

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

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ABSTRACT

Agile methodologies are used extensively at the time for software development. They were defined around 20 years ago, and they become increasingly popular. In contrast to traditional processes that were booming recently, such as RUP and Waterfall, Agile methodologies try to simplify day-to-day processes for developers. Therefore, these methodologies ignore the estimates of traditional projects in time and money, instead, the projects are estimated and measured according to the value generated, which is an abstract concept. The problem for Agile projects lies in describing to the Senior Management and the Business representatives the fact that the project is a profitable activity; calculate the impact and the risks associated with it; describe the impact of the changes with respect to the scope; as well as communicate any event that may alter the effort required to make the project successful. Therefore, this research aims to clarify how the metrics of an Agile software development project can be translated into Business metrics, so that they can be represented in terms of profitability, feasibility, scope and duration that can be interpreted by people outside the process of software development, in such a way that the value they generate can be tangible for the company.

Keywords: Agile, Software Development, Business Metrics

RESUMEN

Las metodologías Ágiles son usadas extensivamente en el momento para el desarrollo de software. Fueron definidas hace 19 años y recientemente se han hecho cada vez más populares. En contraste con procesos tradicionales que estuvieron en auge hace poco, tales como RUP y Cascada, las metodologías Ágiles tratan de simplificar los procesos del día a día a los desarrolladores. Por tanto, estas metodologías dejan de lado las estimaciones de los proyectos tradicionales en tiempo y dinero, en cambio, los proyectos son estimados y medidos en función del valor generado, lo cual es un concepto abstracto. El problema para los proyectos Ágiles reside en describir a la Alta Gerencia y a los representantes de Negocio el hecho de que el proyecto es una actividad rentable; calcular el impacto y los riesgos asociados con el mismo; describir el impacto de los cambios con respecto al alcance, así como comunicar cualquier evento que pueda alterar el esfuerzo requerido para hacer que el proyecto sea exitoso. Por ende, esta investigación pretende esclarecer cómo las métricas de un proyecto Ágil de desarrollo de software pueden traducirse en métricas de negocio, de manera que puedan representarse en términos de rentabilidad, factibilidad, alcance y duración que puedan ser interpretados por personas ajenas al proceso de desarrollo de software, de tal suerte que el valor que generan pueda ser tangible para la compañía.

Palabras clave: Ágil, Agile, Desarrollo de Software, Métricas de Negocio

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DEDICATORIA

Dedico este trabajo a mi familia:

A mi madre, quien, con todo amor, siempre ha sido mi mayor mentora, soporte y guía, y quien me ha enseñado que el trabajo duro lleva al éxito.

A mi esposo, quien ha apoyado todos mis emprendimientos académicos, profesionales y personales, y a quien le debo todo el tiempo para realizar este trabajo, además muchas otras aventuras más.

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1. INTRODUCTION

The main purpose of this document is to research the current methods in which companies report quantitative data that represent business metrics of projects that are using Agile methodologies; to propose a best practice if there is one, and to state a framework for obtaining the status information of an Agile software project in terms of profitability, feasibility, duration, scope and costs. Firstly, the problem of research and corresponding guiding questions are formulated. Secondly, a theoretical framework for the current state of knowledge about the topic is presented. Afterwards, guiding questions are linked to the goals of this research, in order to find a solution to the main investigation of this document. Finally, by taking the outcomes from the research, a schedule for the implementation of the project is suggested.

2. PROBLEM STATEMENT

2.1 Research questions

The main question selected as topic of research is:

How to relate the agile metrics, in which software development projects are currently measured, to business metrics that business stakeholders can understand?

The reasons why the relation between agile metrics and business metrics was selected as research topic is because:

- a) Through practical experience in software development projects, the start of a new project, and even its monitoring activities, require more than the technical view of the system to be developed or modified. They require also an estimation on the time and money to be invested that must be communicated to sponsors and upper management in general. The difficulty of communicating technical with managerial view have created problems in term of resources allocated and stakeholder expectations, that may have been avoided if a clear relation would be able to be established. The existence of articles about this issue tend to suggest it is a real problem that has not been completely addressed (Larusdottir, et al., 2016).
- b) Any given software aims to deliver value to an organization. Building new applications and features, fixing defects and modifying current functionality through a software development process should deliver value to its clients, customers, users and stakeholders in general. Furthermore, Scrum is defined as “a team-based approach to delivering value

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to the business” (Scrum Alliance). However, in practice, scrum teams are not able to see the value that is being delivered. At the same time, the product owners see value delivered by the team, but both visions do not have an explicit way to match, since value is subjective, and it is not being stated clearly in any part of the of the process. In addition, throughout the many sprints that the development of a big system might take, what was defined as value in the beginning, may not be equitable to what value is at the end of the project. Therefore, there is a need for a translation of value, so that both the team and stakeholders have the perspective of the value they are delivering in every point of the project.

The main question of research

How to relate Agile metrics into Business metrics?

Leads to other questions to be answered:

1. First, is this an issue seen by management? The main question of research is born from the development area, but it may be the case that management do not care about making a translation of metrics. On the other hand, it can be that management is dealing with this issue ad hoc, and there may be the need to obtain more detailed information about software development projects.
2. How do companies cope with this issue? Being able to report the progress of a given agile project to upper management or suggesting a new project with convincing arguments is not an unusual activity in software development. There should be a way in which companies are currently undertaking this activity. Finding how companies currently handle these situations will help determine if a solution is required. On this point, there is also a previous work on relating project

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management metrics into agile to agree on scope changes (Quaglia & Tocantins, 2011), however there should be an empirical point of view from the industry, which can add the requirements of a project from business stakeholders, rather than a methodology or theory.

3. Which are the metrics taken by the agile projects in software development industry today? The purpose of this question is to see determine metrics that agile projects measure as a baseline for comparing with business metrics.
4. What metrics are required for business and upper management areas? This question needs to be answered to give the managerial perspective of projects and determine what information is constantly lacking, if any. The main point is to find if there is a void that framework can complete from the existing agile metrics.
5. Finally, how to generate a framework to link agile metrics to business metrics in a way that it gives relevant information to business and upper management?

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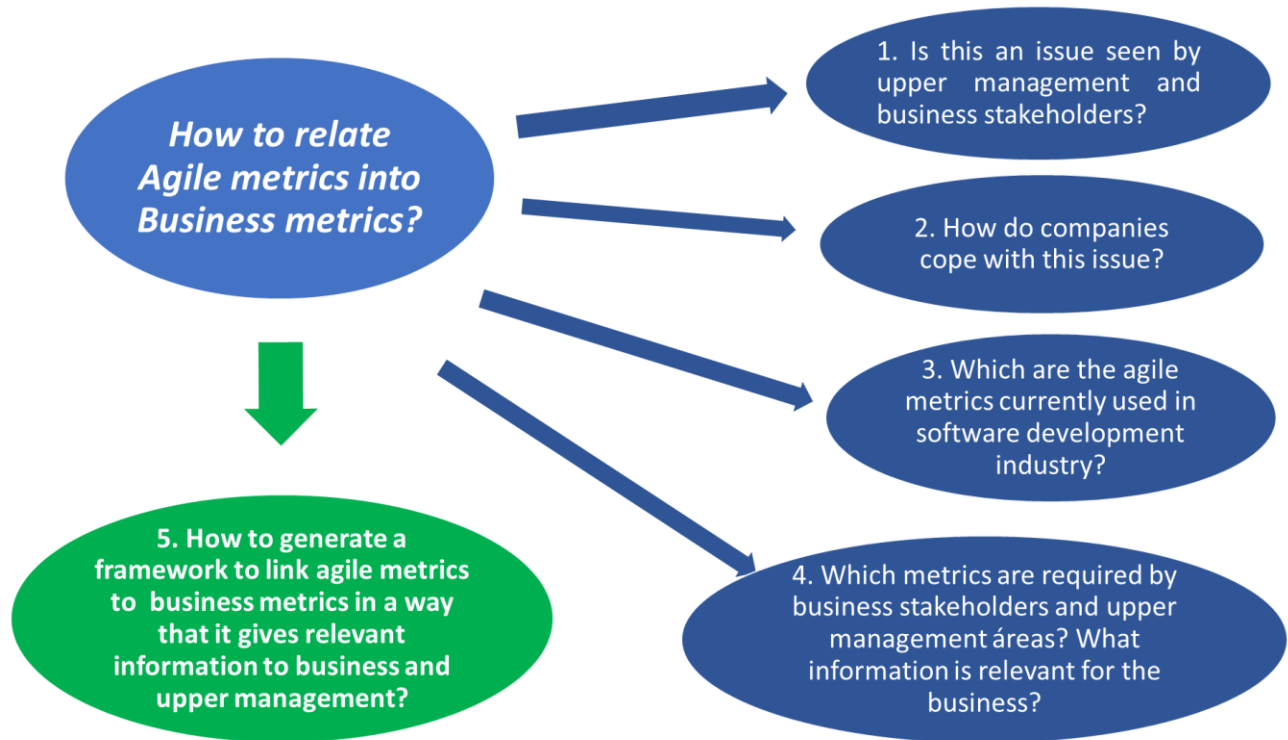


Figure 1. Research canvas presented with the main issues to be answered to respond to main question

In Figure 1. Research canvas presented with the main issues to be answered to respond to main question, a relationship between main research question with other research questions is depicted, with the purpose of visualizing the goal of this paper.

2.2 Hypothesis

The first two research questions guide the development of the present work, hence the hypothesis for these, can also determine whether the thesis outlined in this paragraph was confirmed at the end of this document.

In researcher experience, answers provided to research questions would be as follows:

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1. *“(How to relate Agile metrics into Business metrics?) Is this an issue seen by management?”*

This issue is been sensed by management; however, they do not have the elements to visualize the gap. For this reason, companies rely on traditional metrics to measure Agile projects, and some of them, do not understand the behavior or this kind of projects, while missing the point of using Agile vs traditional project management.

2. *“How do companies cope with the issue?”* The researcher believes that in most cases companies either measure Agile projects with traditional metrics, or use Agile metrics to deliver status to upper management, creating misunderstandings and even lack of real feedback about project progress. In general, someone from the team, performs translation into Business terms about project status and forecast.

3. *“Which are the Agile metrics currently used in software development industry?”* The researcher believes there is a set of standard Agile metrics based on Story Points and Velocity,

4. *“Which metrics are required by business stakeholders and upper management areas? What information is relevant for the business?”* The hypothesis for this question is that there is a defined set of business metrics that upper management and business stakeholders know and monitor constantly.

5. *“How to generate a framework to link agile metrics to business metrics in a way that it gives relevant information to business and upper management?”* The hypothesis for this question is that there is not an existing framework to provide an equivalence between Agile metrics to Business metrics.

3. MAIN OBJECTIVE OF RESEARCH AND MAJOR OUTPUTS EXPECTED

The main objective expected from this research is to generate a framework that allows to obtain business metrics that are relevant to stakeholders and upper management of companies from agile metrics applied on software development projects.

According to the objective stated above, these are the major outcomes expected:

- [OR1] Describe the state of the art in terms of Agile metrics and its impact on business today, to verify if Agile metrics need translation into business terms, from software development industry point of view.
- [OR2] Describe the way companies are dealing with the issue of obtaining business perspective from agile metrics. This implies obtaining information from real companies related to software development.
- [OR3] Mapping between metrics delivered by an agile software project, and the metrics required from business stakeholders.
- [OR4] Design a proposal for a conceptual framework that allows to obtain business metrics from agile metrics of a software development project.

4. TOOLS

To obtain the required information in each one of the objectives stated above, the tools that will be used are:

- a. Literature review to find out if the equivalence between agile software development metrics between business metrics are indeed an issue seen by business stakeholders and upper management of software development companies.
- b. Survey to investigate what are the mechanisms used in the industry of software development companies or clients to cope with this issue. Additionally, a theoretical research to find out about surveys already conducted on this topic.
- c. Theoretical research to determine what are required agile metrics for software development projects that are relevant and most frequently used in the industry.
- d. Theoretical research to determine what business metrics are required.
- e. Theoretical research to check what mappings between agile and business metrics have been done and what are the best practices found so far.

5. METHODOLOGY

The methodology designed for finding answer to the defined research questions, for which a mixed research has been performed: using both qualitative and quantitative approach.

Firstly, and for the qualitative approach, a literature review has to be conducted to analyze in detail the concepts and state of the art on the topics related to the present research. The literature review carried out has taken the following steps:

1. Literature review on Agile: What is Agile? And what are its constitutive elements?
This review has been performed on relevant books on the subject and in articles like the Agile Manifesto(Beedle et al., 2001)
2. Literature review on Agile metrics: Is there a standard set of Agile metrics? If there is a standard for Agile metrics, what is the set of metrics that compose it? This literature review has been performed on the relevant books on the Agile subject.
3. Literature review on Business metrics: What are the main Business metrics taken by any company? This review has taken as source both books and papers on the subject.
4. Literature review on mapping from Agile to Business metrics: Are there any other papers on the gap between Agile and Business metrics? If there are, what is their content? How is this topic handled and what elements can be used in the translation from Agile to Business metrics? For this purpose, the research has been conducted on scientific articles.

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Additionally, and for the quantitative approach, a survey has been carried out to find answers to the research questions 1 and 2, to investigate respectively: “*(How to relate Agile metrics into Business metrics?) Is this an issue seen by management?*” and “*How do companies cope with this issue*”?

This survey method was non-probabilistic convenience sampling of professionals working on software development projects. This method was used, since the goal was to get a notion of how companies deal with the issue in the main research question, and whether they see this as an issue. Then, the sampling for the survey did not restrict the location of the participants and asked about their context to find its relationship with the questions relevant to this paper.

Finally, the elements found on the literature review; the confirmation on the answers found on the results from the survey; as well as the gaps felt by the survey population on Agile to Business metrics translation, were used to propose a framework design to implement this equivalence.

A graphical description of the methodology can be seen in the Figure 2. Methodology to be followed to answer main research question.

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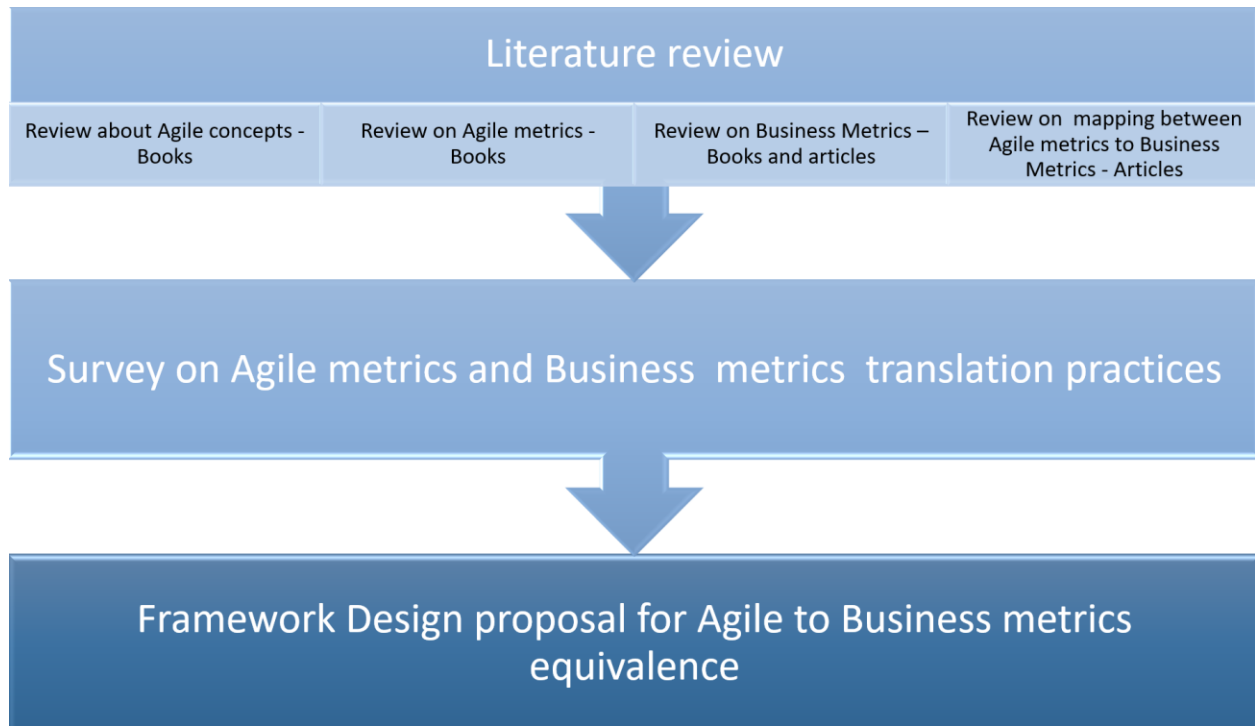


Figure 2. Methodology to be followed to answer main research question. Source: Own elaboration

6. THEORETICAL FRAMEWORK

The purpose of this chapter is to outline the literature review on the topics of research, so those are defined and there is a set of references, as well as to provide elements for achieving main goal for the present document.

The chapter is organized as follows:

1. **General Literature Review:** Which contains references to documents that explore topics like the ones concerning present investigation.
2. Detailed chapters defining the terms that are composed by the elements that define the present investigation. Then there is a chapter for each topic like so:
 - a. **Agile Methodologies:** Definition
 - b. **Agile Process Description:** This section digs into the Agile Process Description in high-level manner. It has many subsections detailing each aspect.
 - c. **Agile Operating Model:** Describes how there is a framework that unites the common elements of common Agile methodologies to give a general perspective on Agile elements.
 - d. **Business cases:** Agile applied in the software industry: This is a literature review of how Agile is used in the industry, especially in the software one.
 - e. **Agile metrics:** This section contains a selection review of main books and papers on most used Agile metrics.
 - f. **Business metrics:** This section contains a selection review of books and papers on main metrics used by the Business.

6.1 General Literature Review

The kind of metrics Agile software development projects have been discussed at length in terms of the iterations in where they are measured, and the dimensions that they are aiming to communicate about the progress of the development at a given point (Kupiainen, Mäntylä, & Itkonen, 2014). For every stage of Agile project lifecycle such as iteration planning, iteration tracking, pre-release quality and post-release quality there are different metrics that give a view into what the progress of the work completed at a given time (Kupiainen, Mäntylä, & Itkonen, 2014). However, even though the work completed on a project is certainly a variable of interest for stakeholders, it does not always relate to the answer of questions like: what is the project end date? given the progress of today, how much money do we have to invest to finish the project?; and more importantly: given the progress and investment made so far, are we closer to achieve the goal of the project?. These are questions that are answered in traditional approaches where the definition of the product or service to be built by the project is defined completely before starting software implementation. In contrast, Agile software processes may allow the inclusion of features in the middle of the project, as well as receive different implementation approaches that can change the result expected at the end, therefore making the duration of the project acceptably longer or shorter than initially estimated.

On the other hand, Agile methodologies use estimation in story points and avoid the use of man/hours in every sprint, which makes it difficult to translate to costs executed and forecasted in the traditional way.

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Therefore, the progress metrics on Agile software development projects are not easily translated into business metrics as software development projects using the Waterfall or RUP software lifecycle approaches.

In addition, Agile mindset focus on the creation of value, which is a subjective construct and it may have different meanings to every company. According to (Alahyari, 2015) value can even be created through the social interactions on the development team through conflict, assimilation, competition, collaboration, cooperation and accommodation. However, these social interactions may not fulfill stakeholder expectations in terms of time, scope and resources invested in the project.

There have been studies about the interrelation between Agile metrics versus those of traditional project ones like the one of (Misra & Omorodion, 2011), in which the authors find an equivalence between Agile aspects in terms of product metrics, resource metrics, process metrics and project metrics, however, the conclusion of the study is that there is a need for a standard, agreement and acceptance of this equivalence. Furthermore, the metrics about both the product and process describe the progress on the project, but they do not represent the business value delivered as a result of the project.

The study of (Hartmann & Dymond) about the relation between agile metrics and business value delivered, proposes a good starting base, by presenting the main variables to measure value at corporate level: Net present value (NPV), Internal Rate of Return (IRR), and Return on Investment and relating them to the agile metrics and diagnostics on the project progress. The example about the Key Metric as Business Value Delivered, embodies the kind of information an external business stakeholder will be most interested in reviewing as the projects moves forward.

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Nonetheless, this key metric is presented as an example and not in a general way of finding the translation between the agile results and business efficiency of the project.

Similarly, the book “The Art of Business Value” by Mark Schwartz (Schwartz, 2016) states again the problem in its first chapter, by bringing the attention to “Business Value” as centric to both Agile and Lean methodologies, but not being defined anywhere in their body of work, by assuming that a business person would know what exactly brings value to a company. Furthermore, Schwartz makes visible the fact that Business Value is often confused with both “Customer Value” and “User Value”, by demonstrating why those concepts don’t always refer to the same kind of value.

In addition, Mark Schwartz (Schwartz, 2016) demonstrates how Agile literature refers to business value and ROI both as equivalent and as different concepts, and how this difference makes again difficult to measure the value delivered by a given feature on an Agile project. Even in the case of being measured in the way ROI is for any other type of project, the calculation should be considering the increment in profit given by that feature as a fraction of the system, rendering it in an impractical way of measuring, by additionally losing the significance of the given result.

The final recommendation of this article is to find one key metric of value and generate a set of subordinate metrics within the project that point to that key metric in order to measure progress and improvement. Again, there is a link missing in terms of a standard, or at least a framework that companies should follow to evaluate agile processes achievements in terms of high-level business metrics.

6.2 Agile methodologies: Definition

The goal of this chapter is to describe Agile as a methodology, therefore contributing an answer to [OR1] “Describe the state of the art in terms of Agile metrics and its impact on business today, to verify if Agile metrics need translation into business terms, from software development industry point of view”, in terms of describing the Agile methodologies and their state of the art. In a later chapter, there will be more detail on Agile metrics definition.

Even though, the definition of Agile in software development context has been attributed to the creation of the Agile Manifesto by a group called the “Agile Alliance” on 200(Beedle et al., 2001), this was just the official agreement between the thought leaders at the time, trying to find common ground on a set of methodologies that aimed to simplify processes, in order to deliver working software (Beedle et al., 2001). The result of this manifesto was a set of 4 values and 12 principles that existing “lightweight” methodologies would comply with, so that the software development process would leave aside unnecessary activities and would provide more value to customer instead.

The set of four values which describe Agile mindset are:

“Individuals and interactions over processes and tools

Working software over comprehensive documentation

Customer collaboration over contract negotiation

Responding to change over following a plan”.(Beck et al., 2001)

The 12 Agile principles are:

“Our highest priority is to satisfy the customer through early and continuous delivery(sic) of valuable software.

Welcome changing requirements, even late in

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development.

Agile processes harness change for the customer's competitive advantage.

Deliver working software frequently, from a

couple of weeks to a couple of months, with a preference to the shorter timescale.

Businesspeople and developers must work together daily throughout the project.

Build projects around motivated individuals.

Give them the environment and support they need, (sic) and trust them to get the job done.

The most efficient and effective method of

conveying information to and within a development team is face-to-face conversation.

Working software is the primary measure of progress.

Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

Continuous attention to technical excellence and good design enhances agility.

Simplicity--the art of maximizing the amount of work not done--is essential.

The best architectures, requirements, and designs emerge from self-organizing teams.

At regular intervals, the team reflects on how

to become more effective, then tunes and adjusts

its behavior accordingly.”(Beedle et al., 2001).

The notion of agility, however, was developed through the early 1990s as a program conceived by the U.S. Department of Defense and the National Science Foundation (NSF), with help of senior business executives, with the goal of creating management tools solving the problem that the manufacturing industry had in responding to unexpected change. (Goranson, 1999, p. xiv)

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The U.S. Department of Defense found a problem during the cold war given that the weapon manufacturing faced the fact of complex systems that had to be developed, which would take long time to be build. Even when the systems would be complete they would require major adjustments, since during the time that they took to be developed, requirements of the systems would be different.(Goranson, 1999, pp. xi–xii).

