of several teams sharing the common objective. SAFe promotes many similar values and principles as other Agile methodologies. The four main SAFe values described by Measey [4 p158], are code quality, alignment, program execution, and transparency.

7.1 SAFE process model

SAFe is organised in three layers which contribute to the value provided: Teams which adopt Scrum, Programs which contain 5-12 Scrum teams which work towards common goal, and finally Portfolio which provides funding and coordination programs.

7.1.1 Teams

The teams work according to the Scrum methodology, using Agile principles and developing the products. There might be some differences in the way each team works and the teams' roles in bigger picture.

7.1.2 Program

The Program's main organisationally managed functional and value-delivering construction is Agile Release Train. It is also known as Agile program. This team-of-teams works in cycles of two to three months. No specific release schedule is defined, but outputs are always delivered on demand. SAFe promotes rapid development but on demand release.

SAFe defines nine roles at the program level. Measey [4 p160] has described their responsibilities:

- Product management is responsible for program backlog prioritization, communication and maintaining the objective
- Release train engineer is responsible of driving the program level improvement effort. The role is comparable to Scrum Master.
- Business owner is a stakeholder from senior management with accountability over delivery of the value. Business owner is actively participating in planning and release review activities.
- System architect is responsible for breaking down system level stories.
- User Interface team (UX) is responsible for creating a purposeful user experience.
- System team is responsible for providing the integration technology and processes along with continuous inspection.
- DevOps is responsible for building and improving the rapid deployment pipeline.
- Release management is responsible for synchronizing releases with other stakeholders.
- Shared resources are responsible for providing support in special scenarios

A key component in the operation of the Program is the 2-day planning event at the beginning of each Program increment, in which everyone from the teams participates. This event identifies the goals that are common or team specific and a plan is created

during the next 4-6 sprints of the program. Team will also vote for confidence in the commitment of the plan.

When the train is on the way there is also coordination between the teams. This facilitated by the release train engineer as a Scrum-of-Scrums meeting. Measey [4 p162] explains that Increments are presented to stakeholders at the end of each sprint to inspect the progress. It is common to have an innovation and planning sprint as a final sprint during the release plan cycle. Purpose of this Sprint is to provide opportunity to explore completely new ideas.

7.2 Portfolio

The purpose of Portfolio is to address wider topics, epics. They also provide funding for the Agile release trains. Basically, Portfolio contains the topics across multiple Agile release trains. Another topic covered by Portfolio are the financial aspects. Measey [4 p162] has stated that value stream is the important flow of customer value, which the Agile release train is continuously aligned towards and has an associated budget. Depending on the status of the current business environment and portfolio, the budgets might change. Portfolio layer also defines roles but those are not especially specific.

7.3 SAFe Agile architecture

SAFe promotes an emergent architecture (design grown incrementally) but acknowledges that it is not effective at scale. Therefore, some intentional architecture is required beforehand. According to Measey [4 p164], SAFe aims to do this just so that the teams can make progress effectively. Typically, non-functional requirements like reliability, scalability and maintainability are handled in program level.

8 Agile methodologies – Lean IT

Lean methodologies originated in the 1950's and have since been widely adopted across many industries. Lean thinking has gained traction in the IT industry as well. Lean IT advocates a wide-ranging shift in traditional way of thinking to alter the organisational

culture towards realizing the importance of value delivery. In ideal situation, Lean IT can support in enabling collaborative partnerships between IT and the business.

Running IT services consume a significant portion of the resources available in organisations. Roughly speaking, much of it does not necessarily provide any added value but is wasted on inefficient processes. Bell and Orzen [10 p3] have claimed that banking and finance enterprises have spent an average of 6.9 percent of revenue on IT in 2008. Bell and Orzen [10 p3] also claimed that if assuming 20% of IT investment does not provide any value to customer it can have detrimental effects on the benefits achieved.

By nature, IT, and business view things very differently. Business might think that IT is only interested in solving technical problems, often too slowly, instead of supporting business needs. IT on the other hand balances on constant reactive crisis management mode to handle the changing environment with upgrades and new releases. There is often more work than IT can ever complete.[10 p4]

8.1 Principles

A key idea with Lean philosophy is to improve the way of working, the processes instead of changing the people. Bell and Orzen [10 p19] have noted that this type of improvement lays out the foundations for empirical approach to improving process. It can encourage individuals to proactively look for and view challenges as an opportunity to improvement. Lean philosophy emphasizes the role of management in efficient communication, highlighting the communication of organisation's objectives and reasoning behind them. This can enable productive dialogue between management and teams to reach consensus. Great value creating improvement initiatives may develop when communication has been clear and people working with the customers identify improvement areas that correlate well with business objectives. According to Bell and Orzen [10 p33], value stream improvement for customer by solving problems and eliminating of waste, are the main objectives and focus on Lean.

8.1.1 Value stream

The value stream concept includes all necessary phases to develop a product from concept to a tangible object or service delivered to customer. This process includes several activities and Bell and Orzen [10 p54] have claimed that value stream improvement requires wide-ranging cross-functional collaboration and perspective.

