Managing Knowledge in Projects: The Transition to Agile Development at Vodacom SA

by
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Thesis presented in fulfilment of the requirements for the degree of Master of Philosophy (Information and Knowledge Management) in the Faculty of Arts and Social Sciences at Stellenbosch University

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December 2023

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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SUMMARY

The thesis presents a case study of a telecommunications company's transition to agile development and the effect this had on knowledge management. The case organization underwent organizational restructuring to improve its responsiveness and competitiveness by introducing agile ways of working.

The thesis proceeds from the observation that knowledge management at the organization is rooted in document management. Whilst the waterfall development method encourages extensive documentation and explicating knowledge, the focus in agile methods is more on tacit knowledge and face-to-face interactions. This means that lots of knowledge is never captured and can be lost when members retire or resign.

The research comprised interviews with people involved in development projects and with selected managers that were project owners. Interviewees were asked how the transition to agile methods affected the management of knowledge, about the technological tools they used in their projects, and their perception of the support from management.

The findings were that top management drove the transition to agile as part of a larger objective to become a technology company as opposed to a mere telecommunications company. As part of this journey, the organization had to adopt a new culture and restructure various departments. In terms of support, agile coaches, and courses it provided afforded staff extensive training in the new method and new knowledge management software tools.

The change of culture, availability, and support of top management in taking the staff through the change management process gave them confidence and trust. The knowledge journey towards the new agile method is still a work in progress with many lessons learnt.

OPSOMMING

Die tesis is 'n gevallestudie van 'n telekommunikasiemaatskappy se oorgang na agiele ontwikkeling en die effek wat dit op kennisbestuur gehad het. Die ter sake maatskappy het organisatoriese herstrukturering ondergaan om responsiwiteit en mededingendheid te verbeter deur agiele werksmetodes in te stel.

Die tesis gaan uit van die waarneming dat kennisbestuur by die organisasie in dokumentbestuur gewortel is. Terwyl die waterval-ontwikkelingsmetode uitgebreide dokumentasie en eksplisiete kennis aanmoedig, is die fokus in agiele metodes meer op implisiete kennis en interpersoonlike interaksies. Dit beteken dat baie kennis nooit vasgelê word nie en verlore kan gaan wanneer werknemers die maatskappy verlaat.

Die navorsing bestaan uit onderhoude met mense betrokke by ontwikkelingsprojekte en met geselekteerde bestuurders wat die projekeienaars was. Responsdente is gevra hoe die oorgang na agiele metodes die bestuur van kennis beïnvloed het, oor die tegnologiese hulpmiddels wat hulle in hul projekte gebruik het, en hul persepsie van die ondersteuning van topbestuur.

Die bevindinge was dat topbestuur die oorgang na agiele ontwikkeling gedryf het as deel van 'n groter doelwit om 'n tegnologiemaatskappy te word eerder as 'n blote telekommunikasiemaatskappy. As deel van hierdie oorgang moes die organisasie 'n nuwe kultuur ontwikkel en verskeie departemente herstruktureer. In terme van ondersteuning, het die organisasie agiele afrigters en kursusse aan personeel gebied saam met uitgebreide opleiding in die nuwe ontwikkelingsmetode en die nuwe kennisbestuursagteware-instrumente.

Die verandering van kultuur, beskikbaarheid en ondersteuning van topbestuur om die personeel deur die veranderingsbestuursproses te neem, het die personeel selfvertroue en vertroue gegee. Die kennisreis na die nuwe agiele metode duur voort met baie lesse geleer.

ACKNOWLEDGEMENTS

It has been a challenging task to complete this thesis, which made me realize that studying is about sacrificing and allocating more time into it. I thank my family for supporting and understanding when I was absent from some of our family activities. It has been quite a journey to be a student, father, and husband at the same time. I praise the following people for support:

My wife Zoleka Mana always encourages me to put more effort into my studies.

My kids Ngesi and Bukhona for understanding that daddy is embarking on this journey.

My dear friend Phila Gaga who always checked up on me as to how I am doing and how are the studies going.

Lastly Doctor Christiaan Maasdorp, it's been difficult as we reside in different towns and during the journey, we had lockdowns because of the pandemic which left us with few communication channels nevertheless you guided me throughout the journey.

CONTENTS

ABBREVIATIONS

AI – Artificial intelligence

AD – Active directory

AM – Availability management

ANN – Artificial neural networks

AUP - Agile unified process

BA – Business analyst

BI – Business Intelligence

CBRS – Case based reasoning systems

CBU – Consumer business unit

CFD – Cumulative flow diagram

CRM – Customer relationship management

COE – Centre of excellence

DBMS – Database management system

EBU - Enterprise business unit

ERM – Enterprise resource management

ERP – Enterprise resource planning

FDD – Future driven development

GDSS- Group decisions support systems

HLD – High-level documentation

ICT – Information and communication technology

IOT – Internet of things

IS – Information systems

ISO – International Organization for Standardization

IT – Information technology

IRR – Internal rate of return rule

KM – knowledge management

NPV – Net present value

OUP – Open unified process

PM – Project management

PMBOK – Project management body of knowledge

PRINCE2 – Projects in controlled environments 2

QA – Quality assurance

ROI – Return on investment

RUP – Rational unified process

SD – Software development

SDLC – Software development life cycle

TCO – Total cost of ownership

TSP- Team software process

SRS – Software requirement specification

UAT – User acceptance testing

WIP – Work in progress

XP – Extreme programming

CHAPTER 1

1. STUDY BACKGROUND AND RESEARCH QUESTION

1.1 Introduction and background

Vodacom SA is a telecommunications company that provides services like data for internet connections, mobile calls, fixed voice, messaging, financial services, and converged services. On adopting agile ways of working the company restructured its business into focused areas that are enterprise business unit (EBU) with services business, corporate and government entities, consumer business unit (CBU) which provides individual contracts and other supporting business units like finance, human resources, legal and corporate affairs.

The organization's objective is to be one of the best leading telecoms companies in the African continent and be the best place to work for its employees. The company is moving towards being a digital technology organization instead of a traditional telco organization it has been right through the years. The organization is now offering various products like IOT (internet of things), financial products like insurance, small loans, gaming, and music downloads.

To achieve the above initiative, management had to come up with a new strategy that will enable the transition. As part of changing the strategy the company had to re-adopt the way it works so that it can be quicker to market. Therefore, the company needed to be more flexible to address the ever-changing customer demands. The decision was then taken to bring technology and business teams closer together so they can improve relationships and be able to deliver products and solutions together.

That then needed the company to change from using the traditional project management tools like waterfall and adopt more lean tools like agile. The organization realized that the continuation of using waterfall, which is traditional methodology, won't be effective in achieving its new business objectives. Therefore, adopting agile principles and tools was the only way that could assist the organization in meeting its new business objectives. Agile methodology has higher quality software results that is achieved in short space of time, with independent teams that collaborate with customers with a use of less documents and shorter time to market (Ahmed, 2010).

The fundamental importance of any organization to adopt agility assist the organization to respond quickly to the changing markets which helps with satisfying customer needs. In agile

environments, customer feedback is welcomed and incorporated into improving and building future products. Therefore, the organization brought the business units, product development, and project management and information technology departments together.

The companies have adopted demand portfolios that analyses and drive the project demands to be aligned to the agile way of doing things that satisfies projects, portfolios, and the enterprise broader (Stendl, 2005). The three levels are connected via iterations of (Assess – plan – develop guidance – perform and measure) where the third step leads down to the next lower level (Stendl, 2005).

We see two approaches for companies to become agile across all three levels: “bottom up” by growing agile techniques that have been applied at the project level to wider parts of the business, and “top down” by defining a new vision and strategy for the business and then breaking it down from the strategic level to the tactical and operational levels (Stendl, 2005).

Together these practices and the methodological guidance are very effective for typical software development projects with uncertain or changing business requirements and with technological uncertainties (Stendl, 2005).

1.2 What will the study achieve?

The reason for this study is to evaluate the strategies, techniques and tools adopted by Vodacom and the challenges the company is facing in capturing and sharing knowledge in the way of doing things. The second objective is to establish how the transition from the traditional software development tools has affected the knowledge management entirely in the organization.

The development of software using traditional methods are well documented whereas agile methods focus more on the working software instead of comprehensive documentation (Kavitha, 2011). With the use of agile methodology, people are drivers of the project success, they convene on daily basis by having stand up meetings which assist in tracking the progress, challenges and new developments within the project which serves as an informal knowledge sharing sessions (Singh, 2012).

Restrictions on the sharing of knowledge within the team members might have a negative impact on the project and the objectives of the organization. Whereas, compared to traditional methods, agile methods value individuals and interactions over processes where informal communication, both between team members as well as between team and client replace a big part of written documentation (Hohl, 2018).

The organizational objective is to be more of a technology company instead of being a Telco and therefore the organization has decided to minimize the time to market and to be as flexible as possible regarding requirements changes; the decision was taken to embrace agile methodologies.

1.3 What I am covering with my study

I will conduct the case study on a few Vodacom SA departments, which transitioned from waterfall into agile. These will be dev ops, solutions architecture, product development, digital and lifestyle services, and software engineering environments. I want to understand what processes and tools the organization used to manage its knowledge and resources that are part of the projects.

To achieve the desired results for my study, I will start by looking into the previous literature and read what the other researchers have discovered. Secondly, I will conduct extensive research in Vodacom by interviewing employees that have been involved in the transition from Waterfall to agile so I can understand how the knowledge was impacted.

1.4 The purpose of the study

The main aim of my study is to understand how knowledge is managed when the organization transitioned from waterfall to agile methodology. All software development projects require resources with different skills sets which are the likes of business analysts, developers, scrum masters, product owners and other personnel. Having the above skills in your project so the organization needs to devise a strategy of acquiring, codifying, and storing the knowledge, which requires knowledge management tools and repositories.

As also a member of Vodacom SA, the organization I am using for my study, this study will help them to investigate how they have managed knowledge management on agile adoption. Also, other organizations will be adopting the same method so they can understand the challenges and where they will need to improve in acquiring and storing their knowledge.

1.5 The study research questions

Main question:

How did the transition from the waterfall to agile methodology affect knowledge management?

The two sub questions:

1. What is the major knowledge sharing approach between waterfall and agile methodology?

2. What are km tools used for knowledge retention in the new agile model?

1.6 The research study methodology

The study investigated how knowledge was managed when Vodacom was transitioning from the waterfall to agile methodology. The transition can be a bit complex for the staff members, especially regarding management knowledge. Waterfall was more about documentation, so knowledge could be stored easily unlike agile which has less documentation and more human interaction.

In my research, I have used qualitative research methods with semi-structured interviews. I view semi-structured interviews as helpful in terms of getting more information from the participants as they are not only limited to answering what you are asking but give a chance to elaborate more on responding to the questions. The method can be used with one on one with individual respondents or even in group discussion interviews and its rigidity, can vary depending on the purpose of the study and research questions (Kelly, 2010). This approach is effective in terms of the flow of interviews. As stated in previous research semi-structured interviews helps to ensure that the interviews are rich in data (Patton, 2015).

The research required an in-depth study into the transition to agile and how it affected the management of knowledge in the organization. Because of the complexity of the study, I have decided to do a case study. Qualitative case study is a research methodology that helps in exploration of a phenomenon within some context through various data sources, and it undertakes the exploration through variety of lenses to reveal multiple facets of the phenomenon (Baxter, 2008). The case study will give me a clear indication of why the phenomenon occurred in the organization and how it helped them in making sure that they retain knowledge.

Information systems projects and how they are conducted seem to play a significant role in assisting companies in meeting their objectives. So, it is very imperative for me to use a case study in this research. The case study is the most common qualitative method used in information systems and is particularly suited to the study of information systems in organizations, when the focus is on organizational rather than technical issues (Myers, 2002).

1.7 Qualitative methods and motivation of its use

The qualitative method gives a researcher a flexibility of preparing questions, asking them and be able to ask to follow up questions which creates conversations with participants. I designed my questionnaire so that I could be able to establish the effects of agile adoption on the

management of knowledge. On designing my questionnaire, I also wanted to understand the view of senior management in supporting the training development of employees and investment in knowledge management tools. Due to the covid-19 lockdown, I conducted the interviews using Microsoft Teams, as it was the most convenient and effective way to reach the interviewees, with their permission to record the conversations.

As I was conducting the interviews, I also had follow-up questions to understand the response of the participant and to make sure that I got as much information as I could. As the participants are explaining I also made some notes on the side that will also help me with next interviews as tips to get more information.

As a researcher I also worked for the organization so I could easily have access to many of the participants as colleagues. I had a challenge of getting some to participate because of nervousness, busy schedules, doubting their level of knowledge in the subject and personal reasons. Most of my interactions became conversations where participants felt comfortable in discussing the journey and the challenges they encountered.

I have designed the questions in a way that will guide myself and the respondents during the interview sessions (Rubin, 2005). I have also made sure that my questions give the respondents more room to explore and formulate their responses (Longhurst, 2003).

I also used available documents in the organizational intranet to get some of the information I needed for my research. There were also newsletters that were distributed on monthly and weekly basis to update employees on the development of projects, success, and bottlenecks.

I have also used literature reviews which helped me explore work that was done by other researchers on both knowledge management and agile adoption. The use of literature gave me a solid foundation that assisted in building my own case study research. It is essential for a researcher to conduct literature review so they can be able to have an idea of what is already known about the subject they are investigating and to establish any gaps that will help them to also contribute into the subject matter body of knowledge.

I selected participants that were involved in the transition from the traditional way of project management to agile methodology. Some of the participants joined the company after the adoption but they understood both methods well. I had to select the participants who have worked on both waterfall and agile because they understand how knowledge was managed in waterfall and how it’s now impacted by agile adoption.

I also interviewed senior management of the organization to understand what strategies they have in place to manage knowledge and ensuring support of employees in knowledge initiatives. Also, what is their plan of retaining and storing knowledge, which tools they acquired to support knowledge management.

Below is the list and the roles of the participants in my research:

Agile coach/mentor

Scrum masters

Product managers

Developers or programmers

Software engineers

Solutions architectures

Executive heads

1.8 The analysis of data

After conducting my interviews on teams, I then listened to each recording and started to make notes of the conversation on a word document, which will also help me with analysis. I wrote down exactly what the participants said so I could go back and read for a better analysis. It was quite a time-consuming exercise, but I managed to document all the conversations.

After listening and documenting all the conversations I started the process of coding with the help of notes I took also during interviews. I started grouping the answers as per the questions I asked the participants and the answer's similarities and differences. The coding terminology refers to the identification of topics, issues, similarities, and differences that the researcher reveals from the narratives of the participants which he interprets for his/her research (Sutton, 2015).

1.9 Ethical research principles

I have respected the rights of participants and the information they shared with me in a way of adhering to the practical ethical principles that guide researchers in conducting their studies. Six generic ethical considerations will be observed (Easterby-Smith, 2013):

Voluntarily participation: The participants will take part willingly in the research (Easterby-Smith, 2013).

Informed consent: I will inform the participants in advance before conduction the research and explain the purpose of the research (Easterby-Smith, 2013).

Non-maleficence: the researcher minimizes the risk of causing harm to the respondents. Potential harm could be physical, social, occupational, psychological, or related to reputation (Easterby-Smith, 2013). The threshold that must not be crossed depends on ethical standards of institutions, cultural values, and the context of the study (Punch, 2014).

I will treat the shared information as highly confidentially and respect the views of the respondents (Easterby-Smith, 2013).

To ensure the privacy of the shared information I won't divulge the names of the respondents to protect them from future problems in their working environments (Easterby-Smith, 2013).

As a benefit I will share the gathered information with the respondents believing that it can help to improve their ways of doing the work as a positive contribution towards the delivery of organizational objectives (Punch, 2014).

I will adhere to the above-mentioned principles and respect the rights of the participants.

1.10 Thesis layout

This is how my chapters are outlining:

Chapter 1 this chapter will cover the background of Vodacom and touches on what the thesis case study plans to achieve. It also outlines the research questions, objective of the research, methodology and ethical considerations. The chapter also details how data was collected, coded, and analyzed.

Chapter 2 deals with the theory of knowledge management and adoption of agile, and agile and software development methodologies.

Chapter 3 focuses on literature review reading on what other researchers have read about knowledge management in the adoption of agile.

Chapter 4 outlines the Vodacom case study, which investigates their strategy, mission, vision, and adoption of agile methodology.

Chapter 5 gives a detailed report of the research findings and discussions.

Chapter 6 findings and recommendations, speak to the analysis of data from the participants and what effect the adoption had on knowledge management.

CHAPTER 2

2. KNOWLEDGE MANAGEMENT WITH FOCUS ON ADOPTION OF AGILE METHOD

2.1 Brief overview

The members should create, apply, and share knowledge to ensure the success of the project (Fong, 2003). The desirable need for the sharing of knowledge amongst the team members has triggered a growing need for more research to investigate its practices and facilitation (Wang, 2012). The effectiveness of each individual activity may improve the sharing of knowledge amongst team members. To address the gap in our understanding of knowledge sharing of project teams as a temporal and multi-level phenomenon, we aim to examine knowledge sharing between team members and gain insights about team outcomes (Hackman, 2003).

The team members should improve communication amongst each other in a way of closing knowledge-sharing gaps between knowledge providers and seekers. Most organizations have introduced different communication media platforms within the project teams, to improve communication practices which sometimes might cause time constraint in the progress of the project (Wang, 2012). In a waterfall method team members usually meet periodically whether its biweekly or weekly to discuss milestones whilst the agile method team members conduct daily stand-up interactions to talk about progress, challenges and the blockers impacting the progress of the project (Hass, 2007).

The improvement of training culture, workshops and interaction amongst team members can ensure the successful adoption of agile by the organization. Organizations needs to invest more on knowledge repositories which will make sure that knowledge is created and distributed in the process of adopting agile (Kotnour, 2001).

2.2 Software development methods within project management

I am discussing various SDLC methods and processes in this chapter to highlight the difference and significance of each. The research is putting more focus on Waterfall and Agile as the organization used in this thesis adopted Agile from the Waterfall methodology. The most emphasis right through the study is more on the two models mentioned in the previous sentence.

Software development (SD) can intensify knowledge because of the high interaction of project team members and its integration amongst various organizational domains (Patnayakuni, 2007).

The tasks taken on conducting a software development project are complex in nature. These tasks involve understanding the people on the project, their needs, and technical capabilities of transferring the gathered requirements into the design of the solution. Technical and social skills of team members are very important for the success of any software development project (Alawneh, 2008).

Software development life cycle (SDLC) has various steps which entails planning, design, develop, testing and implementing new products, software, and changes on existing software (Viller, 2000).

The diagram is showing the various steps of software development life cycle:

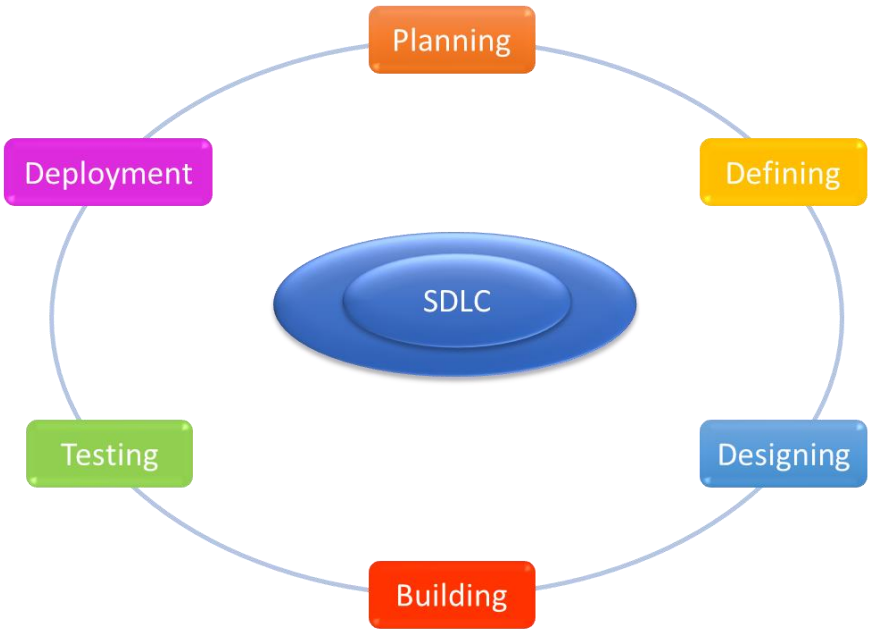


Figure 1: SDLC Process

Discussion various steps of SDLC methods from previous studies

Planning: the planning and analysis are very critical stages as they look into the requirements that are elicited from the product owner or the person requested for the project. The senior business analyst compiles them as per the business requirement specification. The project

leaders then do a feasibility study based on the requirements and then identify resources for the project.

Definition of requirements: The gathered requirements are then documented in detail and sent to the project sponsor or product owner to verify if they agree. After the verification from the sponsor the senior business analyst then drafts a document called software requirement specification (SRS) which will be used for the design of the solution (Ballarini, 2003).

Designing of software solution: the software requirement specification details what the software that will be developed is supposed to do. It also details the functions performed by the stakeholder that requested the software. Initial more than one architecture is designed and then reviewed by important stakeholders according to criteria like risk assessment, robustness, design modularity, time and cost, the best design is selected (Munassar, 2010).

Development phase: this is the actual building or development of the requested software or product. The development team decides on which programming language they will be using id developing the requested software. There are various types of programming languages like C, C++, Java, and the old Cobol. The development team also does the unit testing after completion of each software component.

Software testing: quality assurance phase where the product or software is tested in line with the customer requirements as detailed in the SRS document. Any bugs or defects that are picked up during this phase are then reported so the developers can investigate and fix them accordingly.

Deployment and maintenance phase: this is the stage where software or product in implemented or deployed into the production environment. On signing off the customer will verify if his/her requirements were met. The support team will then formulate a maintenance plan of the software or product (Krishna, 2012).

There are various SDLC methodologies which have been discussed and explained by various researchers in previous research papers and books like waterfall, iterative model, spiral process model, agile etc.

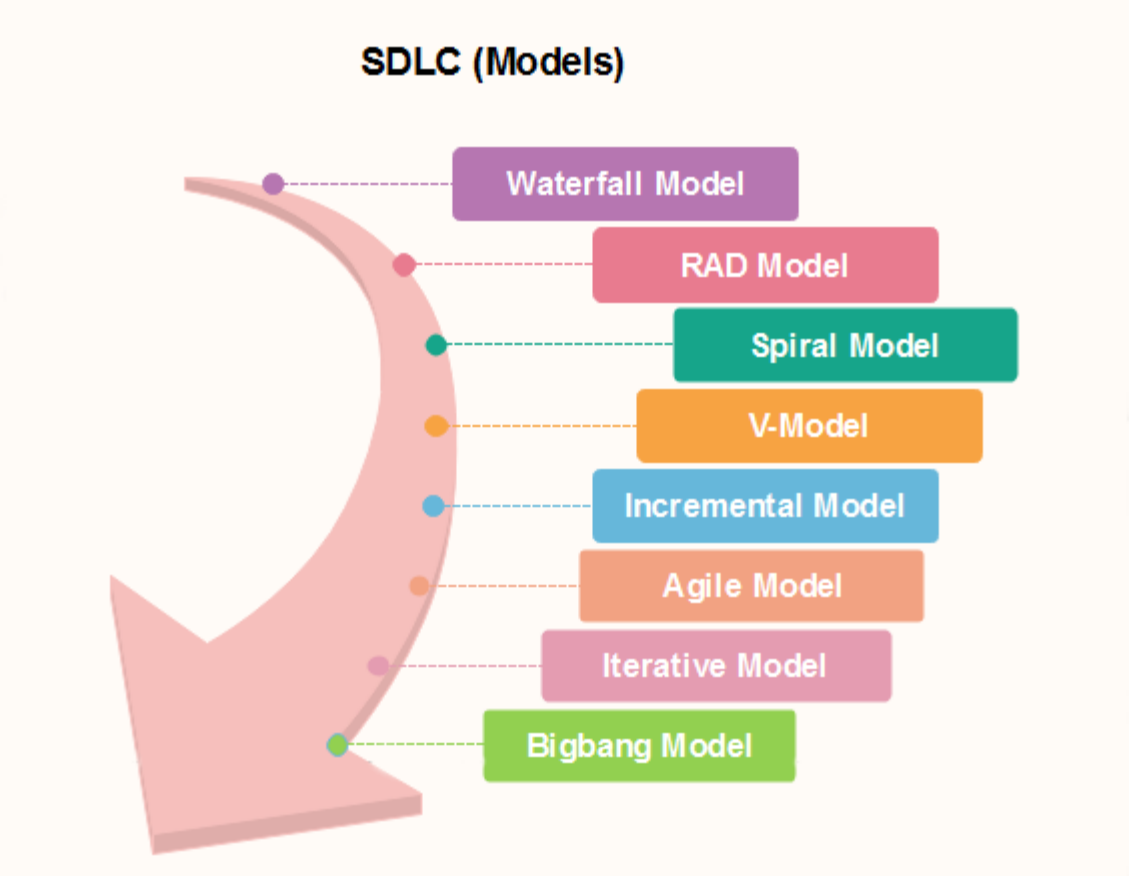


Figure 2 SDLC Methodologies (Java-T-Point)

2.3 Waterfall Methodology

The introduction of water method was done by Winston Royce in 1970 and was since adopted by software project managers and further developed through lessons learned from software projects (Aroral, 2021). Modern project management methodologies, such as PRINCE2, and PMBOK (Project management body of knowledge), evolved from waterfall approach and are the most widely used project management methodologies in Europe and North America (Aroral, 2021).