For that reason, they developed the Agile Manufacturing program as a set of formal management principles and best practices to handle constant change for enterprises (Goranson, 1999, p. xiii).

The Agile term under that light is defined as *“The ability to engineer your enterprise to respond well to unexpected change, to even leverage the ability as a competitive strategy”* (Goranson, 1999, p. xiii).

According to the book *“The Agile Virtual Enterprise: Cases, Metrics, Tools”*(Goranson, 1999), being an Agile company is what allows it to survive in current changing environment and it makes more important responding well to change than its ability to make something better, faster and cheaper than its competitors.(Goranson, 1999, p. 5).

By the time that the Agile Manifesto was signed, these software development methodologies already followed the Agile concept, and their thought leaders were invited to sign the manifesto on February 11-13 of 2001:(Beedle et al., 2001, p. 3):

- Extreme Programming
- SCRUM
- DSDM
- Adaptive Software Development
- Crystal
- Feature Driven Development

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- Pragmatic Programming (Beedle et al., 2001)

One of the common goals of the manifesto was to reduce the part of “process” and “documentation” that made developing software systems a heavyweight endeavor (Beedle et al., 2001, p. 1), which also is similar to the goal of lean thinking in which any process improvement tries to remove obstacles (“waste”) and increase value delivered.(Green & Stellman, 2014).

In conclusion, for the scope of this research, software development Agile methodologies are those mentioned in the Agile manifesto and those which follow their 12 basic principles. Specifically, in software development terms, Agile Methodologies are those that allow to respond to unexpected change in software requirements and favor the value delivered to other measures of progress for the project.

Even though there are many agile methodologies, for the topic of investigation, the generic Agile process is studied as per described in the book Agile Foundations - Principles, practices and frameworks by Peter Measey (Measey, 2015, Chapter 5) that allows to take into account the common elements of the most popular Agile frameworks and avoid limitation to one of them specifically. The core Agile process is described in next section.

6.2.1 Agile Foundations and their relationship with processes

From the latest section, we can see that the first Agile value “*Individuals and interactions over processes and tools*”(Beedle et al., 2001) states that processes are in second place for Agile software development. This sentence is usually interpreted as if there should not be a process in place for software development, as it is also stated in (Highsmith, 2002, sec. The Agile Problem Domain: Fitting the Process to the Project), but all the software development endeavor should be

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carried over based on human interactions. However, it only states that human interactions prevail over the obstacles that processes, and tools may entail in the progress of a given project.

As previously mentioned, Agile is not a process, but a mindset (Measey, 2015, Chapter 2) meaning when a company, project or person is referred to as “Agile” this is part of their identity (Measey, 2015, sec. 2.1), even though it has to be also represented in a set of values, principles, practices, and, finally processes and tools. Figure 3. Agile foundations: The Agile mindset frames a set of values, principles, practices, tools and processes common to all methodologies(Measey, 2015, sec. 2.1) contains a graphical representation for the Agile foundations.

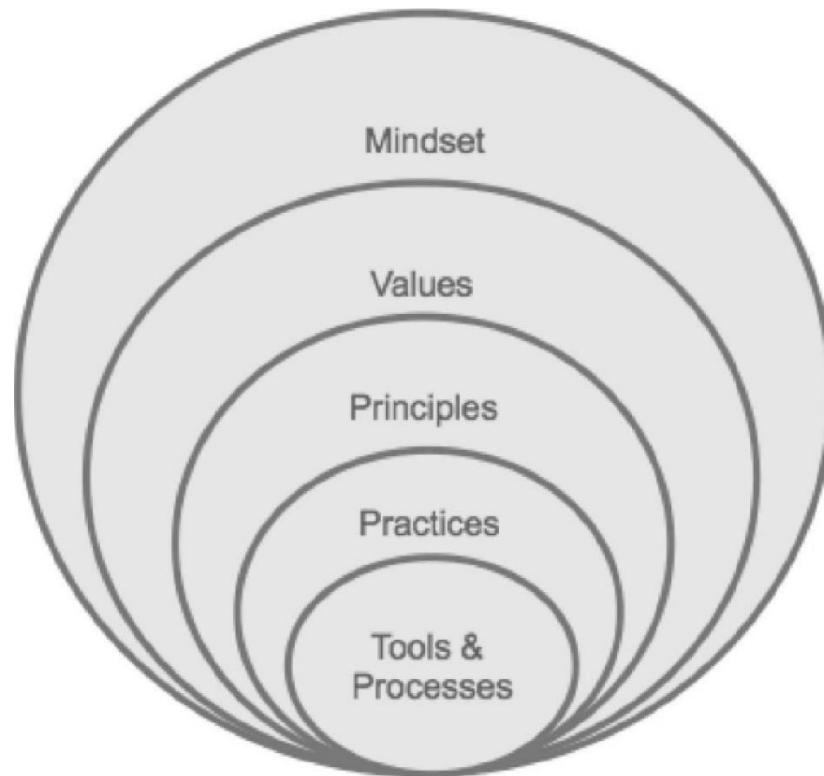


Figure 3. Agile foundations: The Agile mindset frames a set of values, principles, practices, tools and processes common to all methodologies(Measey, 2015, sec. 2.1)

The Agile mindset is described in contrast of the traditional fixed mindset as follows:

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| | Fixed mindset | Agile mindset |
|------------------------------|--------------------------|-----------------------|
| Ability | Static, like height | Can grow, like muscle |
| Goal | To look good | To learn |
| Challenge | Avoid | Embrace |
| Failure | Defines identity | Provides information |
| Effort | For those with no talent | Path to mastery |
| Reaction to challenge | Helplessness | Resilience |

Table 1. Fixed mindset vs. Agile mindset (Measey, 2015, sec. 2.3)

The idea behind an Agile mindset is to provide a frame for specific values, principles, practices, tools and processes in a way to achieve its goal, which is to provide a way to respond to unexpected change and to define a product development lifecycle suited for high variability and complexity.(Measey, 2015, sec. 2.2 Delivery Environments and Agile Suitability)

Additionally, the Agile mindset allows to distinguish between the rituals and techniques that may be used in Agile methodologies that may be distracting from the real purpose. Rituals and techniques should facilitate the implementation of an Agile mindset and not the other way around, or as the author writes it: *“Agile is a journey, not a destination Agile by embedding the Agile mindset deeper inside themselves and the organisation (...)”* (Measey, 2015, sec. 2.1)

6.4 Agile process description

The process described in this document is based on a generic agile framework presented in the “Agile Foundations – Principles, practices and frameworks”(Measey, 2015, Chapter 5. Generic Agile Framework), in which common products, processes and roles from the most popular

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standard frameworks have been summarized. The reason this synopsis is made is to provide a general description of what an Agile process is, without tying their characteristics to the use of a specific one.

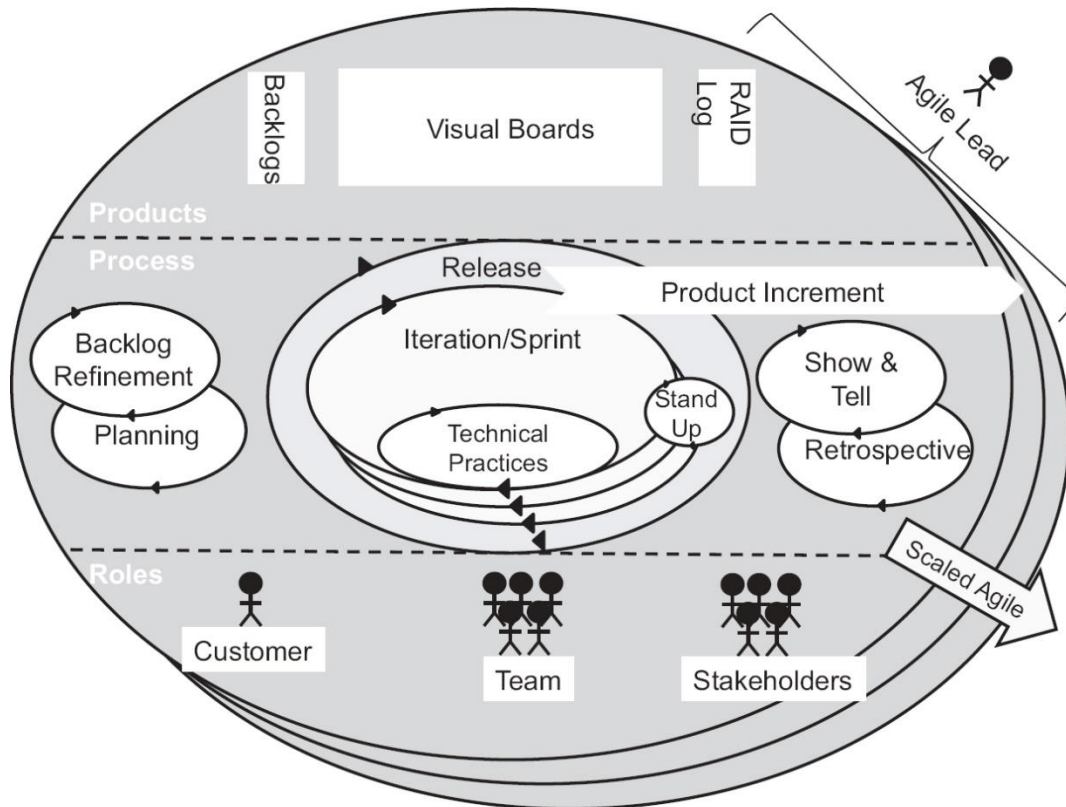


Figure 4. Generic Agile Process Description (Measey, 2015, Chapter 5. Generic Agile Process)

In Figure 4. Generic Agile Process Description (Measey, 2015, Chapter 5. Generic Agile Process) a summary of main elements of the Agile process is portrayed.

6.4.1 Roles

Main roles for the Agile process are: The customer, the team, the Agile Lead and the stakeholders.(Measey, 2015, Chapter 5. Generic Agile Process).

For the sake of simplicity, this document will keep these as the basic roles, even though in specific frameworks such as Scrum, there are additional ones, specifically the Product Owner and Scrum

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Master roles, as specified on the book *Essential Scrum: A Practical Guide to the Most Popular Agile Process* (Rubin, 2012, Chapter 9. Product Owner).

6.4.2 The customer

The customer and other stakeholders are represented in Scrum by a role called Product Owner (Rubin, 2012, Chapter 9. The Product Owner).

The Product Owner role is to represent customers and stakeholders, acting as a point of contact for:

- *“Managing economics*
- *Participate in planning*
- *Groom the product backlog*
- *Define acceptance criteria and verify that they are met*
- *Collaborate with the development team*
- *Collaborate with the stakeholders”* (Rubin, 2012, fig. 9.2 *Principal product owner responsibilities*)

By comparison with the responsibilities from the customer role as described on *Agile Foundations – Principles, practices and Frameworks* (Measey, 2015), as *“continually evolving the overall product backlog (see Section 7.1.3) with help from the team (see Section 6.2) and the stakeholders (see Section 6.4).”* (Measey, 2015, pt. 2. *A Generic Agile Framework*).

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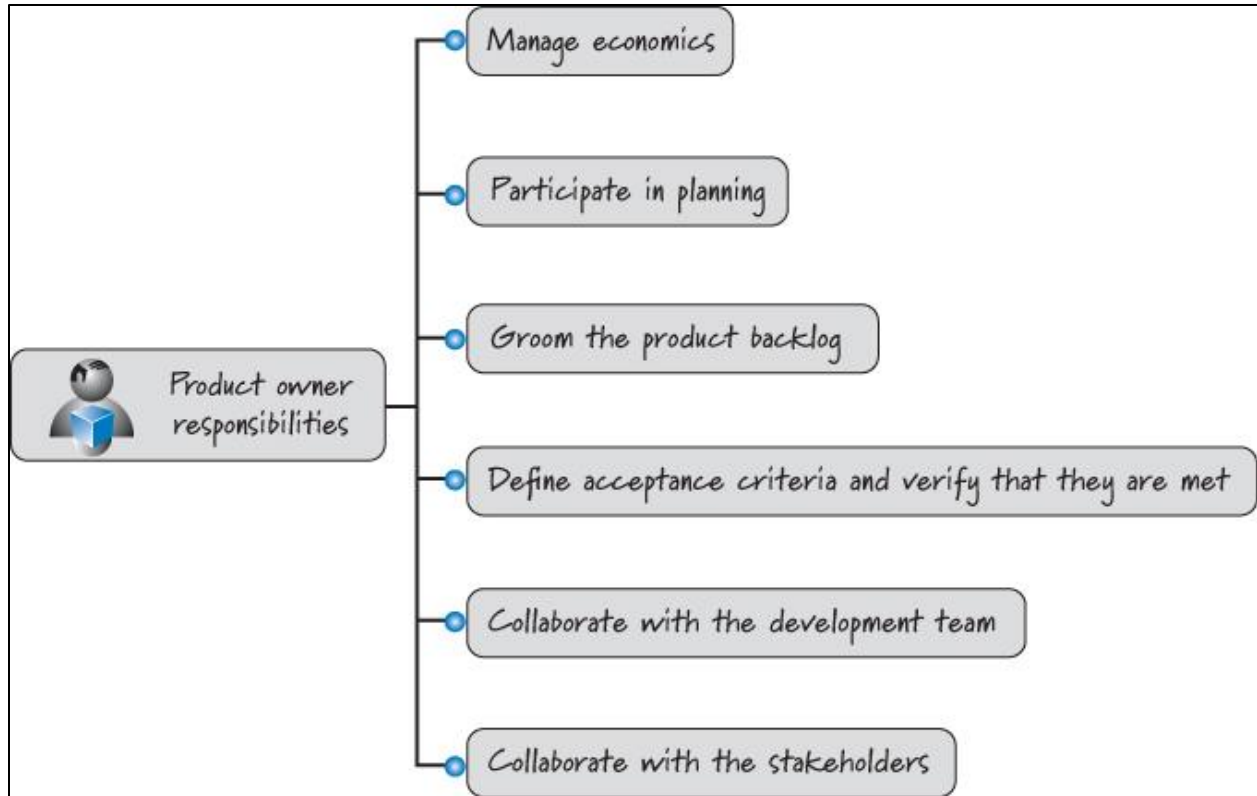


Figure 5. Principal Product Owner's responsibilities. (Rubin, 2012, fig. 9.2 Principal product owner responsibilities)

As can be seen depicted in Figure 5. Principal Product Owner's responsibilities. (Rubin, 2012, fig. 9.2 Principal product owner responsibilities), the product owner in Scrum, is the “central point of product leadership” (Rubin, 2012, Chapter 9. Product Owner), represents both the stakeholders, the customers and the users in understanding their needs and priorities and acting as their voice. On the other hand, the product owner collaborates with the team by directing what should be built to comply with requirements from the stakeholders.

Nevertheless, to keep the description of Agile process generic, in future occasions this role will be referenced as “The customer”, understood as the role that centralizes the voice of customers and stakeholders and acts as a bridge between them and the development team (Rubin, 2012, Chapter 9. The Product Owner.).

6.4.3 The team

This role is represented by the group of people that works in the actual development of the software. Their responsibilities are:

- *“(….) Deliver product increments from iteration/sprints; possibly within releases and governed in a ‘project’ or ‘BAU’ delivery style.(…)”(Measey, 2015, pt. 2.A Generic Agile Framework)*
- *“(…)Perform planning at different levels (release and/or iteration/sprint) and if Agile is scaled, possibly across projects and/or Agile release trains (…)”(Measey, 2015, pt. 2. Generic Agile Framework)*
- *“(…)create releases, backlogs and/or iteration/sprint backlogs (…)”(Measey, 2015, pt. 2. Generic Agile Framework)*
- *“(…)create releases, backlogs and/or iteration/sprint backlogs (…)”(Measey, 2015, pt. 2. Generic Agile Framework)*
- *“(…)Monitor the status of what is happening within the iteration/sprint or release using virtual boards“(…)”(Measey, 2015, pt. 2. Generic Agile Framework)*
- Perform retrospectives to discuss what went well, what didn't go well and what to do differently next time. (Measey, 2015, pt. 2. Generic Agile Process).
- Perform a 'show and tell' about the product delivered, to *“comment the current product and highlight suitability and the next planning period (…)” (Measey, 2015, pt. 2. Generic Agile Framework)*
- Add risks, issues, assumptions and dependencies to the RAID Log; and perform monitoring on them.(Measey, 2015, pt. 2. Generic Agile Process)

6.4.4 Agile Lead

The Agile Lead responsibility is to “*facilitate and enable the Agile Process and for coaching the team to the best they can be.*”(Measey, 2015, Chapter 5. Generic Agile Process)

Similarly, to the case of the Product Owner representing the customer and stakeholders; in Scrum, there is a role representing and advocating for the team called Scrum Master, which equates the generic role of the Agile Lead. This role is in charge of acting as coach, servant leader, process authority, interference shield, impediment remover and change agent for the team. (Rubin, 2012, Chapter 10. Scrum Master).

6.5 Products

6.5.1 Minimum Viable Product (MVP)

The MVP concept is not explained in the Agile Foundations-Principles, practices and frameworks (Measey, 2015) book, however it is defined on “Being Agile: Your Roadmap to Successful Adoption of Agile as the strategy that allows to “*identify the minimum amount of features that customers find valuable for any given release of the product – and no more*” (Moreira, 2013, Chapter 3. Business Benefits of Being Agile). According to this book, it is important to have a strong customer feedback loop to understand what the customers find valuable in the product.(Moreira, 2013, Chapter 3. Business Benefits of being Agile).

This product and its definition are important because it represents what the team delivers in every iteration of the Agile process, and provides the foundation for prioritization of features

delivered to customer and stakeholders.(Moreira, 2013, Chapter 3.Being Agile: Your Roadmap to Successful Adoption of Agile)

6.5.2 The Backlog

The product backlog, as defined by (Rubin, 2012, Chapter 6. Product Backlog) is a prioritized list of desired product functionality and represents the shared understanding of what to build and the order in which to build it.

The product backlog is composed of backlog items. These Product Backlog Items (PBIs) may be features, defects, technical work or knowledge acquisition. They represent tangible value for the user or customer and they are usually in the form of user stories. (Rubin, 2012, Chapter 5. Requirements and User Stories).

Additionally, as the characteristics for a good backlog there is the definition of the DEEP acronym: detailed appropriately, estimated, emergent and prioritized.(Pichler, 2010, Chapter 3. Working with the Product Backlog).

The DEEP definition states that the backlog has these qualities:

- **Detailed appropriately:** High priority items are described in more detail than lower priority ones. This ensures that the items more likely to be implemented in the next sprint are workable.(Pichler, 2010, Chapter 3. Working with the Product Backlog).

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- **Estimated:** The PBIs are estimated in a coarse-grained manner and usually expressed in story points or ideal days. These estimates help prioritize them and plan releases. (Pichler, 2010, Chapter 3. Working with the Product Backlog)
- **Emergent:** The product backlog has an organic quality, in the sense that it evolves, and its contents change frequently, based on customer and user feedback. PBIs are bound to be modified, reprioritized, refined or removed on an ongoing basis. (Pichler, 2010, Chapter 3. Working with the Product Backlog)
- **Prioritized:** Since, as stated above, and by definition, the product backlog is a prioritized list of PBIs, this is the ideal status (Rubin, 2012, Chapter 5. Requirements and User Stories). In general, PBIs destined to near term sprints, are more likely to be properly prioritized according to the product roadmap, and ordered by releases by the Product Owner. (Rubin, 2012, Chapter 5. Requirements and User Stories)

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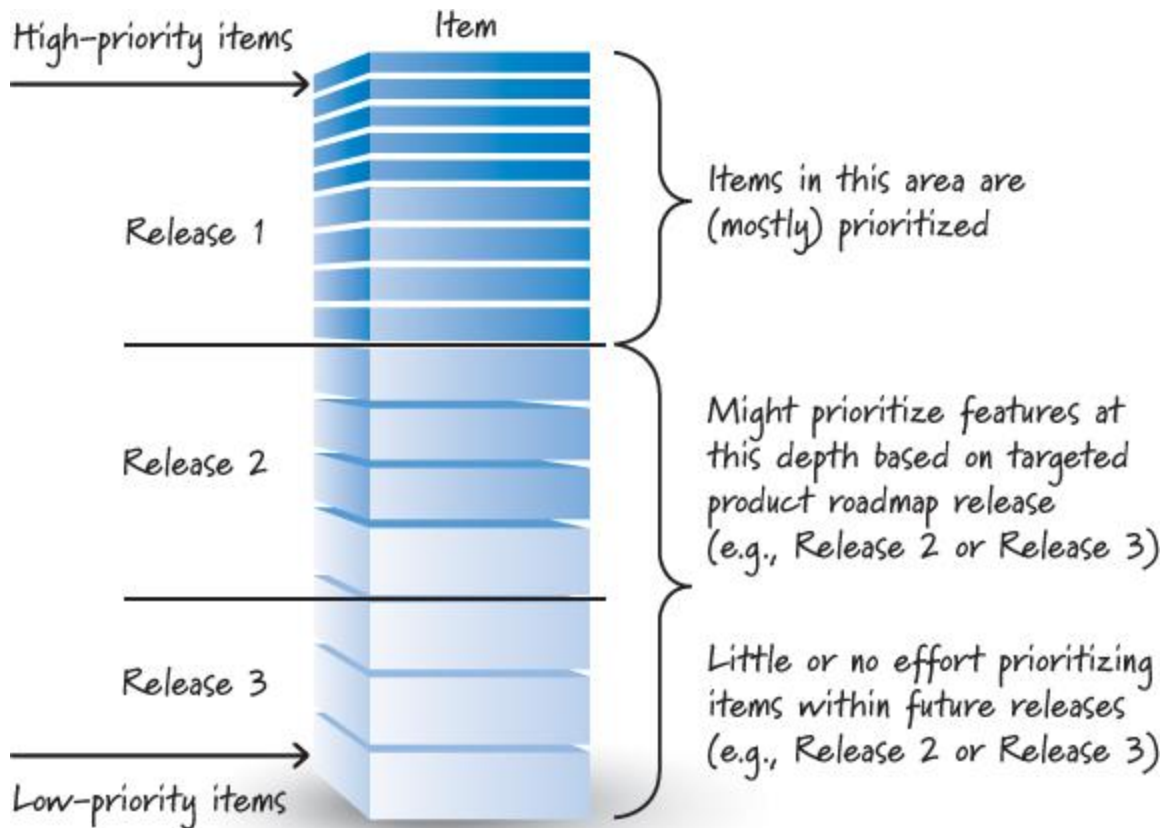


Figure 6. Product backlog items are prioritized. Rubin, 2012, Chapter 5. Requirements and User Stories)

Figure 6. Product backlog items are prioritized. Rubin, 2012, Chapter 5. Requirements and User Stories) contains a graphical representation of a set of backlog items, classified by releases.

6.6 Visual Boards

Visual boards allow everyone monitor the status of what is happening withing the iteration/sprint or release.(Measey, 2015, Chapter 5. Generic Agile Process). Main visual boards described by Patrick Measey (Measey, 2015, sec. 8.7 Visual Boards) are:

6.6.1 Information radiator

Information radiators are physical or virtual boards that allow everyone involved in the project to check the status of stories/tasks and are meant to be openly visible and available “ ‘radiating’ information to everyone who sees it”.(Measey, 2015, sec. 8.7 Visual Boards).

These type of visual boards are key source of information for team ceremonies.(Measey, 2015, sec. 8.7 Visual Boards).

“As a minimum any information radiator should show the current state of tasks/stories a team are working on and how far they have to go to get to ‘done’ status. However, it can also include other information, for example, who is currently working on what task(s).

It can also show a burn-down chart, a burn-up diagram, blockers list or project information such as the key items from the risks assumptions issues and dependencies (RAID) log.”
(Measey, 2015, sec. 8.7 Visual Boards)

An example of Information Radiator can be observed on Figure 7.Information Radiator
(Measey, 2015, sec. 8.7 Visual Boards).