Value is what the customer requires and what it pays for. It is known that not all activities produce value, but after a closer look unnecessary activities can be found. Counterpart of value in Lean is waste and the goal is to reduce it.

8.1.2 Value stream mapping

Value stream mapping is a visual portrayal of current state of information and workflow between different teams contributing to the value creation. The objective with value stream mapping is to identify areas where resources, time or materials are wasted. The benefit of value stream mapping, according to Cudney [16 p47], is that it very effectively outlines the bigger picture of the flow beyond of a single task and can reveal waste sources. Example of a value stream mapping for a Service Desk initial Routing Process is shown in Figure 8.

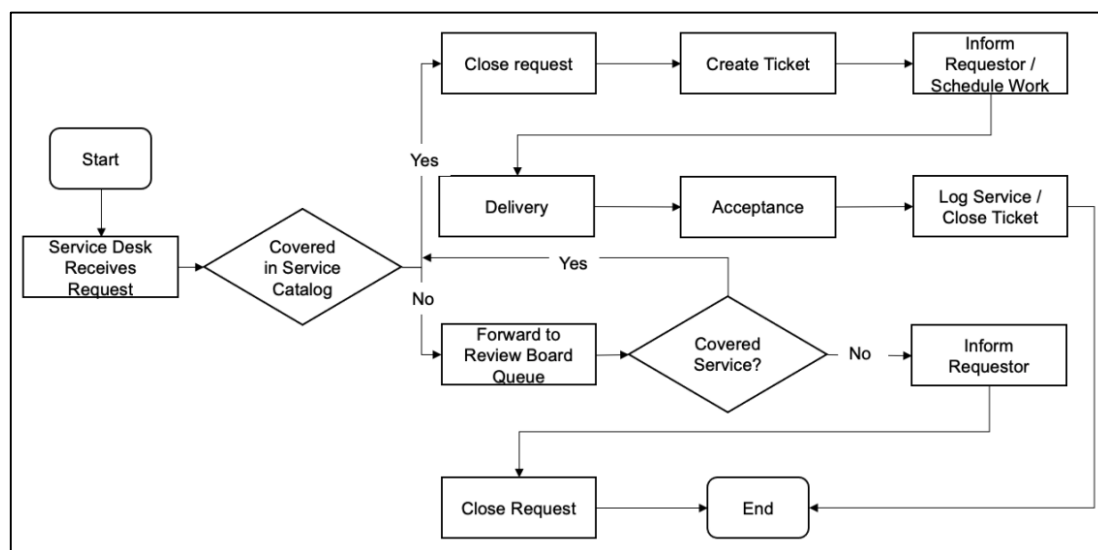


Figure 8. Example Process - Service Desk initial Routing Process.

Example in Figure 8 provides the information about entire process that can be useful for cross-functional teams to understand the information flow and improvement areas.

According to Bell and Orzen [10 p61], accurate evidence-based improvement area decisions are possible, when accurate value stream mapping is available.

8.1.3 Kaizen

Kaizen is a methodology originating from Japan to develop small improvements in a structured manner. It provides techniques to improve processes. Kaizen is one of the methodologies Lean utilizes for process improvement. Kaizen is divided in to two areas, system, and process.

- System kaizen focuses on improving the value stream by improving the flow of information and product components.
- Process kaizen focuses on waste reduction within the value stream. The objective is to optimize team work so that activities follow each other sequentially without any unnecessary waiting time. Purpose of Daily Kaizen is to identify improvements every day.

Kaizen methodology is illustrated in Figure 9.

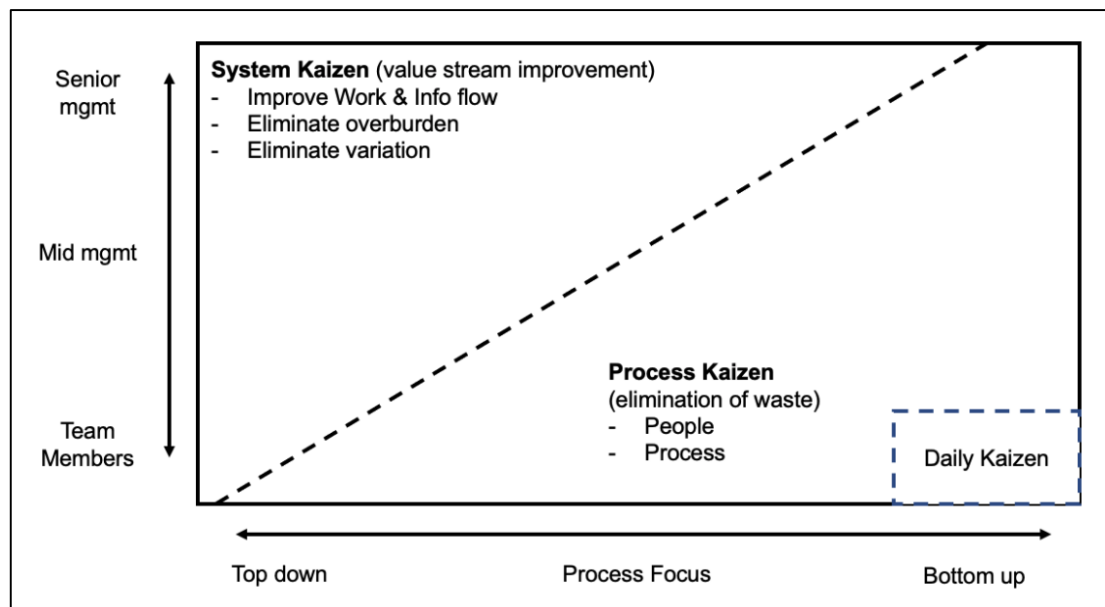


Figure 9. Kaizen methodology.