Waterfall method was the most adopted approach with its sequential steps that is uses to develop software or products (Cusumano, 1995). Waterfall has its own challenges as its difficult to go back to previous step once the next step has been adopted, which means the customer cannot alter the requirements once the project has kicked off(Aroral, 2021). The changes in markets and business objectives might frustrate the customer regarding receiving

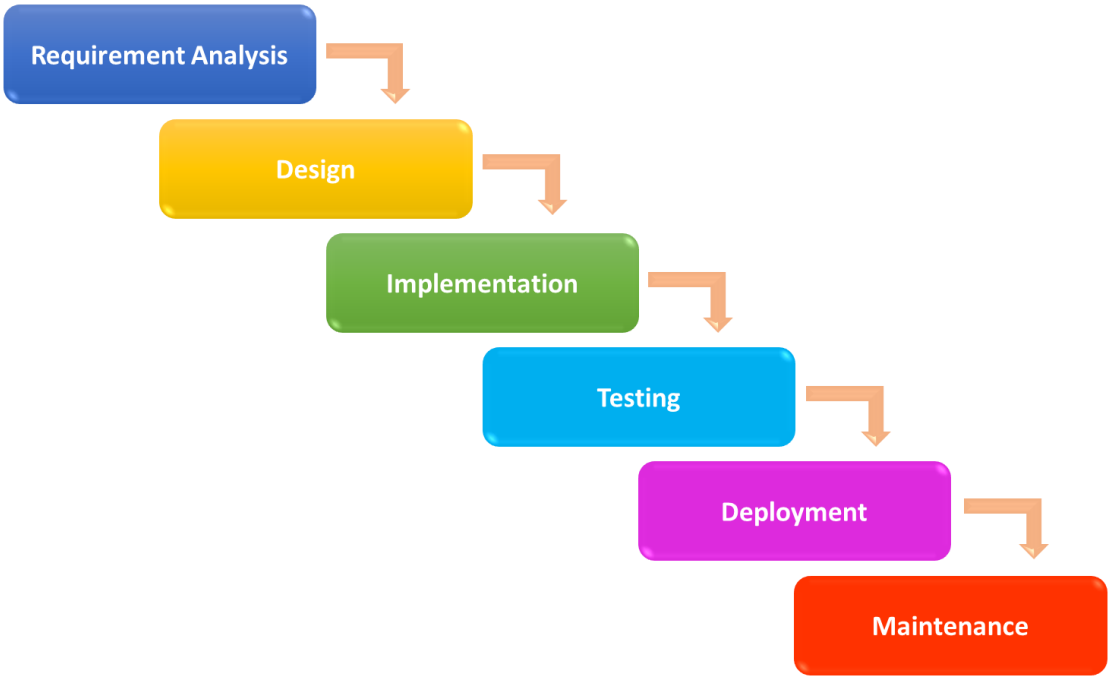
the final product after the completion of the project, which might require another project to enhance the software to be in line with new business objectives.

The waterfall model covers at least five steps which are requirements gathering, analysis and design, development, testing and implementation. The waterfall methodology may be very tricky as it requires different role players for each stage of its methods. The organizations might have to hire or source these skills from their different departments which may cause unhappiness for their departmental heads as they might lose their important resources for the duration of the project.

The method might be frustrating to the project managers due to resignations or other issues that may cause them to lose the resources before the end of the project which might require them to source more resources, an exercise that can be time consuming and causes delays to the project (Aroral, 2021).

Waterfall as the traditional method has its steps flowing downward like a real waterfall. It is important to complete each step before moving to the next one. These are done sequentially in the designed waterfall approach. These steps are stated in the below graph as refined by Youssef Basil (Bassil, 2012).

Figure 3: Waterfall Approach



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The waterfall model provides a basic project plan which states the sequential steps in an orderly fashion. This model is well suited for organizations that have long term objectives or requirements which might not change during the duration of the project. It requires a clear picture and understanding of the customer requirements and what is it the customer wants to achieve (Aroral, 2021).

If the customer decides to change the content of the requirements or the new ones emerge, that cannot be incorporated into the project whilst it's progressing through the steps. That is why it's important to clear any uncertainties during the requirements gathering phase and the customer must read them again before the actual analysis stage (Kannan, 2014).

2.4 Incremental SDLC method

In this model, which is called incremental, its requirements are divided into subset models which looks like multiple life cycle pieces of waterfall model. Each module will go through the phases of requirements analysis, design, testing and implementation. The creation of subsets called modules makes it easier to manage the project and the working version of the software is created in the first module (Stoica, 2013).

Advantages of the incremental model and aligned by Marius Stoica:

- Each stage delivers a working product that meets some of the client requirements.
- Prototypes are delivered to the client.
- Client feedback is distributed throughout the entire development process.
- It is more flexible - involves lower costs where purpose and requirements change.
- It is easy to test and debug during a small iteration.
- Cuts down on initial delivery costs.
- The risk is easy to manage because all risks are managed during the iteration.
- When there are new requirements, they can be introduced in the next prototype (Stoica, 2013).

The disadvantages of the incremental model by Stoica (2013) s:

- It requires good planning and design.
- Requires a clear and complete definition of the entire system before it can be divided and incrementally built.
- The total cost is higher than the waterfall model.
- Design errors are harder to fix and remove.

- Incremental approach may easily turn into “code and repair”.
- The client can see what can be done and can ask for more.
- Object oriented approach provides a comfortable framework for evolution development, in an iterative manner.

The incremental model is recommended for the following cases (Stoica, 2013):

- Systems requirements are clearly defined and understood.
- Major requirements are final, some details may change with time.
- Early launch is required.
- A new technology is used.
- There are high risk characteristics and objectives.

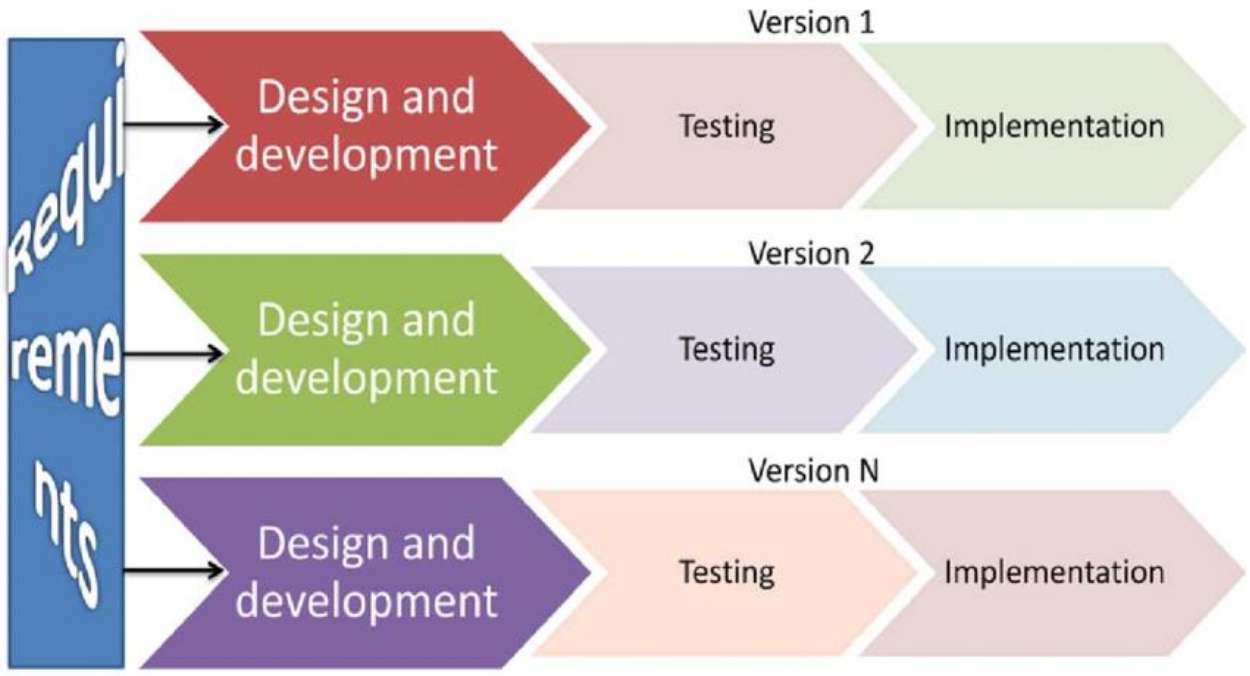


Figure 4: Incremental model diagram

2.5 V- Model methodology

V-model (validation and verification model) methodology is a software development process, which is an extension of the waterfall model. It emphasizes through testing by pairing each software development stage with a matching phase of testing (Balaji, 2012).

Unlike the waterfall model, the V-model was not designed in a unique linear development methodology. It is also known as validation and verification extension of the waterfall model which involves testing in each stage of development. Each stage requires checks and approvals

from the customer before the next stage is initiated which ensures that the development and testing teams works in parallel structures (Balaji, 2012)

The gathered requirements will guide the preparation of test cases which will be documented before the coding is started. On doing coding, testing is done sequentially beginning with unit, integrations and lastly system testing. This creates a working relationship between the development and the testing stages (Balaji, 2012).

Advantages of the V-model by S. Balaji: (Balaji, 2012):

- Same as waterfall model requirements are clear before development starts.
- In this model, the advantage is that the tester role will be involved in the requirements phase itself.
- Requirements changes are possible in any phase.
- Simple and easy to use.
- Proactive defect tracking – that is defects are found at an early stage.
- Works well for smaller projects where requirements are easily understood (Balaji, 2012).

Disadvantages of V-model (Balaji, 2012):

- Very rigid and least flexible
- Software is developed during implementation phase, so no early prototypes of the software are produced.
- The model should be chosen when ample technical resources are available with needed technical expertise.

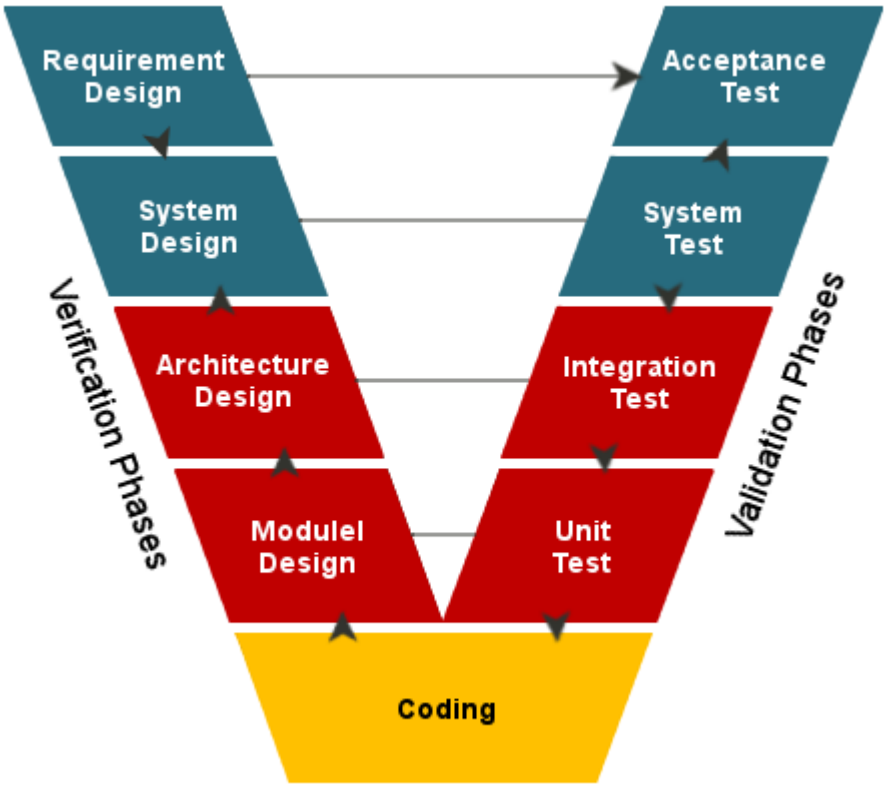


Figure 5: V-Model diagram by S. Balaji and M. Murugaiyan in 2012

2.6 The spiral software development methodology

The SDLC method called spiral is the combination of both incremental and waterfall methods which is used to manage the risk within the project. It is usually used for large, complicated projects which can have a high project cost in monetary value (Alshamrani, 2015).

The project must be broken into smaller segments, which can make changes easy during the development process and provide a golden opportunity to evaluate and assess the risks during the project life cycle. Development is done is smaller sets and gives a development team a chance to go through the lesson learnt after the completion of risk analysis for each set stage (Alshamrani, 2015).

The increasing spiral gives the team an opportunity to add additional functions for new requirements added during the project until its implementation and maintenance stage. These iterations which are done before production deployment are called prototypes (Alshamrani, 2015).

The following steps gives a brief description about the spiral model phases: (Alshamrani, 2015)

- Planning: this phase includes the understanding of the system requirements by conducting continuous communications between the customers and the system analysts.
- Risk analysis: in this phase, a process is undertaken to identify risk and alternate solutions. A prototype is produced at the end of this phase.
- Development/engineering: In this phase, software is produced along with the testing.
- Evaluation Phase: This allows the customer to evaluate the output of the project continues to the next spiral or next round (Alshamrani, 2015).

Advantages of Spiral model by S Shylesh: (Shylesh, 2017)

- The model can manage the continuous changing requirements.
- It can use multiple prototypes.
- The capability of accurate requirements collections.
- It is good for large and complex projects.
- It is good for customer satisfaction. We can involve customers in the development of products at the early phase of software development. Also, software is produced early in the software life cycle.
- It is suitable for high-risk projects, where business needs maybe unstable. A highly customized product can be developed using this (Shylesh, 2017).

Disadvantages of Spiral model by previous authors (Shylesh, 2017):

- The model is not suitable for small projects.
- It is much more complex than other SDLC models. Process is complex.
- Too much dependable on risk analysis and requires highly specific expertise.
- Difficult in time management. As the number of phases is unknown at the start of the project, so time estimate is very difficult.
- The spiral may go on indefinitely.
- The end of the project may now be known early.
- It is not suitable for low-risk projects.
- May be hard to define objective, verifiable milestones. Large numbers of intermediate stages require excessive documentation.

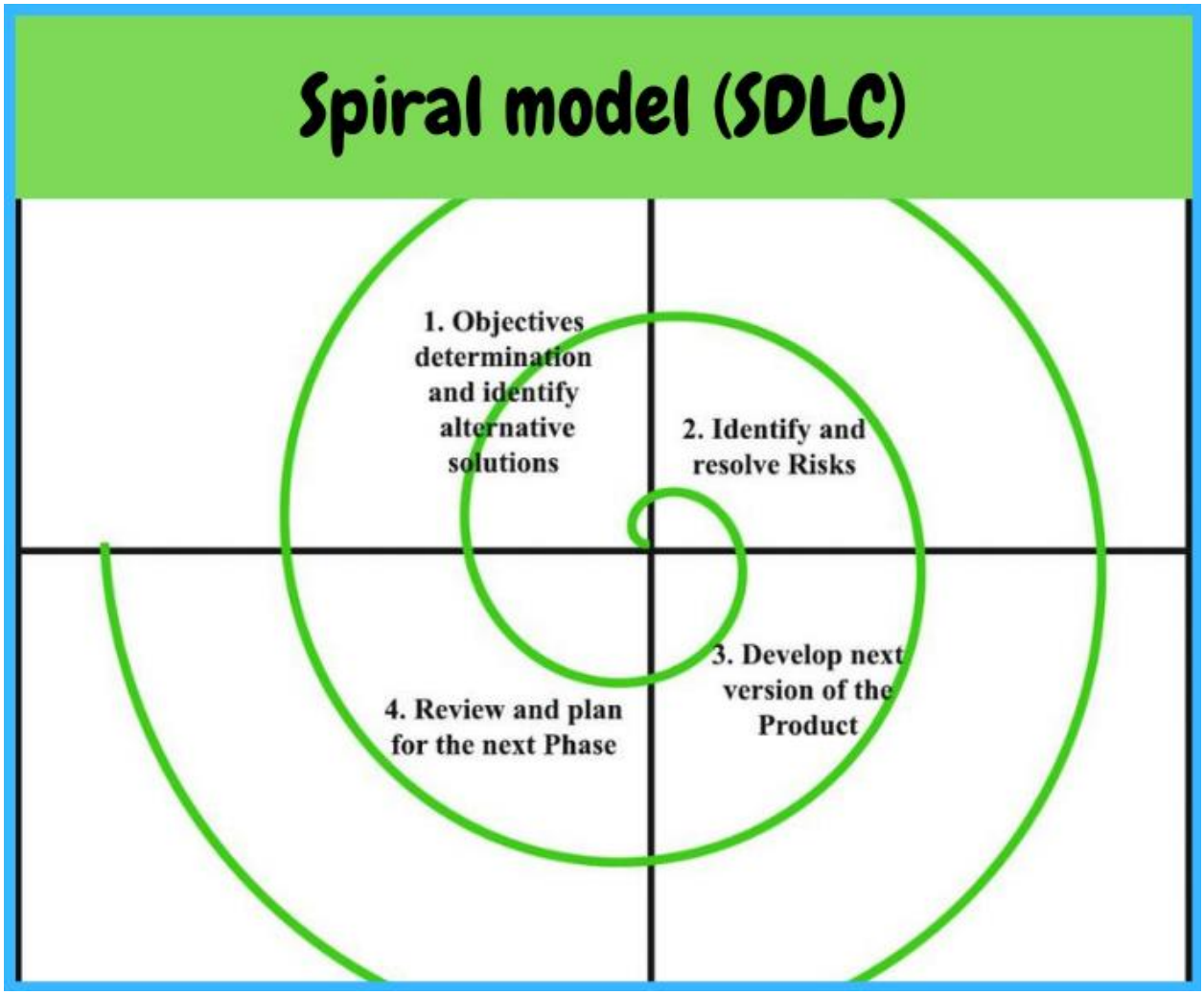


Figure 6: Spiral model

2.7 Agile software development methodology

The agile model consists of various models which evolves with the collaboration of team in organizing themselves and rotates their functions and the process is called incremental in development (Moniruzzaman, 2013). With the rapidly changing environments of organizations, the models before the introduction of agile were unable to meet up with the changing requirements. Agile development can meet up with changes as requirements can be changed at any stage of the project because of the continuous involvement of the customer (Moniruzzaman, 2013).

The business needs are changing constantly with in this technology driven era where the organizations must adopt agility in responding (Nemkova, 2017). The teams must understand the agile ways of doing things in responding and trying to assist the business to achieve its changing requirements (Boehm B. T., 2004). The is a combination of multi-skilled individual

team members in agile teams with extensive knowledge of their domains which helps in terms of understanding and unpacking customer requirements.

Agile methods are a subset of iterative and evolutionary methods and are based on iterative enhancement and opportunistic development (Moniruzzaman, 2013). Most of agile development methods promote development, teamwork, collaboration, and process adaptability throughout the lifecycle of the project (Moniruzzaman, 2013).

The most known agile methodologies are Scrum and extreme programming (XP), but Scrum is the most popular one. Scrum focuses mostly on the actual software project whereas XP is used more by the development team implementing the software.

Agile development process such as rational unified process (RUP), XP, agile unified process (AUP), Scrum, open unified process (OUP) and even team software process (TSP) are all iterative and incremental in nature (Moniruzzaman, 2013). The agile methods focused on different aspects of the software development life cycle. Some focuses on the practices (XP, pragmatic programming, agile modelling), while others focus on managing the software projects (Moniruzzaman, 2013).

Applications in agile use iterations which means that they are distributed in incremental units. These are developed in short periods like a week or few weeks and the developers must try to adhere to the agreed times. Developing the applications in these small chunks gives the development team an opportunity to understand their development process.

Agile methods are lightweight process that employ short iterative cycles, actively involve users to establish, prioritize, and verify requirements and rely on a team's tacit knowledge as opposed to documentation (Moniruzzaman, 2013). Agile practice is a customer oriented, lightweight software development paradigm, best suited for small size development teams in projects under vague and changing requirements (Perera, 2007).

Iterative and incremental agile development process diagram by E. Nemkova

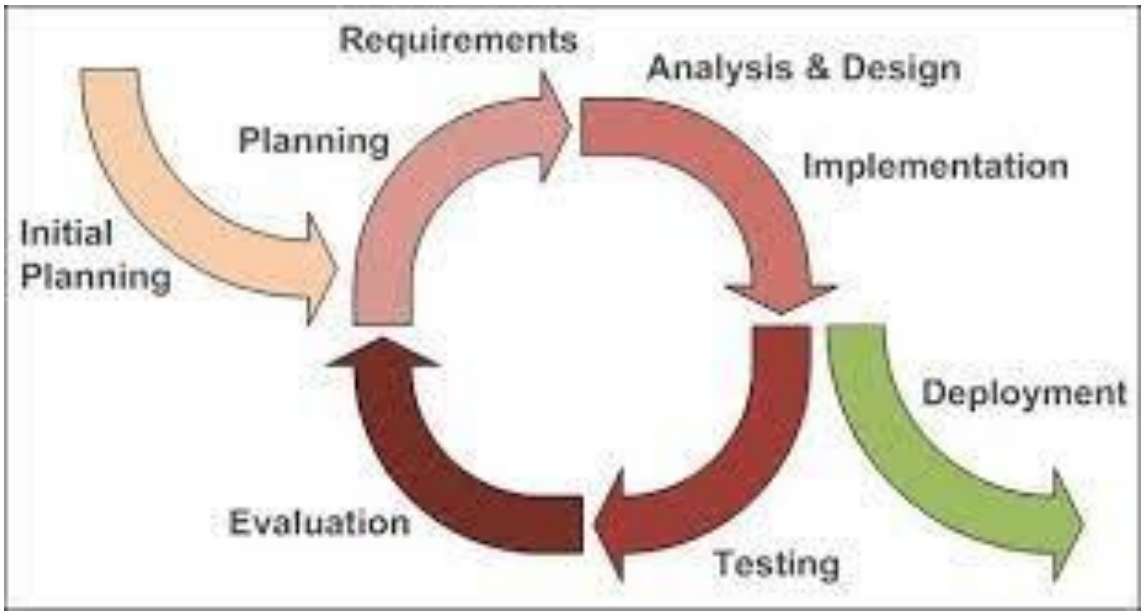


Figure 7: Iterative and incremental agile development process

Agility is most important in agile software projects as the customer is always expecting rapid software products delivery. The process of scheduling the releases ensures that the development team and the product owners collaborate in prioritizing which software applications needs to be developed and released. These are often decided on the sprint planning and program increment (PI) sessions.

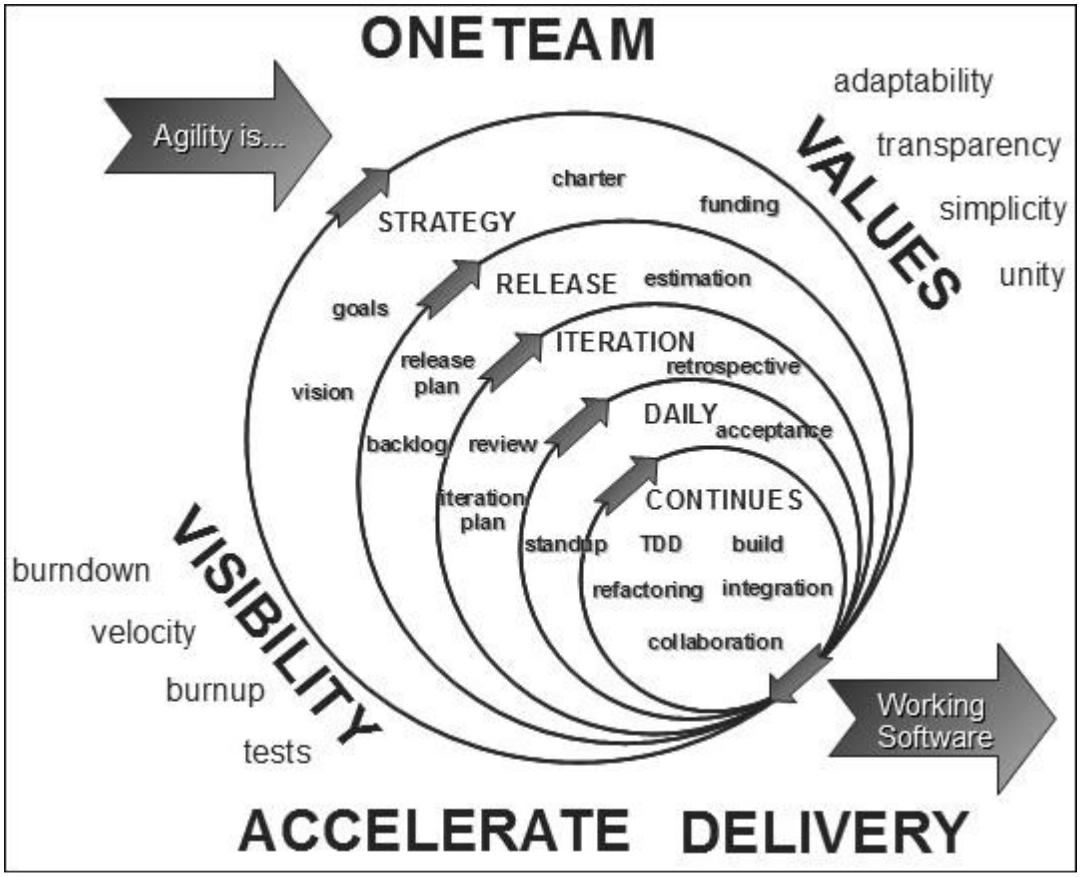


Figure 8: Iterative process and incremental delivery software products

Traditional and agile methodologies differ in how they adopt, deal, and accept changes, with agile focusing on speedy response (Moniruzzaman, 2013).