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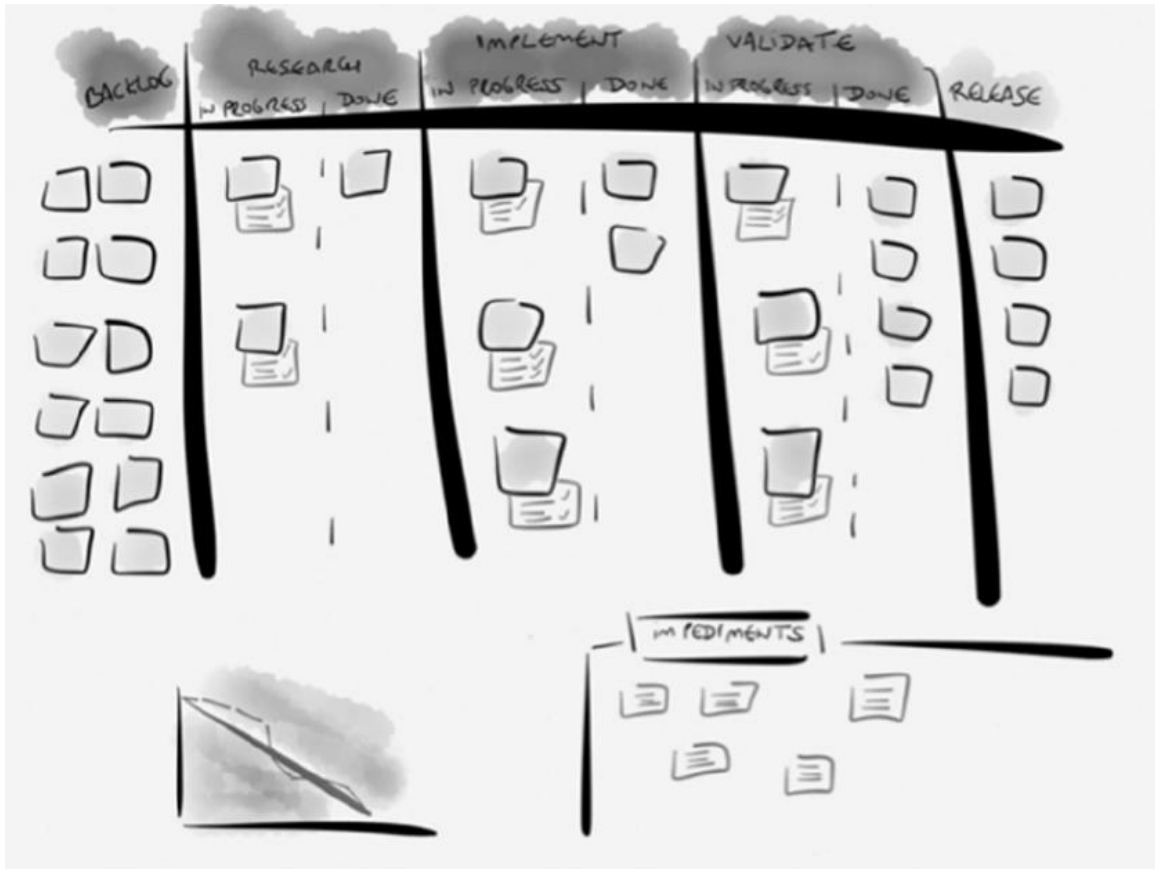


Figure 7. Information Radiator (Measey, 2015, sec. 8.7 Visual Boards)

6.6.2 Burn-down chart

“A burn-down chart normally compares planned effort left to complete a task against the actual effort left”. (Measey, 2015, sec. 8.7 Visual Boards)

Burn-down charts work well for a team that has initially forecasted the effort (in hours, or story points) that will be still be required to complete total delivery of the iteration/sprint. The team should update daily how much effort is left against the tasks they are delivering. The chart contains in its X axis the sprint days, as can be seen on figure Figure 8. Burn-down chart - example

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1.(Measey, 2015, sec. 8.7 Visual Boards), and the point where both projected and actual effort lines intersect, is where the stories are done. (Measey, 2015, sec. 8.7 Visual Boards)

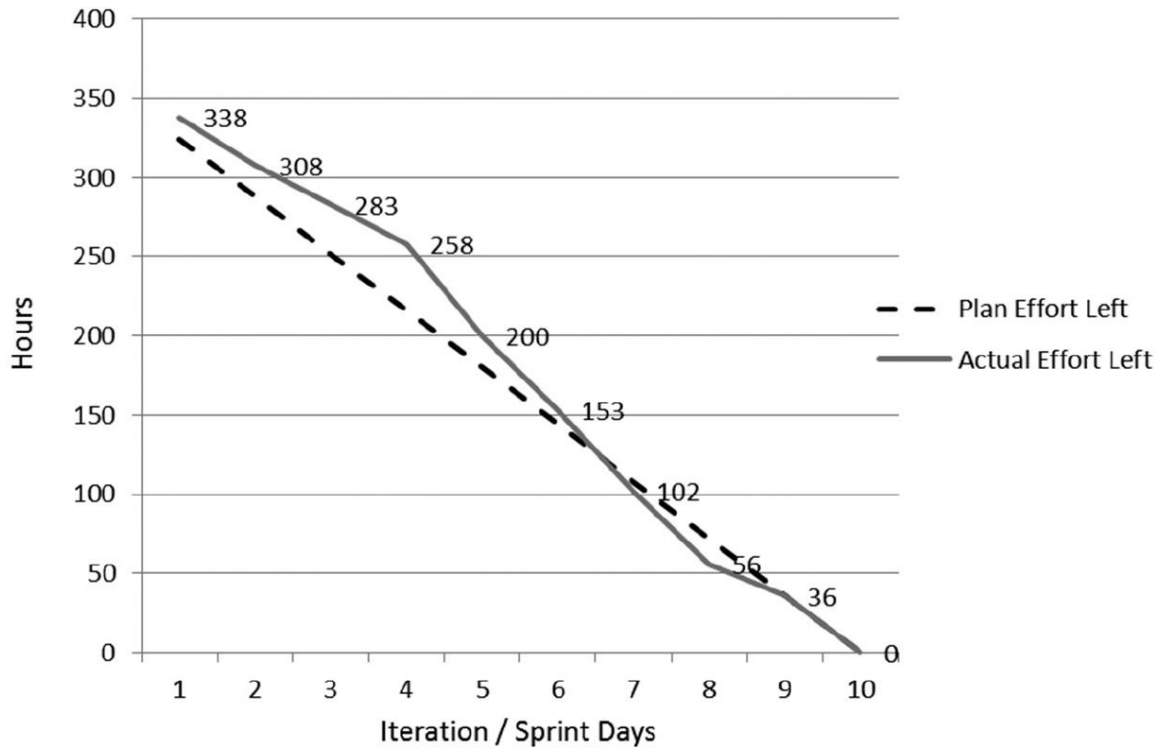


Figure 8. Burn-down chart - example 1.(Measey, 2015, sec. 8.7 Visual Boards)

“A burn-up chart monitors the total work required, normally in hours or story points, and then displays the actual work completed; where the two lines intersect the iteration/sprint is ‘done’.”
(Measey, 2015, sec. 8.7. Visual Boards)

On the other hand, the Figure 9. Burn up chart- example 2 (Measey, 2015, sec. 8.7 Visual Boards), an example of a Burn-up chart is represented, with the variables of the project that tend to increase: Work completed vs work required.

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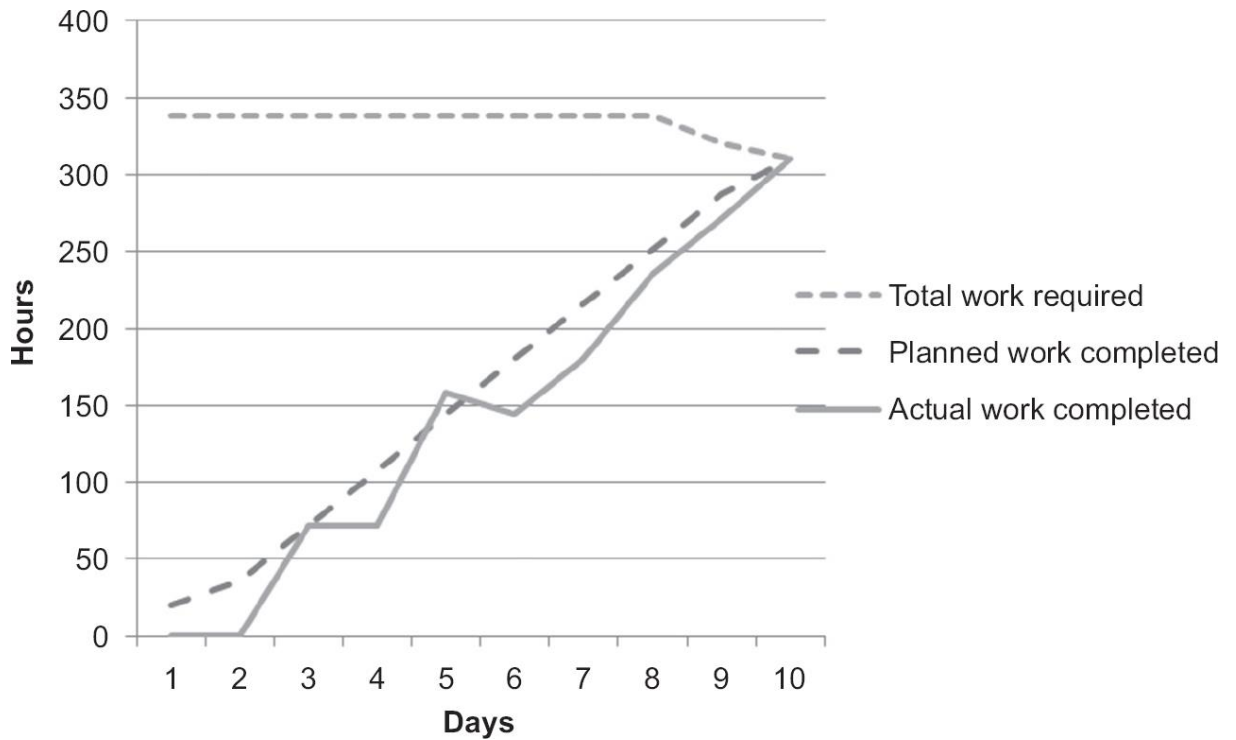


Figure 9. Burn up chart- example 2 (Measey, 2015, sec. 8.7 Visual Boards)

6.6.3 RAID Log

According to (Measey, 2015, sec. 8.7 Visual Boards) it is important to provide a quick view of the content of this board, however it should be simple enough to show information for the current sprint/iteration or release.

“A RAID log is a single repository of all key information about a delivery that is not expressed on the backlog or any other documentation. ‘RAID’ stands for:

- *Risks*
- *Assumptions*
- *Issues/actions*
- *Decisions (or dependencies)”*(Measey, 2015, sec. 8.7 Visual Boards)

6.7 Process

6.7.1 Backlog refinement

As defined in the section **6.5 Products**, the backlog is a prioritized list of PBIs that are usually in the form of stories.

Stories represent what is required from the team by the customer and stakeholders. A story is not a detailed specification of a requirement, but a token that reminds the team that a feature needs to be delivered. (Measey, 2015, sec. 7.1 Stories and Backlog refinement)

Typically, a story consists of:

- **Who:** An ‘Agile Persona’, which represents a person or group who will interact with the features being created, so that it makes sense to stakeholders and the customer.
- **What:** The description of the feature to be built.
- **Why:** The reason the feature is required, usually tied to a business case.
- **Acceptance criteria:** A set of questions, scenarios or examples that allow the customer to check if the story is ready to be signed off.(Measey, 2015, sec. 7.1 Stories and Backlog refinement)

Stories are written in a story card (physical or virtual card) with the format: (Measey, 2015, sec. 7.1 Stories and Backlog refinement)

- **As a** (the ‘who’) ...
- **I want** (the ‘what’) ...

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- **So that** (the 'why') ...
- **Acceptance criteria** (Measey, 2015, sec. 7.1 Stories and Backlog refinement)

The Acceptance Criteria part is usually written in the format:

- **Given** <Starting condition>
- **When** <Action Occurs>
- **Then** <Expected result>

Backlog refinement process can be graphically summarized by Figure 10, Story cards (Measey, 2015, fig. 7.1 Story Cards).

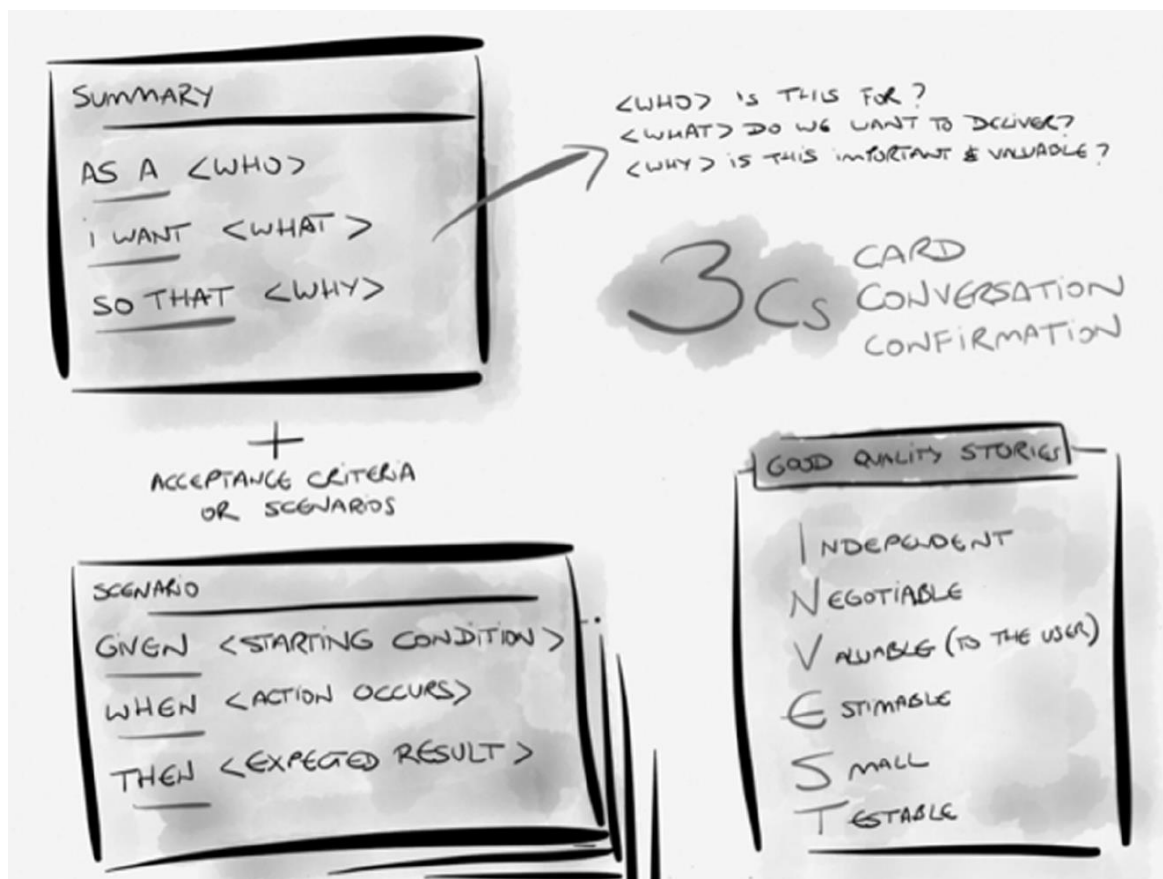


Figure 10, Story cards (Measey, 2015, fig. 7.1 Story Cards)

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The process of refining the stories that are in the backlog is to make sure that they are good stories and comply with the characteristics of the ‘INVEST’ acronym, which stands for : (Measey, 2015, sec. 7.1 Stories and Backlog).

- **Independent** from each other, which enables the team and customer to inject stories that can be delivered in one iteration/sprint. (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).
- **Negotiable**, since stories are not detailed requirements, and are planned within a sprint. (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).
- **Valuable** in the sense that the value of the story is understood by the customer and are stated in a common language. (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).
- **Estimable** Stories should be understood by the team to create estimates, since they are the unit against which plans and estimates are created. (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).
- **Small enough** *“A common mistake when writing a story is to provide too much information too soon. Generally, it is recommended that stories are refined to the 1 to 5 days’ effort size just before the next iteration/sprint is planned.”* (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).
- **Testable** containing testable acceptance criteria in such a way that they can achieve ‘done’ status by the customers and stakeholders. Acceptance criteria are not detailed tests, however they will be driving what the tests will be. (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).

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Backlog refinement also includes the high-level prioritization according to MSCW (pronounced MosSCoW), which is a prioritization technique intellectual property of the DSDM consortium. MSCW stands for:

- **M – must have** means that these stories make part of the MVP (minimum viable product), or the MMFS (minimum marketable feature set), and delivering the product without these means the solution is non-viable, illegal or pointless. . (Measey, 2015, sec. 7.1 Stories and Backlog Refinement)
- **S – should have** *“A story that is very important within a time-box, and that will cause significant problems to the customer if not delivered, though the customer could still get value from the product if this feature is not in place.” (Measey, 2015, sec. 7.1 Stories and Backlog Refinement)*
- **C – could have** *“A story that is very important within a time-box and may cause some problems to the customer if not delivered. However, the customer will still gain value from the product if a ‘could have’ feature is not in place. “(Measey, 2015, sec. 7.1 Stories and Backlog Refinement)*
- **W – won’t have** These are stories that will not be added in a given timebox, previous agreement with the client. They might be added to a later time-box or removed completely from the backlog. (Measey, 2015, sec. 7.1 Stories and Backlog Refinement).

6.7.2 Planning

Agile mindset makes agile planning an activity more than a document.(Cohn, 2006, Chapter 1. The Purpose of Planning) . Additionally, the purpose of planning is to *“find an optimal*

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answer to the overall product development question of what to build. The answer incorporates features, resources, and schedule. Answering this question is supported by a planning process that reduces risk, reduces uncertainty, supports reliable decision making, establishes trust, and conveys information. (Cohn, 2006, Chapter 1. The Purpose of Planning).

Agile planning is differentiated from traditional approaches in that:

- *“Is focused more on the planning than on the plan.*
- *Encourages change*
- *Results in plans that are easily changed*
- *Is spread throughout the project” (Cohn, 2006, Chapter 1. The Purpose of Planning)*

Agile projects perform planning at release and iteration levels. One release may have many iterations or sprints; therefore many rounds of iteration planning may be performed for one release.(Cohn, 2006, Chapter 1. The Purpose of Planning)

6.7.3 Agile estimates

Agile estimates are forecasts of how many stories can be delivered within any time period (iteration/sprint).(Measey, 2015, sec. 7.2 Agile Estimation).

In Agile, estimates for size are separated from those of duration. Firstly, teams take stories from the backlog and determine their size, after that they determine the activities to be performed, thus assigning a duration, as described by (Cohn, 2006, pt. II.Estimating size.). This process is depicted in Figure 11. Agile Estimation (Cohn, 2006, fig. II.1 Estimating the duration of a project begins with estimating its size).

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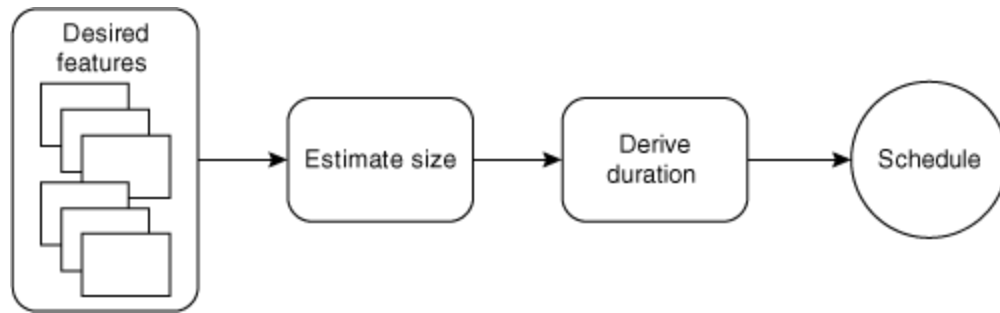


Figure 11. Agile Estimation (Cohn, 2006, fig. II.1 Estimating the duration of a project begins with estimating its size)

Measures of size are taken in story points or ideal time (Cohn, 2006, pt. II. Estimating Size). Story points are a relative measure, which values are not important by themselves, but they relative value to each other. For this reason, estimates made in story points are unitless. The story point estimate represents the effort required to build the feature; the complexity of its development, and the risk inherent to it, all at the same time. (Cohn, 2006, Chapter 4. Estimating Size with Story Points)

Story point estimates are related to the velocity of the team. Velocity is a measure of team's rate progress and is calculated by summing the number of story points assigned to each user story that the team completed during the iteration. This metric is useful to make future estimates with the history of previous iterations for the team. (Cohn, 2006, Chapter 4. Estimating Size with Story Points) As can be seen, this helps to make a relative measure instead of an absolute one.

On the other hand, ideal time can be used as a measure of size as well, by providing the 'productive time' allocated to deliver PBIs from the backlog. (Measey, 2015, sec. 7.2.1 Ideal days). These discard the 'unproductive time', which is the one allocated to do other things like attending calls, meetings, writing emails and so on. (Measey, 2015, sec. 7.2.1 Ideal days). Ideal time is to be distinguished from elapsed time, to make sure that those 2 terms are not confused by stakeholders, since ideal days invested in developing a feature may not correspond to the total time elapsed from

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requirement to delivery, since it involves many other activities and they represent the time actually devoted to implementation of the story.(Cohn, 2006, Chapter 5. Estimating in Ideal Days).

Usually the way that the team assigns estimates in story points to the PBIs on the backlog is determined by a ‘planning poker’ workshop defined by (Grenning, 2002). Planning poker uses relative sizes based on Fibonacci sequence to determine fine and coarse grained differences between numbers.(Measey, 2015, sec. 7.2.2 Story points and planning poker)

“Typical story-point sizes in planning poker are:

- *The story is at ‘done’ status = 0*
- *Fine-grained sizings = ½ (xxs), 1 (xs), 2 (s), 3 (sm), 5 (m), 8 (ml), 13 (l) – the Fibonacci sequence*
- *Coarse-grained sizings = 20 (xl), 40 (xxl), 100 (xxxl)*
- *Not enough knowledge to estimate this story =?*
- *The story is so big it’s impossible to estimate or that the team do not have the capability to deliver the story at all = ∞ (infinity)”(Measey, 2015, sec. 7.2.2 Story points and planning poker)*

6.7.4 Top Down Planning

This is the type of planning performed when there is high variability; it is risky to define a detailed plan, and for long time frames (such as those of a release). Top-down plans are often based on previous data of similar activities and can be done with either ‘story points’ or ‘ideal days’.(Measey, 2015, sec. 7.3.1.1 Top-down planning)

6.7.5 Bottom Up Planning

This kind of planning is used when detailed estimates are required. These are made by the team at the level of committing to deliver in an iteration/sprint.(Measey, 2015, sec. 7.3.1.2 Bottom-up planning)

At this point, the team may already know the stories to be worked on, according to the top-down planning and it's about to identify the required effort required for the next sprint to get the stories in 'done' status. This effort is represented normally in 'total required hours' and contrasted with the capacity of the team, represented in 'total available hours'. If the required hours exceed the available hours, the team may choose to remove some other stories from the sprint.(Measey, 2015, sec. 7.3.1.2 Bottom-up planning)

6.7.6 Release Planning and velocity

As seen on previous sections, in Agile, there are release planning, and sprint planning activities. In a release planning, the release backlog is to be determined. A release backlog is *“subset of the overall backlog that relates to the stories that are forecast to be 'done' in a particular release.”*(Measey, 2015, sec. 7.3.2 Release planning and velocity)

In general, the team should estimate the PBIs in the backlog, then to size each iteration/sprint with a velocity, which is given by previous experience. Once the velocity is determined and given in the same metric for the release size (story points, for example), then the team can plan the stories into the iterations/sprints, with a forecast of how many stories from the backlog can be taken to each sprint and determine a release goal.(Measey, 2015, sec. 7.3.2 Release planning and velocity)

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This process is made iteratively until the release goal is both accurate and tenable (it delivers what the business wants and the forecasts are reasonable) (Measey, 2015, sec. 7.3.2 Release planning and velocity)

6.7.7 Iteration/sprint planning

This is the planning performed for each one of the iterations/sprints. It is usually performed in two parts:(Measey, 2015, sec. 7.3.3 Iteration/sprint planning)

- **Iteration /sprint planning part 1:** The team plans the number of stories to be included on the iteration/sprint according to team velocity and story-point size. The approach is top-down planning.(Measey, 2015, sec. 7.3.3.1)
- **Iteration/sprint planning part 2:** The stories are looked from the bottom-up planning approach. Then the top-down and bottom up estimates are confronted in a way that the sprint is estimated to a point that the team is able to commit to its delivery.(Measey, 2015, sec. 7.3.3.2)

6.7.8 Daily Stand Up

Daily stand-ups are daily meetings, with a duration of maximum 15 minutes, that require the attendees to remain standing.