Bell and Orzen [10 p40] have argued that improvement in system kaizen has positive impact on process kaizen and vice versa.

8.1.4 Pull/demand system

A pull/demand system is central concept in Lean where e.g., a customer request triggers predetermined sequential activities to fulfil the request. The customer demands a service, and the request is pulled through the value stream process in controlled manner. There are many benefits with pull/demand system, and Bell and Orzen [10 p105] have described that this approach prevents waste, overproduction, waiting time and most interruptions are easily identified. Kanban is a pull system and is widely adopted in the manufacturing industry.

8.2 Lean transformation

Upper management is responsible for initiating Lean transformation. This approach demonstrates a commitment to improvement on longer term. However, upper management cannot transform the organisation by themselves. A genuine Lean transformation, according to Bell and Orzen [10 p232], grows from within when individuals proactively seek out challenges to improve. A Lean transformation begins with the basics. The customer, the product or service they are receiving, and the actual value are described first. It is critical for organisations to understand, which features are valuable for customer, and which are valueless. Transformation continues with performing first value stream mapping activities to identify waste and other areas for improvement and continuous improvement proceeds using various specialised techniques and methods.

8.3 A Lean approach to IT Service Management

Continuous improvement is central to ITIL lifecycle stages and is a key element where Lean thinking can be utilized. ITIL provides standardized sets of processes and principles for organisations and enables organisations to set well-established performance metrics to identify areas of improvement in the value stream. According to Bell and Orzen [10 p157], this is beneficial for businesses and IT departments to manage services. The concepts of SLA's and regular customer feedback cycle should be encouraged. Standardized work, in the form of processes, also support Lean thinking.

9 Methodology use case scenarios

The methodologies discussed in this thesis are applied in many types of IT organisations. This section describes different types of organisations and their specific characteristics. Each have different kind of operating environment and requirements that dictate the type of methodology which best suits its requirements.

9.1 IT projects

A typical scenario where Project Management methodologies are applied are IT projects. Typical projects include a deployment of a new application, a deployment of new technology, or for an IT Service Provider, a deployment of a new customer. In these projects, the end results are usually quite precisely predetermined. The project has a certain requirements, budget and time frame where the project should stay in. Sometimes projects include Agile characteristics when, e.g., instead of deploying an off-the-shelf software, a new software is developed and customized during the project. An example of an off-the-shelf software would be an antivirus software. In larger enterprises, implementation of a new antivirus software would be a rather laborious IT project. Even though the basic functionality would be provided by the software, significant configuration work would be needed in order it to be useful.

9.2 Service providers

IT service providers are in the business for providing IT services for their customers. In today's highly cloud service-based world, it is very rare to organisations to uphold all services in-house. A typical example of this could be, e.g., an IT outsourcing project where external operator takes over some, or even all, of the IT functions of the customer. Examples of this may be, e.g., managed IT services, application hosting or cyber security services. ITIL is widely used by service providers as the methodology for IT Service Management. Terms of the service are defined by the SLA and services are built around these metrics. Sometimes, however, the production of a service is very closely related to the development of the service also. In this case, Agile methods are very commonly applied. The problem, however, is that the full use of Agile methods requires developers to be fully committed to it without any external interrupters. If there is an incident where

the developer needs to be involved in service production, e.g., in the event of a fault, the principle is broken. In this case, it is important that clear responsibilities of the operations have been agreed on how to operate.

9.3 Enterprise IT

In larger enterprises, IT functions are often so large that it closely resembles production of IT services by an external service provider. In this case, the service is provided to an internal customer which has very often been defined a SLA agreement, among other obligations. The same challenges as described in the previous section in combining Agile methodologies and IT service production also exist in this type environment.

9.4 Agile teams

Agile methods are usually applied in software development. Agile methods can also be utilized in the situations mentioned in the previous chapters under certain conditions. Lean IT is also a common methodology being used. Another methodology in use in this category is DevOps, which integrates IT operations and the software development with a collection of practices. The main idea in this is to shorten the lifecycle and quality from development to production, providing continuous delivery. Ideally, continuous delivery could produce several releases every day.

9.5 Combinations

Perhaps most typically, an organisation has different teams with different purposes. For example, product development has its own team and another to maintain the production services related to the product. In this case, product development can operate using Agile methods, such as Scrum. A team which maintains a production environment and related support services typically applies a Service Management framework, such as ITIL. A third team may be implementing customer projects, such as product deployment projects, in which case even PRINCE2 may be in use. In this organisation, the different methodologies need to interact and be tailored to support each other. Waterfall methodologies, like PRINCE2 claims to support for this type of operation. Figure 10

illustrates an example organisation where different teams operate with different methodologies.