Previous software development projects, especially with the traditional waterfall methods, were perceived as failed because of their inability to adapt to changing requirements. The introduction of agile made sure that the inability to adapt into change is addressed by making sure that the product owner is contributing and involved in all stages of the project and can advise of requirements changes right through the lifespan of the project.

We are living in times of change and innovation where organizational requirements are changing rapidly to improve business performance and deliver on organizational objectives and agile is best suited for that. Agile software development promotes adaptive planning, evolutionary development and delivery and encourages rapid and flexible response to change (Moniruzzaman, 2013).

In agile methodology requirements changes are introduced by the product owner at any stage as they are part of the project team. The software development is broken down into small modules which makes the response to changes by the developers much easier.

2.8 Scrum agile software development model

Quoted in the Scrumdesk website “Scrum was developed by Jeff Sutherland in 1993 and its goal is to become a development and management methodology that follows the principles of agile methodology”. The adoption of scrum is to create transparency within the team involved in the project and the sponsor because with continued stand-up meetings, which are used as communication platform to advise of the progress on the project.

The teams in agile work together in the development of the product as they all have a common goal which is to produce the proposed product and the product management team contributes and becomes part of the project throughout its life cycle.

The scrum method consists of different roles which are part of the scrum and is led by the scrum master, software developed by programmers and the sponsor is called the product owner. The product owner is the person who request the development of a software of product, whilst the scrum master co-ordinates and leads the project whilst other members are responsible for the delivery of the proposed solution or product (Permana, 2015).

There are various stages within the scrum starting from the requirements analysis which is called product backlog in agile. The requirements are called user stories in the agile world and are provided by the product owner. The other phase is sprint planning which involves the distribution of roles and setting up of timelines for the project team.

Then comes the actual sprint which will have daily scrum meetings to evaluate how the project is progressing. In this phase some organizations used boards with cards that define each task and its status. Most organizations have adopted a software application called Jira which is an electronic version of tracing tasks. It will usually have statuses like in progress which means somebody is working on the task, blockers which are the people or process that hinder the progress of the project and lastly the complete status.

The last two phases will be product increment or sprint review which is the process of looking into each sprint after its completion more as lessons learnt and what can be improved. The last phase is retrospective which mostly look into what can be improved in the next development.

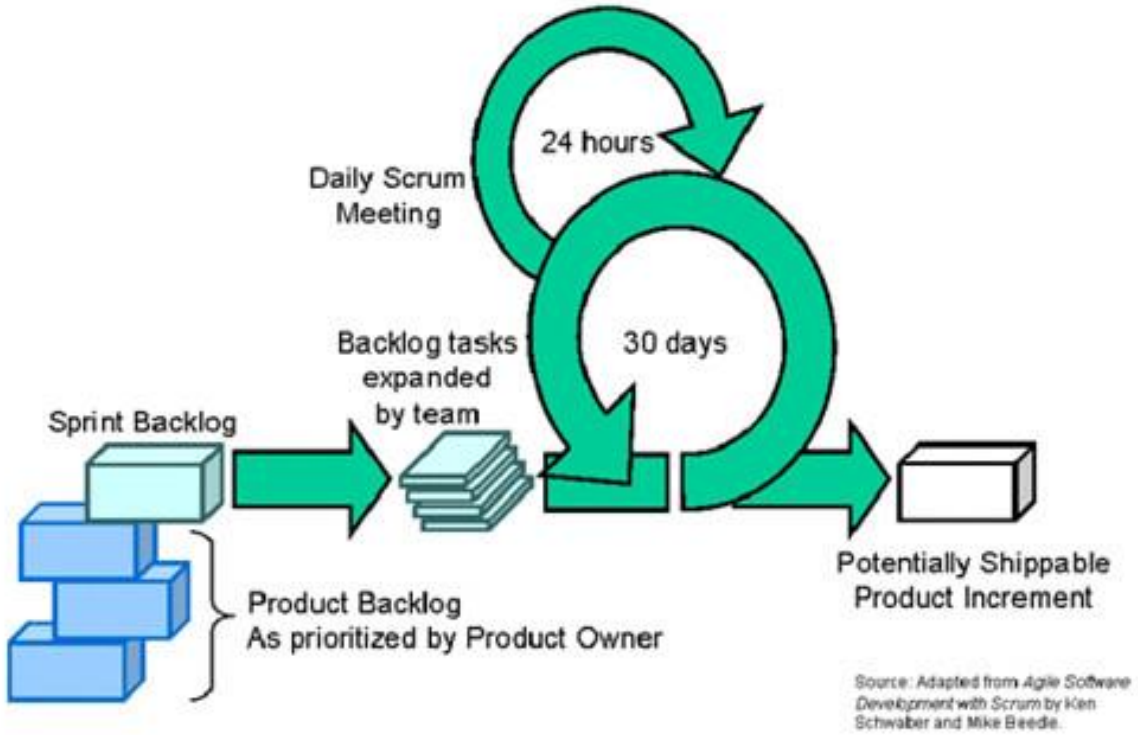


Figure 9: The scrum flow

The product backlog is created with the inputs from the Product owner, which is the stakeholder that proposed the change or product development. The scrum master co-ordinates the product backlog with other project team members to make sure that they gather the requirements from the customer which are called user stories in the agile world.

Secondly the project team conducts sprint planning which is led by the scrum master to agree on the duration and adoption of user stories. There are also sprint reviews which evaluate how the project is progressing and the product owner is always advised and kept up to date.

Members of the project conduct daily stand-up meetings to g discuss what was done the previous day, what are the tasks of the current day. They also raise challenges encountered that prevent them from completing certain tasks. This meeting is used as a communication platform for the project team members and creates transparency amongst each other.

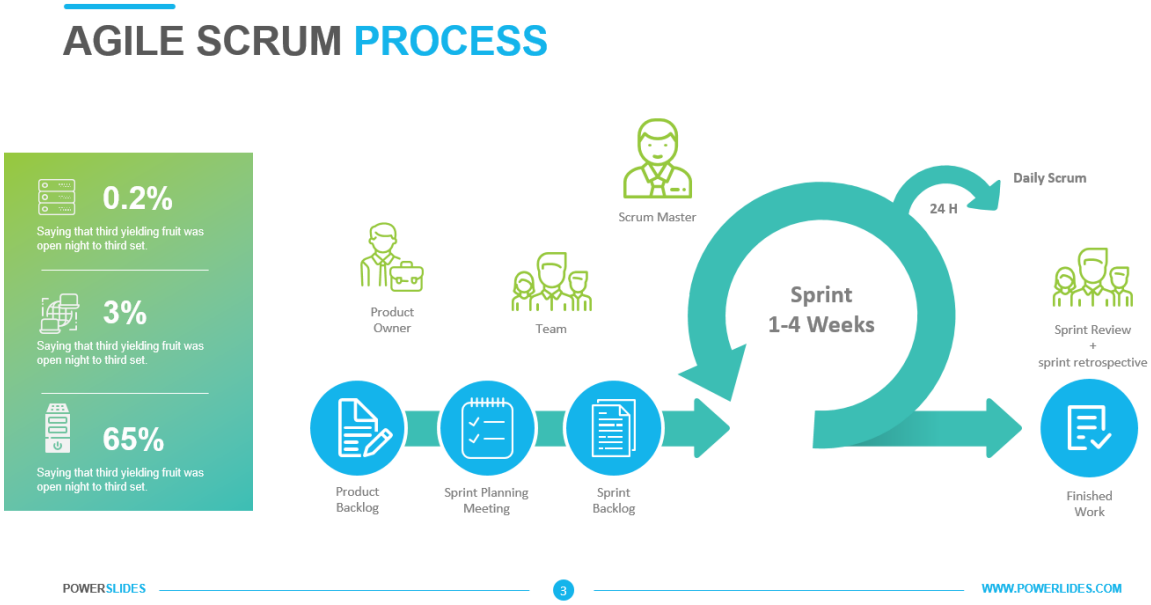


Figure 10: Scrum process

2.9 Kanban software development methodology

To understand the usage of Kanban in a software development process we must first explore its original usage (Kirovska, 2015). The Kanban concept was originally a part of the JIT (Just-in-time) production system of Toyota in the 1950's" (Kirovska, 2015). "Just-in-time" means making "only what is needed, and in the amount needed". Kanban roughly means signal card that is used to trigger manufacturing action. Toyota, when a process refers to a preceding process to retrieve parts, is uses Kanban to communicate which parts have been used" (Kirovska, 2015).

The beginnings of Kanban involvement in software development are connected to David. J Anderson (Andersosn, 2010) when he was invited by Microsoft to assist in one of their small teams for achieving better visualization of the workflow and limiting the workflow. Software development is not a production of manufacturing activity (Reeves, 1993).

The Kanban method is used differently now in software development that it was by the manufacturing organizations, theirs was used producing if the same products repeatedly. In software development Kanban is used to track the progress of the project and create visibility to all project team members so they can see the status of different tasks with the entire project (Kirovska, 2015).

The adoption of Kanban was to improve team communication so to increase productivity and create transparency, have visibility of development flow, and reduce delivery time (Ahmed, 2010).

The reason why agile methods have been adopted in recent decades it's the capability of their flexibility which improves effectiveness as the customer can change the requirements at any given time. The development project is broken down into shorter development cycles that called sprints which are delivered in shorter periods which usually satisfies the customer (Flora, 2014).

In managing software projects, the scrum and Kanban methodologies are usually recognized as the most effective and powerful methods. This is because of their ability of optimizing the development process, identification of tasks and time management (Lei, 2017). Scrum is the most used method according to the study conducted by Forrester, and Kanban is the least preferred from scrum (Forrester, 2018).

Besides the results above in the study conducted by Flora, Kanban is the contender on agile methods because of its capability in tracking the progress and setting the transparent workflow of tasks which gives software engineers an effective way of managing their projects (Flora, 2014). It is also highlighted by Skinner "that Kanban does lack in monitoring progress when it comes to managing software engineering progress". This leads to negative effects in terms of the project success because of scheduling delays that affects the delivery of the software (Skinner, 2015).

The monitoring of task limitations within Kanban method is due to its core principles which are work in progress (WIP) and visualizing workflow (Flora, 2014). The Kanban board is used to have visibility of the development stages to monitor its progress and try to eliminate any blockers if any. The WIP principle allows the development team to focus on few tasks to avoid time delays which is caused by switching from one task to another (Andersosn, 2010).

The Kanban board as illustrated in the figure below is divided into various stages moving from the left to the right. In manual use the tasks will be represented by cards that will state the status of the project and in the electronic version the task will be seen more like the dashboard.

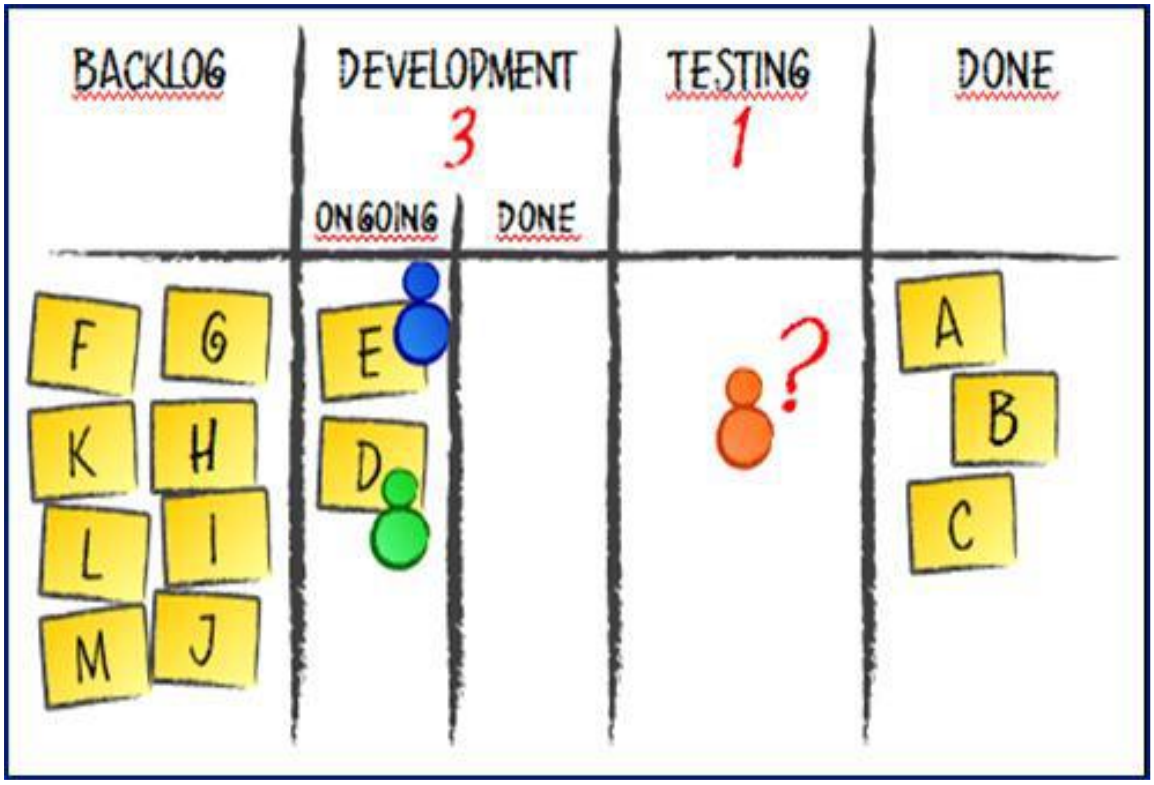


Fig 11. Agile Kanban board

The Kanban board method challenges. As highlighted on the above paragraphs the Kanban inability to monitor progress tasks in the development stages of the software is one of its major challenges. Sometimes even the team working on the Kanban complicates its dashboard by having too much information which does not make sense to other team members.

2.9.1 The tracking of progress

Kanban is a lightweight methodology used in agile practices that is used to track the progress but not the changes of software development (Andersosn, 2010). In this context, it was stated "that applying Kanban method to software development, either as a standalone method or in combination with other methods, has been a highly pertinent topic for software researchers and practitioners" (Flora, 2014).

Kanban is not a standalone method, but a software tool used in agile environments (Ahmad, 2014). Another researcher argued that "Kanban method should be complemented or expanded by agile methods or another method in SDOs to keep schedule of the projects progress as it is planned" (Lindblom, 2015).

The Scrumban method was established by integrating the Kanban with scrum that has value stream mapping. This integrating was motivated the lack of Kanban tracking mechanism in

terms of development progress, so the integration with scrum improves its effectiveness in that regard (Alaidaros, 2018).

2.9.2 Determining work in progress limits

The Kanban method limits the WIP which controls the scheduling of tasks to avoid them from running parallel at the same time. This process helps the team members in organizing themselves so they can assign their own tasks to themselves (Andersosn, 2010).

WIP has been proved to be a very serious challenge facing the software engineers as they don't have a formula to track the success of tasks in each stage due to the limits. It limits members on each stage from monitoring and controlling the tasks of their team members in a way of ensuring progress as initially planned (Alaidaros, 2018).

2.9.3 Visualization of the workflow

Visualizing the workflow is also another core principle of Kanban method, which is defined as the process if highlighting the mechanisms, interactions, queues, waiting and delays that are involved in the implementing of a part of valuable software (Alaidaros, 2018).

A Kanban board is used to visualize the workflow and monitor the project progress by showing the activities of the development process (Andersosn, 2010).

Besides that, data such as lead time, cycle time, number of bugs, throughput, and so on, are usually shown in diagrams, affixed to the walls of the workplace, or in any case continuously updated and made public (Heikkila, 2016).

Within Kanban method, the cumulative flow diagram (CFD) has used to show WIP and average lead-time, and to highlight issues and bottlenecks (Corona, 2013). The CFD is useful for thinking of workflow states as queues, understanding the queues behavior, and diagnosing problems and taking meaningful decisions (Alaidaros, 2018). For instance, Kanbanery tool uses CFD just to report some information, such as average lead-time and cycle time by using data filtering (Corona, 2013).

The agile Kanban method has a good visualization of workflow and project monitoring capability within its Kanban board, but that does not help in showing the target information and fail to relate the project task accomplishments as to meet the project commitment objectives (Alaidaros, 2018).

Thus, there is a need to identify alternative and extra visualization criteria for Kanban method that may provide useful insights and information for helping project managers to take meaningful decisions regarding the projects' progress (Alaidaros, 2018).

Overall, it can be concluded that agile Kanban method has lacking in progress monitoring task during development process of software projects (Alaidaros, 2018).

Kanban board neither reports target information or quantitative calculations about how much work progress is left nor provides some indications of where the project is being progressed, which could be useful for progress monitoring task (Alaidaros, 2018).

2.9.4 The initial model (Alaidaros, 2018).

After identifying the criteria that affect software project-monitoring task of agile Kanban method, this section introduces the initial model for improving software project progress monitoring task of agile Kanban method (Alaidaros, 2018). The initial model was build based on the original Kanban model that is usually represented by Kanban board, which is represented by the figure below (Alaidaros, 2018).

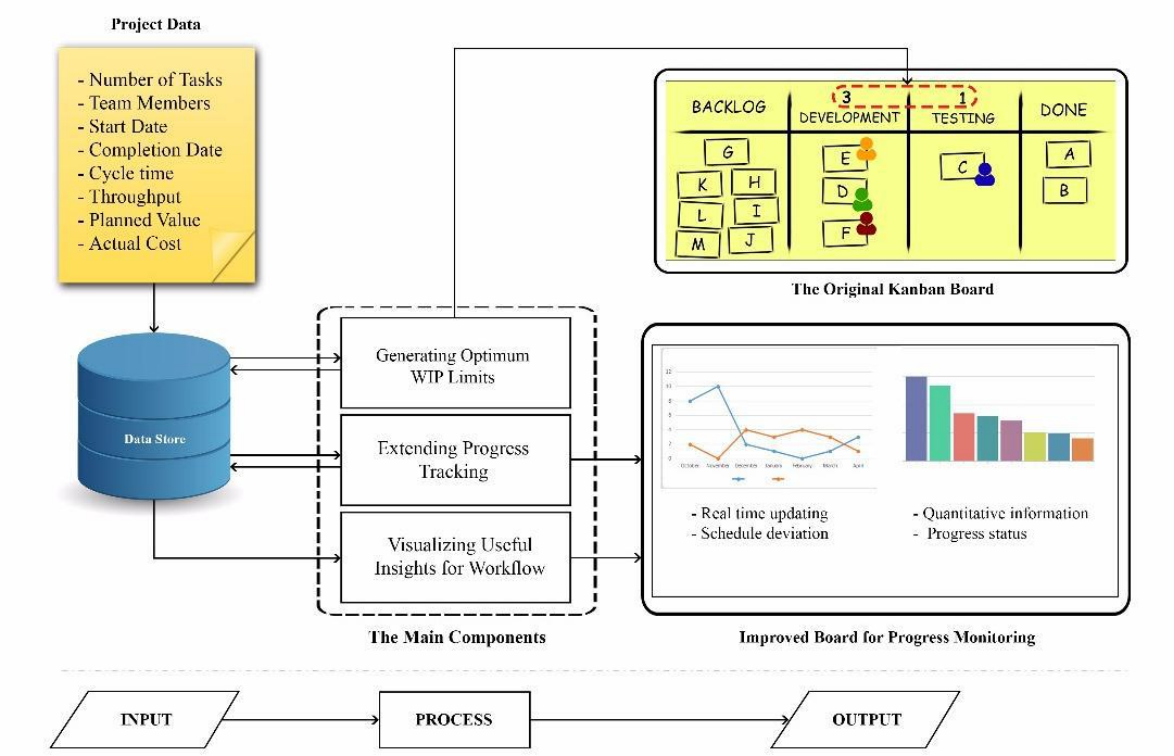


Fig 12. The initial model

There are three components that form the initial model which extends the tracking of progress, also generating the limits and shows the visualization of the workflow insights. These needs

to be identified during the initial stages of development as they influence the components of the model.

2.10 Knowledge management focusing on the performance of the organization

Knowledge has been investigated and described differently by various authors. Richard Hall's views about knowledge "we define knowledge as including of all the factors that have a potential to influence human thought and behavior and that sometimes allow the explanation, prediction and control of physical phenomena" (Hall, 2003).

Nonaka classified knowledge "into tacit and explicit knowledge based on the ease for coding and transferring the available knowledge" (Nonaka, 1994). Explicit knowledge is easily transferrable and coded, while tacit knowledge is rooted deeply into the system within the organization, in its passive form, knowledge is useless, however, when activated through creative process for application, replenishing and sharing, it may lead to outstanding performance (Nonaka, 1994).

Knowledge management has a potential of improving the organization's knowledge economy with the involvement of elements like your human resources, technology availability, culture, and organizational structures (Du Plessis, 2007). Most researchers proposed that knowledge management should involve enablers and processes (Abubakar, 2019). Knowledge management framework should have a basic understanding of knowledge operations and infrastructure to support the organizational operations (Abubakar, 2019).

To improve organizational outcomes like learning, innovation, product quality, revenue, profits and performance, the organization realizes the importance of knowledge management and invest on it. However, what is lacking in the literature and practice of knowledge management and organizational performance is a sound judgement and research on the influences of decision-making style on the process and enablers of knowledge management on organizational performance (Abubakar, 2019).

Knowledge management is the process of using meticulous steps to acquire, design, manage and share knowledge within an organization to achieve better performance such as reduced costly rework, faster work, and use of best practices (Pfeffer and Sutton, 1999). To ensure that knowledge is available for reuse it is important for the organization to make sure that it is saved in its repositories. The steps of knowledge management process have always been captured it, transfer and apply (Abubakar, 2019).

The organizational knowledge creation process has always been based on its products, people, culture, activities, and services. The knowledge creation elements are knowledge assets which includes outputs, inputs, and brokers (Abubakar, 2019).

The process of capturing knowledge involves the creation, acquiring of new information and storing it for future use. There are various technologies used by organizations to store information which are recorded conversations on video conferences, data mines, share point, Microsoft teams and external hard drive devices.

Organizational knowledge process has an association with sharing, indication of knowledge structures, where its listed and modelled. The process involves stages like selection, evaluation, organizing, preparing, and selecting the knowledge. The process stages require continuous evaluation and updating of knowledge (Rowley, 2000). According to Mohammed Abubakar "knowledge organizations should be defined based on the following development phases: knowledge creation, knowledge implementation/adoption, knowledge dissemination/sharing and knowledge modification/revision" (Abubakar, 2019).

The process of storing knowledge is the creating of knowledge which might never be enough but always important to be stored as its created and be stored in a repository that can be accessed by all the members of the group (Alavi, 2000). This triggered a need for more organizational; storage like electronic databases, shared drives etc... where the additional acquired knowledge can be stored.

The dissemination process involves the transferring of knowledge amongst collogues it can be two or a group of them and this can be done through social gatherings, formal meetings, or presentations, in agile ways it can also be through collaboration of squads (Leidner, 2001). Knowledge sharing happens in the form of discussion amongst members regarding an organizational product, or in the case of programmers one showing another one a piece of code or the information shared by the product owner or customer. In an organizational culture where such processes or platforms are encouraged makes the process easy as the members will be free in sharing what they know. This also depends on the level of trust amongst the members which get cultivated with frequent engagements.

Knowledge application process is the essential point in knowledge management that ensures knowledge is used to the benefit of the organization to improve its performance and revenue (Probst, 2000). The process also speaks more on applying knowledge actions to solve problems, assist the leadership of the organizations with making decisions and ensures that

knowledge is created in the process. Knowledge management systems may assist with the reuse of knowledge which may increase efficiency in knowledge application that can serve as a benefit for the organizational performance and process improvements (Abubakar, 2019).

Knowledge enablers characterized as influence factors and can expedite knowledge management activities such as arraying and disseminating knowledge capital among individuals (Chau K. C., 2008). The organization uses enablers to develop, stimulate, create, share and protect knowledge management. Those enablers are structure, culture, and technology (Abubakar, 2019).

Each organization has its own structure which can incorporate knowledge management for effectiveness. The structure of the organization has four components which are formalization, centralization, decentralization, and specialization (Dekoulou, 2017).

To define the four components: (Dekoulou, 2017)

- Formalization is when the organization focuses on decisions, working relationships, operations and its governance which entails its procedures, policies, rules, and regulations.
- Centralization is the process where the organizational activities are controlled and managed in a single point in business terms in its head office.
- Decentralization, the control, and management of activities are managed by its branches.
- Specialization focuses on the employee's delegation of duties and how they are spread across the organizational employees.

Organizational culture can be defined as values, procedures, practices that guide the employees on how to conduct themselves on representing the company and interacting amongst themselves and customers. All employees are expected to adopt the culture and live by it as long as they are contracted by the organization. This is the same culture that can set guidelines as to how knowledge can be managed. Organization expects collaboration amongst its employees and contractors (vendors) in terms of sharing knowledge. It is stated in previous research that "collaboration has three elements which are voluntary collaboration, parity in relationships and goal interdependency" (Abubakar, 2019).

The use of technology enables effective communication amongst organizational employees especially during the pandemic period when people were working from home. Tools like Microsoft teams, zoom and skype were the popular application software that were used for

communication, share documents and knowledge. Companies are forced to invest in technology, especially these days to communicate, be more effective in conducting its daily activities and marketing its products.

The use of technology has been underestimated in the last decades and the covid 19 pandemic made the companies step up their game in making sure that they have the needed technology in their organizations. I always imagine if the pandemic happened in the nineties or a decade before how the organizations could have stayed abreast. The ability of the Microsoft team to record meetings or sessions for future use is one of the benefits of technology.

Most organizations have invested in e-learning where employees can select the courses they want to do online and assess themselves. In most IT courses certifications are required and that is also enabled online by organizations such as AWS for cloud computing. As mentioned by Victoria Marsick "beneficial activities that aids employees to create, acquire and transfer knowledge (dialogue, knowledge inquiry and application) is known as perceived learning climate" (Marsick, 2003).