Each team member will be answering these three questions:

- *“What did I do yesterday that helped(sic) the team meet the sprint/iteration goal?”*
- *What will I do today to help the team meet the sprint/iteration goal?*
- *Do I see any impediment that prevents me or the team from meeting the sprint/iteration goal?”*(Measey, 2015, secs. 8.3 Daily Stand-Ups)

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The goal of this meeting is not to provide a progress update, but to synchronise with the team. The best time for holding the meeting is 30 minutes after starting to work, so that each team member can refresh their memory about the previous day, and prepare for the new one, before attending the daily stand-up.(Measey, 2015, secs. 8.3 Daily Stand-Ups)

Another approach to this synchronization is to ‘walk the board’, which makes references the visual board representing the current iteration/sprint, reviewing the rightmost stories first; the ones that are closer to completion or the higher value ones. .(Measey, 2015, secs. 8.3 Daily Stand-Ups)

6.7.9 Retrospective

Retrospectives capture the concepts of lessons learnt and post-mortem meetings from traditional project management. They provide the team with opportunities to inspect and adapt about what they do and how they do it. Their purpose is to continuously improve the product as is being delivered and how it is being delivered.(Measey, 2015, sec. 8.5 Retrospectives)

During this meeting, the team will be considering the answers to these questions:

- *What went well?*
- *What didn't go well?*
- *What are we going to do differently next time?*

6.7.10 Release

A release is a set of iterations, in which a set of related features is planned to be delivered. This concept is created, given that a sprint/iteration is a short time for delivering the complete set of functionalities required by the customer. (Cohn, 2006, Chapter 3. An Agile Approach)

Sprints are usually 2-4 weeks, while a release may take 3-6 months. Release planning is made at the start of the project, and it is updated throughout the execution of the project, each iteration to reflect the current execution versus the broader plan. (Cohn, 2006, Chapter 3. An Agile Approach)

Planning is made at many levels in an Agile project, however most Agile projects are mostly concerned with 3 levels of planning: release, iteration and days. (Cohn, 2006, Chapter 3. An Agile Approach), as depicted on Figure 12. Planning levels for an Agile project. (Cohn, 2006, fig. Figure 3.1. The planning onion. Agile teams plan at least at the release, iteration, and day levels.)

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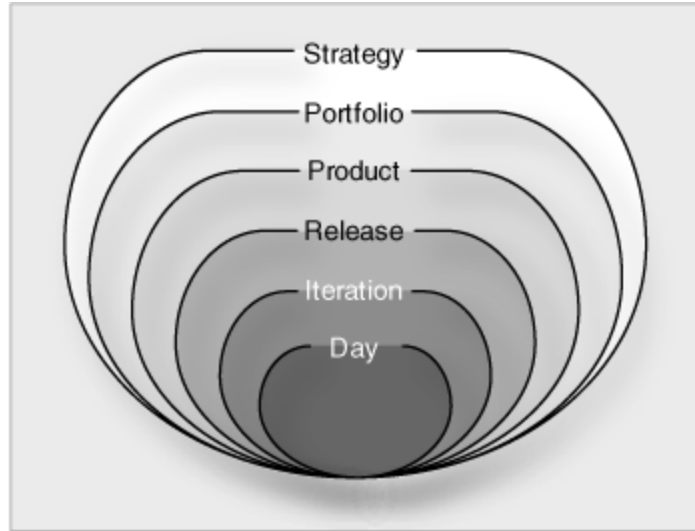


Figure 12. Planning levels for an Agile project. (Cohn, 2006, fig. Figure 3.1. The planning onion. Agile teams plan at least at the release, iteration, and day levels.)

6.7.11 Sprint /Iteration

Unlike traditional projects, divided in phases in which one activity at a time is performed, in Agile projects, there are divisions of time in which: (Cohn, 2006, Chapter 3. An Agile Approach)

- All activities (analysis, design, coding, testing, and so on) are executed concurrently. (Cohn, 2006, Chapter 3. An Agile Approach)
- A version of a coded, tested and shippable software is delivered.(Cohn, 2006, Chapter 3. An Agile Approach)

An iteration is timeboxed, meaning that they finish on time, even if functionality is dropped, and the timebox is often short. The duration is usually between 2-4 weeks, however the team decides its length and agrees the moment to decide it.(Cohn, 2006, Chapter 3.An Agile Approach)

6.8 The Agile Operating Model

According to (Measey, 2015, sec. 5.1 Agile Operating Model), one Agile framework is not enough to provide governance and adequate delivery for everything that the business needs , therefore an ‘Agile operating model’ (AOM) is required.

This model is the combination of many frameworks to complement each other, to fit organizational needs, by providing the emphasis required by each situation: (Measey, 2015, sec. 5.1 Agile Operating Model)

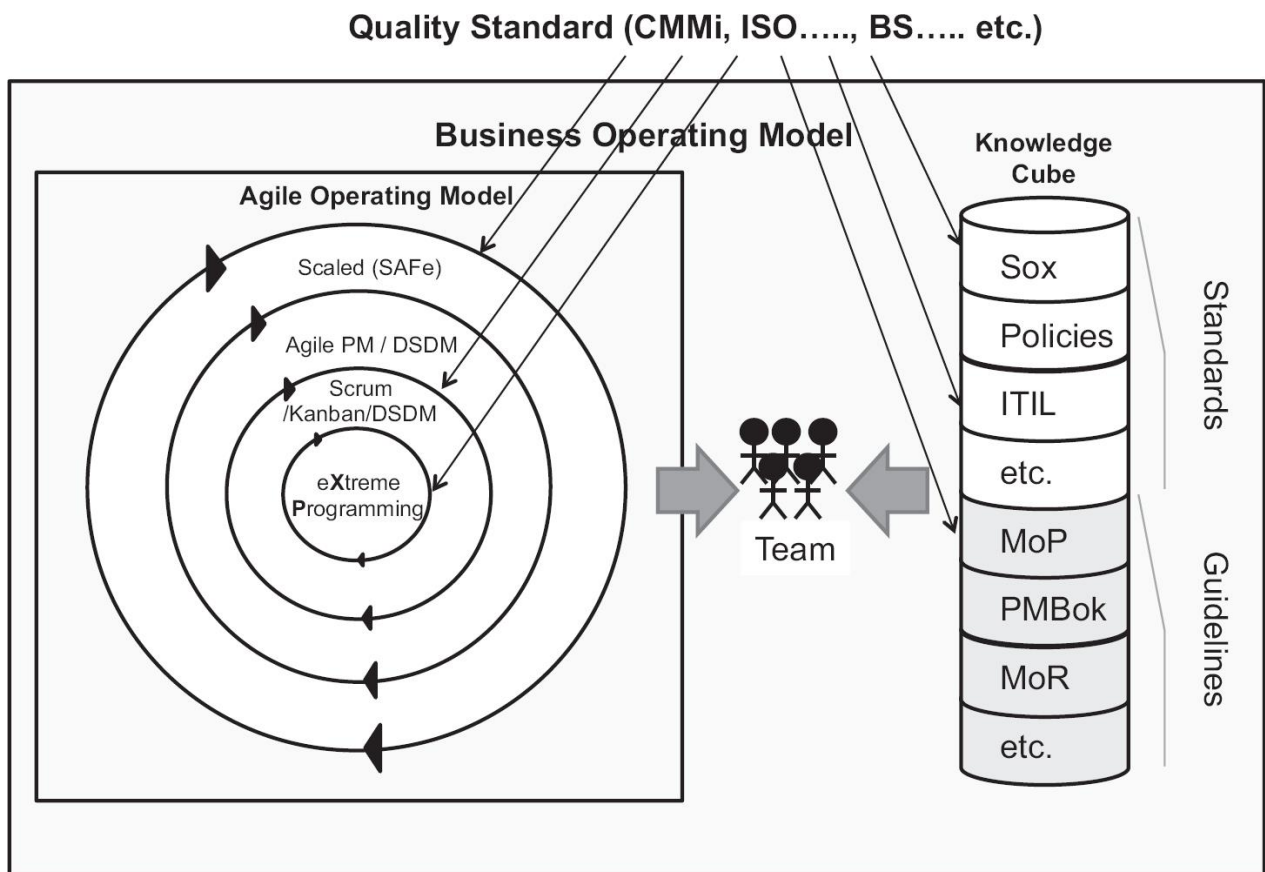


Figure 13. The Agile Operating Model and how it fits the Business Operating Model. (Measey, 2015, fig. 5.3 Agile Business Operating Model)

As can be seen on Figure 13. The Agile Operating Model and how it fits the Business Operating Model. (Measey, 2015, fig. 5.3 Agile Business Operating Model), Measey describes how the Agile

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Operating Model relates to the Business Operating Model, being one of its components. Additionally, he introduces the concept of ‘knowledge cube’ *as a repository of everything that the organization or department needs to run effectively. (Measey, 2015, sec. 5.1 Agile Operating Model).* This knowledge cube will contain standards and guidelines that the company has, and some of them will be audited and inspected. The Agile team will need to adapt to follow the standards, as they are mandatory, and to adapt the guidelines to the Agile mindset in the simplest way. (Measey, 2015, sec. 5.1 Agile Operating Model)

For the Agile frameworks included on the AOM, the team should define the way they should be used. Measey describes the way each framework can fit one or more needs given by the business: (Measey, 2015, sec. 5.1 Agile Operating Model)

- *“eXtreme Programming (...) is generally focused on the more technical (and team) aspects of software engineering.*
- *Scrum (...), Kanban (...) or DSDM (...) are more focused on the team and product delivery.*
- *Agile PM (see Section 14.4) or DSDM (see Section 14.3) can be used if Agile project governance is required (...).*
- *If the Agile delivery involves many teams, then a scaled Agile framework like SAFe (...) may be suitable.*
- *All these are wrapped within the Agile values and principles described in the Agile Manifesto (...).” (Measey, 2015, sec. 5.1 Agile Operating Model)*

6.9 Business cases: Agile applied in the software industry

According to our previous definition of Agile Enterprise (Goranson, 1999, Chapter 7. Agility) as the “*One that responds to (and ideally benefits from) unexpected change*”, an Agile Enterprise is not limited to belong to a given industry, business or body of knowledge.

The first implementation of Agile mindset on the industry as a formal method was on the development of weapon systems, by an effort of the US Department of Defense to find a solution to 3 main problems(Goranson, 1999, Chapter 1):

1. Weapon systems took three times more to develop than the technologies in them took to change.(Goranson, 1999, Chapter 1)
2. Dependency on selection of subcontractors, which blocked some key decisions to move forward.(Goranson, 1999, Chapter 1)
3. High expenses on the use of coordinating firms, used to manage complexity.(Goranson, 1999, Chapter 1)

These problems made the weapon development system cost at least twice of what it should. Therefore, the US Department of Defense sponsored a project in which a general Agile Virtual Enterprise strategy was developed to improve the effectivity of systems used in the weapon manufacturing and which results are applicable to any enterprise. (Goranson, 1999)

However, from 1999 there are several Agile applications, shown by research studies such as those on Agile Manufacturing, in detail, that for the aerospace industry and how it has evolved, comparing it with the application of the Agile principles in the automotive industry (Phillips, 1999).

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Additionally to that contrast, the automotive industry application of Agile has taken advantage of its findings, improving the assembly of components, as the research of Costa, Silva et al describes it (Costa, Silva, & Campilho, 2017).

On the other hand, one remarkable example is the one of the “fast fashion strategy”, which is a “business strategy which aims to reduce the processes involved in the buying cycle and lead times for getting new fashion product into stores, in order to satisfy consumer demand at its peak.”(Čiarnienė & Vienažindienė, 2014). Given the ephemeral nature of fashion products and the short window in which they are saleable, often measured in months or even weeks, it is difficult to forecast the demand within a period.(Čiarnienė & Vienažindienė, 2014). According to (Čiarnienė & Vienažindienė, 2014) agility and responsiveness in the supply chain have provided a background for the “quick response” movement, a concept that aimed to find the cause of delay in the time for a product to go from manufacturing to store, given that the production time was the sixth part of the lead time (Čiarnienė & Vienažindienė, 2014) . In this study, it is found that agility on the context of supply chain management for fashion industries focuses around “responsiveness”; and it defines an agile organization according to the study by (Christopher & Towill, 2001) as a flexible and responsive one, to respond to changes in “*product mix or volume*” (Christopher & Towill, 2001) and uses the word agility to mean “*using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace*”(Christopher & Towill, 2001). The point of the paper by (Čiarnienė & Vienažindienė, 2014) is to highlight the benefits and implications of agile and responsive fashion supply chain, however , even though the agility definition and mindset used for that article are applied in general, the methodology used differs from the one described in the 6.2 Agile methodologies: Definition section, which is the implementation created to be used by the software development industry.

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Even though in other industries the Agile concept is shared, their implementation may differ from the software development Agile methodologies as described in the chapters above. For the case of (Čiarnienė & Vienažindienė, 2014), characteristics of the agile supply chain are enumerated, but there is not a description of the process that organizations should follow to achieve agility, therefore a comparison with agile software development implementation cannot be made at that level.

The purpose of this paper is to study agile methodologies and its measurement specifically on the software development business.

6.10 Agile Metrics

The aim of this chapter is to contribute to provide an answer to [OR1] *“Describe the state of the art in terms of Agile metrics and its impact on business today, to verify if Agile metrics need translation into business terms, from software development industry point of view”*, in terms of describing Agile metrics in detail. Additionally, this chapter aims to provide an answer to the research question 3. *“Which are the metrics taken by the agile projects in software development industry today?”* by researching the relevant literature on Agile metrics topic.

Research on Agile metrics show that, even from definition Agile metrics are ambiguous (Davis, 2015, sec. 1.2 Why Agile teams struggle with measurement). Basically, looking for a reference about what are the official metrics for Agile software development is difficult, since one of the principles on the Agile Manifesto (Beedle et al., 2001) , the one referring to measurement, dictates that *“Working software is the primary measure of progress”*(Beedle et al., 2001, p. 2).

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As the book *Agile Metrics in Action* (Davis, 2015, sec. 1.2.1 Problem: agile definitions of measurement are not straightforward) remarks, “working software” is not an objective criteria, because it usually takes into account functional elements, and attributes like performance and security are left aside.

On the other hand, (Davis, 2015, sec. 1.2.1 Problem: agile definitions of measurement are not straightforward) , other Agile principle cited as a problem for finding suitable metrics is the one that recommends to “*Measure Only what matters*” (Davis, 2015, sec. 1.2.1 Problem: agile definitions of measurement are not straightforward), leading then to the question of what is that matters? And implying that every project, product or team must find the metrics for their specific case.

However, (Davis, 2015) proposes a sample case as starting point to know what metrics to use, so that the emphasis of his book is to provide a solution to visualize and track the measurements taken with PTS (Project Tracking Systems) to an ongoing project team.

Since, Agile methodology does not prescribe any set of metrics by default, the base for a list of metrics most used by Agile teams is found on the work by (Kupiainen, Mäntylä, & Itkonen, 2014a), which is based in Systematic Literature review (SLR) of “*actual use of software metrics in the context of agile software development*”(Kupiainen et al., 2014a). That research aims to answer these questions, framed on the scope of industrial Agile development teams:

- Why are metrics used?
- What actions do the use of metrics trigger?
- Which metrics are used?(Kupiainen et al., 2014a)

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According to the results of their research, most common used metrics for industrial Agile teams are listed below, divided into their respective categories (Kupiainen et al., 2014a):

1. Iteration planning: Metrics used for task prioritization and scoping of the next iteration (Kupiainen et al., 2014a, sec. 3.1 Iteration Planning)

- Amount of revenue a customer is willing to pay for a feature
- Effort estimation metrics were used to measure the size of the feature
- Velocity metrics used to calculate how many features the team can complete in an iteration, and to improve next iteration estimates.
- Effective available hours from team members, useful to select tasks for an iteration

2. Iteration tracking: These are the set of metrics that help in monitoring and identifying problems during a sprint, predicting the result of the iteration and making this progress transparent for stakeholders. These are also called “Progress metrics”(Kupiainen et al., 2014a, sec. 3.2 Iteration Tracking).

- Number of web pages completed (number of artifacts completed, to generalize the metric).
- Story completion percentage
- Velocity metrics.
- Feedback from product demonstrations with customer (ologtative metric)
- Number of tasks completed

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- Open defects

3. Motivating and Improving: Metrics were used to communicate data about project or product to the team members and motivated them to act and improve.(Kupiainen et al., 2014a, sec. 3.3 Motivating and Improving)

- Build status
- Time to fix a failed build
- Number of defects (and visualizing the number of defects on a screen)
- Time to fix defects
- Measuring product size by number automated tests motivated the team to write more tests.
- Measuring Work in Progress (WIP) and setting the goal at maximum 2 features at a time reduced cherry picking of features that were most interesting for the team.

4. Identifying Process Problems: Metrics allowed to determine phases with no value added.(Kupiainen et al., 2014a, sec. 3.4 Identifying process problems)

- Lead time measurement led to removing the “waiting for finalization” phase.
- Story implementation flow metric describes how efficiently has completed a story, compared to the estimate.

5. Pre-release Quality Metrics(Kupiainen et al., 2014a, secs. 3.5 Pre-release Quality)

- Static code check metrics, in order to avoid integration fails.

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- Product test metrics.
 - Metrics that forced writing tests before code
 - Technical debt measured with technical debt board.
6. **Post-release Quality**(Kupiainen et al., 2014a, secs. 3.6 Post-release Quality)
- Customer Satisfaction
 - Quality indicators
 - Customer metrics
 - Number of defects sent by customers
 - Change requests sent by customers
 - Customer willingness to recommend the product to other potential customers
 - Predictions in quality
 - Defect count
 - Maintenance effort
 - Deferred defect counts(Kupiainen et al., 2014a)

From this list, a subset of metrics will be selected to be studied to check how can relate to business metrics for the sake of this investigation.

Additionally, in the article by (Nee, 2010) there are some findings about Agile Metrics that allow measuring progress, by pointing at how these metrics are different from traditional project management methods.

The paper by (Nee, 2010) describes the use of work breakdown structure and Gantt diagrams as “*rare in agile programs*”(Nee, 2010, sec. Introduction), and remarks the change on the role of the project manager from a status report role to a role in which project managers keep “*performance of the team at the highest level of productivity and collaboration(...)*” (Nee, 2010,

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sec. Introduction). Moreover, this study reviews 3 basic Agile Process tools for measuring progress:

1) **Tracking progress chart:** Used to communicate iteration status to the customer and stakeholders; changes from one iteration to the next; and comparing the initial plan vs current and future iterations, according to current progress (Nee, 2010, sec. Tools for Tracking Progress). The Figure 14. Tracking Progress Chart (Nee, 2010, sec. Tools for Tracking Progress) show an example of tracking progress chart by (Nee, 2010, sec. Tools for Tracking Progress).

| Two Weeks Ago | | Today | | Prev. | Curr. Status |
|--------------------|--------------------|--------------------|--------------------|--------------------|--------------|
| Iteration 1 | This is item 1... | Iteration 1 | This is item 1... | 1 | ✓ |
| | This is item 2... | | This is item 2... | 1 | ✓ |
| | This is item 3... | | This is item 3... | 1 | ✓ |
| | This is item 4... | | This is item 4... | 1 | |
| Iteration 2 | This is item 1... | Iteration 2 | This is item 5... | 2 | |
| | This is item 2... | | This is item 6... | 2 | |
| | This is item 3... | | This is item 15... | New | |
| | This is item 4... | | This is item 8... | 2 | |
| Iteration 3 | This is item 9... | | Iteration 3 | This is item 13... | 3 |
| | This is item 10... | This is item 9... | | 2 | |
| | This is item 11... | This is item 7... | | 2 | |
| | This is item 12... | This is item 11... | | 3 | |
| | This is item 13... | This is item 10... | | 3 | |
| This is item 14... | This is item 14... | X | | | |

Figure 14. Tracking Progress Chart (Nee, 2010, sec. Tools for Tracking Progress)

2) **Burn down chart:** This chart has been described on the section 0 above, when listing the visualization tools for the Agile Process. (Nee, 2010, sec. Tools for Tracking Progress) recommends the use of this chart to measure progress inside an iteration, and also for measuring overall project progress, by using a different measure on the y-axis

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(replacing “days” by “iterations”). Additionally, a set of trends are explained to give guidance regarding how to read the chart: a horizontal line may indicate a blocker; the function line going upwards may indicate that the scope has increased or new tasks are being added to the project/iteration; and, finally if the function goes as expected, downward, the project is having success in estimation.(Nee, 2010, sec. Tools for Tracking Progress)

- 3) **Daily stand up meetings:** As part of the team communications that allows how is the daily progress of the team, what issues, risks or barriers they have, and what will they work on for the day. This meeting allows team member what tasks are on track or slipped; what others have completed early, etc, to take actions on a daily basis.(Nee, 2010, sec. Team Communications)

Even though, these tools are presented as Agile process tracking tools, they are mentioned not to be effective, since stakeholder questions are not answered regarding “*value delivered, costs, resources consumed or future expectations*”(Nee, 2010, sec. Team Communications). In addition, the paper explains why Earned Value is not the appropriate metric for an Agile project, given that projects of Agile type do not have a fixed scope, therefore the Earned Value metric cannot be calculated, so the Agile EVM metrics are presented as originally explained by (Sulaiman, Barton, & Blackburn, 2006).

The Agile EVM metrics replace the tasks used in Earned Value measuring, by story points as basic unit for measuring planned work versus completed work, to derive the value delivered by the project (Nee, 2010, sec. Applying Earned Value Management to Agile Project Management).

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The following Agile EVM metrics are listed below, from (Nee, 2010) article in Table 2.

Agile EVM metrics (Nee, 2010, sec. Applying Earned Value to Agile Project Management)

| AgileEVM Metric | Definition |
|----------------------------------|--|
| PSP (planned story points) | Total number of story points planned for this release |
| PW (planned weeks) | Total number of planned development weeks |
| BAC (budget at completion) | Total budget for the release |
| AW (actual weeks) | Number of development weeks elapsed to date |
| CSP (completed story points) | Number of story points completed to date |
| PPC (planned percent complete) | AW/PW |
| APC (actual percent complete) | CSP/PSP |
| AC (actual cost) | Total budget spent to date |
| PV (planned value) | Budgeted cost of the story points that were scheduled to be completed as of today; $PPC * BAC$ |
| EV (earned value) | Budgeted cost for the story points actually completed as of today; $APC * BAC$ |
| CV (cost variance) | Difference between planned budget and actual spend; $EV - AC$ |
| SV (schedule variance) | Difference between planned schedule and actual time spent; $EV - PV$ |
| CPI (cost performance index) | EV/AC |
| SPI (schedule performance index) | EV/PV |
| ETC (estimate to complete) | Based on current state, how much additional budget is needed to complete the release; $1/CPI * (BAC - EV)$ |
| EAC (estimate at complete) | Based on current state, what the total estimated cost of the release will be at completion; $EAC = AC + ETC$ |
| Estimated time to complete | Based on the current state, the total estimated time needed to complete the release; $1/SPI * PW$ |

Table 2. Agile EVM metrics (Nee, 2010, sec. Applying Earned Value to Agile Project Management)

6.11 Business metrics

The purpose of this chapter is to provide answer to the research question no. 4 “*What metrics are required for business and upper management areas? This question needs to be answered to give the managerial perspective of projects and determine what information is constantly lacking, if any. The main point is to find if there is a void that framework can complete from the existing agile metrics.*” For achieving this goal, a set of books on business metrics have been consulted, which are cited according to the concepts found on them.