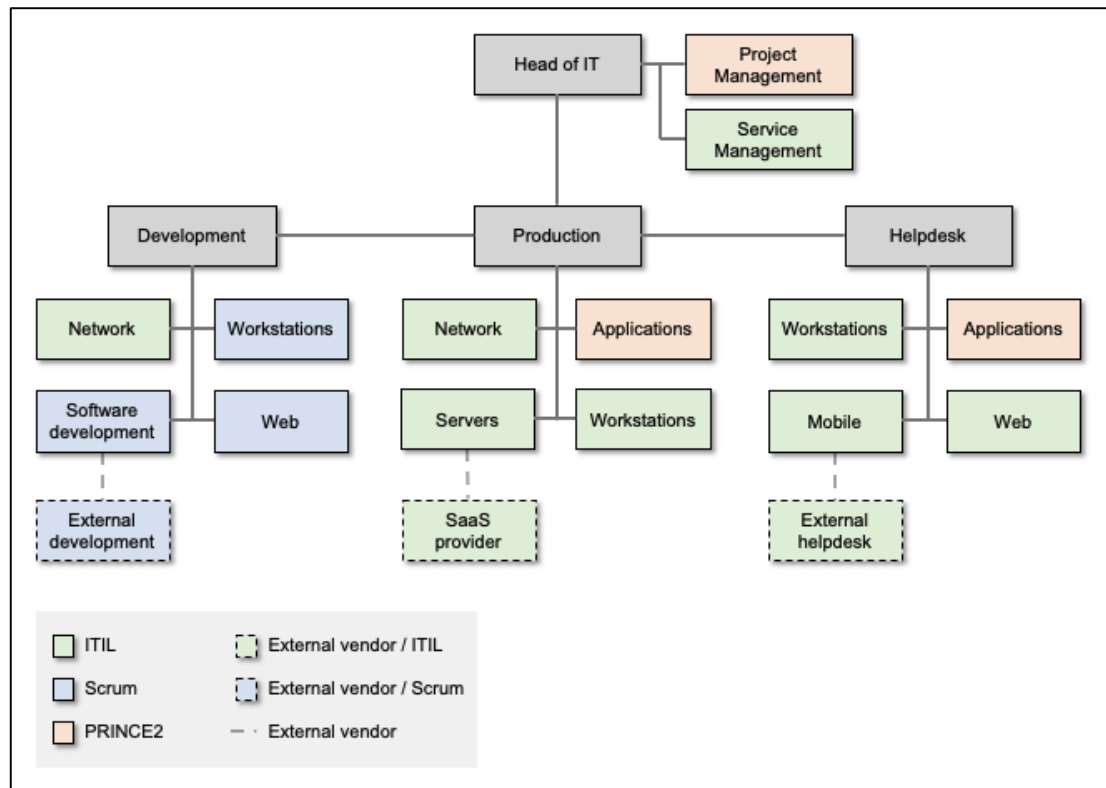


Figure 10. Example organisation chart.

As seen in Figure 10, there is incoherence even within teams how they organize their work. This is clearly seen in the example Development organisation where other teams are operating with Scrum methodology, but Network Development team is operating with ITIL. The reason for this is that in the example organisation, Network Development is working mainly in the Service Transition and Service Design lifecycle stages, but other teams concentrate on Development aspects of the service with an external development organisation. Table 9 describes various other scenarios and suggestions which methodology is suited for the team.

10 Implementing a methodology in an organisation

This chapter discusses the practical implementation of various Project Management and Agile methodologies in organisations. In the first section a comparison is done which shows the most relevant differences between waterfall and agile methodologies.

10.1 Methodology differences

Based on the descriptions from the previous chapters, the main differences between waterfall and Agile methodologies are listed in Table 8.

Table 8. Waterfall and Agile methodology comparison

Area	Waterfall methodology	Agile methodology
Planning	Waterfall model requires planning for the entire duration of project.	Detailed planning is done only for the Sprint. Scaled adaptations might plan beyond single Sprint.
Planning	Sequential planning with pre-planned milestones and predictability.	Feedback is the trigger to adjust requirements and plans iteratively.
Management model	Waterfall projects are managed by managers at various levels.	Agile teams organize by themselves without external intervention.
Project success	Waterfall project is considered successful when it meets the previously agreed schedule, does not exceed the budget, and has the expected level of quality.	Agile project is considered successful when it produces the desired customer value.
Communication	Project Management team provides information using various reports defined by the processes.	Agile team maintains continuous communication within the team and stakeholders.
Stakeholder feedback	User feedback is provided at the beginning and the end of the project.	Stakeholder feedback is integral to the Sprint-based Scrum team's work.
Requirements	Requirements are defined at the project start up and changes are unwanted.	Constantly evolving requirements based on the stakeholder feedback.
Roles	Waterfall projects include multitude of roles and management levels.	Agile teams have very few roles and shallow organizational structure.
Roles and responsibilities	Team member roles and responsibilities are not unified.	Each member has same kind of accountability and responsibilities.
Change	Change process is very controlled and strict, and changes are not welcome.	Agile project requirements are constantly changing by nature.