2.11 The creation of organizational knowledge

The capability of the organization in ensuring that the continuous creation of knowledge gives them a competitive advantage and improves its performance significantly. The speed at which things are changing these days requires the employees to keep on improving their skills so they can keep up with the changes. So, it's very important for any organization to create knowledge and make sure that its employees use it to their advantage. The leaning organization improves innovative creativity amongst its employees and enables them to generate more ideas that can assist the organization in achieving its organizational objectives.

The process of knowledge creation is described as the composition of descriptors, as part of the creativity process: "the ability to originate novel and useful idea" (Marakas, 1999), "chaotic, unstructured and unsystematic" (Davenport, Prusak, 2000), "when the firm acquires and adopts knowledge from others, it modifies knowledge to make it suitable" (Bhatt, 2000).

The knowledge gathering begins with data which is processed into information and information used as knowledge. Once the information is gathered the organizations can then store it into their repositories which can be databases or their share drives. Once the knowledge is created and stored the members of the organization can access and use it. Nonaka's views on knowledge creation developed a theory with a process called SECI model that shows how

knowledge is created from the individual and shared throughout the organization (Nonaka, 1994).

The above paragraph emphasized the creation and storage of knowledge that gives a conclusion that intellectual property is valuable in organizations. It has been mentioned in previous papers that "knowledge is contextual which means that it is created in a specific context and has relevant meaning for each organization" (Jakubik, 2008).

As mentioned previously the Nonaka "SECI model consider knowledge as a dynamic process, in which the continuous dialogue between tacit and explicit generates new knowledge and expands it across different levels within the organization" (Nonaka, 1994).

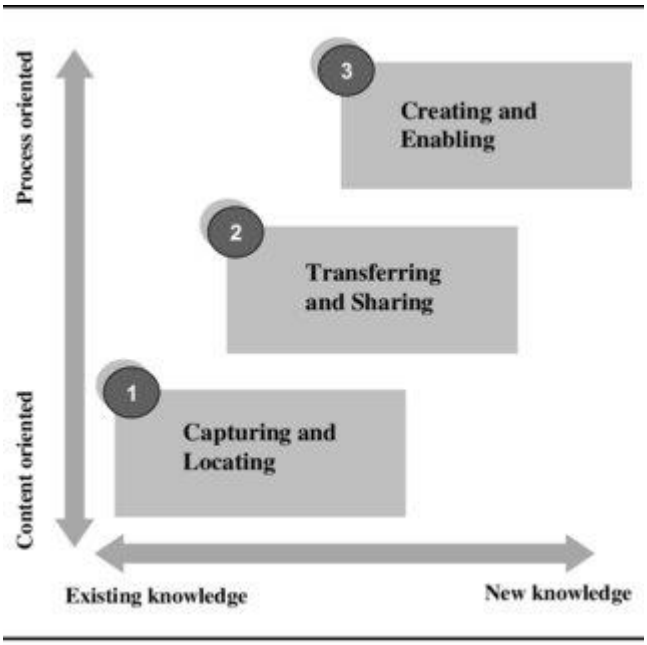


Figure 13: Evolution of knowledge management initiatives (von Krogh, 2000)

The process of creating knowledge in most cases is initiated by the organization to ensure continuity and its survival when the knowledge holders leave the organization. It is controlled by the employees themselves anyway as they decide when to share and create the knowledge they have. They can feel comfortable sharing knowledge with the colleagues they are closer to in the office or in their social gatherings. Each employee has control of the knowledge they have on their minds.

The organization has a duty then to persuade the employees to share the knowledge by compensating them for knowledge shared. In my view the organization must create a space where all employees feel valued by the organization in a way, they see themselves as part of

the building and contribute to its success. When their efforts are recognized even by spotlight awards or their names mentioned on monthly published new letters, they tend to feel at home.

The company should give them more responsibilities and let them work independently with the visibility of service level agreements. The middle management can then have monthly or weekly review just to check the challenges and developments encountered in their respective roles. Some might highlight knowledge creation and storing as a challenge which might give management an opportunity to address that. On discussing development management can try and understand their plan of developing themselves in the upcoming weeks or months.

Giving them control on determining their learning journey might open them up to sharing their knowledge freely as they feel in charge. The organization can suggest that they should free part of their responsibilities to be able to acquire knowledge. On letting go they will be sharing what they already know with other colleagues, especially the new joiners in the organization. As the company is formulating its knowledge management strategy it should be transparent to the employees, so they understand what is expected from them in a way of building the knowledge repository.

The organizational vision of embracing knowledge creation and sharing should be done with employees in each department, so they also value the importance of knowledge management. Furthermore, the organization should make the creation and sharing of knowledge part of the employee performance assessment. Employees know that the performance assessments are linked to increment and bonuses and therefore they will want to tick that box.

For knowledge to be created and justified based on the firm's knowledge vision, the firm needs a concrete concept, goal, or action standard to connect the vision with the knowledge-creating process of dialogue and practice (Bratianu, 2010). Such a concept standard is often called a driving objective because it drives the knowledge-creating process (Nonaka, Toyama, 2007).

The companies should also try and have more team-building exercises, preferably offsite, and make sure that employees are free and comfortable. The games played on team building gives an opportunity to employees to link them with their daily functions. Most of them highlight the importance of teamwork. The coordinator of the games can give feedback every time the results are shared as to how each team performed. That feedback might be very important in triggering collective efforts in the next upcoming games where each employee will utilize their talent to contribute towards their team effort.

They will also find time to discuss their game plan before each exercise and each one will share their views. This exercise can then trigger the SECI model created by Nonaka in 1994, where people will open and share what they have on their minds with other team members which in return they can also register on their minds.

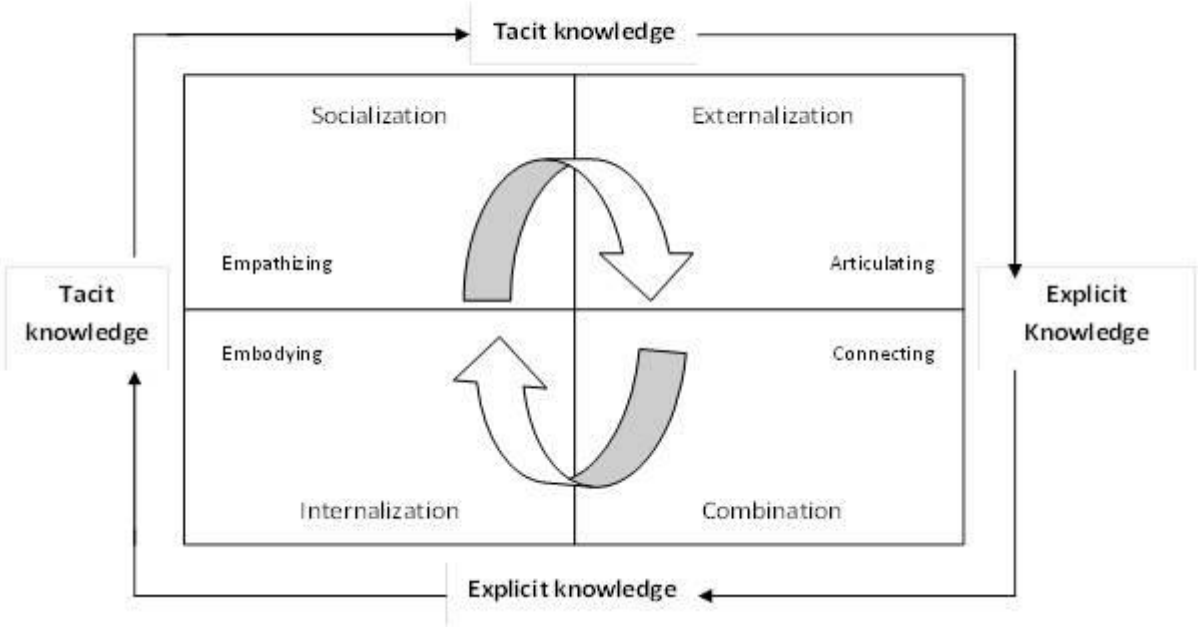


Figure 14. SECI model and the knowledge spiral. (Nonaka, 1994)

Below is the discussion of the SECI model in detail as outlined by the author Ikujiro Nonaka:

Socialization is discussed by Nonaka and his co-workers as the beginning of sharing knowledge as it speaks to the knowledge that is on the person's mind which has been created throughout the years with academic education or work experience. This wealth of knowledge is then shared with the other individual in a social gathering or workplace. In terms of knowledge, knowledge is called tacit as it's on the individual's mind. This exercise allows individuals to interact where knowledge amongst themselves is shared (Nonaka, 1994).

Externalization is the phase where the shared individual knowledge is processed by the other party which in knowledge terms is called transforming tacit knowledge to explicit knowledge. The party receiving the knowledge can record it as its verbally shared by the other party or document it. This phase covers the knowledge creating part of the process. What is most important is the platform where this knowledge is being shared, does it create a conducive environment for the parties to share and create the knowledge.

Combination is the phase where the shared knowledge is created and stored by codifying it from its tacit state into explicit knowledge. Nonaka and Toyama outlined that “In practice, combination entails three processes. First, explicit knowledge is collected from inside or outside the organization and then combined. Second, the new explicit knowledge is disseminated among the organizational members. Third, the explicit knowledge is edited or processed in the organization to make it more usable”. In this phase the knowledge repository discussions take place, were have knowledge where are we going to store it (Toyama, 2007).

Internalization is the phase that covers the part where individuals have access to explicit knowledge, and they can use it to empower themselves. As outlined by Nonaka and Toyama ““Internalization is the process of embodying explicit knowledge as tacit knowledge. It is closely related to learning-by-doing. Through internalization, knowledge that is created is shared throughout an organization. Internalized knowledge is used to broaden, extend, and reframe organizational member’s tacit knowledge”. In the organizational structure the employees have access to the knowledge repositories by accessing recordings or documentations which are compiled as stored knowledge (Toyama, 2007)

2.12 Knowledge sharing and trust

The culture of the company is the reflection of the people’s thinking and feeling of their organization. It speaks to the trust issues between management and their employees and the willingness of them to adopt organizational changes and embrace them to move the organization forward (Alawneh, 2008). Organization must understand that the knowledge residing on the employee’s mind might be difficult to codify and they might also be skeptical in sharing it which might hinder on the knowledge sharing exercise (Alawneh, 2008).

When a high level of trust in the organization is developed, employees will not need to be self-protective and keep knowledge and information to themselves (Venkatesh, 2019). Hence, trust in the organization can encourage knowledge sharing (Venkatesh, 2019). Trust in teams allows team members to achieve results and function frictionless and it holds relationships together and facilitates collaboration (Venkatesh, 2019)

Managing of knowledge within the software engineering needs management to acknowledge that members in the project need social interactions (Birk, 1999). However, as software development projects grow larger and the discipline moves from craftsmanship to engineering,

it becomes a group activity where individual need to communicate and coordinate (Alawneh, 2008). Individual knowledge must be shared and leveraged at a project and organizational level, and this is exactly what KM does (Alawneh, 2008).

With agile engineering the team members will always be able to create, retain and share their knowledge because of the nature of its communication platforms, continuous human interactions make sure that knowledge is managed. The interaction amongst them encourages the more experienced once to share their knowledge in a way of improving he skill capabilities of the novices so they can be comfortable working on the project (Khalil, 2013). The geographical working places of project team members might affect how they share knowledge which might be caused by time differences, language barriers which might affect the delivery project timelines (Khalil, 2013).

Agile method makes sure that everybody is onboard during the SD process which allows them to interact more frequently and that helps in terms of building trust between them. The level of trust and communication amongst the team members in the project might create problems and challenges in knowledge generation and creation.

The efforts of collectively owning the code, with stand-up session and the availability of product owners, the promotion of pair programming might improve trust, respect and compliments amongst the members working on the project and might accelerate the delivery of the software or product (Chau, 2003). The key knowledge sharing here are the interactions among members of the teams, which happens voluntarily, and not by an order from the headquarters (Chau, 2003).

Even though the level of communication is encouraged and practiced on the SD project, it is also advisable that the scrum master or project lead always makes sure that knowledge is shared amongst the members because trust only without monitoring cannot guarantee the knowledge sharing. Also encourage knowledge seekers to make time to seek it from the more experienced members. The organization identifies success factors and links them to the performance of the employees as a model of identifying key performance indicators.

Organizations could check the performance of the project staff which contributes towards its objectives of increasing its revenue as a measure to see if the trust amongst the members is working on its favor which supposed to improve knowledge sharing amongst them. A good attitude and trust amongst team members should contribute positively towards the organization and should also increase the level of knowledge sharing and its effects amongst the receivers.

The organizational management should acknowledge the knowledge created by its employees and invest into tools and software applications that will make sure that it is stored for future use and cannot be lost (McNeish, 2010).

Organization can be able to examine the information being stored in the warehouse and can have maintenance mechanism to make sure that it is kept safe and can be accessed by team members. The conclusion whether the information will translate to knowledge depends on the members themselves and leaders should motivate them (Soo, 2002).

The value of knowledge shared will be shown through appreciation of technology processes and its effect on the performance. The sharing of knowledge amongst members is always depended on their willingness to do that and the organization can only do so much to make sure that happens, and it if shared then management must make sure that the create a knowledge repository so that it stays within the organization.

Knowledge creation, retention and sharing will always be very important for any organization as this can assist in terms of organizing and aligning its vision and values in order to improve customer satisfaction, collaboration of teamwork and making the organization more competitive. The improvement of organization processes can also contribute positively to reducing time to market its products (McNeish, 2010).

Improved processes and knowledge sharing amongst organizational members increase the value of organizational performance and it also instill confidence amongst its members. To create job satisfaction, the organization must value the contribution of employees and show appreciation towards them. When they feel appreciated by the organization then they can be able to share their knowledge more willingly and that will also improve trust amongst them.

It is difficult for the organizations to identify the trust issues amongst its employees. Other researchers have the view that “the study of trust is problematic with respect to the definition of trust itself: lacks clarity in defininf the relatioship between risk and trust; and confuses antecedents and outcomes of trust” (Mayer, 1995). As Joanne McNeish highlighted “trust is used in this paper based on the definition of trust as the willingness to be vulnerable to the actions of another party based on the expectation that the other will perform a particular act important to the truster, irrespective of the ability to monitor or control the other party” (McNeish, 2010).

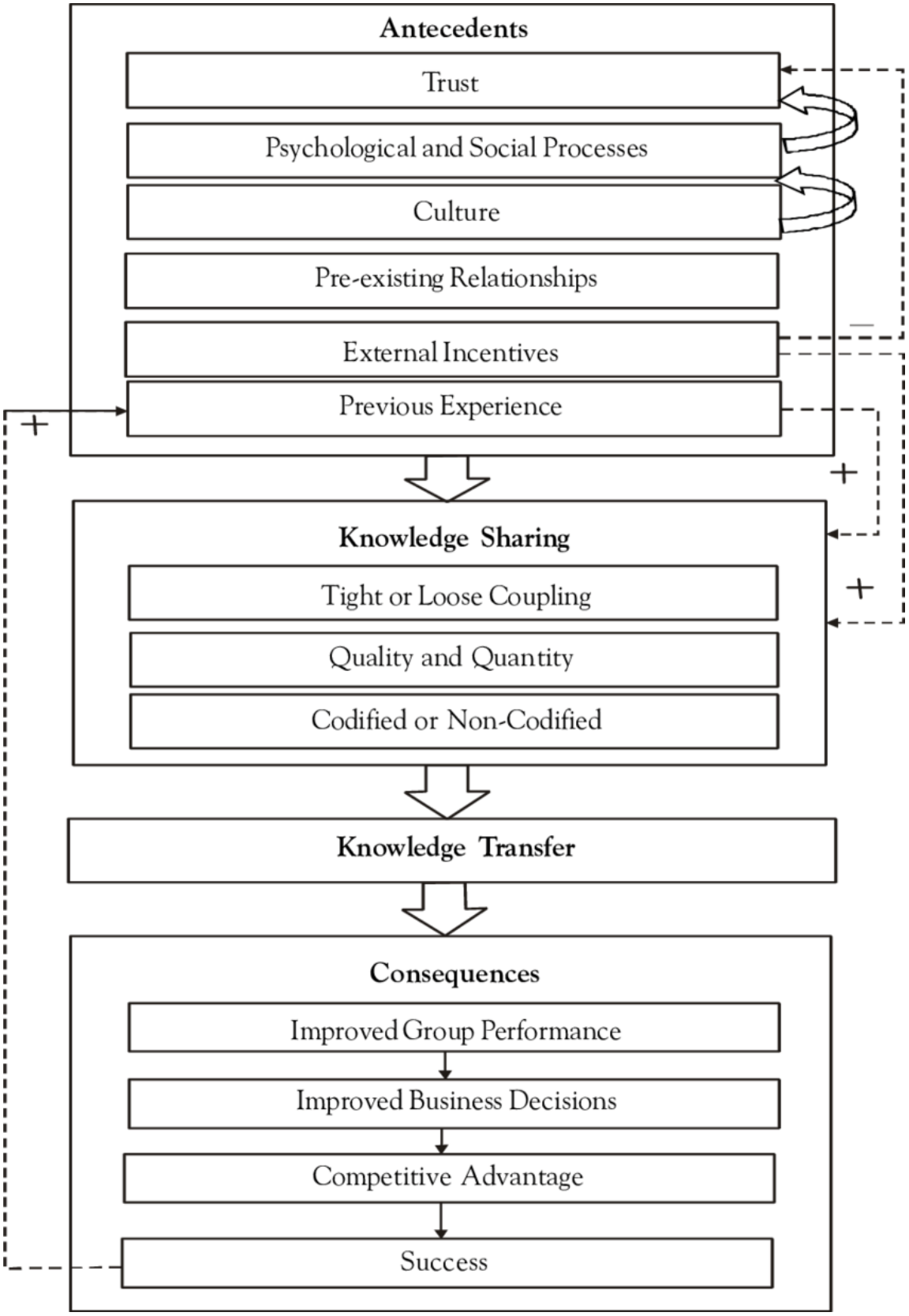
There are various factors that supports knowledge sharing amongst staff like the organizational culture, social activities, level of interaction, and incentives offered to employees on their

sharing initiatives (McNeish, 2010). The level of trust goes a long way in imrpoving knowelge sharing amongst team members. The relationship amongst employees improves with the time the group spend with each other so as the trust levels (McNeish, 2010).

Trust is something employees gain through interaction. It might be easy to grow between two people and might be difficult amongst the group as people tend to trust one or two people which led to the comment by other researchers that “uncrotrolled information disclosure may allow ones’s partner increased bargaining power in the relationship or possible help to create a future competitor” (Baugh, 2001).

The organizational culture and the relationship amongst organizational members can improve trust which can contribute to knowledge sharing. Trust amongst group members can also improve their performance, which can contribute positively to company deliverables. With a high level of trust amongst team members, improves the level of information shared and makes it more accessible and available when needed.

Figure 15: “Trust and Knowledge Sharing in Organization: A Proposed Model” (McNeish, 2010).



2.13 Knowledge management tools and techniques

The organizational objective of managing knowledge is to develop its employees, enhance communication and making sure that all available knowledge is preserved (Steels, 1993). Organizational management should create facilities like databases to store the knowledge and make sure that its accessible to employees. Knowledge management is viewed as a complex issue where each employee can claim it as if its belonging to them and the organization should emphasize that once its codified and stored it is then an organizational property.

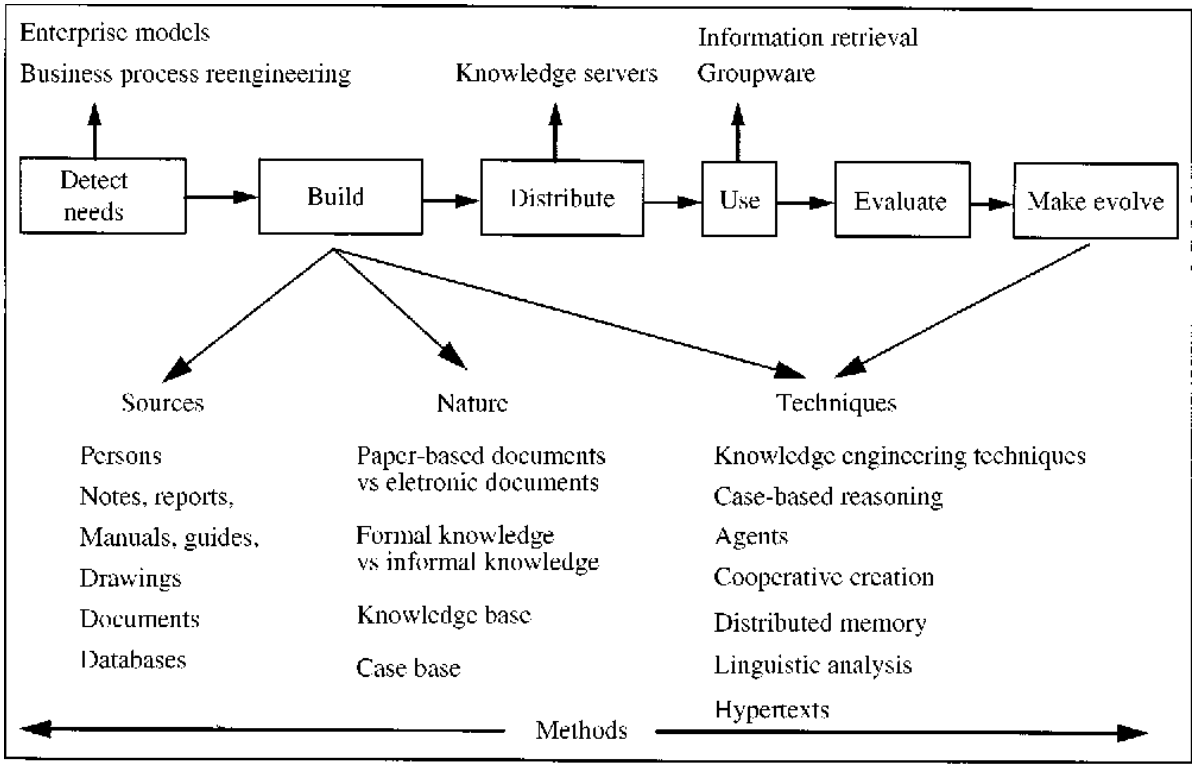


Figure 16: Organizational knowledge management methods and tools (Dieng, 2006)

2.13.1 Tools used in knowledge management

In one of the papers Rizal Siregar highlighted that "the development of information technology organizations developed systems like enterprise resource systems (ERP) to enable organizations to execute their process plans (Siregar, 2009). As stated in previous research, the management of ill-defined, knowledge process has not been that much of a success. Because of that the knowledge management professionals started using tools to process and distribute knowledge. The goal of IT organization is to create software systems that will enable the effectiveness of the tools so they can be used in employee communication (Siregar, 2009).

The knowledge management tools are used to integrate, process, and compiled the gathered information from individuals which is then processed and transformed into useful knowledge

(Siregar, 2009). The processed information is linked to various people who shared it and the organization should make sure that it processes and creates as much of that information as possible to ensure availability when its needed.

The knowledge management term called explicit which means available knowledge is just regarded as information shared by people in general which people shared to others or the organization (Firestone, 2003). The information in recorded as its verbally shared or gets documented so it does not get lost hence now the need for knowledge tools which assist in that exercise. The tools are used in the process of transforming it into usable information called knowledge.

The requirements of KM tools reasons as stated by Rizal Siregar (Siregar, 2009) include:

Contextualize the information: they enable the contextualization of information, characterize the data about data, and integrating it so it can be ready to be stored. In doing the above the tools are ensuring that the knowledge seeker will be able to retrieve the information easily (Siregar, 2009).

Intelligence built to transfer information: few issues must be considered on the process of transferring information like its content, the user, and the timing of the transfer. The tool should be able to optimize the above-mentioned items for easy access and use (Siregar, 2009)

Facilitation ability for interaction and networking: the users should be able to communicate verbally, and the tool should be able to record the verbally interactions and code them for future use. It should be user friendly for the searching of information (Siregar, 2009).

Customized graphic user interface: the tool should enable a user-friendly graphic interface the knowledge seeker can access. The interface should also enable the re-using of the tools for future knowledge codification (Siregar, 2009).

2.13.2 Tools available for management of knowledge

There are various tools available to support the functions and processes of knowledge management and below are listed and discussed (Siregar, 2009):

Used tools for knowledge access: using these tools people can access codified knowledge, share, and transfer it to using the information systems. One example of such a tool is Convera, which is used for retrieving purposes. It works on powerful indexing systems to classify expertise based on both content and collaboration dynamics and networks within the enterprise (Siregar, 2009).

Tools for collaboration work: these tools enable teams to globally share dedicated spaces for managing the project lifecycle; editing and publishing material; conducting live discussions and interactions; and maintaining a repository of materials associated with every step of the process. For example, Quick Place is Lotus's web-based share workspace, core workers, suppliers, partners, and customers can communicate online immediately within a structured workspace created for that purpose. An online workspace can make it possible for people to work together more easily and less expensively (Siregar, 2009).

Some of the tools are used for knowledge extraction: these are the kind of tools that support structural queries. They are more used in data mining as they can interpret relationships amongst data elements. One of the examples of the tools is ClearForest Text Analysis Suite which is used mostly by business intelligence solution personnel (Siregar, 2009).

There are tools for expert localization: they are used for the location of knowledge holders which is exchanged and collaborated amongst members. One example of such tools is Activenet (Siregar, 2009).