There are many kinds of business metrics, depending on the perspective that a given stakeholder has over a company:

- a. Investors and general public, look a set of metrics related to the present and future performance of the company, by looking at the financial statements as described on (Brodersen & Pysh, 2014).
- b. Companies want to track internally their progress through the Balanced Score Card (BSC) management tool, which uses Key Performance Indicators (KPIs) to measure company performance, defined by (Kaplan & Norton, 1992). BSC, as management tool has been discussed, analyzed and refined by other authors, like (Parmenter, 2015), in which a framework to define KPIs is provided.
- c. On the other hand, given the rise of software startups, a new set of business metrics have emerged. The paper by (Kemell et al., 2018) compiles a list of metrics used by startups in a multi-vocal practitioners’ literature review. The

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software startup context is the best example for Agile software development business, since they operate in contexts of high uncertainty and chaos (Kemell et al., 2018, sec. Abstract).

Since the latest source is the one containing closer information for the highly challenging context that companies (startups or not) face today, and the metrics contained in this study include also traditional business metrics used by more mature and larger organizations which aim is to develop software.

6.11.1 Metrics for investors and general public

According to (Brodersen & Pysh, 2014), based on Warren Buffett's ideas about value investment, there are financial metrics to look at , when investing in a company. Warren Buffet is CEO of Berkshire Hathaway and one of the most respected stock market investors, with a net worth of around 60 billion (USD).(Brodersen & Pysh, 2014, sec. Preface). Several books have been written about the way he makes investments, such as the whole "*The Warren Buffet Way*" Series (Hagstrom, 2005) and the three (3) book collection with the common name "*The Warren Buffet Accounting Book*"; among others written by different authors. Buffett is therefore one referent in terms of stocks investment.

Although Warren Buffet has been skeptic about making investments on tech companies (Moore, 2019), his company has started buying shares in Amazon, Apple and Tesla. In spite of these transactions, he still explains that he has allowed this investment from Berkshire Hathaway specifically in the case of Apple "*more for the strength of its brand with consumers, than for its underlying technology*"(Moore, 2019). For the sake of the present research, these metrics represent the traditional financial business metrics companies would care about, to attract potential investors.

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Firstly, (Brodersen & Pysh, 2014, Chapter 1. How to Look at the Stock Market) makes a clear distinction between stock investment and value investment: stock investors look at the price of the stock today, and they believe that the price of today reflects value of the company; whereas value investors know that the prices of stock fluctuate and they do not look at the stock, but at the value of the company (Brodersen & Pysh, 2014). The value of the company, should be determined at long term, looking beyond stocks, and analyzing the profit and cashflow they are willing to give over time(Brodersen & Pysh, 2014).

It is worth to mention, that the metrics that an investor has to look in a company, are affected by 3 factors (Brodersen & Pysh, 2014, Chapter 2. Concepts Every Investor Should Know):o

- **Interest rates:** They represent the *price of money*, and act like the gravity for living entities. They make economy difficult when they are high, and easy when they are low, and are usually regulated by a central bank or, in the case of USA The Federal Reserve (“Federal Reserve Board - Home,” n.d.).
- **Inflation:** It is the increase on price of goods and services over time (Brodersen & Pysh, 2014, Chapter 2. Concepts Every Investor Should Know). Inflation for investors adds uncertainty when it is high, generating changes in the economy, therefore in the stock value of companies. Also yearly inflation diminishes the real return of an investment over time(Brodersen & Pysh, 2014, Chapter 2. Concepts Every Investor Should Know).
- **Bonds:** Bonds are loan of a par value by a term, with an annual rate paid from the borrower. Bonds from the government are ruled by the common interest rate, but

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those from private companies have their own interest rate. This means that when interest rates are high, the annual rate increases (Brodersen & Pysh, 2014, Chapter 2. Concepts Every Investor Should Know). They are also affected by inflation and, in some cases it can annulate the gain (if the inflation is the same percentage as the annual rate, for example). *“Bonds are preferred in the situation where inflation is low and interest rates are high. This is partly because inflation diminishes the fixed income received from bonds, but also because a high-interest environment may yield better returns. In all other cases, stocks are likely the preferred choice”* (Brodersen & Pysh, 2014, Chapter 2. Sec Takeaways from this chapter)

Once these concepts, and their influence on investments are clear, (Brodersen & Pysh, 2014, Chapter 3. A brief Introduction to Financial Statements) gives an introduction to the financial reports and financial statements contained in them. Government imposes these reports to publicly traded companies and they are of special interest of the government, shareholders and other stakeholders for the company (Brodersen & Pysh, 2014, Chapter 3. A Brief Introduction to Financial Statements):

- **10K – Annual report:** Contains *“all major business activities conducted in the last year”* (Brodersen & Pysh, 2014, Chapter 3. A Brief Introduction to Financial Statements). This report covers the company background, mission and vision of the organization. It has to be filed within sixty to ninety days after fiscal year ends. (Brodersen & Pysh, 2014, Chapter 3. A brief Introduction to Financial Statements). The main content of the 10K report are the three financial statements: Balance Sheet, Income Statement and Cash Flow Statement. These statements are *“published with detailed notes on accounts, disclosures*

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and any events that might have occurred after the balance sheet date”(Brodersen & Pysh, 2014, Chapter 3. A Brief Introduction to Financial Statements).

- **10 Q – Quarterly report:** This report has the same content of the 10 K annual report, but only referent to the latest quarter (3 months). Companies are required to file the 10Q report within 40 to 45 days from the end of the fiscal quarter. (Brodersen & Pysh, 2014, Chapter 3.A Brief Introduction to Financial Statements).
- **8K – Current Report Filing:** Publicly traded companies are also required to file a report containing a major event that may have affected the company’s financial position, like mergers, or any incident that may harm the company’s earning capacity: bankruptcy, sale of a subsidiary, change in the board of directors, etc. These reports should be filed no more than 4 days after the major incident has occurred (Brodersen & Pysh, 2014, Chapter 3. A Brief Introduction to Financial Statements).

These reports, containing the financial statements are able to give investors, stakeholders (and general public, in the case of public traded companies), the view of what the value of the company is, current and long term (Brodersen & Pysh, 2014, Chapter 3. A Brief Introduction to Financial Statements).

As for the three financial statements, these contain information that can give a very clear view of the status of the company. A description of these statements is as follows:

- **Balance Sheet:** The main purpose of the balance sheet is to answer the question “How much the company is really worth?”. (Brodersen & Pysh, 2014, Chapter 3. Sec. Income Statement) . It is composed of two sides: The left representing the

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Assets; and the right representing the Liabilities. Assets represent what the company owns, and Liabilities represent what the company owes (Equity, which is owed to investors and shareholders, and Debt, which is owed to third parties, such as banks). To be a 'balance' sheet, it must be 'balanced', therefore Total Assets should equal Total Liabilities. Equity is also the difference between the Assets and Liabilities (Debt), and what allows to keep this equation balanced (Brodersen & Pysh, 2014, Chapter 3. Sec. Income Statement). Having the Equity value, and dividing it by the number of shares outstanding, the **Book Value** of the company is obtained (what the company is worth). The **number of shares outstanding** is at the bottom of every income statement and balance sheet. (Brodersen & Pysh, 2014, Chapter 3. Sec Income Statement).

- **Income Statement:** The purpose of this statement is to answer the question "How much profit does a company make in one year?". It summarizes how much money has the company made during the year and how much it has spent. The conclusion of the statement is the **Net Income** that gives the actual profit made, without all taxes and expenses, hence serving the purpose of the report. From the Net Income, it can be obtained the **Earnings per Share** by dividing Net Income by the number of shares outstanding, which, as mentioned before) can be found at the bottom of the balance sheet and income statement. (Brodersen & Pysh, 2014, Chapter 3. Sec. The income statement)

Cash Flow Statement: This statement shows the flow of cash in and out of the company periodically; periodical income, payments and expenses, therefore it can be seen the amount of cash available that the company can keep and produce.

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Although it may seem that the income statement and cash flow statement are alike, the difference between the two is that Income Statement measures profit over time, whereas Cash Statement looks for changes of cash available over time (Brodersen & Pysh, 2014, Chapter 3. Sec Cash Flow Statement).

6.11.2 BSC and KPIs for business performance measurement

The Balanced Score Card (BSC) management tool, created by (Kaplan & Norton, 1992), provides a way to include non-financial metrics into performance measurement of a company, by adding 3 new perspectives: customers, internal processes and learning and growth (Robert S. Kaplan, 2007, p. 2) .

Based on the knowledge and implementation of this strategy performance management tool, (Parmenter, 2015) has created a framework working on previously cited conceptual ones like those defined by (Kaplan & Norton, 1992), (Spritzer, 2007), (Edersheim & Drucker, 2007), among others, by extending the KPIs utilization and adding the classification of Key Result Indicators (KRIs)(Parmenter, 2015, Chapter 1.The Great KPI Misunderstanding), which are defined as those that are usually mistaken by KPIs, but that are distinguished because they represent “*good summary measures*”(Parmenter, 2015, Chapter 1.The Great KPI Misunderstanding), meaning that they represent the performance of the company overall, hence they cannot be attributed to the performance of a given team or set of teams. On the contrary, KPIs represent the performance that can be traced to one or many teams within the organization (Parmenter, 2015, Chapter 1.The Great KPI Misunderstanding).This extended framework is called by his author “*Winning Key Performance Indicators*”(Parmenter, 2015, Chapter 6. Background to the Winning KPI Methodology and Its Migration), aims to help companies develop their KPIs in such a way that an

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alignment with the strategy is achieved(Parmenter, 2015, sec. Preface); the Critical Success Factors(CSFs) of the company are covered(Parmenter, 2015, Chapter 6 Background to the Winning KPI Methodology and Its Migration); and the commitment of the CEO, Senior Management, as well as staff, unions and third parties(Parmenter, 2015, Chapter 7. Foundation Stones for Implementing Key Performance Indicators), among others, to achieve success in both the definition of a strategy and accomplishment of measures established.

Both Winning KPIs (Parmenter, 2015) and Balanced Scorecard(Kaplan & Norton, 1992) methodologies take indicators, measures and metrics that are defined by each company, according to their strategy, and in the case of Winning KPIs (Parmenter, 2015), also the Critical Success Factors in the context of a given organization. In other words, metrics and measures are different for every company and what these authors provide is a framework to guide the definition, and later ongoing measurement of those metrics.

This research is going to take the Winning KPIs (Parmenter, 2015) as a base, given that is the most recent and it is already based on the previous work of (Kaplan & Norton, 1992), as well as on the experience of the author on the implementation of KPIs in practice and case studies (Parmenter, 2015, sec. Preface-"Organization-wide understanding of winning KPIs definition.").

Winning KPIs methodology is, in summary, a six-stage process(Parmenter, 2015, Chapter 6. Sec. The New Six Stage Process), with seven "Foundation Stones"(Parmenter, 2015, Chapter 7.Foundation Stones for Implementing Key Performance Indicators), as represented on Figure 15. Stages and Foundation Stones defined by the Winning KPIs methodology(Parmenter, 2015, Chapter 7.Background to the Winning KPI Methodology and Its Migration).

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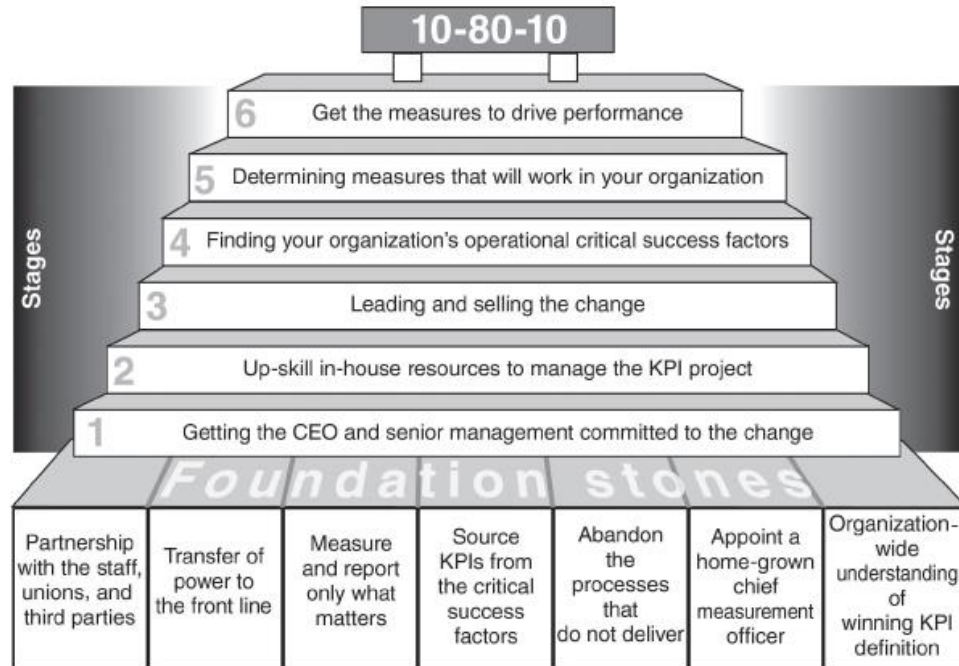


Figure 15. Stages and Foundation Stones defined by the *Winning KPIs methodology* (Parmenter, 2015, Chapter 7. Background to the Winning KPI Methodology and Its Migration)

Although *Winning KPIs methodology* considers a six-stage process, the present research is concerned with the resulting indicators generated at the end of it as a result, therefore it will be focused on stages 5 – *Determining measures that will work in your organization* and 6- *Get the measures to drive performance*.

Additionally, it is worth to mention that the seven *Foundation Stones*, being transversal to the process, are going to be of interest, given that are also based on /related to Agile principles : “Transfer of Power to the Front Line” Foundation Stone, for example, is related to the notion of empowered, self-managed teams, and actually the book mentions in literal way that this stone requires exposure to Lean and Agile methodologies (Parmenter, 2015, Chapter 7. Sec “Transfer of Power to the Front Line” Foundation Stone) . Another Foundation Stone, related with Agile concepts is the one for “Measure and report only what matters”(Parmenter, 2015, Chapter 7.Sec.“Measure and Report Only What Matters” Foundation Stone), that follows the value of

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being guided by “*Individuals and interactions over processes and tools*” (Beedle et al., 2001) from the Agile Manifesto, given that individuals determine what is to be measured and reported, not the methodology. Similarly happens with the “Abandon processes that do not deliver” Stone (Parmenter, 2015, Chapter 7. Sec. “Abandon Processes That Do Not Deliver” Foundation Stone) in which it detects what is not working and applies the “*Responding to change over following a plan*” value.

Furthermore, to complement the KPI and KRI definition provided by (Parmenter, 2015), there is a study by (Fotrousi¹, Fricker¹, Fiedler¹, & Le-Gall, 2014) in which an overview of the current research on KPI use on software ecosystems is provided (Fotrousi et al., 2014, sec. 2. Research Methodology.). As can be read on the cited paper: “*A software ecosystem (SECO) is about “the interaction of a set of actors functioning as a unit and interacting with a shared market for software and services, together with the relationship among them*” (Fotrousi et al., 2014, sec. 1. Introduction), therefore, it describes the set of KPIs that can be used between a software development company and its client, given that this relationship is a SECO, according to this definition. However, software development companies by themselves are excluded explicitly from the research (Fotrousi et al., 2014, secs. 2.2 Systematic Mapping Approach-Exclusion), hence the results can only be applied to software development companies which services and products are offered to another company.

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6.11.3 Startup context metrics

According to (Kemell et al., 2018, secs. 4. Results: General-Purpose Software Startup Metrics), the most commonly cited metrics by practitioners were:

1. User churn and User retention metrics.
2. User engagement metrics and metrics measuring user activity.
3. Financial metrics focusing on short-term developments and cash burn.
4. User-focused financial metrics such as User Acquisition Cost. (Kemell et al., 2018, secs. 4. Results: General-Purpose Software Startup Metrics))

This classification can be applied to the whole set of most common metrics listed on Table 3. List of Software Startup Metrics from Practitioner Literature (Kemell et al., 2018).

Table 3. List of Software Startup Metrics from Practitioner Literature (Kemell et al., 2018)

| Metric and up to 3 Reference(s) | Description |
|--|---|
| Abandonment [12] | Transactions abandoned before completion |
| Acceptance Rate [12] | Avg. no. invites accepted by new users |
| Activation Rate [8, 13, 25] | Number of visitors or users performing a specific action such as registering or installing Active |
| Active User Growth Rate [12] | No. new active users in a time period |
| Ad Inventory [12] | Total views of each ad in a time period |
| Ad Rates [12] | Value of each ad. inventory |
| Amplification Rate [25] | No. shares on social media per customer |
| Annual Contract Value [13, 17, 22] | Avg. annualized revenue per customer contract |
| Annual Recurring Revenue [13, 22, 41] | Predictable revenue annually (e.g. subscriptions) |
| Annual Run Rate [13] | Projected annualization of monthly recurring revenue |
| Avg. Revenue per User [13, 15, 25] | Avg. revenue per user over a time period |
| Avg. Revenue per Customer [13, 17, 25] | Avg. revenue per customer over a time period |

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| | |
|---|--|
| Average Time on Hold [12] | Time user spends on hold when calling support |
| Billings [13] | Current quarter revenue plus deferred revenue from previous quarter |
| Bounce Rate [8, 40] | Percentage of visitors leaving website quickly |
| Breakeven Analysis [3] | Analysis to determine the point where revenue covers the costs of receiving it |
| Burn Rate [8, 15, 18] | Rate at which available capital is used |
| Campaign Contribution [12] | Added revenue from an ad campaign |
| Capital Raised to Date [23] | Amount of investment capital raised in total |
| Cash Flow Forecast [3] | Forecast of financial liquidity in a period of time |
| Cash on Hand [19] | Available capital |
| Churn Rate [1, 15, 17] | Lost users or customers over a time period |
| Click-Through Rate [12] | Visitors that clicked a specific website link |
| Committed Weekly Recurring Gross Profit [45] | Percentage increase in profits weekly committed recurring profit |
| Compounded Monthly Growth Rate [13] | Avg. % growth per month since inception, or another start point for measuring. |
| Content Creation [12] | No. visitors that interact with website content |
| Conversion Rate [1, 8, 17] | No. visitors that become users or customers, or no. users that become customers. |
| Cost of Goods Sold [23] | Cost of products or services sold (e.g. hosting) |
| Customer Acquisition Cost [3, 7, 8] | Average cost of acquiring a paying user. |
| Customer Acquisition cost to life-time value ratio [11, 30] | Customer Acquisition Cost vs. Customer Life-time Value |
| Customer Concentration [13, 31] | Revenue from largest customer vs. total revenue |
| Customer Count [39] | Total number of customers (paying users) |
| Customer Retention Cost [25] | Amount of spending on customer retention |
| Daily Active Users [9, 11, 13] | No. users who use the software daily |
| Daily Active Users to Monthly Active Users ratio [25] | A more detailed measure of user activity |
| Deferred Revenue [13] | Revenue received in advance of earning it |
| Development Time [18, 39] | Time it takes to implement a new feature |
| Direct Traffic [13] | Traffic coming in directly |
| Downloads or Installs [22] | Total amount of downloads or installs |
| E-mail Conversion Rate [34] | Number of recipients that e.g. became users |
| E-mail Open Rate [34] | No. mailing list members that open an email |
| Facebook Likes [5] | Number of likes on firm Facebook page |
| Fixed vs. Variable Costs [3] | A measure of total spending split by source. |
| Frequency of Logins [17] | Average frequency of user logins |
| Frequency of Visits [25] | Average frequency of visits to e.g. website |

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| | |
|--|--|
| Gross (Cash) Burn [13] | Monthly expenses and any other outlays |
| Gross Churn Rate [13, 37] | Total users lost |
| Gross Margin [7, 13, 15] | Total revenue compared to cost of goods sold |
| Gross Profit [13, 17, 22] | Total revenue minus cost of goods sold |
| Innovation Metabolism [14] | Number of build-measure-learn cycles |
| Intent to Use [28, 34] | Data indicating that a new user is about to start using the software. E.g. imported custom data |
| Invitation Rate [12] | Avg. no. invites sent per existing user |
| Launch Rate [12] | No. downloaders that launched the software |
| Leads [29] | An estimate of prospective customers. |
| Lead-to-Customer rate [29] | Number of leads converted into customers |
| Life-time Value [3, 7, 8] | The average total revenue a customer generates |
| Likes per Post [34] | Likes per social media post |
| Number of Logins [5, 13] | Logins per user over a period of time |
| Number of Transactions [39] | Number of transactions made in a time period |
| Office Morale [5] | How motivated the team is |
| Operation Efficiency [15, 18] | Comparison of firm expenses by source |
| Organic Traffic [13] | Unpaid traffic from e.g. Google search results |
| Payback Time [25] | Time to recoup from an expense via revenue |
| Payment failures [45] | Number of failed transactions from users |
| Platform Risk [13] | Dependence on a specific platform or channel |
| Profit Margin [17, 25, 30] | Revenue minus cost divided by revenue for a product. Different ways to measure for e.g. Software-as-a-Service companies. |
| Prospects [12] | Number of users that might become customers |
| Purchases [12] | No. purchases made by a user in a time period |
| Recency [21] | Days since last visit of user |
| Referrals from current users [8, 27, 31] | How often current users refer new users |
| Referral rate [1] | Volume of referred users or purchases |
| Registered Users [17] | Total number of registered users |
| Repurchase Rate [23] | No. customers that made a purchase during the previous and current period of time |
| Retention Rate [1, 7, 8] | Percentage of users or customers still using the service after a period of time |
| Retention by Cohort [13] | % of original user base still using the software or conducting transactions in it |
| Return on Advertisement Spending [7] | Profits divided by advertisement spending |
| Revenue [5, 17, 22] | Total Revenue |
| Revenue Growth Rate [41, 43] | |
| Revenue Run Rate [11, 15] | |
| Reviews Considered Helpful [12] | Number of reviews considered helpful |

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| | |
|--|--|
| Reviews Written [12] | Number of reviews written |
| Sell-through rate [13] | No. units sold in a time period in relation to the no. items in inventory at its beginning |
| Session Interval [17] | Average time between software use sessions |
| Session Length [17] | Length of average software use session |
| Social Media Reach [34] | Post reach within e.g. Twitter or Facebook |
| Sources of Traffic [17, 27, 31] | Source and volume of user traffic per source |
| Stability [9] | Frequency of crashes in software use |
| Time to Customer Breakeven [12, 30] | Time it takes to recoup from Customer Acquisition Cost |
| Time to First Purchase [12] | Avg. time users take to become customers |
| Top Keywords Driving Traffic to You [12] | Search terms used by visitors to find your site |
| Top Search Terms [12] | Both those that lead to revenue, and those that don't have any results. |
| Total Ad Clicks [12] | Number of advertisements clicked by visitors |
| Total Addressable Market [13, 17, 50] | Total hypothetical market size |
| Total Contract Value [13, 17, 22] | Value of one-time and recurring charges |
| Total Number of Customers [8, 32] | |
| Total Number of Users [5, 50] | Based on e.g. registered user accounts |
| Traffic [1, 5, 18] | Total number of website visits (non-unique) |
| Traffic-to-Leads [1] | Total traffic in relation to potential customers |
| Uptime [40] | Percentage of time software or website is available and operational |
| User Acquisition Rate [5, 9] | Total new non-paying users in a time period |
| User Demographics [5, 9] | Avg. age, gender distribution, location etc. |
| User Engagement [9, 17, 28] | Measured through e.g. login frequency. Definition depends on context. |
| Unique Visitors [11] | Unique website visitors during a time period |
| Viral Coefficient [11, 13, 32] | No. new customers each existing one converts |

The metrics gathered by (Kemell et al., 2018) and listed in the table above, require classification, by the 4 categories listed at the beginning of the section. Likewise, and as the same article states, metrics may be useful depending on the specific context of the company (Kemell et al., 2018, p. 11), and the on the stage of development of a given startup (Kemell et al., 2018, p. 4).