Quality control	Quality Control is performed mostly when the products are delivered.	Quality is inspected continuously.
Processes	Number of management processes is significant and need to be strictly followed.	Only few and flexible processes.
Deliverables	Project products or services are delivered at the end of the project.	An Increment is delivered at the end of each Sprint.
Progress monitoring	Project progress status is based on estimations.	Progress is inspectable in the form of Increment
Progress monitoring	Project meeting progress reviews	Daily progress reviews

The differences are fundamental but serve different purposes. To illustrate the differences even further, Table 9 describes different team and project types and the suitability for a methodology. An important point to consider at this point is to the question when a minor upgrade becomes too large to be handled as an operational task? The answer to this question relates to mainly to risk and a structured methodology provides tools to manage it.

Table 9. Methodology suitability for a project or team per type

IT team or project type	ITIL	Waterfall project (I.e., PRINCE2)	Agile project (I.e., Scrum)
Office move, related IT tasks	Suitable with all lifecycle stages	Suitable because clearly defined requirements	Not suitable
Software development project (game)	Suitable with Service Operation only to manage e.g., incidents.	Not suitable, because lack of user feedback and requirements.	Highly suitable
Software development project (software for ventilator in healthcare)	Suitable with all lifecycle stages	Suitable	Can be used, but with caution
Deployment of new off the shelf IT application (no development required).	Suitable with all lifecycle stages	Suitable because of clearly defined requirements	Not suitable
Software upgrade of existing software	Highly suitable	Not suitable	Suitable only if upgrade has been

			developed internally
IT for Olympiad event	Suitable with all lifecycle stages	Suitable because of clearly defined requirements	Some parts of the projects could benefit from agile methodologies, e.g., website and mobile application development.
Network device renewal project refresh	Suitable with all lifecycle stages	Suitable because of clearly defined requirements	Not suitable
Very small IT department work, e.g., 2-5 employees.	Not suitable and impractical, because of too detailed process definitions for a small team. Single person does most of the task.	Suitable only for projects with clearly defined and fixed timeframe	Suitable, but requires a Product Owner if using Scrum.
Large company IT department with multiple vendors	Suitable for all lifecycle stages	Highly suitable for clearly defined projects with strict requirements	Suitable for most projects

A structured approach also raises the chance of project success tremendously. However, for small tasks or organisations, a heavy methodology might introduce unnecessary management overhead and therefore any the methodologies described in this thesis are not recommended.

10.2 Recommendations and best practices

The introduction of a methodology to an organisation is often done in a situation where an organisation acknowledges that the current working structure no longer works and there is a need to look for new ways to organize work in teams. Drikus [20 p254] has described this kind of scenario as a Task conflict, which is a disagreement about task description or execution responsibilities. According to Drikus, “this type of conflict happens naturally in a team and while there is still uncertainty about the benefits of such conflict, it would seem that it can sometimes help a team to find better and improved ways to deal with various tasks”. [20 p254] Another type of related conflict described by Drikus is a Process conflict, which is “harmful to the team and could lead to a negative climate, lower decision-making quality and creativity, and lower productivity”. [20 p256] There may also be changes in the structure of the organisation or changes in the

responsibilities of the teams. The organisation is often accustomed to a certain way of operating and resistance may arise with the change. In all this change, the management of change begins with leadership. When something goes wrong, “very often criticism focuses on technical aspects of the change programme, an insufficient execution of otherwise right concepts; for example, the change message was not properly communicated, necessary changes were not implemented swiftly or thoroughly enough, or managers were not decisive enough in their decisions”. [14 p149] To summarize, clear communication, clear awareness of problems, goal setting and financial support are the key recommendations for management level.

However, there are challenges to this type of change which need to be recognized. The different methodologies emphasize that it should be fully followed as described, and nothing should be left out unless specifically allowed. For example, PRINCE2 and Scrum are very specific about this requirement. For example, an organisation can implement Agile methods and set up individual teams, and leadership assumes that managing work with a Kanban board alone is enough to be an Agile team. However, this is by no means the case. One of the basic ideas of Scrum is that any member of the team can perform any of the tasks in the sprint. Best expertise commonly focused on certain individuals and true way of working by the principles is not achieved. Thus, there is no real division of tasks within the team within the meaning of the model. Another significant problem arises if, for example, the Product Owner described by the Scrum method is not assigned. The Product Owner has an important role in describing and prioritizing product characteristics and decision-making. A development team that is devoid of a product owner might not know what they should do. One might also fall back into micro-management instead of proactive way of working. It is recommended to provide necessary training for each member of the projects.

The same type of problems might also arise with the implementation of traditional Project Management methods. If the themes, processes, and other criteria defined by the Project Management method are not implemented, a significant risk exists for project failure due to management-level problems.