There are tools for work collaboration: these ones are more suitable for teams that are sharing knowledge globally, editing and publishing material; conducting live discussions and interactions; and maintaining a repository of materials associated with every step of the process. For example, QuickPlace is Lotus's web-based share workspace, core workers, suppliers, partners, and customers can communicate online immediately within a structured workspace created for that purpose. An online workspace can make it possible for people to work together more easily and less expensively (Siregar, 2009).

2.13.3 Development if IT tools used for knowledge management

The web services have powerful platforms that can be used to support all stages of knowledge management. The web allows for an unprecedented degree of integration of different representation and communication media (Siregar, 2009).

Table 1: IT tools commonly associated with knowledge management (Siregar, 2009)

Technology	Descriptions/ Examples
AI technology	Expert systems, learning systems
Communication & collaboration systems groups	Email, teleconference, video conference, chat, IM, forum, Listserv, groupware calendar, log, shared information spaces, workflow management systems, group decision support systems
Document management system	Management of electronic documents, a system to search, edit, distribute, retrieve, archive and otherwise manage the complete lifecycle of documents
Content management system	Management of electronic content including multimedia files
Intranet	A network contained within the enterprise. It is used to share information and computing resources among employees as well as to facilitate group working
Search engine	Tool that searches the contents of a web
Learning system	Distance learning, e learning and computer-based training.
Knowledge mapping tools	Human resources skill set inventory system

Table 2: Types of knowledge and different types of knowledge management tools (Siregar, 2009).

Explicit knowledge	Know how	Know who	Tacit knowledge
Systems tools	Collaboration tools	CRM tools	Video Conference
DBMS	Email	Social network analysis	face-to-face facilitation
Data warehousing	Groupware	Knowledge portals	Other technologies

Most of the websites we previously used had users that could not modify the data on them, they were mainly for reading only purposes. These new ones now like wiki and blogs users can add more information on the site therefore allowing dialogue and more sharing on information. They allow people to engage in different discussions and the ability to share what they know on the topic discussed, which can allow them to educate themselves more about the subject matter.

As mentioned above there are various website services that allows the later like wiki, tags and blogs which are discussed in detail below:

Blogs are an online version of an individual or organizational website that allows engagement from outsides on a share information or product in the case organizations. Most organizational websites, people are not allowed to modify or comment on the information shared, they are basically one way communication. Whereas the blogs do open that part of comments where people can like what is shared or add more information in a way of interacting with the person owning the blog. It allows for two-way communication and is always kept up to date. Blogs can also help the organization in getting feedback from their products or service they render to the public. People will comment on some positive and some negative which the organization can analyze and help them in improving of modifying their product. This can also help the organization or individual to get more customers as they can customize the service or product based on the information shared on the site. This is also a great tool for networking or getting more information even on the piece of writing one is busy with.

Tags can be used for browsing between documents and websites. People can tag a particular page and can be able to see how many other people have done so. Tagging also helps people use certain words to describe the site where others can find it easily when looking for information. They can also be used as a form of collecting data as you can see how many people are interested in the page or document.

Wikis can bring together people from various parts of the world to share and educate each other on their topic of interest. They are also one of the online tools used for knowledge creation and sharing. Some people looking for more information on an assignment or project they are busy with usually uses wikis to get more information. They can write a question that will trigger others to give more information on the subject. The most well-known example of a successful wiki is Wikipedia.org, a free online encyclopedia composed of articles written by the public (Siregar, 2009).

2.14 Knowledge management technologies

Over the years there have been various information communication technologies that have been developed which are used by organizations for the creation and sharing of knowledge. Some of them are mentioned and discussed below based on various authors:

CBRS – case-based reasoning systems: these are mostly used by adopting a previous resolution to the current problem. These tools are more like human imitations which applies some reasoning to solve current problems. The case bases are kept more like human memory by the tool and can be re-used when needed to solve a particular problem. These are some kinds of business intelligence built for knowledge storage which will be used in future as needed for a particular problem solving.

According to Richter "the cases are interpreted knowledge and added in some form of containers that can be shifted from one to another for future re-use" (Richter, 2013). These cases can be built over time into a knowledge library that will be very useful for the organization in dealing with future challenges. The case system technology tools create easier way of searching for information by creating indexes.

GDSS group decision support systems: this is a computer-based system that allows a group of people working on a project or problem to interact in a more unstructured format. They can take multiple inputs from different people in the group simultaneously in assisting with the group decision. This allows for some form of group learning as well as information shared can be in real time and be seen immediately by all members. These can be supported by groupware

and web-based tools that enable a group of people to have meetings or video conferences using technology. These are made possible by hardware, which are computers, network like software and the people involved in the group decision.

ERP enterprise resource planning: as described by different authors it's a packaged information system that is used to integrate all business functions into one single system component and enables them to share one database. The ERP allows employees from various departments to share knowledge about their domains. The collaboration amongst them using one single component makes the creation, storing and sharing of knowledge easy and accessible.

DMS document management systems: the use of computer systems or software to electronical store documents. The organization is therefore able to store and retrieve documents containing knowledge by using this system. In this day of technology, the was an introduction of cloud-based document solution which can enable the organization to store their documents centrally and enable more members in the organization access to them.

2.15 The insight of knowledge management on waterfall vs agile

Software development projects bring together various stakeholders from different environments of the organization and therefore knowledge management in key. So, all members of the organization should be able to share and create knowledge throughout the project. The sharing of knowledge starts in the initial stages of the project when the requirements are gathered from the project sponsor. All parties are also involved in the design stage, which is a very important part of the project as it should be a guidance for the development team. This is where the solution architecture is constructed so the business should share more information about the desired solution.

Members in an agile project focus more on short development cycles which must be delivered in a short period of time. Previously on the waterfall model the releases were delivered after a couple of months and there were few releases in a year and with agile the is a release almost every week. These frequent releases assist the team members to have retrospection and get feedback from the product owners. This frequent meeting of stakeholders in an agile environment also creates quick decision making as everybody is here to review the changes and contributes their inputs. So, all these efforts and meetings contribute a lot to building and creating knowledge but most of the knowledge created is tacit in these environments.

According to Boehm, “organizations must carefully evolve towards the best balance of agile and plan-driven methods that fits their situation” (Boehm B. , 2002). The waterfall software development focused more on processes which were highly documented, with the belief that the information required throughout the project is captured and will be used without the presence of the people who contributed to it. In agile the scrum master should coordinate the collaboration of people as their interaction is more important than processes. The allocation of work is done on the sprints that are conducted daily called stand up meetings.

These create a visibility of how things are and the progress of the project. Agile methodologies favor a collaborative style that gives facilitation and coordination practices to the person leading the project.

Agile methodologies are more about roles played within a team and the detailed plans right through the cycle. In the other hand the waterfall method follows the plans aligned in the requirement specification document. The plan details exactly what needs to be done and by which resources with the expected delivery time. The plan also mentions the time frames of each task assigned to the resources, then during the daily standup the members are expected to give feedback on their tasks, identify the challenges and the blockers if any.

The agile practitioners support the idea of having less documentation in their projects as the believe that the information shared during the interaction encounters is sufficient and the interaction amongst themselves creates more collaboration that clears the project objectives. To them the focus on creating and managing documents creates more delays on the project as people turn to do less work and worry about documents instead. The most important thing on agile is to make sure the software solution is developed and delivered to the product owner.

Agile does have documents but they are minimal and unstructured, like development team will make notes on the side of the code for another developer that might take over from them. The software solution source code should also be stored for future debugging.

The importance of documentation in waterfall methods gave the members of the organization and its leadership that the knowledge is documented and the is surety that the project will continue irrespective of the loss of members in the project. This is in knowledge management terms called externalization which is mentioned in the SECI model by Nonaka where the tacit knowledge is codified into explicit. In most instances the person capturing information into the document might miss some of the information shared or the resource forgets to share key information. When it comes to compiling documents the development team are the worse

people, as they focus more on developing sources codes and creating notes understood only by them.

One of the agile development methodologies, which is extreme programing, also externalize the knowledge as it uses index cards. Other agile methods like feature driven development (FDD) and agile modelling, suggest domain knowledge and system design alternatives to be externalized in the form of models (Ambler, 2002).

Agile modelling suggests this should be done only if the models facilitate better communication or understanding of the system (Chau T. M., 2003). In cases when details models like in FDD, sophisticated case tools are recommended to reduce the amount of manual effort required for generating and updating these models (Chau, 2003).

The elicitation of requirements is very important in any software development even in agile because this is a guideline and roadmap for what the project is expected to deliver. Before moving the requirements to design it is also very important that the product owner verifies if everything is captured and understood by all members. In waterfall the business analyst will then engage with the technical team and forget about the product owner when the requirements are confirmed as correct but in agile the is a continuation of engagement even long after the requirements were verified.

Knowledge management focuses on the transfer of knowledge, this can be done using various processes and platforms, some organizations use classrooms, in some project environment its document and over the shoulder training. The above approach applied more on the old traditional projects, agile is more on interaction approach amongst members. It is also a common practice in agile to record those interactions and the recordings can be used in future projects or as the current one progresses.

Previous studies suggests that “methods like pair programming together with regular meetings helps to mitigate the risks of knowledge loss due to attrition” (Benedicent, May, 2001). The pairing of programmers might have their own challenges also as most developers tend to focus more on fixing the code than noting or sharing information and that may hinder knowledge sharing. The advantage of formal training like classrooms or online content always gives the learners a reference to check on when the information is needed to refresh their memory.

Continuous engagements in agile are a very good process of knowledge creation and sharing, because the retrospectives also talk to lessons learned which are very important for future projects to avoid re-occurrences. The lessons learned in the previous waterfall model were

conducted right at the end of the project whereas on agile it's a continuous exercise throughout the project. The only thing that was done on the waterfall was to track the progress of the project with no room for modification of requirements. The product owner was not given much information on the challenges encountered during the project.

CHAPTER 3

3. THE REVIEW OF LITERATURE

3.1 The agility versus systems documentation in corporate world

The adoption of agile methods by corporate companies has introduced a less emphasis on formal documentation (explicit knowledge) but more emphasis on personal interactions (tacit) on managing knowledge (Nakayama, 2020). The above approach is prone to knowledge hoarding, as well as knowledge loss from employee turnover and reassignment during significant organization restructuring (Nakayama, 2020).

The understanding of corporate companies moving to agile methodology is that tacit knowledge is more important than focusing more on documentation. The agility way of doing things promotes mostly the interaction of people in building the solution. As mentioned in the above paragraph, tacit knowledge may result in knowledge loss, it's been mentioned in previous literature that 90 percent of knowledge resides in people's heads which result in knowledge loss when they leave the organization (Smith, 2001).

The traditional methodologies like waterfall relied more on documentation and it helped them a lot in tracking the status of the project and continuation when members leave the project. The less usage of documentation then poses a challenge and risk on corporate entities that have adopted agile as to how they track the project and make sure that the is continuation without losing track of time. In waterfall system documentation was used as the solution manual, audit trail and the training guide for solution handover.

When the solution is handed over to the project sponsor, the documentation in waterfall served as a reference guide when system challenges are picked up. The organizations can easily go to the requirements to establish if they are encountering a system defect debt, or they require a change as identified defect was never mentioned in the requirements. The system knowledge that has been acquired through the development of the solution is defined as the awareness, understanding the capabilities of its design, development, implementation, and its maintenance (Nakayama, 2020).

It's always been a challenge to implement new enterprise resource management systems since the traditional methodologies which had lot of documentation. The configuration of the new systems and data management process from the old legacy systems are not easy to manage and transfer into the new proposed solution. Such projects are risky in nature, with high system

failures and budgets can be exceeded, hence industries prefer to use documents so they can refer to when tracking the life cycle of the solution (Sammon, 2010).

In a previous study conducted large corporates preferred to use waterfall method with vast use of documentation procedures but the actual implementation of information systems used is agile (Nakayama, 2020). Knowledge transfer between consultants and clients only succussed when they combine communication, collaboration, motivation, and knowledge related factors (Ko, 2005). On the other hand, other interviews identified challenges on moving to agile approach because of demand changes in the workflow for the entire project team brought by the new system development methodology introduced (Nakayama, 2020).

Some organizations prefer a mixed waterfall and agile approach on conducting their system development projects. They need to have the capability of documenting the project scope, design and coding whilst prefer agility in delivering the solution. The ability to have workshops that supports knowledge sharing, discussions and lessons learned are most dominant with organizations that uses the mixed approach (Nakayama, 2020). Postmortems are also crucial in assisting the transition to start new projects.

In some organizations they strongly believe that documentation should also be complemented with face-to-face interactions and engagement of developers to bring the new inexperienced personnel up to speed (Ersoy, 2015). In some instances, the face-to-face engagements do not bear much fruit as some of the experts won't be forthcoming with the knowledge they have. Some staff members also realize that some of the documentation is outdated as it does not cover the enhancement or configuration of the system throughout its life span.

3.2 Knowledge sharing approach between waterfall and agile methods

Waterfall methodology required various knowledge skills because of its various steps starting from requirements gathering, design, development, testing, deployment, maintenance, and management activities (Chau T. M., 2003). So, for all the steps you require a different skill set like gathering requirements (Business analyst), development (developer) and testing requires a qualified tester so getting one person to perform all that is impossible. This challenge then required extensive knowledge sharing amongst those experts so the organization could create a knowledge repository.

The waterfall model then used documentation as its form of acquiring, storing, and sharing knowledge. They also have role-based teams, and the requirements are clearly defined and detailed for the entire software solution development (Chau T. M., 2003). The plan of

allocating the work is structured in such that everyone knows what to do, how and when, this assists in shifting the focus from individuals but to processes (Taylor, 1998). This then distinguishes between the two methodologies; waterfall is more plan-driven whilst agile puts more emphasis on individuals and interactions over process (Chau T. M., 2003).

Some authors argue that agile is also plan-driven and may involve more planning than the waterfall method. Waterfall is known for its use of documentation which helps in knowledge capturing and in contrast to that agile suggests that written documents can be replaced by informal communication (Cockburn, 2001). The belief in agile model is that its costly to create and update documents with a lot of changes in requirements and source code and they can't see the benefits of its use as a knowledge domain (Chau T. M., 2003).

Documentation is not completely deserted in the agile world, but modelling is more endorsed as a documentation tool. The common ground on both models is that they should be able to create, store and share knowledge. Most of the knowledge in software development are tacit, and more often software developers are reluctant to share to due time constraints on their side and are not in favour of documenting (Rus, 2002). In scrum which is one of the agile models, documentation is only used to create vision or user documentation (Schwaber, 2001).

Some agile methods suggests that explicit knowledge should be kept in models where each member of the project will be able to access and update, in doing so they create knowledge as the project progresses (Chau T. M., 2003). The is a limitation of updating the models though as the cost is high, so the update is approved if the cost of updating surpasses the one-off keeping the old on which now hinders the sharing of knowledge (Chau T. M., 2003).

To manage knowledge, agile methods advocate for stakeholder engagements, the participation of users on requirements elicitation, conducting joint-application design (JAD) and customer focus groups (Highsmith J. , 2000). The above practices ensure collaboration between the customers and the development team to ensure the system features implemented are correct (Chau T. M., 2003). It also ensures that the product and domain knowledge is shared with the development team with the frequent close contact with the customer.

In waterfall on a business analyst will discuss the requirements, in agile all project members are involved and when requirements change all members are privy to that information. The constant dialogue amongst the product owners, scrum masters and development team enable the sharing of skills assist in the tacit knowledge sharing (Chau T. M., 2003). Product owner's

needs and the knowledge they require to solve their needs are often tacit and they find it hard to express it explicitly (Chau T. M., 2003).

In waterfall methods the members are often given formal training by their organizations whereas in agile they prefer informal training more on the job (over the shoulder). Formal training has its own advantage as it reaches to as many members of the organization as possible but comes a cost whilst in agile, they pair their programmers which is a cheaper option (Williams, 2002). Some studies states that by pairing programmers and encourages them to have regular meetings mitigates the risk of losing knowledge as some leave the organization (Williams, 2002).

In waterfall they believe in documents which are used as a knowledge repository to avoid the loss of knowledge whereas in agile they believe in an expert finder concept (Chau T. M., 2003). The critics argue that the document repository approach does not address how the knowledge is internalized which allows the users to convert the explicit knowledge into tacit (Prusak, 1999). The knowledge repository on its own does not facilitate communication and collaboration amongst people and requires mostly intervention from management to encourage staff members to interact with each other.

3.3 Strategy used in agile to manage knowledge

Knowledge is regarded as one of the best assets in software development and most of it is tacit which gives a challenge to manage for most organizations (Rus, 2002). In software development environments tacit knowledge is regarded as intellectual capital but now the problem with it has legs and leaves the inexperienced vulnerable (Wendorff, 2005). The distinction between agile and plan driven methods is that they treat both tacit and explicit knowledge differently, their approach to requirements is also different.

In previous research they established that in software development some decisions are governed by gut feeling and experience which triggers a challenge as software development is such a complex and diverse process and not all their managers have experience (Rus, 2002). This is the very same concept failure that resulted to plan-driven methods to emphasis the use of documents and prescriptive processes (Wendorff, 2005). The emphasis on processes led to less attention on human interaction.

Software development methods could not formulate an explicit knowledge management strategy instead focus more on practices that relate to knowledge management. The ideology on the agile world is that the success of the project depends mostly on people than technology

factors hence they focus more on creating a learning environment for their people to assist in their development growth (Wendorff, 2005). One author also added that only the people can predict the timelines of the project in contrary to process and technology which supports the agile view of valuing people over processes and technology (Wendorff, 2005).

In agile projects they always seek a mix of highly skilled people, and they value social skills more than technical ones as that promotes the ability of interaction. The belief of agile on tacit knowledge requires their knowledge personnel to have an ability to cultivate, manage and share it accordingly (Boehm B. T., 2004). It is understood that in agile software engineering tacit and explicit knowledge coexist, for a person to understand anything he/she needs an explicit to activate his/her tacit knowledge (Wendorff, 2005).

The most important requirement in agile software is the transfer of knowledge though conversations, preferably face-to-face instead of documenting and the preference for conversations is always a value proposition to agile alliance (Wendorff, 2005). The reliance on conversations is the key characteristic of knowledge management in an agile environment (Highsmith J. , 2003). Therefore, in agile software it is the responsibility of all stakeholders to communicate important information, when necessary, instead of when its convenient for them (Cockburn A. , 2002).

Most of the problems within an agile project may be due to the lack of someone communicating important information to other members in the project and listening is also emphasized (Wendorff, 2005). Having experts in the project accelerate the ability to make decisions that will assist in avoiding project delays and the success depends also on the knowledgeable product owner who can provide the necessary needed information (Boehm B. T., 2004).

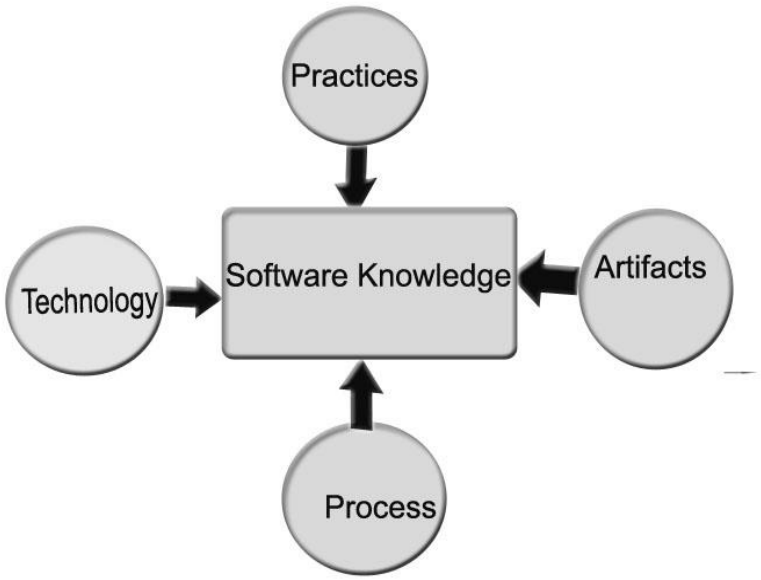
The most important aspect on agile software is to pair programmers and ensure the more experienced are willing to be paired with inexperienced ones and the organization should have a mechanism to manage that (Wendorff, 2005). Waterfall method is more inclined to codification of knowledge whereas agile is more on personalization knowledge strategy, therefore agile success depends on the implementation of personalized strategy (Wendorff, 2005).

3.4 Agile software development knowledge management framework

The success of software development depends on the technical knowledge of the developer and therefore knowledge management is key in software solutions development (Kavitha, 2011). The discussion around knowledge importance has been discussed a lot within the software

solution development with the realization that project success depends on creation and embodiment of knowledge into products and services (Kavitha, 2011). The realization that knowledge is embedded on people, technology and processes led to the creation of a knowledge software framework creation:

Figure 17: Software knowledge (Kavitha, 2011)



Software knowledge has always been created and stored in the documents, process, technology, and other project repositories. Waterfall method has always been privy on storing its knowledge with the use of documents whereas agile put more emphasis on developing a software and knowledge will be created along the way (Kavitha, 2011). Agile methodology has an inbuilt practice that are enabled to facilitate the transmission of experience and knowledge in organizations and pair programming is one of the practices (Ally, 2005).

The concept on pair programming allows programmers to work side by side, on the same code and algorithms, this interaction assist a lot in making sure that in create an environment that promotes knowledge sharing and collaborative knowledge discovery (Kavitha, 2011). This pairing also allows for rotation where pairs are swapped with other programmers and this

ensures that tacit knowledge is spread effectively in a face-to-face interaction without the use of documentation and databases (Kavitha, 2011).

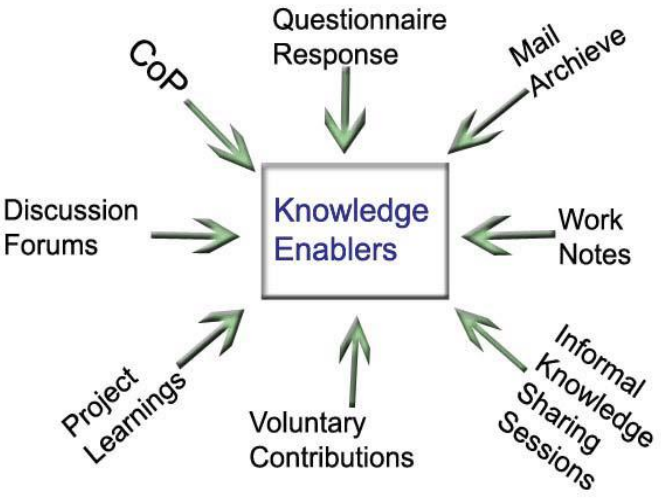
Even though the agile method focuses on tacit knowledge, but it has its challenges as the knowledge is not documented so the experts get tired of answering the same questions repeatedly, same problem can be identified as it resurface but the solution was never documented, informal communication cannot serve as the record and less knowledge is stored in the organizational repository (Kavitha, 2011). The other main challenge in agile is to transfer implicit knowledge to explicit and transferring explicit knowledge from individuals to groups within the organization (Levy, 2009).

The developers tend not to document their task-related knowledge, contextual knowledge which is generated through pair programming citing overburdened with other urgent tasks or assumes that the knowledge maybe irrelevant or no interest to other programmers (Chau T. M., 2004). The Soft-System Knowledge management approach for knowledge management system development was proposed to make sure the is a fit between the organizational needs on new product development and knowledge management initiatives (Shankar, 2009).

Other knowledge management tools were also suggested like email, newsgroups, instant messengers and real time tools like video conferencing and application sharing facilities which are necessary for tacit knowledge (Kavitha, 2011). The other tools that were tried are wikis which enables users to do update on the web, JSPWiki and MASE which provides a process support environmental tailored for agile development teams (Schummer, 2009). Other tools like Milos can also provide the developers with a basic to do list and Sangam which is a plug in for distributed pair programming which can help the pair to program effectively and be able to track defects as they are chatting (Kavitha, 2011).

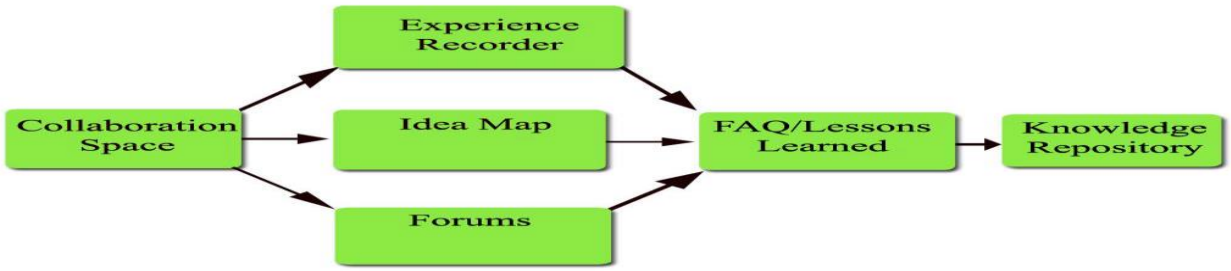
The framework for capturing and distributing knowledge generated whilst using agile methodologies which can be used by members that are collocated or distributed, it facilitates incremental organizational learning and can maintain knowledge or information as needed (Kavitha, 2011).

Figure 18: Tacit Knowledge Enablers: Collaboration Tools (Kavitha, 2011).



The generated knowledge during software development should be used on other project that will be conducted in future, members of the new project should be able to retrieve the structure or unstructured data using database query mechanisms.

Figure 19: Proposed frameworks for tacit knowledge capturing during agile software development (Kavitha, 2011).



3.5 Effective knowledge sharing for agile software teams

The most focus on agile software development is tacit knowledge sharing, which is the provision of task information and a know-how to a person, so that that person can collaborate with others to solve problems, develop new ideas, and implement new procedures (Santos, 2015). Knowledge sharing is such an important knowledge process as it can improve the organizational performance and its competitive advantage (Santos, 2015). The agile culture always emphasizes team knowledge sharing through conversations, dialogue, and discussions.