7. SURVEY ON AGILE AND ITS RELATIONSHIP WITH BUSINESS METRICS

For the purpose of give an answer to the [OR2] “How do companies cope with this issue?” (the issue of not having an equivalence between Agile and Business Metrics), a survey has been implemented. This chapter shows the results of the survey with answers from people who have participated in Agile and traditional projects in software development.

7.1 Survey Design

The questions presented on the survey are detailed on the section APPENDIX: SURVEY QUESTIONNAIRE, and were validated by experts on Agile software development: two expert Agile Coaches; one Software Engineering Manager and one Software IT director. After the revision by these experts, these questions were added and included:

- 1. What are the metrics used to decide if one project is traditional, and another agile?*
- 2. Defined deadline, scope, and budget are not seen as critical for many agile projects/teams - but maybe seen as critical by the business. How are deadline, scope, and budget measured or monitored by the business when the agile team does not compile this.*

The survey has been applied to a population selected by non-probabilistic sampling for convenience on social networks like LinkedIn and Facebook, in which the subjects would add their contact information and their role in Agile and non-Agile software development projects.

7.2 Survey Results

The survey was answered by 52 people with no restriction of location around the world. This was planned to give an idea of Agile implementation without having cultural or location constraints to the situation of the projects and professionals providing information.

Their personal email was requested, just for the purpose of verifying that they were personal answers and they were not automated responses given by a technical device, however, in order to protect their personal data, this information is not written as result on this investigation.

The survey was divided in two parts: in the first one, the goal was to know more about the profile of the respondents: where are they located; in what type of company they work for; what is their experience working with Agile software development; etc. For the second part, the questions were aimed to know how they handled metrics and whether they have found gaps between Agile and Business metrics on their projects.

7.2.1 Answers for the first part of the survey

1) What is your current work location?

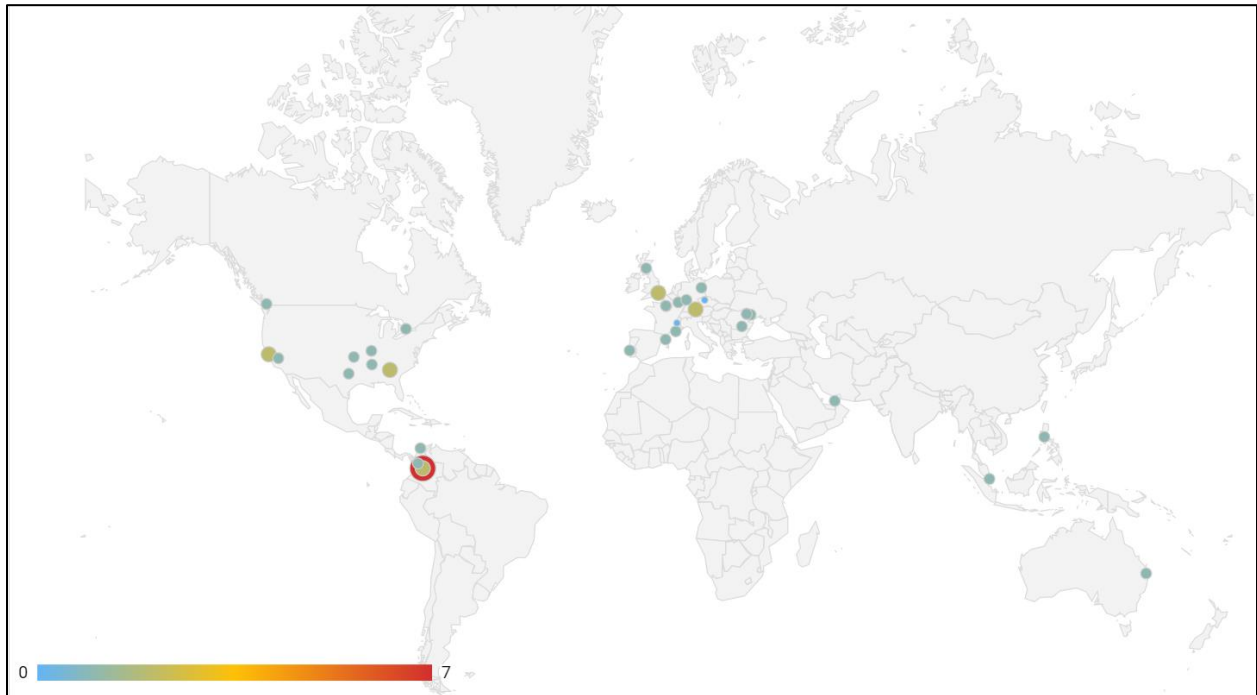


Figure 16. Map with geographic distribution from respondents to the Agile Metrics vs Business Metrics survey. Source: Own elaboration

Most of the people interviewed were in Bogotá, Colombia, however this represented 26,9% of total population. Other participants were distributed in other locations, rather evenly (1 or 2 participants per location). There were no respondents from Africa and from other places in Latin America outside Colombia. In Asia there were participants in Dubai, UAE; Philippines and Singapore, (one per each city). Also, in Australia, there was one respondent in Brisbane. Then most of survey answers were from Colombia, North America (USA, specially) and Europe.

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The charts in Figure 16. Map with geographic distribution from respondents to the Agile Metrics vs Business Metrics survey. and Figure 17. Percentage of work location of survey participants.

show the geographical distribution of the participants.

What is your current work location?

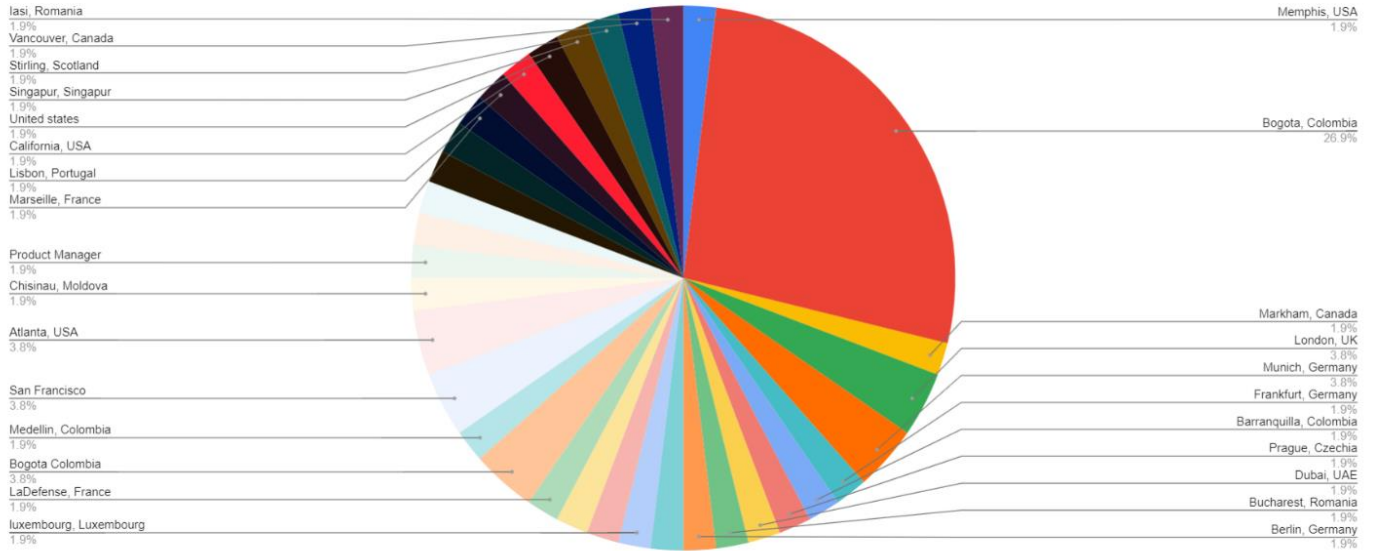


Figure 17. Percentage of work location of survey participants. Source: Own elaboration

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2) Please select your main role (related to Agile or Traditional Projects you are related to)

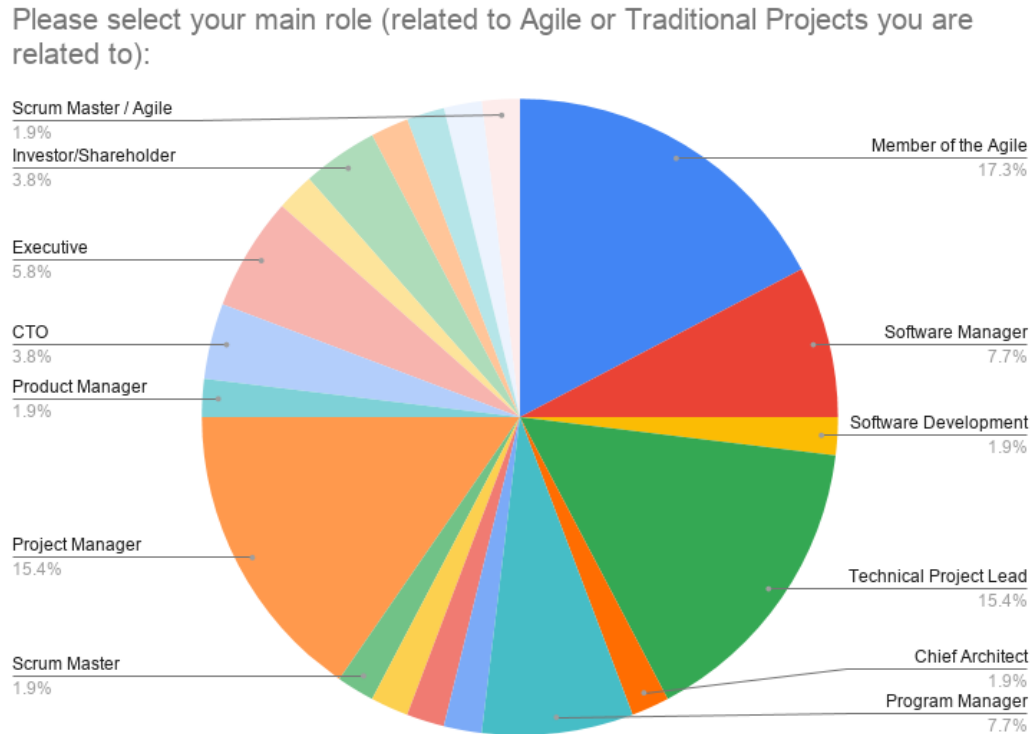


Figure 18. Role of survey participants in software development projects (Agile or not). Source: Own elaboration

In the chart Figure 18. Role of survey participants in software development projects (Agile or not), it is possible to see that around 50% participants are closely related to work directly for an Agile software development team (Member of the Agile team, Technical Project Lead, Project Manager and Scrum Master), while the other half is distributed around Management roles, most likely outside the team like Product Manager, Program Manager, CTO, Chief Architect, Executive and Investor/ Shareholder. This is an expected good mix for the answers required for the survey, because we have even proportion of roles inside and outside the team. Furthermore, management roles can provide their business, high level perspective on the Agile to Business equivalence.

3) What is the type of your company?

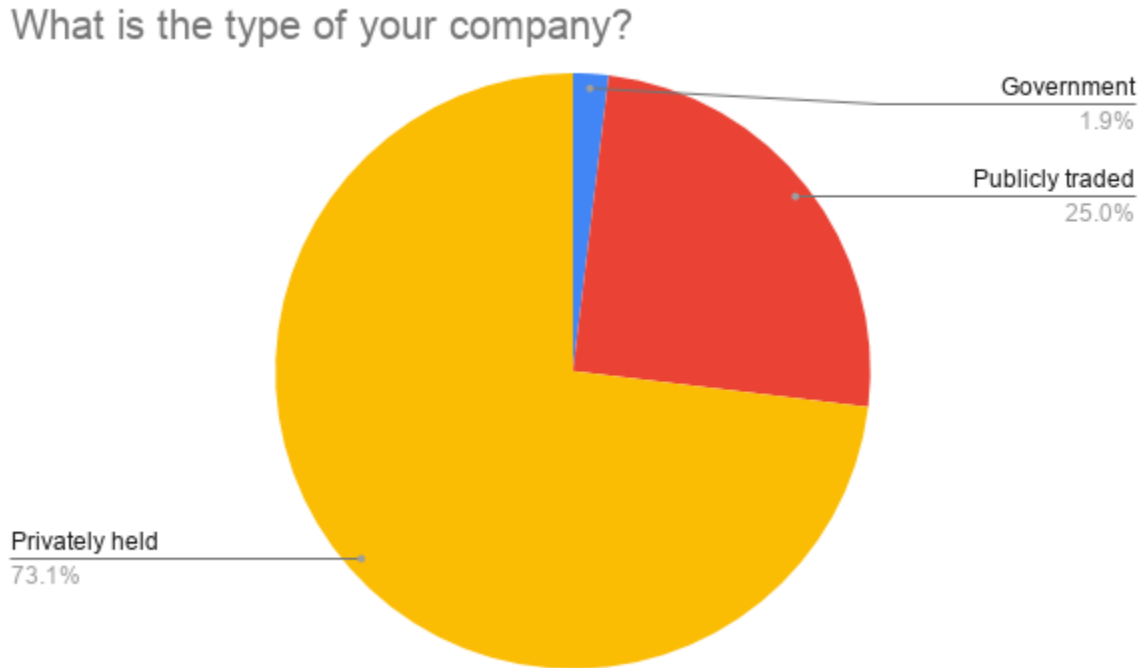


Figure 19. Type of company of survey respondents. Source: Own elaboration

As show on the image in Figure 19. Type of company of survey respondents., most respondents work for privately held companies, however publicly traded companies are 25% percent and the government entities are just 1.9%. This question was asked to know the conditions in which the remaining questions would be answered, and if there was an impact on their answers. The only conclusion so far is that only 1.9% of respondents work for a Government entity.

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4) Industry for which the software development is targeted

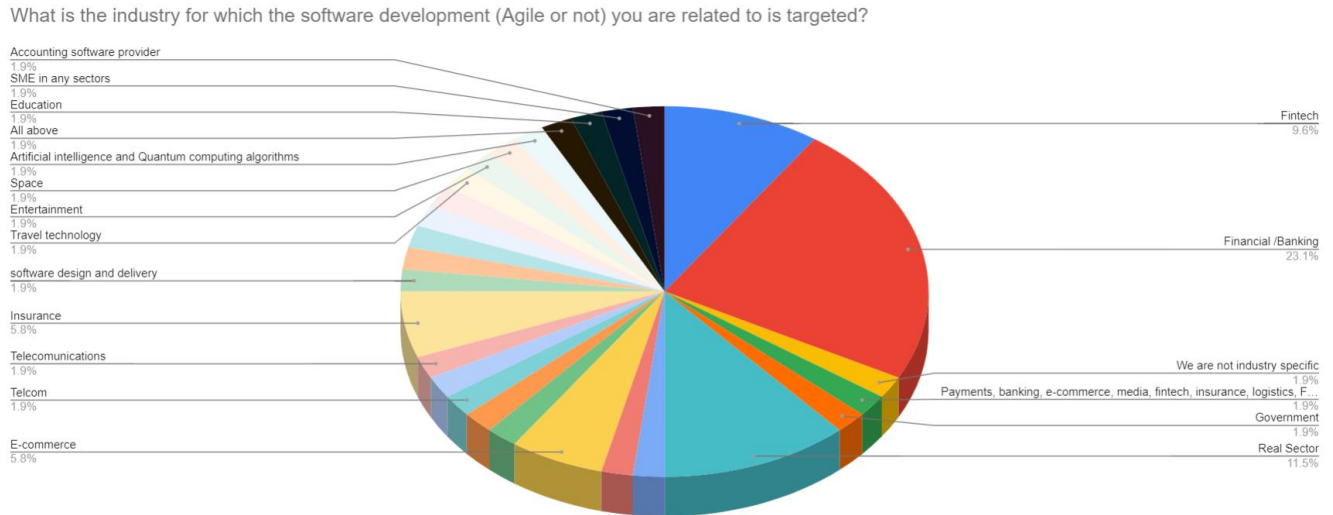


Figure 20. Industries for which the software development is targeted, from survey respondents. Source: Own elaboration

According to Figure 20. Industries for which the software development is targeted, from survey respondents Financial, Fintech, Real Sector, Ecommerce and Insurance are the sectors with more survey participants, however there are multiple other industries for which respondents work, meaning that the study is not limited to one specific industry. There are also survey participants on Education, Accounting, Space and Artificial Intelligence and Travel industries that are interesting to have and were not initially planned, however they are great addition to the combination of industries in which Agile software development can be used.

5) Is the company which receives the product or result of the project a startup?

According to the survey, there is 21% of projects delivered for a startup. This question was planned to give a hint of the urgency in which results were required from projects in which survey participants are working. This result shows how common is to work in startup environment, given that these are companies that behave in a more demanding way in terms of metrics than traditional businesses.

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6) What is your company size?

What is your company size?

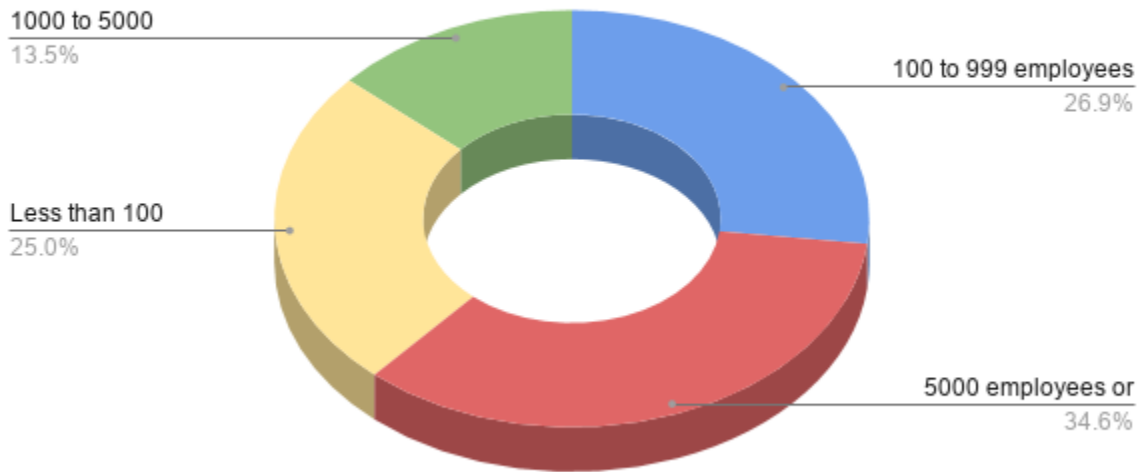


Figure 21. Company size for companies to which survey respondents work. Source: Own elaboration

The Figure 21. Company size for companies to which survey respondents work shows a good mix of respondents in terms of company size. However, it is important to notice that 47% of respondents belong to companies with more than 1000 employees, in contrast of the 25% companies with less than 100 employees. It can also be said that 72% percent of the population surveyed belong to companies with more than 100 employees, however, this represents an even distribution in terms of company size.

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7) What is the number of Agile programs / projects you have been related to?

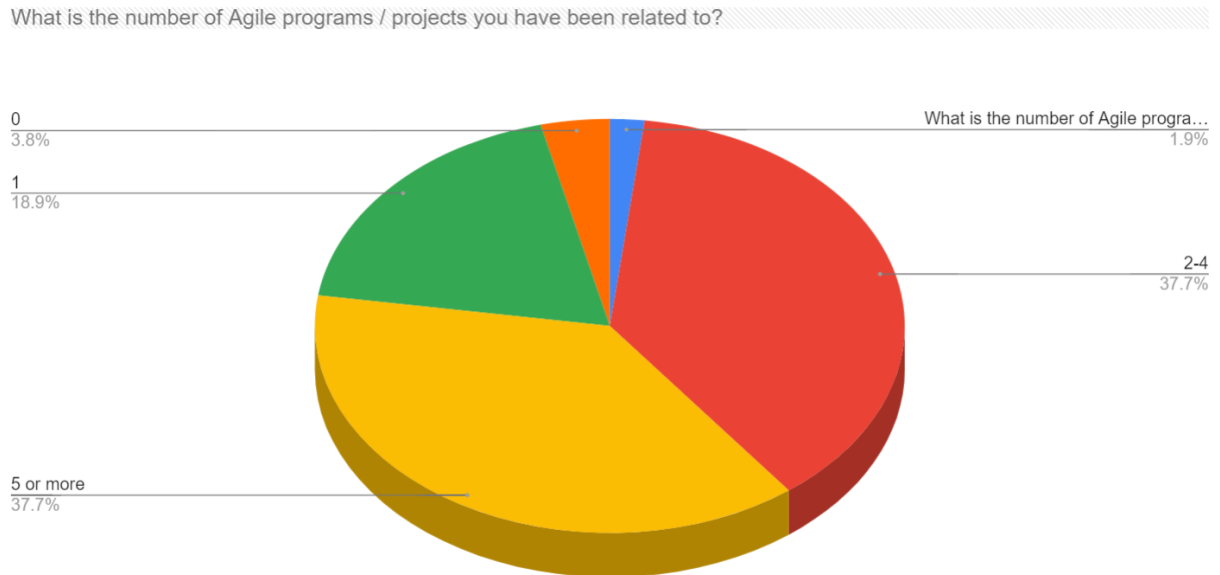


Figure 22. Agile program / project exposure of survey participants. Source: Own elaboration

The chart Figure 22. Agile program / project exposure of survey participants, shows that participants have had fair exposure to Agile projects: 75% have been involved in more than two projects and 37.7% have been involved in 5 or more. Only 3.8% do not have Agile experience, and 1 participant has filled the question incorrectly (by answering with the same question asked). This is an indicator that participants know about the Agile methodologies, in general.

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8) How long is your typical Agile program/project duration?