People who are part of projects or Agile teams should understand how the methodology works. It is not enough for a Project Manager or Scrum Master to understand their role. Each team or project member should also receive relevant familiarization and training in the operation of the methodology. Not just the team members' own role, but for the big

picture as well. This helps the individual to better understand their purpose and meaning in providing the value for customer. This highlights the recommendation for sufficient training for all team members. Well established training and certification programs exists that can be utilized but requires considerable financial investment from organisation which needs to be taken in to account.

It is also possible to inadvertently introduce a completely wrong model to an organisation. It does not make sense to introduce the Scrum methodology in an organisation implementing IT service production or in a more traditional waterfall model project. This can happen when proper training has not been provided for management.

Management needs to recognize if the team is ready for the methodology. The organisation probably is not going to have the optimal skills available right away, or the environment circumstances might be sub-optimal as the projects begins or continues, for example, with Scrum practices. To help identify the most important elements following topics are recommended to be evaluated.

- The team needs to be committed to the development process. The team also needs to possess necessary skills to build products for the customer.
- The organisation needs to have a Product Owner. If not, someone temporary needs to be found so that the team can begin with development of the key features, until the permanent product owner is assigned.
- The product owner needs to formulate a product vision and a create the Product Backlog.
- The team needs to have possibility to establish a maximum of 30-day sprint, or preferably shorter.
- The business stakeholders need to have the time and capability to participate the sprint review. Purpose for this is to drive the urgency and visibility to the team.
- The team needs to possess confidence to communicate the challenges honestly as they arise.
- The Scrum Master needs protect the Development team from any external interruptions.

The team needs to be able to efficiently engage in discussions. Leopold and Kaltenecker [15 p154] define effective discussion as dynamic connection between individuals and as the art of cooperative thinking. This is based on four abilities:

- Ability to listen is about receiving outside perspectives.
- Ability to respect is about acknowledging conversation partners and their perspective
- Ability of suspending is about keeping the pace suitable and holding back when advancing too fast.
- Ability of voicing is about honest expression.

It is also possible for a small organisation to not follow any specific methodology described. However, as PRINCE2 notes, using the model significantly increases the likelihood of success.

A project which has a single, clearly defined deliverable, and fixed schedule can be very well-suited candidate for a waterfall type Project Management methodology. Davis [17 p74] has argued that waterfall projects would be the default option in well-established industries with stringent corporate culture and high compliance requirements. Waterfall Project Management methodology requires meticulous planning, high amount of documentation and strict management control.

With complex software development projects where continuous customer feedback is an integral part of the development process and vital in achieving the desired objectives, Scrum is often the most suited work management methodology. Scrum can be suitable methodology if developing a software and there are no fixed release deadlines, strict initial requirements and the needed amount of work is not initially clear.

A summary of the key recommendations is provided in Table 10.

Table 10. Key recommendations

Recommendation	Description
Management commitment needs be sufficient	Management commitment with clear communication, acknowledgement of problems, setting of targets, and financial support
Methodology should be fully followed as described	The different methodologies emphasize that it should be fully followed as described, and nothing should be left out unless specifically allowed.
Provide relevant methodology training to all team members.	People who are part of projects or Agile teams should understand how the methodology works or there is the risk that methodology is not followed as intended. Well

	established training and certification programs are available, but require financial investment
Select suitable methodology to an organisation.	To avoid inadvertently introducing a completely wrong model to an organisation, provide necessary training to management level. It does not make sense to introduce the Scrum methodology in an organisation implementing IT service production or in a waterfall type project.
Select waterfall project management methodology in correct situations.	Projects which have a single clearly defined deliverable and fixed schedule can be very well suited for waterfall type Project Management methodologies.
Select Scrum methodology in correct situations.	Complex software development projects where continuous customer feedback is an integral part of the development process and vital in achieving the desired objectives, Scrum is the most suited work management methodology. Scrum can be suitable if a team is developing a software and there are no fixed release deadlines, strict initial requirements and the needed amount of work is not initially clear.

By following these six recommendations, the likelihood of successful implementation of a methodology in organisation increases.

11 Project Management tools

There are many tools and applications available specifically designed for Project Management. Two tools are described which are commonly used. These tools provide the necessary features to track work, progress and provide suitable reports and visualizations for Project Managers and different teams.

11.1 MS Project

Microsoft Project (MS Project) is a software application for Project Managers to assist in projects with scheduling, resourcing, progress, budget, workload analysis. In addition to having specifically designed toolset for more traditional waterfall Project Management, it also includes some features to manage Agile teams. It is developed by Microsoft Corporation.[11] It has a long history with first version released in 1984. MS Project is a widely used application used by Project Managers to comprehensively manage project planning and documentation activities. MS Project is offered as standalone full-featured client application or as a reduced web-based version.[11]

11.1.1 Features

MS Project supports the following Project Management use cases:

- Create Project Management plans at any detail level required by the project environment.
- Control activities, resources, tasks, and costs at multiple levels as required by the project environment.
- Create various project views and reports.
- Track and control project progress during the ongoing project phases.
- Create task with relations to each other
- Share the project data
- Utilize resource pools to combine aspects between multiple projects as required by the project environment.