In agile the attitude of members changes as their relationships are strengthen, this then develops trust and improve communication amongst themselves which leads to transparency, with less imposition by managers it then creates some sense of responsibility to members and freedom of expression (Santos, 2015). The above approach also helps in promoting a better understanding of work processes that will decrease individual dependances through owning source codes collectively so the teams can be organized (Karlsen, 2011).

Several authors have agreed that agile methods facilitate knowledge sharing amongst team members but generate little explicit knowledge for future sharing and learning (Chau T. M., 2003). Others also argued that agile methods appreciate tacit knowledge and its free flow of knowledge, but it does not give special emphasis on its organizational knowledge and agile practices do not recommend mechanisms on how to communicate or share knowledge between agile team and stakeholders (Pikkarainen, 2008).

Agile methods excessive focus of the product, delivering value to customers, its lack of knowledge practices and time constraints makes sharing knowledge difficult which makes the repeat same mistakes than learning from them (Karlsen, 2011). The system called PRIME was developed that has a searching strategy that assist in information retrieval, capturing and distribution of specific tasks from the available information sources that can assist other members to have insights of available information (Holz, 2002). The system is mostly used by Scrum teams mostly in academic institutions in support of their communities of practice so they can be able to reduce the time spent on maintain the knowledge repository (Holz, 2002).

Another tool that was developed is MASE, which is a web-based collaboration, also used as a knowledge sharing and a facilitation tool (Chau T. M., 2004). Other authors suggested a framework which is based on ontologies to capture and share experiences of development team members (Maalej, 2008). The other tool that was developed is called RISE (a reuse tool in

software engineering) which is focused on people, and it uses WIKI based semantics for agile development environments (Santos, 2015).

Organization needs to motivate the people to talk and share how they perform tasks in a way of creating an effective knowledge sharing and instead of tools they should create coffee rooms or small boardrooms where people can interact social (Desouza, 2003). It is a common practice to rotate project members to other projects where they can share their knowledge in an already created community of practice in an agile environment (Santos, 2015).

The other informal discussions held in agile are what we call birds of a feather, and they were tailored to share and create knowledge in agile (Conboy K. F., 2010). To add more value all the mentioned practices require integration between product owners, scrum master and development teams so they can have a wide view of products in development phase (Santos, 2015). Most knowledge in these projects is in developer's heads, so agile uses stand up meeting to make sure that developers can even share demos of the developed software as a knowledge sharing exercise that assist other members like product owners and scrum masters (Santos, 2015).

Another initiative by developers is to share the complex technical solution developed with other technical people so they can evaluate it and once validated they then share it with their bigger teams inside the organizations (Santos, 2015). For all the practices used in agile to succeed they need a commitment from the organizational leadership to reinforce the knowledge sharing and culture practices. If the organization is knowledge driven that then assist in influencing its members to share knowledge willingly and making sure that the project performance improves (Santos, 2015).

3.6 How knowledge is managed in agile methods projects

People are in a driving role when it comes to project success in the agile methodology environment, they conduct short meeting daily which serves as the knowledge sharing exercise that also gives feedback on the project status (Singh A. , 2013). In the waterfall method the project is driven by detailed requirements and design, which are elicited right at the beginning of the project, and they are documented and used for knowledge sharing. Agile on the other hand put more emphasis on personal interactions and collaboration amongst its members in practicing knowledge sharing (Andriyani, 2017).

In software engineering knowledge is classified into three types which are project (resources, functions, milestones, budget), second one is the product (features, standards, and protocols)

and lastly process (business process, workflows, responsibilities and supporting technologies) (Andriyani, 2017).

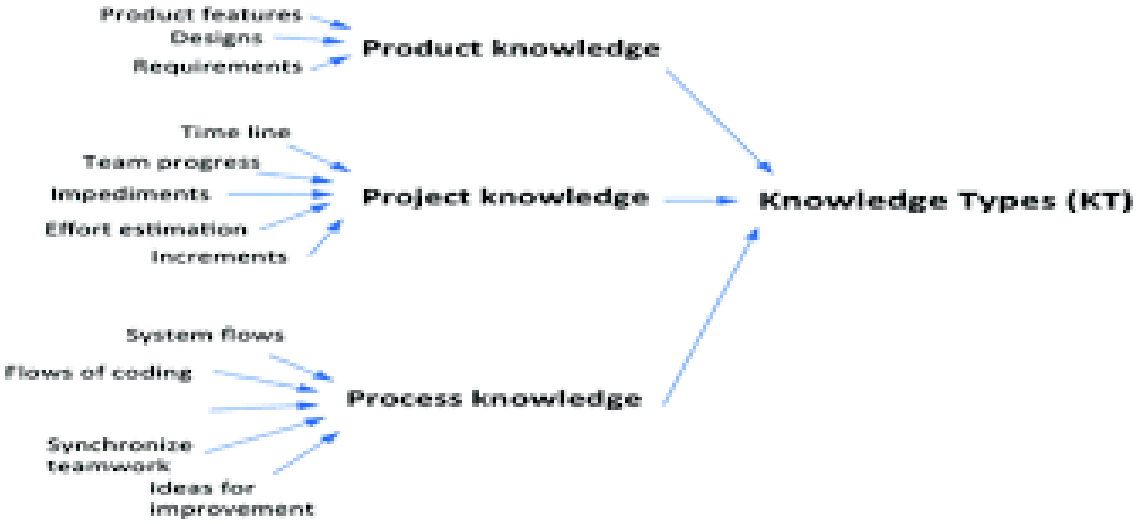


Figure 20: Emergency of Knowledge Types (KT) Theme Categories (Andriyani, 2017).

The agile practices that support knowledge management practices are activities such as discussions, artifacts, and visualization (Andriyani, 2017). The knowledge that is embedded in sprint review, testing and sprint releases focuses more on product knowledge and its usually presented in demo meetings (Deemer, 2012). The knowledge that covers product refinement, reprioritization, product owner feedback, reviews by team members, is such a valuable knowledge that members in the agile project should store and share amongst other team members (Andriyani, 2017).

Project knowledge in agile practices focuses more on sprint/release planning, daily stand-up, sprint retrospective and game planning, in daily meeting the team speak more about the status of the project, blockers if there are any and the plan for the day ahead (Bjornson, 2009). In the retrospective of sprint, the knowledge about project focuses more on time constraints in accomplishing tasks, uncompleted tasks, and new changes from the product owner (Andriyani, 2017). The process knowledge is about sprint release planning, daily stand-up, pair programming and refactoring and its practice includes knowledge about system flows that are visualized by UML modelling, coding flow, business process and product features (Andriyani, 2017).

Agile teams use discussions to share requirements, user stories and burn down charts to manage the project, product, and process as their knowledge management strategy (Andriyani, 2017). Discussions about project knowledge includes discussing the project content, blockers

identified in the last sprint of how they are affecting the members and timelines (Kithenham, 2002). Agile teams also use a technique called visualization which supports tacit knowledge sharing amongst themselves. Scrum boards are also used where story cards are used to reflect the progress of the project, achievements, project performance and screen displays for showing source codes used by the development team (Andriyani, 2017).

Even though agile has some practices and tools to manage knowledge there are still some challenges which includes the lack of focus on what is working for the project, lack of discussion on improving teamwork and difficulties in transferring lessons learnt into action steps (Andriyani, 2017). There are also discrepancies between the scrum theory and the actual practice which relates to the effectiveness of using knowledge in those practices (Andriyani, 2017).

3.7 Knowledge management adoption in agile practices

The adoption of agile is about social change as its about the recognition of people as drivers and leaders of the project and its success depends on the people (Singh, 2014). Knowledge sharing amongst agile members is the most challenging and important aspect that increases the value of knowledge management and agile methodologies discourages the use of documents (Singh, 2014).

Agile members always believe that knowledge management practices are embedded in different practices of agile like pair programming, scrum meeting and customer collaboration which requires knowledge transfer between developers and customer (Singh, 2014). The practices make the team members believe in tacit knowledge sharing than writing their knowledge down in documents (Boehm B. , 2002). The capturing of tacit knowledge in agile software engineering helps with the improvement of project performance, enhance learning and decision making (Singh, 2014).

The is an inclusiveness of communication, cooperation, and knowledge sharing in agile cultural infrastructure already and the process that support knowledge management are stand-up meetings and informative workplace (Singh, 2014). Researchers have identified two schools that are linked to software development which are technocratic that is mostly used but waterfall and the behavioral that is linked to agile method (Shull, 2009). Looking into the agile teams they have good practices of knowledge management like frequent conversations, retrospectives, co-located teams but the agile methodology does not provide knowledge support beyond its teams (Singh, 2014).

Communities of practice fits well with the organizational school of tacit knowledge as they involve people who are working on a similar task or project and allows them to share knowledge (Holz, 2002). Agile software development software uses a personalization strategy (tacit) and this is due to trust among members, conversations, access to experts and focus (Singh, 2014). As agile is associated with tacit knowledge, this brings a challenge as knowledge created turned out not to be recorded in terms of explicit which makes it difficult to refer to previous projects when the problem arises on the current project.

As its mentioned previous knowledge management practices are embedded in agile practices with self-organizing teams and members feel that knowledge management is the responsibility of all members of the project as there are no knowledge management personnel appointed in the project environment (Singh, 2014). The researcher also found that agile provides a healthy environment for knowledge to grow in the organization as they maintain lessons learnt and best practice repositories (Singh, 2014). Agile organizations are leaning towards aspects of knowledge management which are healthy knowledge management environments and providing technology that enhances the adoption of knowledge management (Singh, 2014).

3.8 The drivers of knowledge sharing in software development

Effective knowledge sharing is very important in software development as it signifies its characteristics that refers to task related information exchange, ideas, how task are performed, feedback about process and products under development, whilst exploring other opportunities and addressing current challenges (Cummings, 2004).

Software is a product that continuously emerges from intensive and iterative development and quality assurance that has reflection and frequent introspection to the members who has different specialties and may have conflicting priorities (Sowe, 2008). In software development knowledge sharing is key so it can allow team members to discuss critical project aspects and overcome cultural and social challenges so they can have collaboration on knowledge creation (Chua. A.L. Pan, 2008).

Software development teams have some challenges of sharing knowledge which are caused by diverse social identities and cross functional team members even though they have component-based development which supposed to facilitate development and enable developers to share reuse components (Ghobadi, 2015). Another researcher suggested emphasis on the role of human relations such as transactive memory that can be useful in driving knowledge sharing across global software projects (Kotlasky, 2005).

To support knowledge, transfer the software teams should explore the transactive memory and have standardized templates and methodologies with frequent teleconference sessions (Ghobadi, 2015). Knowledge sharing is shaped by goals, tasks and reward interdependencies amongst the team members which also include outcomes, interaction, cooperation, and competitive behaviors which shape the quality of knowledge sharing (Ghobadi, 2015). Previous research recognizes feedback regarding software products and processes, answering member's questions and contributions on mailing lists using virtual development teams as contributing to business and technical knowledge which assist members in the project (Baggozi, 2006).

In previous research the knowledge sharing drivers were identified and classified into four categories which are (people-related, structure-related, task-related, and technology-related). Task-related uses tasks to transfer knowledge, whilst technology-related uses templates, tools, and methodologies to drive knowledge sharing (Ghobadi, 2015). In previous papers the knowledge sharing drivers were investigated and the findings were "team perceptions (people-related), team members may influence each other in various ways like project commitment which increases the trust amongst themselves, goal interdependencies which helps and motivated team members to understand the possibility of receiving rewards collectively" (Pee, 2010).

Knowledge sharing is a concern in collaborative team members and software development teams as it assists in exploring existing opportunities in software development that can be used to resolve current project challenges that might have been experience in previous ones (Ghobadi, 2015). Previous literature put emphasis on understanding what motivated team members to contribute to software development practices to address existing challenges, on the other hand how communities of practice can link product owners and developers to improve knowledge sharing practices (Ghobadi, 2015).

Some of identified mechanisms that assist in software development knowledge sharing are gift giving which are sharing of code by developers and answering of other member's questions increases communication, credibility, and trust amongst the members of the team (Hsu, 2011). The importance of knowledge sharing creates burdens to the coordination and communication in the software project, so for effectiveness of knowledge sharing teams should understand the variations in people-related, structure-related, task-related, and technology-related drivers (Ghobadi, 2015).

The understanding of factors that drives knowledge sharing, should be a prerequisite for software development teams so they can be able to monitor its patterns and progress so they can take steps in achieving an accepted level of communication (Ghobadi, 2015).

CHAPTER 4

4. VODACOM STRATEGY AND TRANSITION INTO AGILE METHODOLOGY

4.1 Introduction

Vodacom SA started in South Africa in the early nineties and has since grown into other African countries which are Tanzania, Democratic Republic of Congo, Lesotho, Kenyan and now recently opened in Egypt. They started with the focus on global system for mobile, they provided mobile voice and messaging and in the last two decades They started enrolling data to millions of people. They are now offering all their services into the African countries.

The organization is striving to provide internet access to even the poor communities like rural areas and other disadvantaged communities in the urban areas. Moving to digitization where they are rolling out Internet of Things (IOT) products, making sure that communities have access to digital platforms, whilst doing that the organization is ensuring that it adheres to environmental regulations.

Vodacom strategy which interprets to what the company needs to do to be the best internet and mobile network service provider.

- Best customer experience: ensure that they give better service to their customers, as IT supports the business by providing them with the best IT experience.
- Segmented propositions: divide the organizational entities and manage them according to their needs.
- Financial services: offering financial products like insurance, provide finance for smaller starter up businesses.
- Digital content platforms: invest more into the internet of things products with the to meet the digital rollouts.
- Best technology: the ability to improve in providing excellent technology services so They can service their customers better.
- Digital organization and culture: the organization is encouraging its employees to enroll on digital courses and be more agile in terms of executing their duties.
- Its brand and reputation: in promoting their brand They pledge the employees to be brand ambassadors that are always flying the organizational flag high and always provide the best service to the customers.

The organization needed to integrate its thinking by having a clear strategy that speaks to its development by making sure that they use data extracted from their business intelligence platforms to make decisions. The development of the strategy speaks to the pillars of the business and how the different organizational environments relate to each other. With the recent acquisition of the new spectrum, the organization must make sure that it rolls out data services to more customers across the country and the African where its already providing service with minimal service disruptions.

4.2 Reporting boundary, scope, and framework

The organizational audit risk and compliance team ensures that the internal process and policies are adhered to and always ensures quality assurance. The audit and compliance reports are presented to the board of Vodacom by the Chief risk officer with the help of the audit and risk committee. The committee investigates the operating, compliance and risk mitigating factors.

The purpose of the group is to also look at the organizational strategy, look closely into the business model, how it manages risks, explore opportunities, and manages its governance policy. The is Vodacom SA and Africa, which is called the Vodacom group so the scope on the committee is widened to cover the entire groups. Data from all sectors is consolidated both financially and non-financial.

The group committee audits all organizational environments to address the risks, issues, opportunities, and other challenges encountered. The group's business intelligence process is guided by "the principles and requirements contained in the International Financial Reporting Standards (IFRS), the IIRC's International <IR> framework, the King Code on Corporate Governance 2016 (King IV), the Johannesburg Stock Exchange (JSE) listing requirements, the South African companies' No. 71 of 2008; and the Global reporting initiatives guide the reporting process initiatives sustainability reporting standards" (Vodacom year report).

The group issues that significantly impact values creation. The group uses various models to investigate internal policies that speak to quality assurance and its external vendors:

Business intelligence platforms:

- Collection of data
- Creating models
- Analysis of data
- Data visualization creation

- Produce report for decision making.

4.3 Covid 19 lockdown with their digital connections

When the Covid 19 hit their shores, the government opted for a lockdown where all organizations had to shut down their offices. Their employees had to work from home and only essential workers could go to their places of work. The organization had to make sure that its corporate employees can connect from home with no interruptions, so they had to improve their data connectivity.

Vodacom firstly had to make sure that its own employees can connect so they can be able to assist their customers with data connections. The organizational safety measure for employees had to be extended to their contractors also and support them with connectivity also. The pandemic was a trying trial that tested their capability in providing connections.

Vodacom also partnered with the department of education to provide data for remote educational classes to ensure that the kids continue to attend school. The universities are also given discounted data packages to assist their students to continue their learning.

Its staff and engineers had to up their game to always ensure activity right across the African continent as businesses had to continue providing their services irrespective of the stressful conditions brough by the pandemic.

The Vodacom foundation group which provides social responsibility services to communities supported government across Africa in their initiatives to ensure continuity especial with schooling, they also donated about 200o smart phones, big data initiatives and free voice minutes for health departments. The minutes given to the health departments enabled them to collect and share data about the pandemic daily to keep the citizens up to date.

The social distancing requirement enabled the organization to strengthen Mpesa to assist with online payments to avoid human contacts and the extended loans to assist small-medium enterprises with their cash flow challenges.

Vodacom introduced new data packages to cater for the needs of organizations and zero-rated data packages for public schools, colleges, and universities. The was also free Vodacom e-schooling for all grades that also assisted the learners to keep up to date with the schooling. The virtual learning needed connection always and the data assistance to academic organizations was a great initiative.

Vodacom also partnered with the health and insurance organization named Discovery to assist with online doctor consultations. Both organizations donated 10 million donations to set up the virtual doctor consultations for the South African citizens.

The above initiatives needed agility and robust measures from Vodacom employees and contractors to ensure They deliver on them. This period gave us a change to evaluate their ability in providing connections for communities and makes sure that They always strive to provide the best services to their customers with quality service.

4.4 Vodacom products and services

Vodacom is growing and managed to acquire other small entities like Safricom to extend their markets and improve their customer services. Vodacom traditional products have always been voice calls, messages, data connection, fixed lines, home fiber and now venturing into financial services. The objective is to also provide more internet of things (IOT) products and act as data center for other organizations.

Customer packages:

- Voice: GSM and GEO products
- Data: Internet connections, fiber to home
- Message platforms: short messages

Consumer Services:

- Other platforms: Video conferencing
- Cloud computing
- Other connections: Fiber to home
- Non global service for mobile networks
- Risk mitigations
- Technological subsidiaries
- Online customer service

Financial services:

- Transfer of money/digital payments
- Point of sales/Loans/Insurance/Nano

Customer services

- Be the best network in Africa.
- Improve the quality of service with less drop calls.

- Provide the best value for money.

Vodacom has spent R5.38 billion to acquire the 4G and 5G spectrum in the recent Icasa spectrum auction. This will ensure that they deliver into the plan of rolling out more data products to assist big businesses with digital strategies and connecting more communities even the disadvantage ones. This acquisition and rolling out of more data services will enable the organization to grow into revenue and be in a position to invest more in growing its business.

The company future business model strategy:

- The acquisition of the new additional spectrum puts their plans into motion as they now can expand their network infrastructure, making sure that they roll out more fixed broadband services like fibre and cables. The company's strategy of also being more like a technology than being only a telecommunications entity, by providing more services like fintech, data centers and providing big data services.
- Improve its procuring capability by managing their relationships with suppliers, ensure that they follow good practices in acquiring services by complying with contractual obligations. The organization deals with various suppliers like cellphone device manufacturers, network equipment providers and government entities like Icasa for spectrum acquiring.
- As an organization the is always assurance in making sure that the is continuation in product development based in customer needs, have the correct pricing models, and categorize customers based on the needs and promote their products. Their account managers always research and keep in contact with customers to monitor their behavior when it comes to connectivity products. To make sure that they are always ready for the above they adopted agile methodology across their departments to keep abreast with customer needs and challenges.
- Vodacom customers' especial enterprise entities are diverse with different needs, so their strategy is always to ensure they deliver on their needs based on their business model. Their marketing team with their big data capability are always analyzing customer data to check their spending and product needs so they can customize the products based on that. They also introduced their online channel where customers can pay or order services online.
- Vodacom constant communication with its customers through marketing accounts managers makes sure that they are market leaders. The introduction of online services

like MyVodacom app, Tobi and USSD makes sure that their customers can communicate with anytime and anywhere they are.

- Vodacom creative marketing and advertising team always comes with innovative ways of introducing their new services to customers through social media, tv, radio and billboard advertising. The adoption of agile assisted a lot as these are done with the collaboration of them and their IT teams.

4.5 Vodacom's future vision and strategy

Vodacom's ambitions are to accelerate the growing of its revenue, always improve customer relations and delivering quality service and products:

- In this era of digitization their customers can do most of the things using their cellphone device and avoid driving and long queues. They can pay their bills and manage their banking transactions at any time of the day.
- Vodacom has tried to make data affordable by introducing low data rates, some are daily, weekly, and monthly depending on the customer needs. They can also buy cheap data for a specific application like data for WhatsApp, and the introduction of Vodabucks for their loyal customers assists them to get discounted products.
- Organizational Vodacom shops have introduced digital stores where customers can use e-signing on upgrading or taking new contracts, this initiative has shortened the time the use to spend in those shops.
- Their provisioning of financial services allows their customers to sign insurance for their devices as they are signing a contract, with flexible premiums.

The organization is moving most of the data to the cloud and will also provide cloud solutions over and above traditional services. Trying to improve the quality of their services will embark on various projects like:

- Vodacom's growing its big data analytics and artificial intelligence environments so they can be able to analyze market trends and be able to provide their customers with suitable packages.
- Vodacom has bought the IT solution company Nexio as an initiative to strengthen the objective of being a technology company not just a telco.
- They have restricted their prices in most of the packages so that more customers can afford their products.

- Its loan offering scheme will assist most small medium enterprises to grow their businesses especially after the challenges brough by the Covid 19 pandemic.
- Vodacom has partnered with companies like Toyota to provide internet in the car, and trackers with machine-to-machine IOT packages.
- They have also simplified the recharging process for their hybrid and prepaid customers where they can buy airtime and data using their devices, atm and most of the retail shops.

The above changes show their seriousness in improving customer services and bringing their products to the people.

4.5.1 Ensure easy and secured connections

- Vodacom has expanded the fourth generation (4G) network to most places across the country, even the ones that had the third and second generation. With the acquiring of the new spectrum, they are also expanding their fifth generation (5G) also for faster and better connection.
- They have also extended their agreement with Rain so they can also roam on their network, which will give their customer more connections in a wide area network.
- Vodacom is also partnering with Liquid Telcom to share some of their spectrum and all these agreements are done to better their services and improve customer connectivity.
- The organization is also investing billions in improving the network infrastructure so they can have enough capacity to service their growing customer base.

4.5.2 Introducing more self-service platforms

- Vodacom has introduced a chat-bot called Tobi which their customers can use to perform various transactions like airtime transfer, buying bundles, make payments through their payment gateway and prepaid customers can also do sim swaps. Tobi is also used internally by staff to report IT and HR related problems.
- The customers can also use My Vodacom app to check their bills, make payments, upgrade their contracts, or buy bundles. The app also has some promotions and competitions where customers can win vouchers, cash, and other goodies.
- The organizational investment on digital platforms has seen an improvement in customer satisfaction and a reduction in operational cost as the call volumes to their

call centers had decreased. The is also ongoing biometrics project the company is enrolling to simplify the customer onboarding journey.

4.5.3 Rewarding loyal customers

- The company has been running competitions to reward their loyal customers and onboarding new ones also, with initiatives like Vodacom million competition that has assisted most people that are winners.
- Vodacom customers are so excited with the previous summer shake competitions that saw some winning data, cash and even cars just by downloading the My Vodacom app and start shaking. Now customers are even given Vodabucks just by paying the accounts or recharging online.
- Vodacom prepaid customer base has been growing a lot especially with the introduction of the loyalty programs mentioned on the previous sentence.

4.5.4 Digital services for their customers

The organization is working hard to give customer's control on managing their services in the comfort of their homes or offices without driving to their Vodashops with the introduction of their online services.

Vodacom is introducing a lot of monitoring programs so they can avoid unnecessary volumes of calls into their call centers and look closely into root causes to avoid re-occurrences. They continuously strive to improve their customer experience.

The use of big data analysis in giving them visibility to see which platforms their customers are using to communicate with their customer service centers. This enables them to advise those customers to download their online services that will simplify their journey with them.

Vodacom have also digitized their billing to move away from the post office as they have seen challenges with the post office. Now customers can view their bills online, some are getting them via emails, and they have also introduced a portal that uses USSD where customers van view all their bills even if they have more than one service with Vodacom.

Vodacom call centers have a voice recognition biometric which has minimized the risk of fraud where people call in to temper with other customer's lines or services. This is done the first time the customer calls in so they can recognize them immediately the next time they call.

4.5.5 Rolling out of financial services

The company has delivered significantly on the 2020 strategy that looked into introducing financial services. They are now offering different insurance packages for handsets, and other gadgets they are offering. These insurance packages can even cover the damage to screens. As mentioned on the above sentences They are also offering loans specially to growing small businesses.

In terms of figures the insurance segment has grown by 16.1% which is R812 million with the profit margin of 23.5% with rand value of R263 million. The insurance on the device claims they saved about R5 million a year.

The processing of online payments through gateway was a value of R785 million for all vendor self-care payments. The organization has introduced a few pays online platforms like point of sale and the ability for customers to buy prepaid electricity using their app.

Prepaid customers can get airtime advance when they don't have cash which gets deducted the next time they recharge, that has grown by about 79% in use with a rand value of their million growing to nine million in less than five years. The company has managed to generate just above a billion rand on it.

The Mpesa project was first introduced in 2006 partnered with Nedbank and that was not much of a success. The organizations relaunched again with Safricom and focused more on the other African countries, and it is has grown significantly with 39.6 million users throughout the African continent.