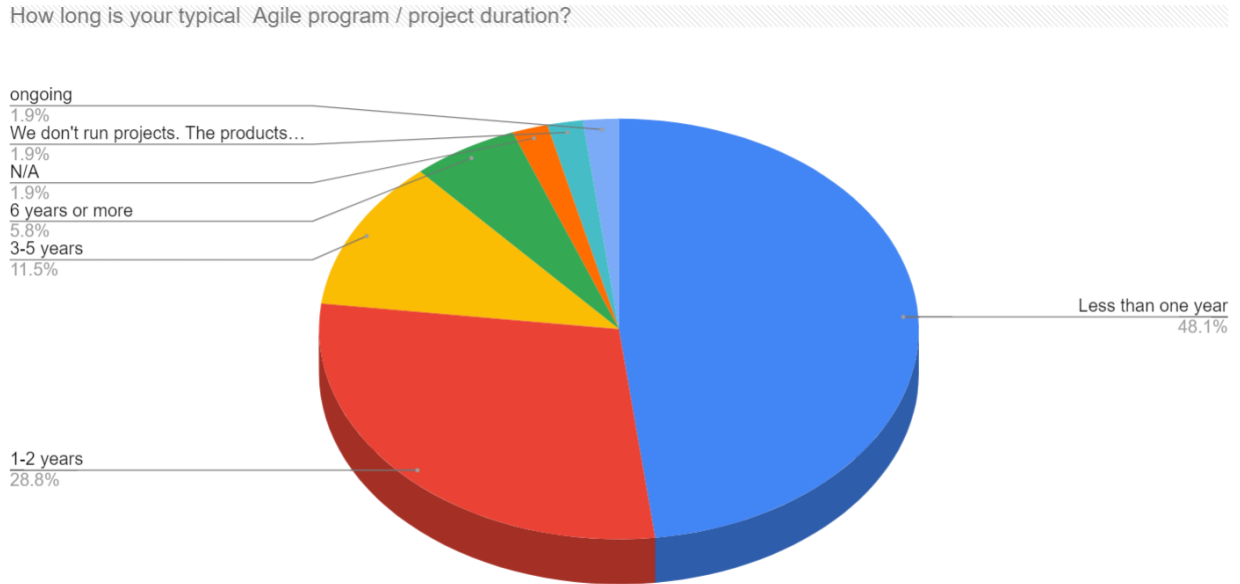


Figure 23. Typical program / project duration for survey respondents. Source: Own elaboration

Agile projects, in theory, should deliver fast, however this does not mean that project duration is always short. The chart Figure 23. Typical program / project duration for survey respondents, depicts the typical duration of Agile projects for survey participants. It can be seen that 48% have a duration shorter than a year, as expected, and around 76% have a duration shorter than 2 years. Even though these are the most part of projects, there are significant percentage of projects with a duration of 3-6 years, counting for 16% of total. This may be since the question includes “Agile programs”, however this is not possible to tell from the data gathered. A program may last more years if it involves many projects, then it would make more sense.

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9) How many people are typically involved in your Agile projects? (Per project)

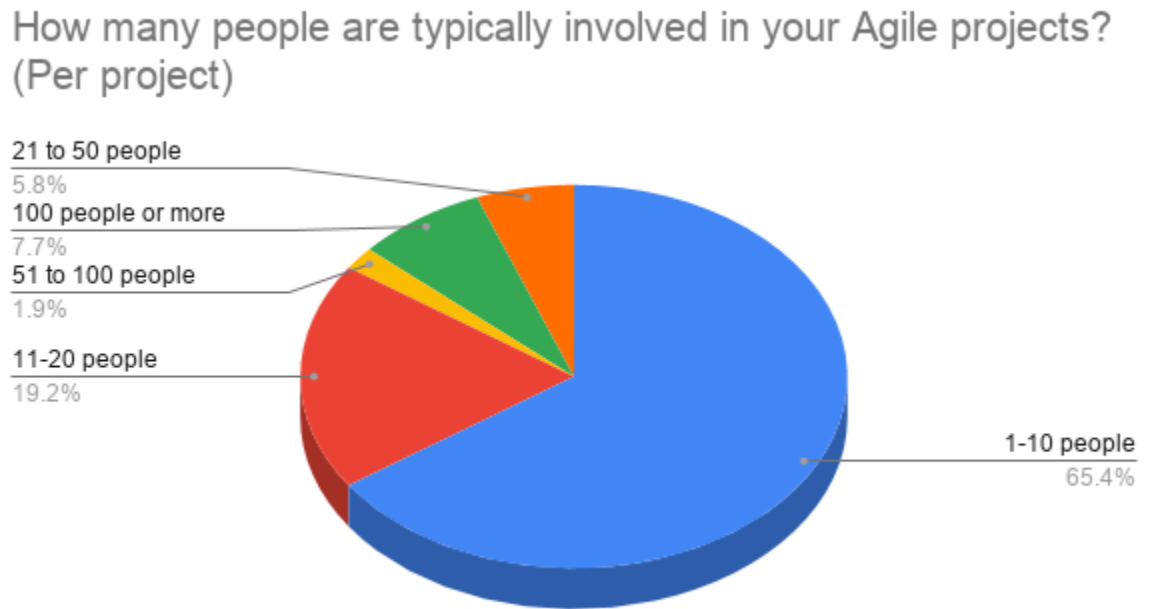


Figure 24. Team size for typical Agile projects of survey respondents. Source: Own elaboration

Agile methodologies like Scrum recommend a small team of 10-15 people. In Figure 24. Team size for typical Agile projects of survey respondents, 84% of teams which survey respondents have dealt with are composed of less than 20 people and 65.4 % of total are used to teams of about 10 people or less. It is surprising that there is a 7.7% which has selected to have teams of 100 people, but that can be possible for large projects, in which several teams are conformed, each working in one specific feature.

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10) Do you manage traditional (non-Agile) projects as well?

This question was asked to know whether the survey respondents would have the experience required to compare between Agile vs traditional projects. Most participants have worked with both approaches, representing 63.5% of total population, whereas 36.5% claim they have worked exclusively with Agile projects. This is good because both teams have experience with Agile, and those who have worked with both approaches are in capacity to give a comparison in later questions.

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7.2.2 Metrics: second part of the survey

For this second part, survey participants start to answer questions about what they have learned in their experience with both with Agile and Business metrics, and the gaps they may have found.

11) Are you satisfied with the performance of Agile Projects/Programs vs the performance of traditional (non-Agile) ones?

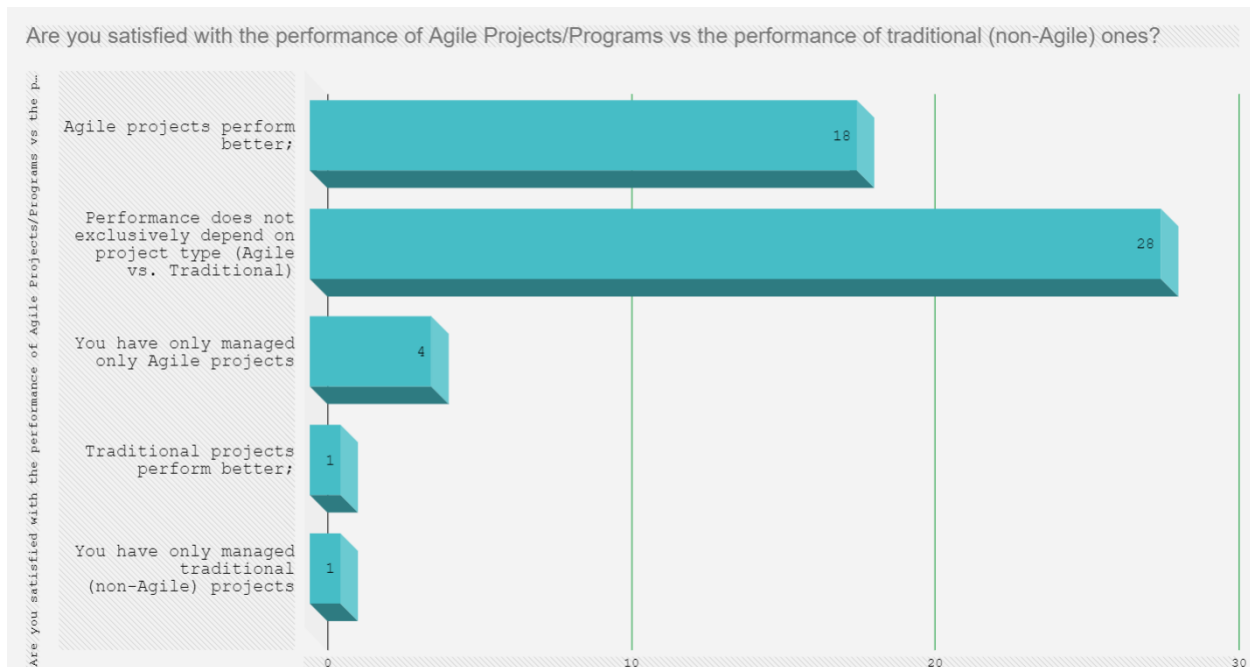


Figure 25. Project performance Agile vs Traditional according to survey participants. Source: Own elaboration

The graph Figure 25. Project performance Agile vs Traditional according to survey participants, shows that there is an agreement that project performance, in their experience, does not correspond to the type of approach (Agile or not). However, a significant amount, consider that Agile projects perform better, while one respondent considers that traditional projects are better in terms of performance. Remaining options are useful to avoid forcing participants to answer if they have only managed one type of project, therefore they do not have information to compare.

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12) What do you use to measure success of Agile projects?

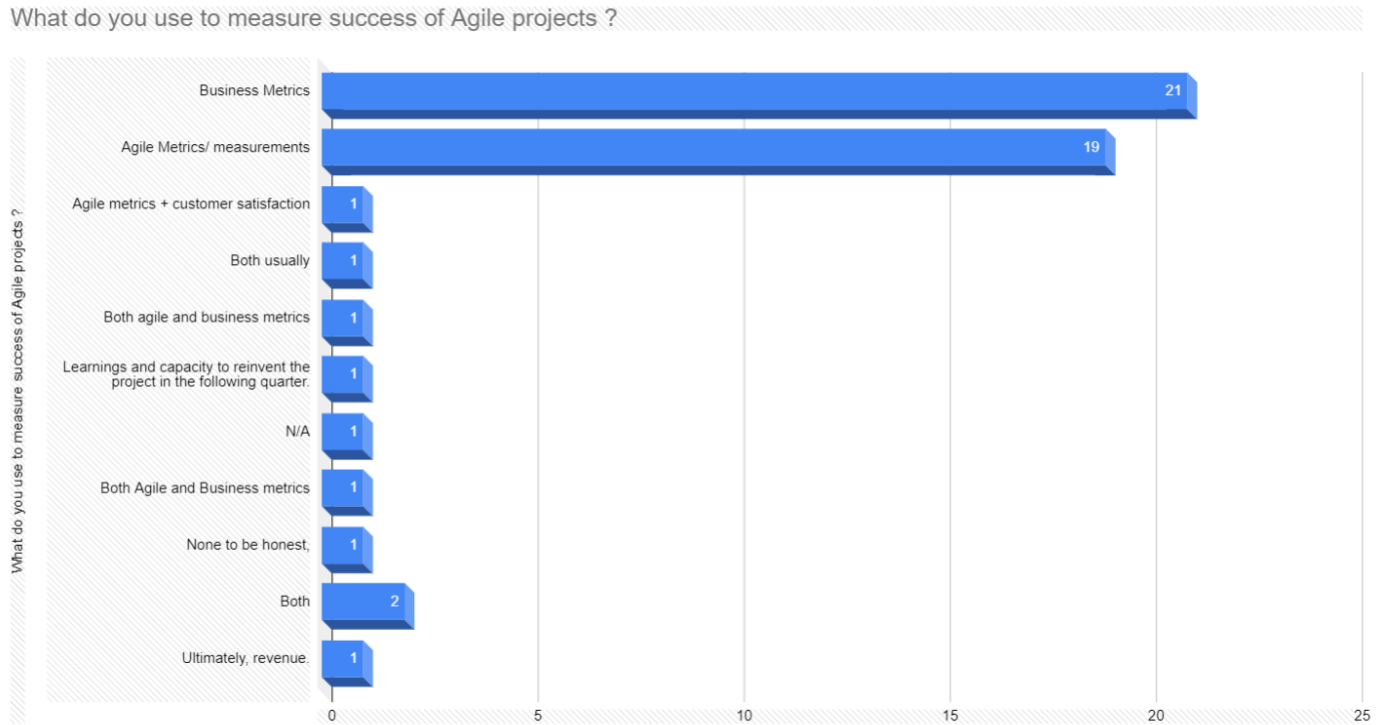


Figure 26. How Agile projects are measured according to survey results. Source: Own elaboration

The chart in Figure 26. How Agile projects are measured according to survey results, presents the way that survey participants use metrics for measuring progress of their Agile projects. There is a clear majority that use Business metrics to measure progress, however Agile metrics are similarly used, and the difference between them is small. There are also 4 equivalent answers, indicating that they use a combination of the 2: “Both usually”, “Both”, “Both Agile and Business metrics” and “Both agile and business metrics”. Additionally, a smaller percentage indicates a different answer that belongs to their own category: “Agile metrics +customer satisfaction” which can be seen as simply “Agile metrics”; “Learnings and capacity(…)” which can be translated to Business metrics, as well as “Ultimately revenue”. In conclusion, Business metrics or a combination of Agile +Business metrics are most commonly used to measure project progress.

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13) How do you rate your knowledge on Agile Metrics?

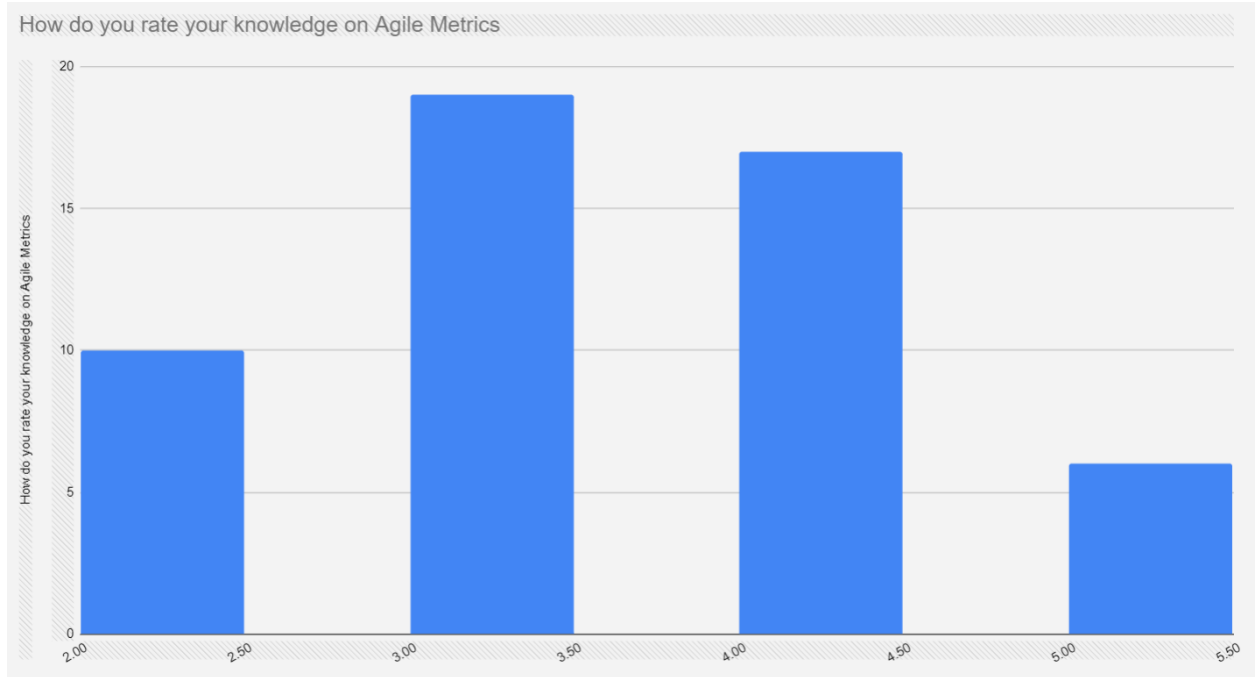


Figure 27. How do participants rate themselves on Agile metrics knowledge? Source: Own elaboration

Even though in a previous question, most participants have answered that they have at least 1 or more Agile projects, here in Figure 27. How do participants rate themselves on Agile metrics knowledge?, most survey respondents have rated themselves between 1 to 3 in their knowledge of Agile metrics. This is interesting because it says that the topic of Agile metrics is not clear, even for experienced individuals.

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14) Do you use different metrics to measure status of traditional projects from those to measure status from Agile projects?

The answer received to this question shows that even when the most part of survey participants use the same metrics to measure Agile and traditional projects. However, it is notable that 44.2% use different metrics to measure Agile projects. This fact is telling in the sense that there is a notion that Agile projects behave differently, represented by the 44.2% percent of people measuring Agile projects differently, but there is also a tendency to keep measuring all types of projects in the same way, represented by the 55.8% of population on the survey.

15) Do you think that current Agile metrics cover all the information you need for measuring success?, or do you usually require translation of Agile project metrics into Business Metrics (or other kind of metrics) to determine whether an Agile project is being successful?

Do you think that current Agile metrics cover all the information you need for measuring success?, or do you usually require translation of Agile project metrics into Business Metrics (or other kind of metrics) to determine whether an Agile project is being successful?

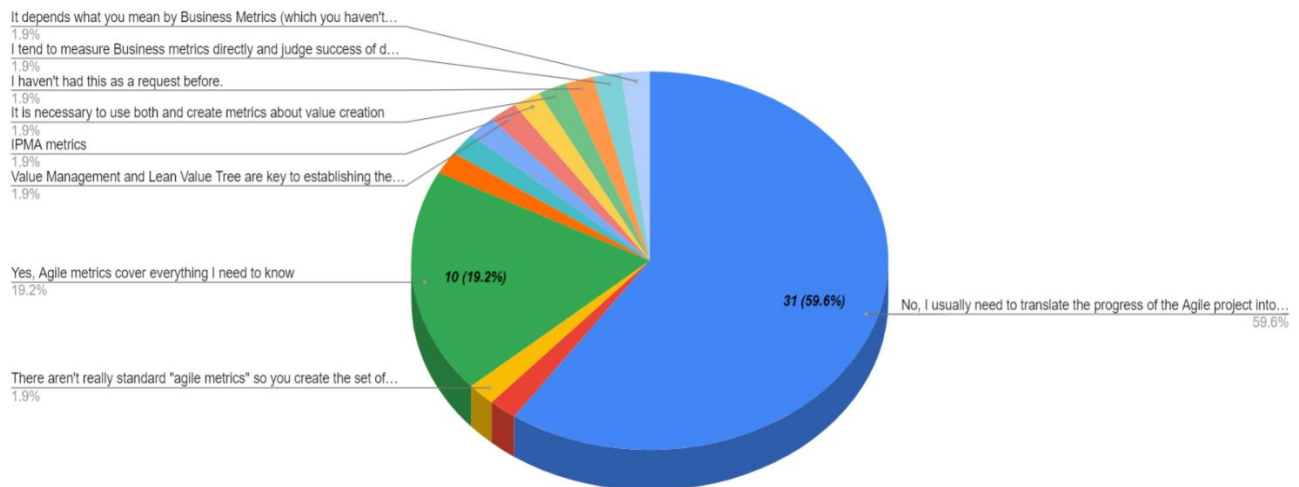


Figure 28. Do Agile metrics cover all the information required from an Agile project? Source: Own elaboration

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The chart on Figure 28. Do Agile metrics cover all the information required from an Agile project?, it can be clearly seen that current Agile metrics do not cover all the information about project progress, and teams usually require translation into Business metrics. It is very telling that 59.6% agree that there is a translation required, and it answers [OR1]: this is an issue seen for most participants. There are, however, 19.2% of these participants for whom Agile metrics seem to cover everything a project needs to measure. It is important also to highlight the answers that bring important information:

- “It depends on what you mean by Business Metrics (...)”
- “There are not standard “agile metrics” (...)”

Which are validated by the literature on these topics.

16) Do you consider helpful to have a standard for translating Agile Metrics into Business Metrics for measuring Agile project success?

Do you consider helpful to have a standard for translating Agile Metrics into Business Metrics for measuring Agile project success?

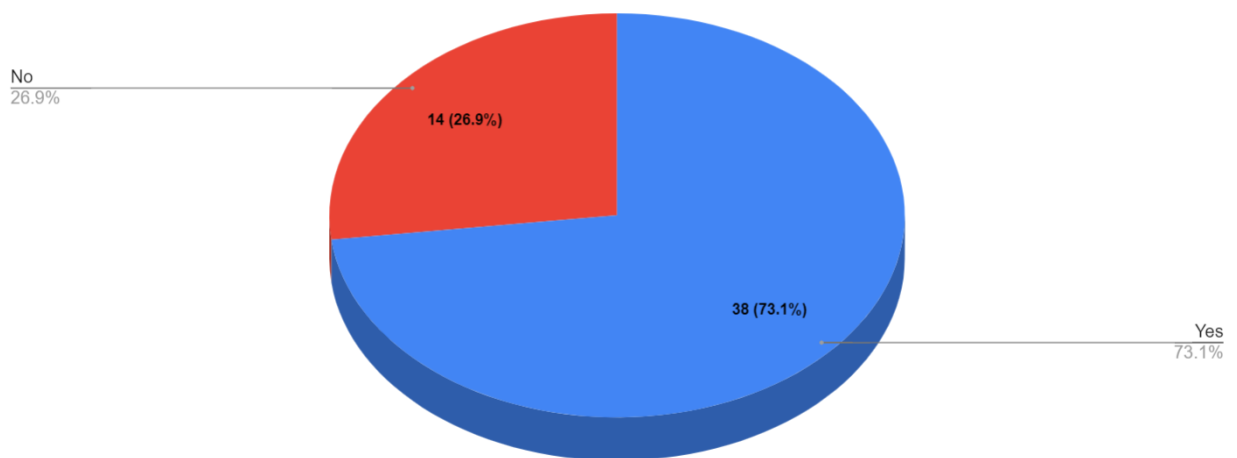


Figure 29. Would a standard for translating Agile metrics into Business metrics be helpful, according to survey respondents?
Source: Own elaboration

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The result on the chart Figure 29. Would a standard for translating Agile metrics into Business metrics be helpful, according to survey respondents? clearly denotes that a standard for translating Agile Metrics into Business metrics would be appreciated by involved participants. There is, though, a 26.9% that considers that a standard is not necessary. May be that for that percentage of people Agile covers everything needed or there are other standards that cover all information needed for their projects, like IPMA metrics and Lean Value mentioned in the answers from Figure 29. Would a standard for translating Agile metrics into Business metrics be helpful, according to survey respondents?, however these two belong respectively to traditional project metrics and business metrics in terms of processes, therefore they are not frameworks to provide the translation the present research is investigating.

17) Would you say that you can explain in very straightforward manner how your Agile projects are delivering the value expected?

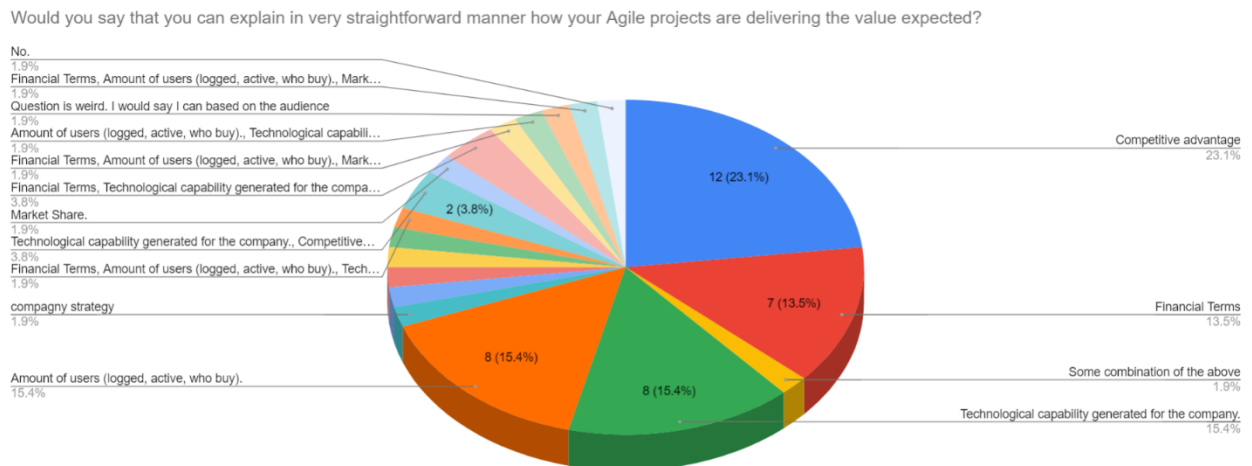


Figure 30. What terms are used to show if the Agile project is delivering the value expected, according to survey results. Source: Own elaboration

This question is about finding what aspects are most commonly used for showing that the projects are delivering value. Most common options here are “Competitive Advantage”, “Financial Terms”,

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“Technological capability generated for the company”, and “Number of users (logged, active, who buy)”, or some combination of these variables, selected in a smaller percentage. The question may be was not clear enough, however most participants seemed to understand it. One answer is remarkable: “No” meaning that the respondent cannot explain clearly the value the project delivers. Figure 30. What terms are used to show if the Agile project is delivering the value expected, according to survey results shows the distribution of answers for this question.