User interface consists of different views meant for different aspects of the Project Management. Default view for Gantt Chart is shown in Figure 11.

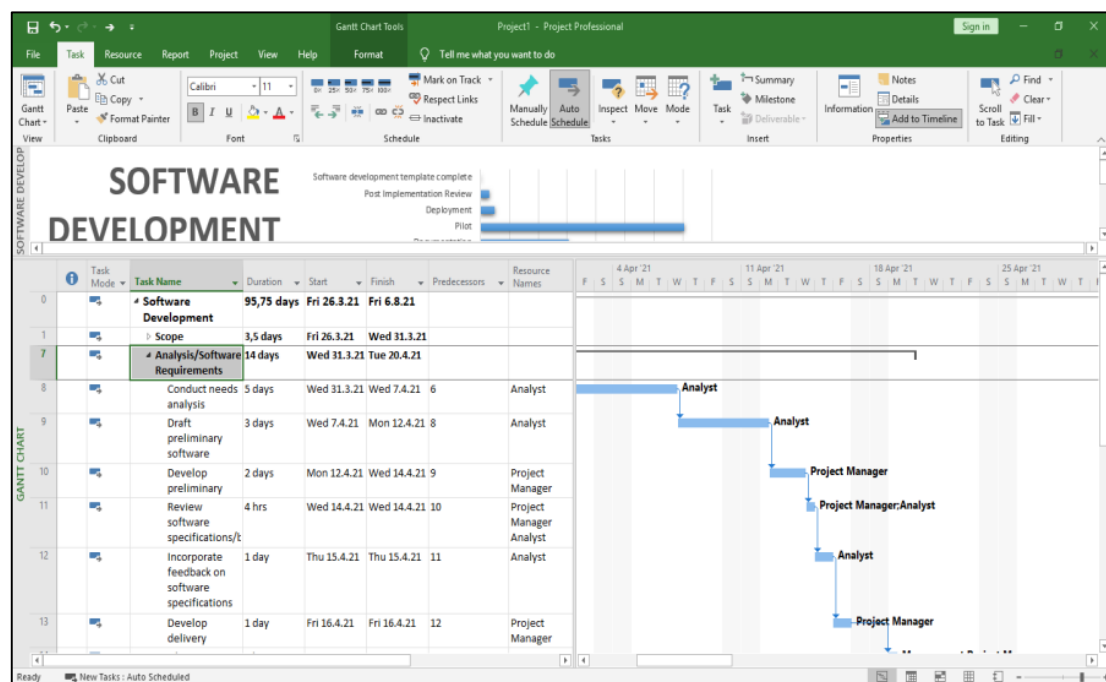


Figure 11. MS Project template project example.

The application includes resource management in a way that a resource has its own calendar which defines when the resource is available. Resources have rates defined so

that the cost is calculated and summarized. MS Project also provides critical path schedules for the tasks.

11.1.2 Advantages and disadvantages

MS Project has a long history, and the features have been well tuned during its existence. Therefore, it is safe to assume that it is time-tested and suitable for managing many different types of projects.

MS Project is feature-rich, flexible, and in great Project Management tool which can be utilized in various project environments. However, there are several reasons some Project Managers avoid using it.

- MS Project is only available for Windows PC's. E.g., Apple users need to rely on virtualization to utilize the program.
- MS Project can be too advanced for beginners. There is quite steep learning curve to get familiar with the software.
- MS Project is mainly designed as a stand-alone tool for the Project Manager, and it is not well suited for collaboration within the project.
- MS Project is expensive. Significant criticism exists about the cost vs. functionalities.
- Visualization of progress in MS Project is adequate, and reporting is cumbersome.
- MS Project several features that are not consider user friendly.

However, MS Project has the development resources of Microsoft Corporation behind it so it is likely that it will be a well-developed and useful tool far in the future. MS Project offers close integration with Microsoft's cloud ecosystem which benefits many organisations who are heavily using other Microsoft products.

11.2 Atlassian Jira

Atlassian Jira is a web-based generic work management application for many types of teams, and part of Atlassian's ecosystem of closely integrated products. Jira is developed by Atlassian Corporation Plc. Jira was released in 2002 and reportedly

over 65,000 companies globally have adopted Jira.[12] The origin of Jira is in the issue and bug tracking but currently supports a comprehensive set of use cases with extensive set of tools for Agile software development and other Agile teams. Jira is offered as a Cloud and Data Center version to serve different customers with different kinds of infrastructure requirements. Software development teams have widely adopted Jira to manage their activities.

11.2.1 Features

Jira is a feature rich work management tool for many kinds of use cases, from requirements and test case management to Agile software development. Jira enables creation of user stories, laying out development plans, software releases in customized manner, and generate various reports. Jira also has comprehensive set of tools for Service Management teams to handle customer requests and incidents. Jira integrates with many other applications which can be further expand the use cases.

A typical view of Jira user interface is shown in Figure 12.