4.6 Digital transformation journey

The organization is always advising the employees to live by the organizational values and culture to promote the Vodacom brand. Moving towards the digital world the company has also enrolled in a lot of courses on the Vodacom universities and employees are always reminded to complete the courses and company also pays for externa certification exams for courses like AWS. All these initiatives are to make sure that the company is serious about the digital way of doing things. The company is also in a recruitment drive to attract highly skilled people.

4.6.1 Nurturing digital and agile methods skills

The spirit of Vodacom, which is a new culture program that speaks to customer relationship, driving digital innovation and value staff members was launched at the beginning of 2020. It

speaks to ensuring customer loyalty, creating a better future, learning from mistakes, and get things done.

The company is driving the agile structures throughout the organization, ensuring the availability of Scrum masters, creating squads, and having collaborations to accelerate the digital strategy implementation. Most of the departments are fully working on agile and assisting other teams that are moving to agile and the company makes sure that the agile coaches are on the ground to help enroll agile. The executive management is also supporting the staff and giving them the necessary tools needed.

The organization has made available various agile courses starting from the basics up to expert in the Vodafone university website and employees constantly get email reminding them to enroll on the courses.

The organization has invested about R430 million in training throughout the Vodacom markets so employees can get the necessary training required. They can do training via their online learning, or through external service providers, some employees are on the bursary scheme and studying through universities and Tvet colleges. The most focus is on data science, cloud, IOT and converged network training.

Vodacom also has a graduate training program, where they give graduates 2-year training rotating them on various departments, and some get permanent positions after the program if there are any vacancies. Whilst on training they also get a stipend to assist with travelling to the office. The organizations have also attracted a few employees with software engineering skills which are recruited from other organizations.

The company has also invested a lot of money for leadership courses which are done through various universities, like Northwest university offering Next generation network strategy, some enroll for master's in business administration through universities liked Harvard and Gordon institute of business science.

4.6.2 Diversify the workforce

The organization promotes diversity by employing people from all races, across all ages, with no discrimination of sexual orientation or disability.

Looking into their statistical data the people of color representation is seventy seven percent, sixty percent in top management and sixty-seven on executive level in their South African market.

The is a lot of money invested in skills development with R412 million for all employees, of that R331 million was invested on black employees, R149 towards black females and R14 million towards the black youth living with disabilities.

The numbers of women in the telecommunications sector are still very low in South Africa with only 44% and 34% in senior management levels. The company is trying very hard to improve those numbers by attracting more black women into the organization.

The organization is also going through salary reviews to make sure that the is equal pay for people doing the same jobs irrespective of gender or race, especially in senior positions.

The organization has also developed a mentorship program where 12 of their youth employees are allocated to a senior manager that will mentor them for 12 months. This is also another development program to make sure that They are uplifting their youth and create future leaders.

4.6.3 Employee engagement

The company is inviting employees to participate in strategy formulation by having frequent surveys where employees can give feedback or offer advice on how the organization can do things better. This is done on their environments, but they are also encouraged to look into other departments especially with the ones they liaise with on daily basis. There are also rewards paid to them for the best executed advice.

In 2020 their organization was rated as the top employer in the African continent. Previously they rated number six in the ICT/telecoms sector and now with top employer certification they have moved to number two and striving for the top position.

As part of their wellness, they are offering both parents leave on the birth of the child and parental leave for child adoption. They also educate employees on issues like gender-based violence which is devastating communities.

4.6.4 Wellbeing and safety of employees and contractors

In the year 2020 they had about 2 fatalities one happened in the democratic republic of Congo which involved a member of the public and the other one in Lesotho which involved their contract worker. The risk team is investigating these occurrences and make sure that They have mitigating measures to prevent the same occurrences in future.

The was no change in their injury occurrences, which they remain at 0.07 percentage, same as last year. In terms of their incident reports the vehicles counted for 47%, and 12% were electrical fires, 68% reported incidents by their contractors.

They are promoting a well-being program for their employees, like mental health policy especially with the effects of the pandemic. They have wellness center offices in all provinces with a qualified nurse and a doctor on site. Employees can also book trauma counselling via their wellness centre program. There is also a fitness program that is driven by a wellness center where they organize monthly games or walks.

4.6.5 Enrolling digital platforms

Vodacom is thriving to be a leading brand in the telecommunication space. So, every year they are enrolling different digital programs with the help of their agile method adoption. All their projects are done using the agile methodology where employees are encouraged to share knowledge amongst themselves. These projects ensure excellent delivery to their customers.

Vodacom key strategic objectives:

- Vodacom is having periodic reviews on their spirit of Vodacom culture to make sure that it is followed and practiced by all employees.
- Making sure that Vodacom leaders starting from junior management have coaching sessions with their subordinates.
- Vodacom also has personnel that investigate departmental repetition work and promoting an automation process by introducing robots to take over those functions.
- Always make sure that the organization complies with the country's labor regulation policies that promote diversity.

Connecting all citizens

- Vodacom is rolling its network across South Africa and making sure that they have network sites even in rural areas. They want to ensure that the rural communities have access to the internet by expanding their 4G network in those areas.
- Vodacom is introducing affordable smart phones for poor communities so they can also access the internet some as cheap as R299. They are also making sure that they source more smart phones from their suppliers to meet the customer demands. The government has also instructed the telecoms service providers to cut data prices and they have been doing that.

Driving digitization:

- Mpesa has been performing well in the Africa countries reaching even remote rural areas, this has been made possible by Safricom. They have grown the Mpesa customer base to over 39 million active customers, which is about 9.7% yearly growth.
- Vodacom is continuing with the zero-rated data services they introduced during lockdown from e-schooling as a social responsibility to assist disadvantaged communities. This is done by assisting health services, internet access for youth in the locations so they can apply for jobs online, and educational programs.
- Vodacom is assisting the public health facilities like clinics to monitor their stock like medication using online platforms to get accurate figures.
- They have also introduced an application called MyFarm which is used by agricultural entities through their value chain activities. It assists them with real time ordering and delivery, and they can incorporate other functions into the platform.
- They are rolling out various digital platforms for their communities like the one that connects the citizens with Municipalities which is called Thetha nathi. Additionally, to that they also introduced another platform that connects patients with doctors called Mpilo.
- The municipalities through our digital drive have managed to install thousands of electricity smart meters in about five provinces which assisted them a lot for accurate revenue collection and improvement of service delivery.

Contributing towards better education:

- During the lockdown they introduced their e-schooling education for learners of all grades and now it has reached over 900 thousand learners. The program continues to other African countries where in Tanzania they have provided e-learning material to about 66 00 learners.
- Vodacom has also assisted about 300 schools in South Africa to set up more than 300 virtual classrooms across all provinces.
- The organization has increased the social spending through their foundations department to make sure that most teachers are connected for e-learning.

Youth development programs

- They have also embarked on developing unemployed youth since 2014 and to date they have assisted over 1000 with ICT training skills.

- They also gave teenage girls from poor communities a chance to learn programming codes and life skills for a duration of a week.
- Vodacom gave about 308 young people of that 71 were disabled a chance to enroll in an ICT skills training and employed them as interns to give them exposure in the corporate world.
- Vodacom is continuing to build more platforms that will be able to assist the youth in their country with online connections and training.

Empowering women in South Africa:

- Vodacom has established a maternal health care clinic that has more than 1 mil registered nurses to assist the mothers and babies who are impoverished via the baby platform application.
- The organization have also given about 1000 females farming skills and ICT training going on for two years.
- The Vodacom graduate program has managed to offer permanent employment to about 45% of women after they have gone through their two-year training.

4.7 Their continual agile implementation

There are a lot of programs introduced by the organization as part of agile implementations objective, one of the projects is Novo, which introduces teams to new roles in a but to cross skill them so they can deliver better and quicker to their customers.

4.7.1 Approach for their agile implementation

Involve all stakeholders in the process to understand and agree to the need of their agile implementation, collectively identify what changes might be necessary, define and implement the online delivery.

People:

- Engage with business stakeholders.
- Engage with development technical teams.
- Engage with operations teams.
- Defined center of excellence teams based on functional journeys.
- Allocate team members per COE.
- All team members attended formal training on agile and scrum.

4.7.2 Approach for agile introduction

Process:

- Delivery process and governance documented and implemented.
- SDLC methodology
- Demand and delivery process across tools
- Testing strategy
- AD/AM governance
- Security strategy
- Configure the delivery process with approval levels in Jira.
- Compiled backlog per COE
- All stakeholder's involvement

Technology:

- Evaluate tool set best practice, also cater for rest of CSB.
- POC with evaluation licenses on real business requirement
- Install and configure full tool sets.
- Migration of current tools i.e., Clear case, Clear quest, Quality center
- Security testing also aligns with agile i.e., daily runs.
- Training to all stakeholders on new toolset

Roles and responsibilities:

- Product owner: vision, roadmap, prioritization, requirement sign-off, backlog grooming, sprint planning 1 participation, operational daily stand-ups (not for status updates), sprint review participation and outcomes, release planning participation, UAT testing and sign-off, production feature verification.
- Scrum master/ Project manager: commercial management, overall accountability for COE's process (agile scrum), attending all scrum ceremonies, release planning and projections, sprint forecasting, team availability, sprint final reporting, general project reporting.
- Business analyst: requirements refinement, specifications, stakeholders/sessions facilitation regarding requirements, demo's where applicable, backlog grooming session preparation and facilitation, attending all scrum ceremonies, sizing (functional point analysis) with tech lead.

- Tech lead/architect: facilitate sprint planning 1 and 2, design, investigations, technical and functional input into requirements refinement, responsible for sizing of requirements (function point analysis), bug resolution, attend all scrum ceremonies, manage developers, application optimization, other maintenance activities.
- Developer: develop, provide technical or functional input into requirements and when required.
- Test analyst, Tester: test pack and test data creation, test execution (IS and QA environments) automated regression testing, script updates, produce manual regression testing.

4.7.3 Vodacom online SDLC and agile definitions

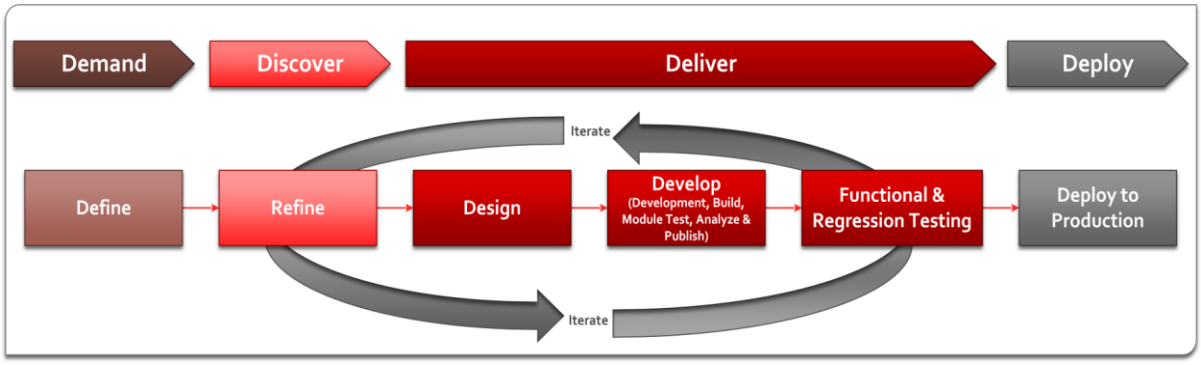


Figure 21: Vodacom SDLC

- Investigations: outcomes from investigations are enough information to produce or continue a fix (e.g., P1), DoR, Low-level design, some form of resolution/solution or no action.
- Definition or ready: the requirements are in a state that development can commence i.e., specifications, test pack, test data, estimated, applications operations sign-off, design authority sign-off, business sign-off.
- Definition of done when the product owner has signed off on UAT, and production verifications is completed, will the requirements the Definition of done, i.e., development done, BA verification done, text execution done, acceptance criteria met, Product owner sign-off on UAT and production verification completed.

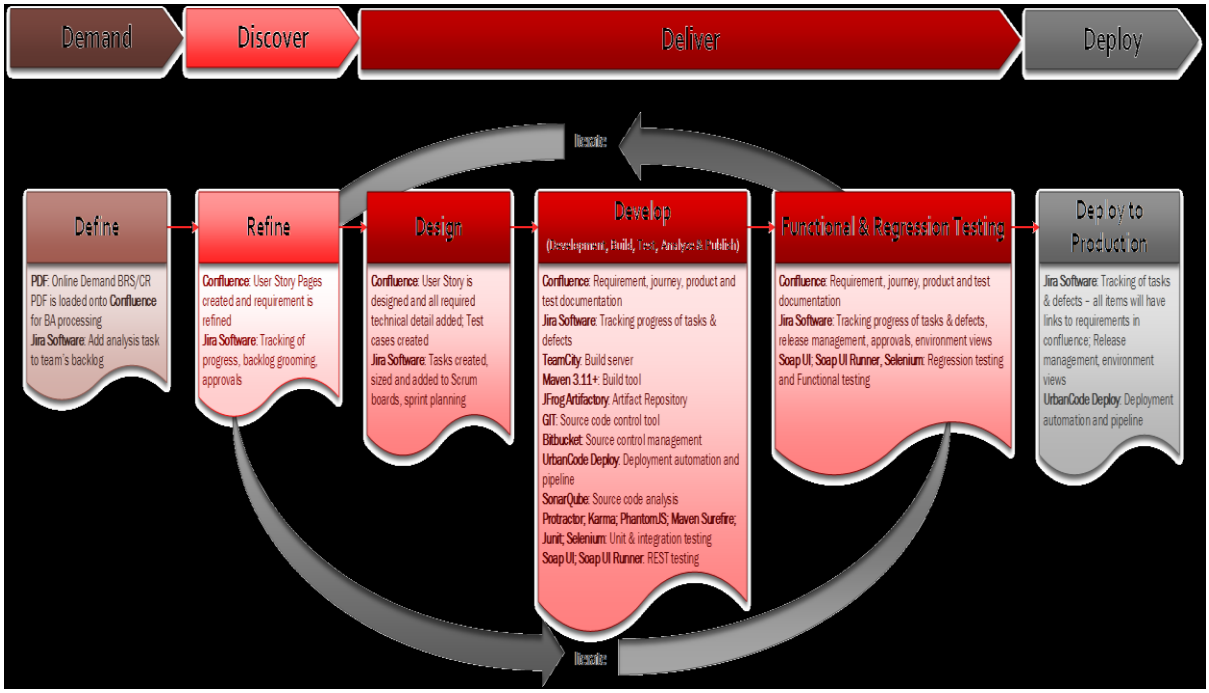


Figure 22: Vodacom processes

4.7.4 Their experience and learnings

Sprint reviews and retrospectives are held for each sprint and major points identified so far:

- The importance of backlog grooming and the continual work required to stay ahead of development.
- The importance of DOR and the impact of rushing an item into development when not ready
- The impact of their integration partners on sprint planning.
- Communication of the team members on items.

Constraints: Product owners understanding of their role and importance in the agile delivery process. Outside stakeholders and businesses requiring release dates for items that are not in DoR or still have outstanding commitments from third party partners or dependencies. The impact of the rest of the Vodacom business still retains a waterfall approach before demand and after requirements leave development – leading more to a Water-Scrum-fall type of approach. Lastly, the co-location of the COE teams due to lack of office space is also a constraint.

Improvements seen: A great understanding for the roles a Product owner and the scrum team at large play the agile delivery approach. Stand-up meetings add a lot of value. The use of user stories has not only helped business in understanding their journeys and requirements better it also makes development easier along with producing test cases as well as it produces a working

up to date document for how specific journeys work allowing for easier knowledge transfer and knowledge repository. Backlog grooming has proven invaluable in assisting business to understand their priorities, constraints, and dependencies to make delivery happen. Buy in from all team members and the understanding that it takes a team of people to make a delivery successful as the is better involvement, business is not separated from dev, yet at the same time development is not interrupted by business.

Benefits: Focus: they have three weeks' worth of work to worry about. The team should not be concerned with anything outside of this. Except the PO and the manager who would then communicate, it to the team and the sprint will be adjusted accordingly still giving the team 3 weeks focus. Visibility: because 3 weeks work has been committed to the team has a good view of where they stand on all items.

Efficiency improvements: Given the greater understanding of the importance of backlog grooming and achieving a DoR state before reaching development they have saved a lot of wasted efforts at the time of development. Teams that are running agile efficiently are experiencing greater focus on what needs to be delivered in a sprint, better visibility on backlog requirements and better communication between the scrum team at large. Because of the collaboration between team members, they can plan their time a lot better, and less time wasted running around asking questions. With the implementation of Jira and Confluence the UAT signoff sheet and service transition checklist for releases is now generated electronically ISO manual sheets and documents.

4.7.5 Vodacom DevOps structure

In the agile world organizations must set up DevOps environments, because the business users (Product owners) are also involved in the building of software or product development project. This is done to bring IT operations together with the programing members for the success of the project to be delivered according to the specifications and a quick analysis can be conducted when the requirements change while the project is still in progress.

The DevOps structure set up in Vodacom can be explained as follows. In the agile world organizations must set up DevOps environments, because the business users (Product owners) are also involved in the building of software or product development project. This is done to bring IT operations together with the development team for the stable running to ensure software is delivered according to the specifications and a quick analysis can be conducted when the requirements change while the project is still in progress.

There are also testers from the test factory that are sitting very close to the development team, they help design the test cases based on the user stories, and they start testing as soon as they get a go ahead from the development team.

Business analysts assist in documenting the user stories from the product owner and they are involved in eliciting the requirements from them. They also work as coordinators in collaboration with the scrum team throughout the project.

The product team has a combination of different skills sets ranging from product managers, customer service representatives and credit controllers in other projects to get constant feedback from DevOps team.

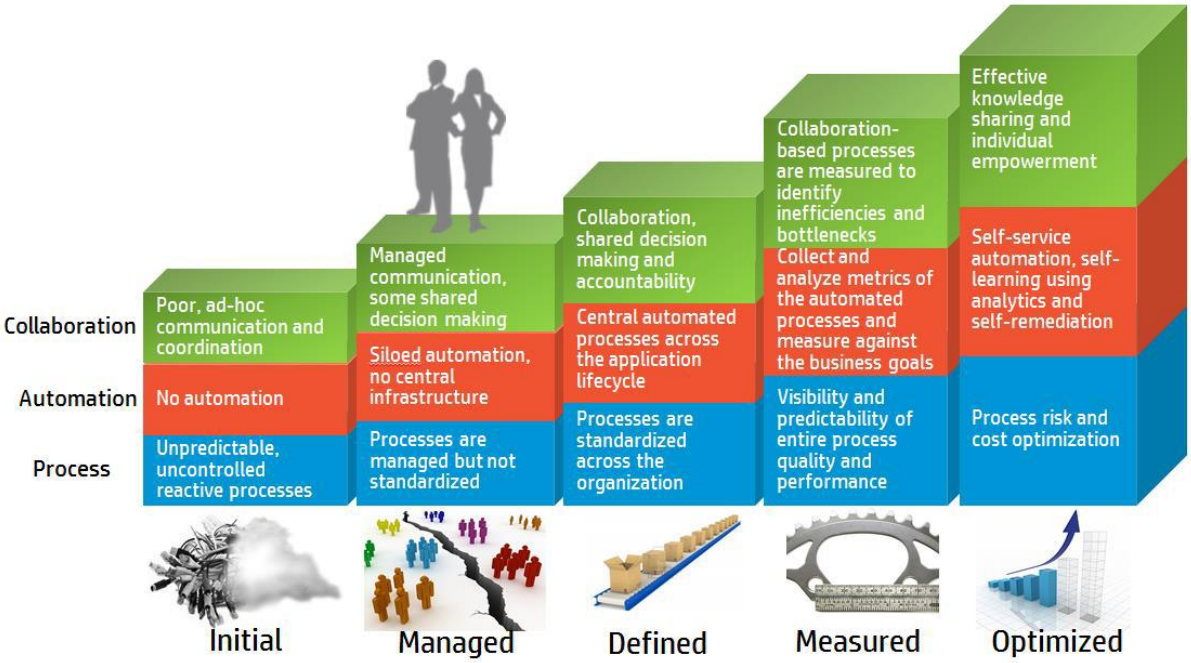


Figure 23: DevOps maturity Model

The DevOps maturity model has helped the organization to determine its standing of the DevOps journey and what more is needed to achieve the desired results.

CHAPTER 5

5. RESULTS AND DISCUSSION

5.1 Results overview

The purpose of the thesis is to investigate how the adoption of agile method from waterfall has affected the creation and sharing of knowledge in our organization. SDLC projects fail for various reasons like time constraints, budget, retirement, and resignation of personnel. The organization must make sure that it invests in a good plan, and tools to create, manage and retain knowledge in its projects.

The report that was compiled in Vodacom looking into the future objectives looked into how important it is for the company to accelerate the agile adoption. As we are moving towards the digital future it's important for the company to recruit and retain highly skilled employees to assist the company in fulfilling its objectives. The organization wants to change from being only a traditional telecommunication and become a technology organization, so that requires a lot of investment into technology, projects, skilled personnel, and knowledge management.

I also used the literature review of that speaks into agile adoption and knowledge management studies that investigated various organizations to understand the challenges and developments in that space. I also interviewed employees within Vodacom that were involved in the transition and now working on agile.

5.2 Roles of respondents and questionnaire

I conducted semi-structured interviews with 15 people from various IT environments within the organizations. I conducted the interviews using Microsoft teams as that was the most viable way considering the challenges, we had with lock down. The questions were compiled as follows, first part of the questions to understand the participant better, second part to understand how the transition impacted knowledge and the tools used to manage knowledge.

Table 3: The list of questions asked during interviews:

Question	**Reason**
What is the agile methodology used in your organization	Agile has different methodologies companies can use so it's important to know which one is used
How long has you been using agile	Understand the number of years they have been using it
What is your role	To know the interviewee role
How has the transition from waterfall to agile affected the knowledge sharing in your environment?	To understand the impact of the transition on knowledge sharing
Did you get the necessary support from management before and during the transition	Management support is very important, so we want to establish if this was supported by them
What tools are you using to share and retain knowledge	To understand if there are any systems in place to support the knowledge management course.
Did you attend any formal training in agile methodology?	To understand how they were brought up to speed on the new methodology.
How has the change affected your knowledge development	To understand if they are continuing to develop their knowledge.

How has the change affected your daily functions?	To understand how they are managing their functions with the new methodology in place.
Do agile practices sharing of knowledge help in reducing work uncertainties?	Trying to understand if people are comfortable and secured with the new methodology in terms of sharing knowledge
Are the new agile knowledge practices enable the innovative creativity capabilities?	The company is motivating staff to come with creative innovative ideas, is the new way helping.
Is the new knowledge practice assist in better production of creating software quality?	Company wants to improve better delivery of software.
How is the new agile knowledge sharing practice helping in creating and exploring knowledge?	Understand the effectiveness of the

Table 4: The respondent's positions and their work environments listed below; I had 15 people that accepted to participate in the interviews out 22 people I approached.

Respondent position	Environment	Respondent code
Programmer	Devops	Dev2
Executive Head	Digital Lifestyle Services	Exec1
Scrum Master	Solution Architecture	Scr1
Agile Coach	Digital Transformation	Agch1
Executive Head	Business Transformation	Exec2
Business Analyst	IT support and Billing	BusA1
Solutions Architecture	IT Enterprise Business	Sol1
Executive Head	Demand Portfolio	Exec3
Programmer	IT support and Devops	Dev1
Executive Head	Digital Engineering	Exec4

Programmer	Software Engineering	Dev3
Team Lead	Digital Transformation	Lead1
Business Analyst	IT Business Enterprise	BusA2
Managing Executive	IT Comms and Infrastructure	Exec5
Product Manager	Product development	Prod1

Table 5: Agile method used and period:

Position	Environment	Period	Methodology
Product Manager	Product development	6 years	Kanban, Scrum
Programmer	Devops	5 years	Kanban, Scrum
Executive Head	Digital Lifestyle Services	5 years	Kanban, Scrum
Scrum Master	Solutions Architecture	2 years	Kanban, Scrum
Agile coach	Digital Transformation	10 years	Kanban, Scrum
Executive Head	Business Transformation	4 years	Waterfall, Scrum, Kanban
Solutions Architecture	IT Enterprise Business	4 years	Scrum
Executive Head	Demand Portfolio	4 years	Scrum
Programmer	IT Support and Devops	4 years	Kanban, Scrum
Executive Head	Digital Engineering	7 years	Kanban, Scrum
Programmer	Software Engineering	3 years	Kanban, Scrum
Team Lead	Digital Transformation	6 years	Kanban, Scrum
Business Analyst	IT Business Enterprise	4 years	Kanban, Scrum
Managing Executive	IT Comms and Infrastructure	5 years	Kanban, Scrum
Business Analyst	IT Support and Billing	4 years	Kanban, Scrum

5.3 The transition effects on knowledge sharing and retention

To understand the impact the transition had on the knowledge sharing in different environments in the organization. The traditional software development models like waterfall use a lot of documentation to facilitate knowledge sharing whereas agile believes in enhanced informal communication amongst team members. Briefly, traditional models focused more on explicit knowledge whereas agile is more on tacit knowledge.

About two of the 15 people I interviewed feel that it is a bit changeling to share knowledge in the new agile model because of the lack of documentation and the fast pace they must deliver the projects (Dev2, BusA2). The other 13 people feel that it has become much easier and has improved relationships between the team members. To quote one of the programmers "In waterfall we worked in silos, one programmer will just be doing one section of the work. Now using the agile scrum method, it is natural to share as a team; we can see different parts of the project and sharing the load and knowledge is a lot easier" (Dev1). There are quicker lessons learned that help to avoid repeating the same mistake on each stage of the agile project (BusA1).