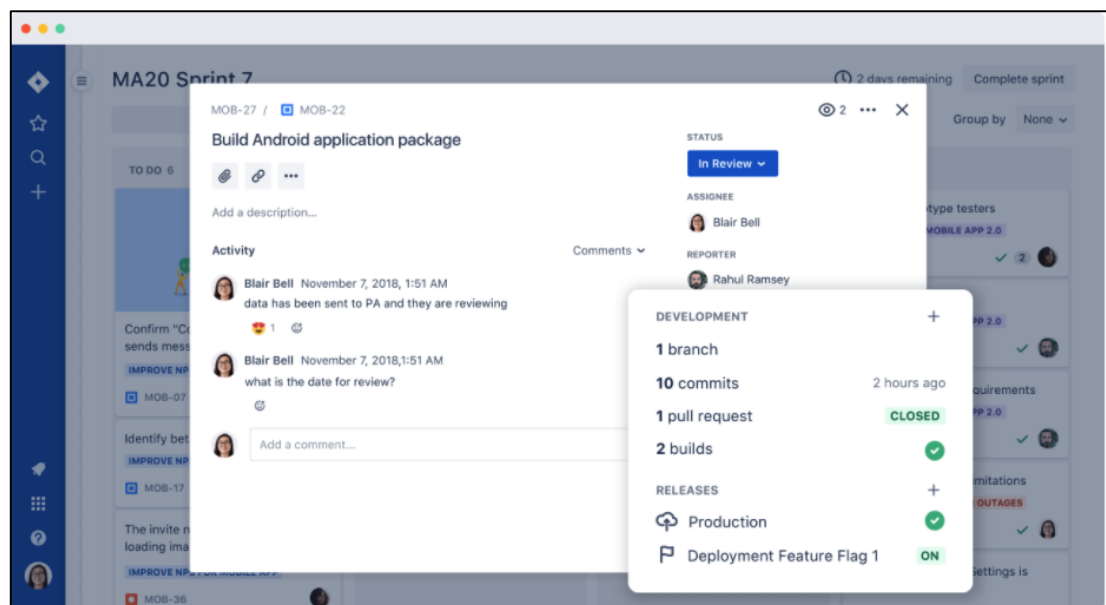


Figure 12. Atlassian Jira issue example.[12]

Following use cases and features have been defined by Atlassian [12]:

- Wide array of tools for Agile teams, for example Kanban boards and various features for Requirement and Test Management.

- Tools for Project Management teams. Jira can track tasks and other units of work that move through a workflow and provide many types of reports.
- Tools for Software development teams. Jira provides features to plan and manage stakeholders, budgets, and feature requirements.
- Tools for Product Management to manage various aspects related to roadmap planning.
- Task Management features to track and manage tasks during the entire task lifecycle.
- Bug tracking features for tracking and prioritization of the tasks related to bugs.

Jira is one of the most feature rich project tracking applications on the market and has a broad support for Agile methodologies. Jira has also wide support to extend the functionalities with plugins.

11.2.2 Advantages on disadvantages

Jira is clearly designed for Agile teams in mind. It is very feature rich, highly customizable, and offers all the necessary interfaces and tools for Agile users to perform their tasks. Jira also provides many useful tools for Project Management and Product Management teams. It has well thought and simple graphical features for reporting and other templates.

As a disadvantage, Jira is quite challenging to integrate with other applications that an organisation might be using to run operational activities. Some users have also complained about the user interface for being inconsistent and confusing.

12 Discussions and Conclusions

Whether an organisation is running a project, developing a software, or running an IT service, a structured set of processes, tasks and tools provide guidance for successful execution of a project or task. However, there is no single methodology which provides everything a business requires to deliver products and services. Common among all the work management types discussed in the thesis is that they concentrate on three key attributes: budget, time, and quality. A project is considered successful when it meets the previously agreed schedule, does not exceed the budget, and has the expected level of quality.

Traditional Project Management methodologies are classified as waterfall models and project activities are divided into a sequence of separately executed controlled steps, and each step has dependence on the deliverables from the previous step. Considerable criticism exists towards waterfall Project Management methodologies, and some argue that they are outdated. Even though these methodologies offer clear structure, it can be described as defect of these models that the end goal is defined too early, and it makes making changes difficult. Generally, testing might also be delayed until completion. However, projects which have a single, clearly defined deliverable and fixed deadline, can be very well-suited candidate for waterfall type Project Management Methodologies.

Agile practices have evolved to counter the issues with waterfall methodologies. To discover requirements, a cooperation between committed skilled self-governing teams and their customers is upheld to develop products. Key characteristics of Agile development are quick and flexible adaptation to changes, iterative development cycles, fast releases, and commitment to continuous improvement. Scrum is suited for well for development projects which are complex, require continuous customer feedback, long-lasting without fixed deadline and has evolving requirements. IT Service Management practice has evolved to provide these products as a service for customers.

A key finding in the thesis is that the focus needs to be in business value and consistent execution of the selected methodology. Also, not all organisations are ready to implement the methodologies described in the thesis. A thorough knowledge of the methodologies, resourcing, commitment, and proper change leadership is required for success.

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