The business analysis people feel that interaction on process perspective has made sharing easier in the agile environment (BusA1, BusA2). In the product management environment, they mentioned that it is important to understand the organizational products, so knowledge management is key for them. One product manager mentioned, "It is important to learn as you go and learn quicker as we engage with different stakeholders in the organization. In agile we depend on subject matter expects to define requirements, we then compile a list of products, and we turn to tap into other knowledge platforms that other department have created which helps us on our knowledge creation" (Prod1). Some product managers feel that in their environment they must use a hybrid approach in sharing knowledge as most products have a lot of documentation so even though the is a lot of human interaction, documentation is still used (Prod1, Exec2).

The agile approach of bringing everybody from the product owner, scrum master, business analysis, developers and testers together has improved the quality of communication in projects. All stakeholders interact daily with the introduction of stand ups, sprint planning and retrospectives; this has closed the gap in terms of requirements understanding.

The product owner contributes to the project until it ends, which enables him/her to advise members in the project immediately if there are any changes in the requirements, which also enables them to share knowledge quicker and effectively. Agile cultures that implement methods like scrum have already incorporated a lesson's learnt method in their "sprint" process called the retrospective.

5.4 Top management support

It is very important for any project to be successful to have top management support, their executive involvement can significantly improve the project's success. As the organization has

transitioned from the waterfall to agile methodology, would like to understand if the top management did support the transition and make sure that the staff have the necessary tools and skills to move to the new method.

The is a strong narrative that management was pushing for the transition but never prioritized the staff capacity instead revenue generation took more priority (Prod1). Top management has been talking about agile long before the transition as the organization is also in a drive of moving away from being a telecommunication only into being an information technology company and will also offer financial services (Dev2). Therefore, to fulfil that objective then the company needed to be more agile.

One of the executives mentioned, “In IT we adopted a full program as part of our change management capability and the first step was to change the culture of the organization. We looked into the three pillars, which are autonomy, mastery and purpose. Once we identified the pillars, we started sure casing back to the staff the why part which helped us to start the change management process and the mindset started changing.” (Exec4).

The agile coach was brought into Vodacom to make sure that staff are getting the necessary support in moving to agile. “Very interesting for sure in your studies you should have learned that without leadership support any transition to agile will never be a success. There was more support on IT side not so much in other environments” (Agch1).

The agile transition was a top-down approach and because of that; it was then supported (Sol1). Leadership understood the urgency of moving into agile and therefore they were buy in from them. In the portfolio management “There was an urgency to change how deliver our products which was driven from top management. The introduction of a new CIO, which was appointed from Standard bank, helped a lot as he was coming from an environment that has been using agile for some time (Exec3). The staff members were given an opportunity to be more involved in the process, which made it easy to manage the change.

Leadership took time to explain why the move was necessary and assisted in terms of easing the resistance from people on the ground. The leaders also managed to find the early adopters, which helped a lot in terms of bringing those resisting the change onboard (Exec3). Another executive mentioned that “From the transition stance, we sat down and decided together that we should split up the teams into smaller squads and from a communication perspective we never had a challenge as the change management process was done delicately with everyone involved in the change management process” (Exec4).

In software engineering felt they can have the necessary support and were given time to understand agile ways of working (Dev3). Digital transformation feels that “The executives were keen to move to agile, so top management supported the initiative. Executives underestimated the shift; they thought course and training were enough and expected the staff to be ready to go. With agile standups, you put all the ceremonies, grooming sessions, sprints, and sprint planning but people were still stuck on their project management mindset, which is more forecast on deadlines, and they couldn’t let go.” (Lead1).

The concept of PI used in most organizations focused more on capacity planning and not prioritization of work so; executives wanted to balance on capacity and expected one person to have five squads but agile states that a person must focus on one squad at a time. Our organization is results driven and the change of scope, which agile permits might hinder on that. Agile expects requirements to change and people involved in the project to adapt as they proceed (Lead1). Top management embraced and supported the change (BusA2).

Three main ingredients make or break the agile journey, firstly create a purpose for people, secondly equip them with the necessary skills so they can be ready for the transition and understand what the organization is trying to achieve. Thirdly you need to trust that they will be able to work unsupervised. Ensure that there are skilled technology people with skills like development, agile experts, necessary training, and product owners that understand the business (Exec5).

In essence, the involvement of the executive management in the transition brought the necessary support needed to the staff. People must know where the company is and what was its objectives and the transition necessity to achieve them. The introduction of new senior members into the executive committee who already understood the method assisted in terms supporting the people on the ground. The most of decisions in any organization have an influence of senior management that also includes organizational culture, spending, and its resources (Hoda, 2011)

5.5 Available tools to share and retain knowledge

I am trying to establish if there are any tools in place to retain and share knowledge in the new agile methodology. In waterfall, documentation was key in terms of project requirements and detailing solutions. Agile focuses on getting things done and adding value to customers with minimal regard for documentation. So, most of the knowledge is on people’s minds, which might be lost when they leave the organization.

In the product management environment, they are using Kanban with Jira as tools to track the project. In the old waterfall model, they used the G: drive to store documents, then they moved to share point and now over and above Jira they use teams for recording and documentations storing (Prod1). In the solution architecture environment, they use a tool called Confluence, which is dominantly used for knowledge retention and sharing. They tried using share point, but it never helped them as not everyone had access and clear visibility on it. They also use Jira as the ticketing tool and confluence as knowledge storage (Scr1).

The lack of documentation has made the sharing of knowledge difficult. "In our environment there should be readily available documentation that will define each program we are using and explain in detail how it works. In the new agile way of doing things training happens through over the should training, so if we need to make a change and the developer that wrote the program is on leave, we then wait for him/her to come back as we can't trace the code they wrote. So, getting away from documentation in our environment is a challenge, with our previous documents we had steps of each code written by the programmers which made things easy for a programmer that takes over the program" (Dev2).

In the digital and lifestyle services, they use a couple of tools like Jira, Confluence, teams, and Git. "Jira is an agile scrum master tool to track progress as a team which gives full visibility of initiatives down to task level. Confluence is used to store documents like solutions design, business requirements and it enables staff members to work on same documents, as each document is visible to all the members belonging to our team. Microsoft teams also has the capability of storing information and documents itself, so we use it a repository. Lastly Git is the tool used to store code by programmers which enables them to share code amongst themselves" (Exec1).

In software engineering teams, they also use Jira for project visualizations tracking and Confluence to store their knowledge information (Dev3). In the business transformation space, they use Confluence to keep all business rules and documents and Jira to track their projects. They also use stand ups to go through the Jira boards.

To quote "I know it's bad to force my subordinates to use the tools but to ensure compliance I don't sign memos that are in word documents. I designed a template that is built on Confluence, which enables them to write in the memo using the tool as I check before signing if it is the same template from the tool. Therefore, using the document directly from Confluence creates a visibility for anyone in the team to access the document. Firstly, I advised them to use the

template, but they did not cooperate hence I came with the process of enforcing it by refusing to sign any document that is not on the tool" (Exec2).

In IT and billing support, they are using Jira and stand up to share knowledge (BusA1). In another solutions architecture department, they also use Jira and Confluence as primary tools (Sol1). "We do not have a specific tool, but we use continuous engagements, and we rely on each other a lot. We have also set up squads to be knowledge sources, so they are our knowledge workers (Exec3). In the IT support and Devops space, they are using the G: drive, Jira, and Kanban board to store and share knowledge (Dev1).

In digital transformation, people use desktops to share and retain knowledge, and when they leave the organization or computers crashes then the information is lost. "We then introduced two tools, which are Jira that is used as the Kanban board and Confluence for knowledge sharing and retention. We then aligned the two tools so when you click on the Jira ticket for user stories it takes you into Confluence, which means that the user story from Jira is hyperlinked into Confluence, which is a repository. Then we introduced getup for developers to manage their codes and we created a link that cuts across Jira, Confluence, and getup so that the story, task and the code can be seen on all the tools" (Lead1).

In IT business enterprises, they use documentation and Confluence to store it. They also use user stories, sprint backlogs, sprint planning's and retrospective meetings to share their knowledge (BusA2). To quote one respondent "People have a misconception that agile does not use documentation of which it does. Documentation is compiled collectively where all members of the team contribute, and the information is stored on Confluence.

We also use other tools like Microsoft teams, one drive and Jira. At the end of each sprint the Scrum masters do retrospectives where they get feedback and suggestions from the teams which they then share amongst team members." (Exec5). Developers in their team also use system demos and they arrange ceremonies with different squads (Exec5).

In summary, most departments use the tools Jira and Confluence to store knowledge across the organization. Departments can share knowledge amongst their members, which is kept in those repositories for continuation and knowledge retention. Using stand ups and Kanban boards is also common in all departments and that is the standard practice in agile. In one department, their head realized that having tools in place is one thing, but compliance is another hence, she introduced mechanisms to enforce the compliance.

5.6 Type of training provided

I want to understand if the staff received any formal training on agile before and after the transition or which kind of training did, they received.

The respondent from product management took the initiative of attending training privately but other members in the team got their training in phases by introducing the train the trainer approach. The organization also has online training, which is available via the Vodafone University that is available to all staff members and contractors (Prod1).

The Devops respondent also took some google online training to understand agile as the formal training was not available for them and the organizational university material (Dev2). In solutions architecture the organization brought a trainer to give them training on agile fundamentals (Scr1).

To quote one respondent "As an agile coach I have given the staff a two-day beginner's course which I ran formally in the board room. The same course was developed and shortened, and it is now available on the University website as a one-day course. It's named agile fundamentals and I have received positive feedback from the people who attended it" (Agch1).

In the IT support and billing team an agile trainer and coach were invited to give training to the staff members (BusA1). To quote "yes, we received formal training through the classroom and online via the organizational University. Management also invited professional coaches to be part of our agile implementation sessions (Sol1).

The demand portfolio team had the on-the-job training, which enabled them to learn from one another and they received formal training also. "Vodafone also created an online University which enabled staff to do online training on various agile themes. We also had many experts onsite that shared their knowledge and skills. Some staff members were offsite to other organizations that were already using agile. People were also encouraged to do certifications, which the company paid for the exam fees (Exec3).

In the IT support and Devops environment, they did not receive any formal training instead they had an agile coach onsite to guide them and they used you tube also to learn more about agile ways (Dev1).

In digital lifestyle, "We did formal training which was different for our agile teams and squads. We used the same trainer for our vendors, and we did not have an agile coach. When we transitioned the same trainer was involved in our implementation and was giving constant

feedback on our progress" (Exec1). In software engineering, they also invited a trainer, which gave them training onsite (Dev3).

In the digital transformation space, they also had formal training and the agile coach was available onsite (Lead1). In the IT business enterprise, they visited other organizations, which were already using agile to learn how the methodology works. "Management also brought in agile specialists like scrum masters and agile coaches to train the staff. There were also notes provided on Jira to track projects which we used for training" (BusA2). In the IT infrastructure, they organized agile coaches to guide the people and bring them up to speed with the necessary training. They also had scrum masters to lead and guide their members (Exec5).

Overall, most departments received formal training onsite, boardrooms and online via the organizational university. Management also took the initiative of bringing agile coaches, which assisted with the transition in guiding the people through the process.

The organizational management also took an extra mile by arranging with external organizations to take their staff into the tour in their organization to see and understand how the methodology works. For further development staff members were encouraged to write exams after receiving training so they could have certifications in different modules, which the company paid for, and staff appreciated the support.

5.7 The transition effects on daily functions

In the product development environment, it became a challenge as agile delivers in sprints, which means the project is broken down into small shippable products. The product in their environment must be delivered in full so breaking it down into smaller iterations is not working. The change also affected their delivery times negatively which resulted in escalations from customers (Prod1).

It also affected the Devops team negatively, they feel that people are ready to be fully agile, but they do not have enough tools to support them. They still use some of the old tools, which affects their speedy delivery as required by agile methodology (Dev2).

The digital lifestyle "The change has brought technology and business teams close together, it has also improved relationships, not saying it's working perfectly but we are able to execute and deliver more in this point in time" (Exec1). Solution architecture team also agree that it has improved communication as they have daily sprints and stand ups, which brought transparency in terms of what each person is busy with in the project (Scr1).

Business transformation stated that agile is not working for them as they use shared system, which they do not own. To quote them "Because we do not own the system then we can't dictate what needs to change. Our complex architecture also makes things difficult to use agile, for example to create a service bundle I need visibility on eight systems, which has dependencies that complicates agile. Agile is about self-efficiency, so with too many dependencies, it's difficult to own a ticket without waiting for another system to complete their task" (Exec2).

Another team member "Agile seems so unstructured; it allows you to start the phase and deliver the component which helps a quicker response on each phase" (BusA1). In solutions architecture they feel that things are more organized as they have scrum stand up sessions before the start of each day. "The team members get a chance to give updates of what they did the previous day and what they will be doing in the day ahead. The challenges encountered also get attention from other staff members who are willing to assist. Previously a person struggled alone and had to find solutions without assistance due to lack of transparency" (Sol1).

In demand portfolio, "Initial the change yielded no positive effect, as putting a new process to what we were already doing, was not easy. We all had a single goal, and now we needed to split it into phases, which created chaos. We needed to have a proper structure to guide the people especially those rejected the change." (Exed3). In IT support and Devops, it affected their functions, as they had to be more task oriented unlike in waterfall where they were chasing one project (Dev1).

In digital engineering, "It has been significantly better if we speak of objective numbers like in 2016 when we still used waterfall, our MPS (managed platform services) was minus eleven and now its plus 54. Our application store rating was 2.6 and now we are sitting in a region of between 4 and 4.4 depending on which application store you are looking at. We had 100 releases a year when we used waterfall and now, we do more daily releases which has improved our performance significantly." (Exec4). In software engineering, they all participate in stand ups, which has brought them closer than before the transition. They can quickly see if the code is failing and that has improved their service delivery (Dev3).

In digital transformation "The company is results driven, so meeting deadlines is very important but agile can have an impact on meeting deadlines as the scope changes as you go along with the project, and that has an impact on delivering on time" (Lead1). In the IT enterprise business space, "It is affecting our business analysis function negatively because we

need a lot of time to unpack and do analysis so we can understand the existing as-is process and to define the to-be process, and that requires a lot of engagement with different units and resources and unfortunately agile requires quicker turnaround times." Their team cannot keep up with agility because of capacity and time constraints, with not having enough time to review previous work. It is putting a lot of pressure and strain on them. (BusA2).

From the executive management perspective "It has improved if you look at deliverables and increase in a number of features, we deliver with almost three times in terms of improvement and that has increased revenue drastically" (Exec5).

There is a split in terms of how the transition affected the daily functions in the organization. Some people have been impacted negatively, mostly because of staff capacity and time constraints. In some environments, it has brought positive effects and has improved their work performance and executives mentioned that it has increased revenue drastically. In terms of relationships, it has brought the staff members more closely together and has improved teamwork a lot.

5.8 Reasons for the change and its effect on organizational performance

There are multiple factors that triggered the change, and the main one being the organizational change from being a telecommunication to being a digital information tech ology sector. The company had to change the strategy, in a way of re-adopting how it works, so that it can have a quicker turnaround to the market, be more flexible in addressing the ever-changing customer demands. This has increased the company's ability to react to competition, and the ability to introduce non-telco products like music, gaming, and financial services. The change brought an increase to the company share price and revenue (Exec1).

The digital engineering "Before the organizational transformation to digital space, we decided that we needed a change, so back in 2014, we started collocating with business and we naturally got to a point of agreeing to adopt agile." (Exec4).

Another respondent "There were few drivers that triggered the change, increase speed to deliver quicker in a short space of time, whilst maintaining quality standards and delivering more value to the customer quicker. Create a new way of working to give them autonomy, so can deliver their own features and people feel more empowered. Mostly importantly get more value from IT. I was not immediately pooling a trigger and we started delivering three times more, we needed to pay some school fees to get there, so we had to get our journeys and objectives in order. Eventually we had about 300% improvement in terms of features delivered

from the CVM (customer value management) perspective, which led to an increase in revenue" (Exec5).

All executive management agreed that the change has improved performance in the organization and staff felt more empowered in performing their functions. The increase in performance brought more customer satisfaction and that brought a significant increase in the organizational revenue.

5.9 Analysis and discussion summary

All my participants have experience in both waterfall and agile methodology. In the organization, the dominant agile methods used are scrum and Kanban. In terms of the effect, the transition had on knowledge sharing only about two percent of the interviewees had a challenge and the rest of the people adapted easily in finding new ways of sharing and storing their knowledge.

Agile methods prioritize individuals and their interactions contrary to waterfall that is more about process and documents. This has also played a role in making sure that the organization also promoted more team interactions by practicing the agile stand ups process. It became natural for the teams to share knowledge and have a visibility on all phases of the project. The bringing of different teams from different environments like product owners, scrum masters, developers and solutions architecture improve the communication in the organization.

The buy-in and support of executive management contributed to the critical success of the transition. The support came easily from the top as this initiative was driven from the top and management saw a need for the company to transition. The organizational run members felt more supported as they were given a chance to be more involved in the transition process. Leadership took enough time to explain the need for the transition and assisted the staff with the change management process.

Both management and staff realized the need to have tools to store and share their knowledge, so it is not lost when people leave the organization. They then make use of tools like Jira for tracking the projects, Confluence to store the knowledge, share drive and Microsoft teams. The sprint planning and retrospectives also contributed to the sharing and retention of knowledge.

Most of the staff got formal training though classrooms with the introduction of trainers. The organization also invited agile coaches to assist with the transition and training. The organization also introduced online training via the organizational university and encouraged

staff to get certifications. Some of the staff members give tours to external organizations so they can learn and understand the agile ways.

The transition affected the daily functions in various ways, some affected negatively because of capacity and time constraints. Others had a positive impact that contributed to their teams sharing more information, assisting each other, and creating transparency into their projects. Most of the members state that the transition has increased performance in their teams.

Most factors in the organization triggered the transition into agile so they could be more competitive, flexible in delivering quicker to the customers and providing quality service. Because of its increase in the organizational performance the customers got satisfaction, share value increased and the organizational revenue increased significantly.

CHAPTER 6

6. CONCLUSION AND RECOMMENDATIONS

6.1 Overview

The determination of conducting this thesis was to understand how knowledge management was impacted by organizational adoption of agile. This chapter will summarize some of the findings from the interviews conducted with staff numbers, which are detailed in the previous chapter.

The organization used in my study, which is Vodacom SA, is the leading telco company in South Africa, which is also expanding into few countries in Africa. I followed literature reviews from previous researchers, which investigated the adoption of agile, and knowledge management. I conducted the study using semi-structured interviews; because of the lockdown, I could not meet them face-to-face, so I used Microsoft teams.

Like all other big organizations Vodacom is also looking to move towards the digital world, that will enable us to excel in the competitive telecommunication space that has few giant organizations providing the same service we are offering. Therefore, there are many changes within the organizations that will assist them in terms of meeting their objectives.

The company is in a drive of recruiting and retaining skilled soft engineers and experts in various fields. It is clear from the results of this study that the organization, like many others, is not immune to the challenges of knowledge sharing and retention faced by other bit organizations. In this study, I engaged experts in the organization, which were involved, in the transition and sill using the agile methodology in conducting their daily functions.

6.2 The importance of knowledge management in our organizations

The research results have highlighted the importance of creating knowledge in the transition to agile. As stated in the previous chapters the transition from previous methodologies before agile used a lot of documentation which assisted in retaining and sharing knowledge.

As stated by the respondents that they are now working in a fast-paced environment, with a lack of documentation. In agile the focus is more on tacit than explicit knowledge type unlike in the previous methods.

There were mixed feelings about the sharing of knowledge in the new way of working most of the staff feels that it is a challenge to share and retain knowledge with the speed things are

changing at with the agile way of working. They are expected to deliver projects in a short period on time, which does not give them much time to share their knowledge.

Some staff members feel that relations amongst themselves have improved, which has made sharing knowledge easier. They feel that in the old way of doing things there was no transparency as teams focused on their projects without sharing any information with other groups. The programmers/development team could now share their expertise as they were working in silos in the waterfall method. Agile introduced a method called extreme programming which is a pairing of two or more programmers that should work on one software development.

In addition, the introduction of stand-up, which is a common practice in agile, also assist them as they share the details of the projects, they are busy with and the challenges they are facing in those projects. The waterfall method allowed the exercise to go through the lesson learn right at the end of the project whereas in agile that is a daily standard practice. The daily stand up also gives everybody a view of the current project and people can share ideas or contribute their skills even if they are not part of the project. In agile all stakeholders are brought together to work on the project like product owners which are the sponsors of the project, business analysts, testers, developers, and scrum masters. In waterfall, the sponsor participated int the planning phase of the project to detail their requirements and at the end of the project. With this new practice, they are involved right through the project, so if there are any changes in the requirement the project team can incorporate them immediately into the project.

All stakeholders interact daily to conduct stand-ups, sprint planning and retrospectives, which helps in closing the gaps in the understanding of requirements. It was also highlighted that in agile quick learning is required and members should learn as the project progresses. The involvement of all stakeholders also helps the developers and the architecture team to improve the design and development results as they get a clear understanding of the sponsor's requirements.

6.3 Support from top management

As mentioned, in much previous research in literature review and previous projects, for any project to be successful it requires top management to support it. The agile adoption in Vodacom was driven from the top down, as it was needed to meet the objectives of the company. Top management already formulated a strategy to move the company from being

only to telco to be a technology company. The organization needs to adopt an agility approach to meet that.

Most of the staff members felt that management supported them right through the transition and after the rollout. The company introduced the role of agile coaches and agile training courses to bring them up to speed. There was restructuring done by top management, which also had a shift on the culture of the organization to prepare the staff for the transition. A few executives were also recruited from other organizations that were already using the agile methodology.

Some staff members feel that top management never focused on the capacity of the staff, instead the focus was more on revenue generation, which caused a lot of frustration to them. Nevertheless, top management was more visible before and when the transition was ongoing to explain the need for the change and make sure that the staff gets the necessary support from the experts. They also involved external organizations to assist in transferring the knowledge internally. Executives though underestimated the shift and thought that training was only necessary to prepare the staff for the move.

One of the executives in adamant that they provided the necessary support by making sure that they created the purpose for the staff, they equipped them with the necessary skills, and they cleared an understanding to make sure they know what the company is trying to achieve.

6.4 Vodacom's knowledge management tools and techniques

Most of the staff are using Kanban and Jira to track the projects, which keeps visibility of the project and milestones. They were using the G: drive on the waterfall model to store documentation and moved to share point when it was introduced. Jira tracks the stages of the project from planning until implementation, which also highlights the blockers of the project, and this helps in creating and retaining the knowledge from the project.

The organization also introduced Confluence system, which is used to store documentation, and it is one of the knowledge management tools used by other organizations also. The technical programmers and developers are using a system called Git, which is a system that stores source code. The storing of source code helps other programmers that are introduced into the project and newly created junior developers.

One of the departments introduced a sync between Jira and confluence so that all the updates done on Jira are immediately stored in confluence. The company also introduced Microsoft teams to replace skype as a communication tool. Microsoft teams have the capability of sharing

documents when staff are meeting and the capability of storing them for future use. In enforcing the sharing and storing of knowledge by making sure that documents are signed in a Confluence format so that they are visible to other staff members.

6.5 Training methods in the organization

Some of the staff members took the initiative of taking private agile training to prepare themselves for the transition. The organization also introduced agile coaches to conduct onsite and over the should training. There was also online training introduced where the staff members can use in their own time to upskill themselves.

Most of the staff members attended classroom training, which introduced them to the beginner's courses in agile. The organization also introduced Vodafone university, which provides all courses needed by the staff especially on agile, the company also encourages staff to get certifications, which it sponsors.

The members were also taken offsite to other organizations, which were already on agile. The is also on-the-job training, which staff members are learning from other staff members that understands the methodology better. Agile coaches are always available and monitors the transition to always make sure that they support the staff. The scrum masters are also leaders of the squads and assist in coaching the squad members.

6.6 Effects of the adoption of staff functions

Some of the projects in the organization cannot be broken down like product development they have to be delivered in their complete form. Therefore, the introduction of sprints, which breaks the projects in agile into small shippable products, has caused a lot of confusion and frustration to product managers. They now cannot deliver their products on the estimated date, which impacts negatively on their deliverables.

The adoption also improves the relationship amongst team members and other stakeholders they interact with daily. The improvement of relations amongst staff members has brought transparency and trust amongst them, which has improved the working relationships. The team members are more organized now in how they perform their duties with proper structures in place.

The project deliverables have almost improved three times and that has increased the performance of the organization. Improvement in the performance also increases revenue, which has brought a return on the investment into the transition.

The transition has also increased the company's capability to react more to competition by having a quicker turnaround in the market.

6.7 Recommendations

Based on my discussions and findings mentioned in the previous chapter I would recommend that the organization invest more in technologies and tools to promote knowledge management inside the organization. The discussions have revealed that the is a system in place called Confluence that is a management tool but not everybody seems to be using it and the company should motivate everybody to use it as a knowledge repository.

The company should promote the writing of exams to get certifications in agile and other methodologies that are useful to assist it in achieving its objectives. Line managers should include that in the performance assessment appraisals as one of the goals each staff member should achieve in each financial year.

Top management should also support the staff and recognize the courses they are doing so that they can invest more in the organization. Surely when the company pays for these courses it expects a return on such an investment and top management should do a follow-up on that.

6.8 Areas of future research

The study has revealed that staff members are keen to share and contribute to knowledge initiatives inside the organization. The research focused more on the transition to the new methodology and has used one organization. I will recommend that future studies should be conducted in the after-transition process, to check what effects it has on knowledge management. They should focus more to the broader part of the organization to look into other departments like customer services, HR, finance, and the warehouses.

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