18) What are the variables considered in your company to decide if one project is traditional, and another agile?

What are the variables considered in your company to decide if one project is traditional, and another agile?

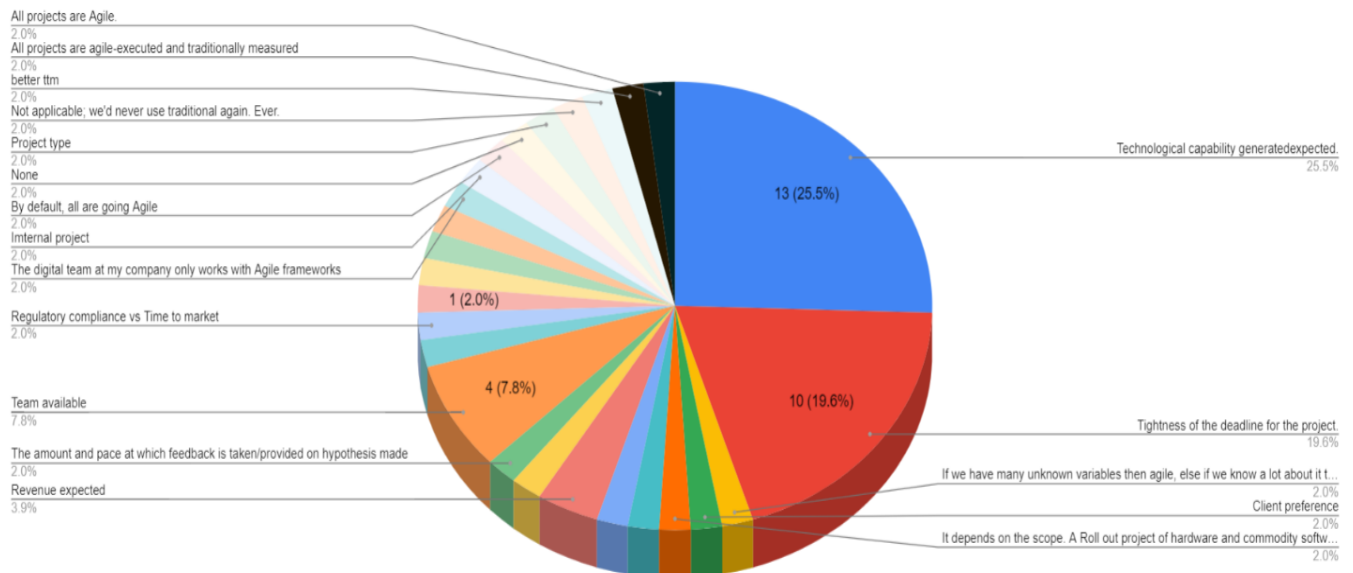


Figure 31. Variables considered to decide if a project is Agile or traditional, according to survey results. Source: Own elaboration

The chart on Figure 31. Variables considered to decide if a project is Agile or traditional, according to survey results, show the main factors that use companies in which survey respondents work to define whether a new project should be Agile or managed in a traditional way. For the 25.5% of survey participant companies take the decision based on the

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“Technological capability generated/expected”, maybe inclined to decide over Agile to achieve faster results. Another 19.6% percent consider the “Tightness of the deadline”, most probably inclined towards traditional projects to avoid running into risks of slipping the deadline and have more control. It is notable that for 7.8% the team available can also influence the type of approach to take for a new project, maybe considering that Agile methodologies recommend smaller teams than traditional ones.

Additionally, there are interesting answers like “All projects are Agile”; “All projects are Agile-executed and traditionally measured”; and “Not applicable, we’d never use traditional again. Ever”. These answers reveal a trend of taking Agile as the standard approach for software development.

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19) Defined deadline, scope, and budget are not seen as critical for many agile projects/teams - but maybe seen as critical by the business. How are deadline, scope, and budget measured or monitored by the business when the agile team does not compile this?

Defined deadline, scope, and budget are not seen as critical for many agile projects/teams - but maybe seen as critical by the business. How are deadline, scope, and budget measured or monitored by the business when the agile team does not compile this?

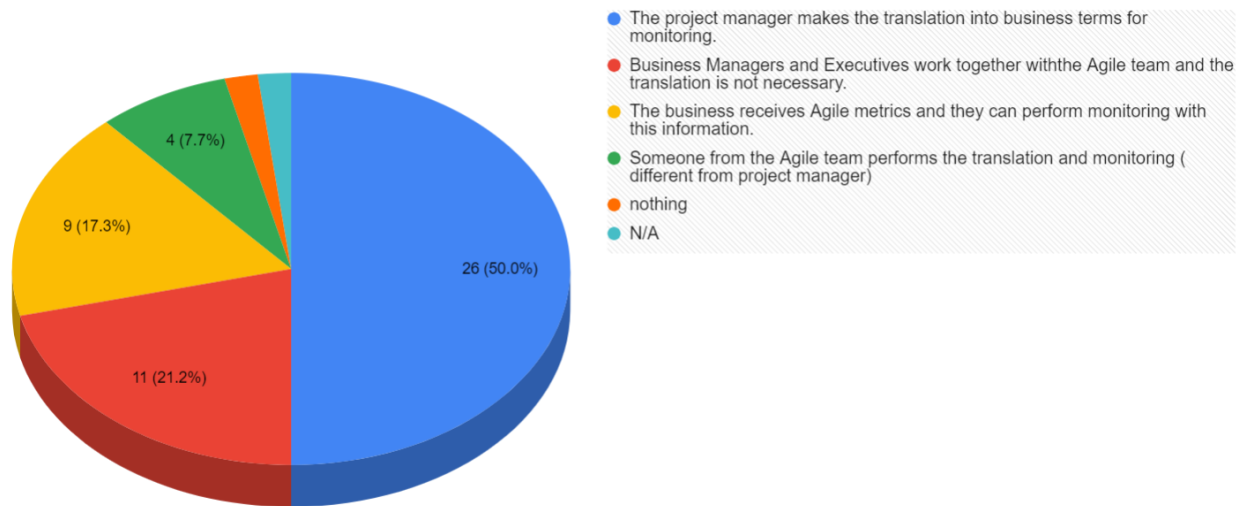


Figure 32. How are deadline, scope and budget measured and monitored by the business when the Agile do not compile this?
Source: Own elaboration

This question was designed to obtain information about how companies deal with the issue of translating into Business metrics. The graph Figure 32. How are deadline, scope and budget measured and monitored by the business when the Agile do not compile this? , shows that in 50% of the cases the project manager makes this translation, whereas in 21.2% of cases the Business managers and Executives work along the Agile team, making the translation unnecessary. In addition, a 17.3% percent of the answers show that the business receives Agile metrics and can perform the monitoring with this information. Finally, 7.7% responded that someone different to the project manager makes this translation inside the Agile team. The answers “N/A” and “nothing” maybe are saying that this translation is not necessary and does not take place. In conclusion, 57.7% require the translation by either a project manager or a member of the team, whereas in

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38,5% of the cases the Business stakeholders do not need translation between metrics either because they are involved day by day with the work of the Agile team or because Agile metrics are useful to monitor the project as they are.

20) What are your suggestions in terms of aspects that a standard for measuring Agile projects should cover (and current Agile Metrics do not cover)? (Please select all that apply)

What are your suggestions in terms of aspects that a standard for measuring Agile projects should cover (and current Agile Metrics do not cover)? (Please select all that apply)

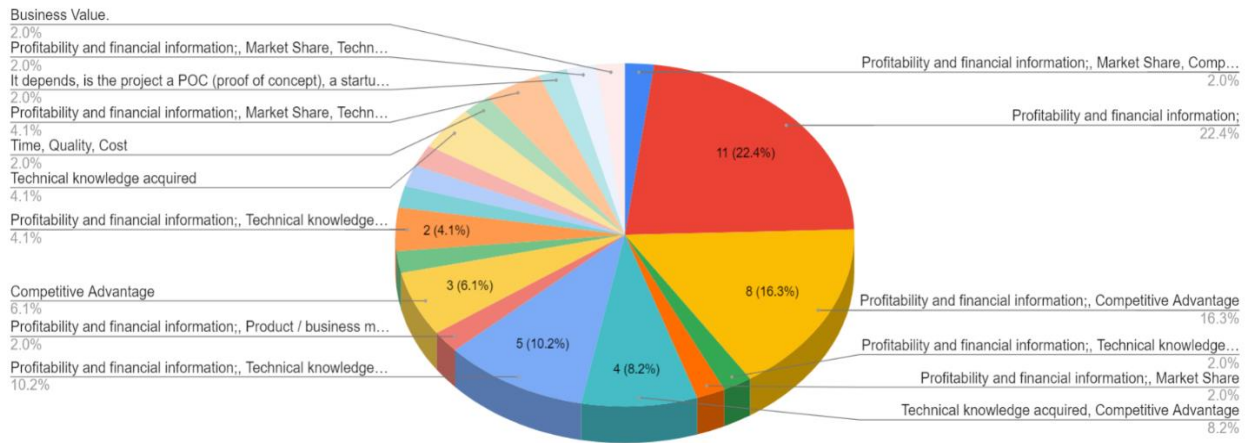


Figure 33. Suggestions from survey participants on what is missing to cover from Agile metrics. Source: Own elaboration

Lastly, the survey participants were asked about the aspects that a new standard should cover in order to fill the gap that Agile metrics have in terms of measuring progress of a software development. From the graph in Figure 33. Suggestions from survey participants on what is missing to cover from Agile metrics. , it can be inferred that “Profitability and financial information” is a clear gap with 24.2% of answers, plus the its combination with other factors such as the case of “Profitability and financial information; Competitive Advantage” with 16.3% of answers. On the other hand, “Technical Knowledge Acquired” and “Competitive Advantage” both individually, 3% and 6% respectively, and in combination with other factors seem to be important gaps to fill for Agile metrics.

7.3 Main conclusions on survey results

In summary, survey was carried out was to provide a result for [OR2] *“Describe the way companies are dealing with the issue of obtaining business perspective from agile metrics”*, as well as to provide answer the main research question *“How to relate Agile metrics into Business metrics”*, by answering also to research questions 1 and 2 , respectively: *Is this an issue seen by upper management and business stakeholders?”*, and *“How do companies cope with this issue?”*.

- For research question1 the answer to question 15 in Figure 28. Do Agile metrics cover all the information required from an Agile project?, is yes, since the 59.6% percent responded that Agile metrics do not cover everything needed to know to measure project progress, then it is an issue seen by stakeholders involved with the Agile project.
- In the case of research question 2, the most representative answers were number 14 in Figure 28. Do Agile metrics cover all the information required from an Agile project? Source: Own elaboration and number 19. in Figure 32. How are deadline, scope and budget measured and monitored by the business when the Agile do not compile this?, in which answers the respondents tell that they use mostly traditional metrics to measure project progress (55.8%); and that the project manager (or someone from the team) makes the translation between Agile and Business metrics

[OR2] results are represented by the following points as main conclusions of the survey, and additional points brought by survey respondents:

- Respondents mainly do not believe that the approach has an impact on project performance. However, for those who do, Agile seems to be a more effective approach than traditional project management.

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- Most of participants use Business metrics to measure project progress, however a good percentage use Agile metrics and combine this information with some business metrics as well.
- Even though, survey respondents were experienced in Agile, most part of them rated themselves between 1 to 3 over 5 in their knowledge on Agile metrics, meaning that this topic is not clear even for experienced individuals.
- There is a tendency to use traditional metrics, even though the project measured is an Agile one.
- 59.6% of population agrees that Agile metrics do not cover all the information needed to monitor the progress of a software development project.
- 73.1% of population considers helpful to have a standard to translate Agile metrics into Business metrics.
- In 57.7% of cases it is necessary a translation of Agile metrics into Business metrics from the project manager or someone from the team, to report project progress.
- In terms of aspects suggested for a standard that measures Agile projects should cover these are the main topics selected by survey respondents: “Profitability and financial information”; “Competitive Advantage” and “Technical Knowledge Acquired” were the aspects more required among the survey population.

8. MAPPING BETWEEN AGILE AND BUSINESS METRICS

The goal of this chapter is to sum up the analysis of articles that have tried to bring the Agile metrics to represent Business metrics and their results. In some cases, results are not plainly metrics, but the measure in Business Value, which can be later translated into Business Metrics, as it is the purpose of this document. The content of this chapter answers to the research objective [OR3] Mapping between metrics delivered by an agile software project, and the metrics required from business stakeholders.

The point is to establish how Agile Metrics describe how Agile projects impact businesses in a way that allow them to achieve their goals, and its contribution can be seen clearly by the organization and its stakeholders.

8.1 Mapping from Agile to Business Value

From the literature review, one book stands out, by the thorough way it covers the way Business Value can be obtained from Agile projects. *“The Art of Business Value”* (Schwartz, 2016) puts in evidence the fact that Business Value may mean different things to different companies, and before the organization is able to tell what brings Value, they should first figure out what they expect (Schwartz, 2016, Chapter 1. The Problem). Additionally, it is usual to confuse Business Value with User Value and Customer Value. Despite this confusion, each type of Value should be distinguished to achieve the one that is useful for each project.(Schwartz, 2016, Chapter 1. The Problem.) On the other hand, it is also remarkable that the author points out as part of the problem of delivering Business Value through Agile projects, the fact that the term “value” is mentioned everywhere in Agile Literature, but not clearly defined in it.(Schwartz, 2016).

In his book, (Schwartz, 2016, Chapter 6. The clue) makes interesting findings such as:

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- The Business Value is not a simple formula somehow known by the business. And in this context, “the business” means the Executive team or Subject Matter Experts on the corporate rank. Therefore, the Business Value of projects or the company is not automatically known by businesspeople, but they should work with the purpose of finding out what is that brings value to the company at a given point in time.
- Bureaucracy and culture sometimes are thought to be obstacles of Agile projects, however, in order to understand the company, it is useful to dig into these, and look at them as assets, because they may be hidden value in the way the rules and culture have been designed for the company.
- In order to find value in Agile projects,(Schwartz, 2016, Chapter 6. The Clue) defines 3 main tools:
 1. **Cost of delay:** Represents the cost of delaying the introduction of features in production. It helps as a measure of how much a feature is valued by the business in terms of money: If the cost of not having a feature in production, exceeds the investment in implementing it and deploying it, it means that the investment adds economic value (of at least the cost of not having it available).
 2. **Scenario Planning:** This technique takes into account the multiple scenarios in the future (and their consequences) and is useful to be prepared when an event signals whichever scenario unfolds. This tool helps in a way of defining the result of a project in a given time and understand what the business value in that case could be.

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3. Options thinking: This is a concept borrowed from the financial world.

When an investor calls an option, it means that they have a right to buy a share at a given price on a given date. This is a right, but not an obligation, and what the option does is to give the investor an advantage in case the price of the share rises for the date that it has stipulated: If the price of the share is higher than the price given as option, the investor can buy the share at lower price, and sell at the current price of the share, being able to obtain earnings. The same concept can be applied to invest in an Agile project: If the value obtained after a few sprints is bigger than the economic investment at the beginning, this creates an option of continuing a new investment. For example, the MVP generated after the second sprint, may have developed new capabilities for the engineers that give them capacity to tackle projects on a new technology that the company wants to be proficient; or the resulting MVP has potential to be the POC for several other projects, that could not be envisioned before having it; or simply the resulting MVP is able to generate revenue in ways that the company was not expecting, etc. Those are resulting sources of value higher than the organization may take advantage if they happened (calling the option), or in other case, the opportunity is just discarded by the company by doing what was established at the beginning of the project, or just calling off the project because it didn't bring any value. (Schwartz, 2016, Chapter 6. The clue)

8.2 Mapping Agile to Value on Business Financial Metrics

Additionally, articles like *Appropriate Agile Measurement: Using Metrics and Diagnostics to Deliver Business Value* (Hartmann & Dymond, 2006) , and “*Business Value of Information Technology in Small and Medium Sized Companies*” (Rózsa & Herdon, 2009) concur in their aim of trying to find Business Value from IT and development projects . (Hartmann & Dymond, 2006) takes a financial approach, and sets the same goal as this paper, in which it states how IT projects are difficult measure by business managers (Rózsa & Herdon, 2009, sec. Abstract). However, the definition from (Rózsa & Herdon, 2009) for Business Value differs from that of (Schwartz, 2016), since it says that “*Business value is the benefit for business units and the enterprise as a whole, represented in money terms, that is a result of IT solutions or services*”(Rózsa & Herdon, 2009), therefore it takes Business Value as having only a financial dimension. The scope of the research, was centered on projects related to ERP systems for the company, which limits the study only to that area of IT development, however its findings are valuable in terms of the connection it achieves from IT value to financial value terms.(Rózsa & Herdon, 2009)

On the other hand , (Hartmann & Dymond, 2006) is more general in terms of collecting information of what a metric should have to be appropriate to measure an Agile project, and it share views with previous authors on the challenge that represents to define “Value” for an Agile project, based off on the Agile Manifesto (Hartmann & Dymond, 2006, sec. 3. One Key Metric Drives the Organization), and puts in manifest the problem previous discussed authors see as well: “*Software is simply inventory until its value is realized, which requires participation of non-developers: Research, Marketing, Sales, etc. Measuring value in this more holistic way encourages collaboration within the enterprise to create real value – products which not only “work” but are,*

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for example, usable, marketable and which sell.”(Hartmann & Dymond, 2006, sec. 3. One Key Metric Drives the Organization).

As for the valuation methods, (Hartmann & Dymond, 2006, sec. 3. Main Valuation Methods) takes the traditional metrics:

- **TCO (Total Cost of Ownership):** Total costs that were incurred by investing in and maintaining the equipment during its all useful lifetime at the business beginning from the ones related to preparing the decision (Hartmann & Dymond, 2006, sec. 3. Main Valuation Methods).
- **Public ROI (Public Return on Investment):** It represents what percentage of the invested capital is constituted by the “profit” resulting from the investment.(Hartmann & Dymond, 2006, sec. 3. Main Valuation Methods).
- **Net Present Value:**

$$NPV = -C_0 + \sum_{i=1}^n \frac{C_i}{(1+r)^i},$$

(Hartmann & Dymond, 2006, sec. 3. Main Valuation Methods)

“where

C₀- means the capital invested in order to realise the investment,

C_i- means the net cash flow for period i as a result of the investment,

r - means the discount rate,

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n - means the analyzed service life of the investment".(Hartmann & Dymond, 2006, sec. 3. Main Valuation Methods) .

This one of the most important business metrics, gives an idea of how the present investment, would pay off with expected future cash flow, considering a series of periods and a given discount rate.

These valuation methods in (Hartmann & Dymond, 2006) are used in the traditional fashion to measure ERP decision making, but the results show, that the SMEs (Subject Matter Experts) would use them as criteria for finding value in the technical result of a system. However, being a study with limited scope, just for specific type of system, and targeted to a limited size of companies, it cannot be extended to other types of technical projects.

In the same way, another important study found is that of (NJEGUŠ & MILANOV, 2012), which seems more relevant since it analyses the ROI (Return on Investment) on different Serbia projects using Agile methodologies. Using ROI as its only metric, it looks for something determining the success that Agile brings to software development. The study from (NJEGUŠ & MILANOV, 2012) concludes that, for the projects surveyed, success maybe defined for the team to deliver what is defined, however *"the use of agile methodologies for successful teams cannot be a decisive factor where the return on investment is concerned"* (NJEGUŠ & MILANOV, 2012, sec. 6. Conclusions). However, it finds that determining the factors of the project that bring ROI and streamlining them into project development, becomes decisive for the project to be successful. It can be inferred that, if optimization factors and synchronization of the factors that determine expected ROI with the development team are crucial for project success, therefore these have to become metrics and monitored processes that should be included in every sprint goal and should be monitored in their dashboard.

8.3 Mapping into an existing framework: The Gartner Business Value Model framework

The Gartner Business Value Model framework (Smith, Apfel, & Mitchell, 2017) has been developed as part of the Gartner /EBRC KPI Initiative (Gartner & ECBR, n.d.) with participation led by Gartner Inc and EBRC (The Enhanced Business Reporting Consortium), “*World Intellectual Capital Initiative, XBRL International, Industry Sector specific companies, Financial Analysts and Investors*”(Gartner & ECBR, n.d., sec. Who is Involved). The aim of the Gartner Business Value Model framework is to extend the metrics in which companies report the business value, that traditionally were measured using accounting metrics only. The Gartner /EBRC KPI Initiative noticed this measurement gap and its goal was to generate a standard so that companies would add measures that describe more accurately their business performance, by considering part of the picture that accounting metrics were not considering.(Smith et al., 2017, sec. Analysis).

It is worth noticing, as well, that the most important driver of this initiative was to deliver a way to communicate value from the IT perspective (Smith et al., 2017, p. 9. Paragraph 3). Even though the document with the framework definition was proposed in 2017, the Business Value Model was first mentioned on the book “The Real Business of IT: How CIOs Create and Communicate Value”(Hunter & Westerman, 2009)|, which point was to present the difficulty that CIOs had to communicate value that delivered from the IT department to the rest of the organization. The premise, given the date of writing, is that IT is a support area within the companies. In contrast, today IT is seen as a driver for strategy and key success factor for most businesses.

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The fact that the driver for adding new metrics in Gartner's business value performance model, with additional non-accounting metrics, is the need to communicate the value generated from IT, gives a link to the present research, since software development makes part of the services than an IT department would provide to an organization. Furthermore, by the time of writing this investigation, IT services have become more critical for businesses to survive in today's markets. In conclusion, it means that the nature of software development, and IT products and services have created a new way to represent value, not only at an intermediate levels (like value provided by artifacts useful inside a company), but as the factor generating new forms of value for the business, that can be standardized, and in which business performance can be measured as a whole. The Figure 34. The Gartner Business Value Model.(Smith et al., 2017) portrays the main elements of the Gartner Business Value Model at high level.

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| Business Aspect | Aggregates | Primes | | | |
|-----------------------------------|---------------------------------------|---------------------------------|-------------------------------|----------------------------------|-------------------------------|
| Demand Management | Market Responsiveness | Target Market Index | Market Coverage Index | Market Share Index | Opportunity/Threat Index |
| | | Product Portfolio Index | Channel Profitability Index | Configurability Index | |
| | Sales Effectiveness | Sales Opportunity Index | Sales Cycle Index | Sales Close Index | Sales Price Index |
| | | Cost-of-Sales Index | Forecast Accuracy | Customer Retention Index | |
| Product Development Effectiveness | New Product Index | Feature Function Index | Time-to-Market Index | R&D Success Index | |
| Supply Management | Customer Responsiveness | On-Time Delivery | Order Fill Rate | Material Quality | Service Accuracy |
| | | Service Performance | Customer Care Performance | Agreement Effectiveness | Transformation Ratio |
| | Supplier Effectiveness | Supplier On-Time Delivery | Supplier Order Fill Rate | Supplier Material Quality | Supplier Service Accuracy |
| | | Supplier Service Performance | Supplier Care Performance | Supplier Agreement Effectiveness | Supplier Transformation Ratio |
| | Operational Efficiency | Cash-to-Cash Cycle Time | Conversion Cost | Asset Utilization | Sigma Value |
| Support Services | Human Resources Responsiveness | Recruitment Effectiveness Index | Benefits Administration Index | Skill Inventory Index | Employee Training Index |
| | | HR Advisory Index | HR Total Cost Index | | |
| | Information Technology Responsiveness | System Performance | IT Support Performance | Partnership Ratio | Service-Level Effectiveness |
| | | New Project Index | Cost Index | | |
| | Finance and Regulatory Responsiveness | Compliance Index | Accuracy Index | Advisory Index | Cost-of-Service Index |

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Figure 34. The Gartner Business Value Model. (Smith et al., 2017)

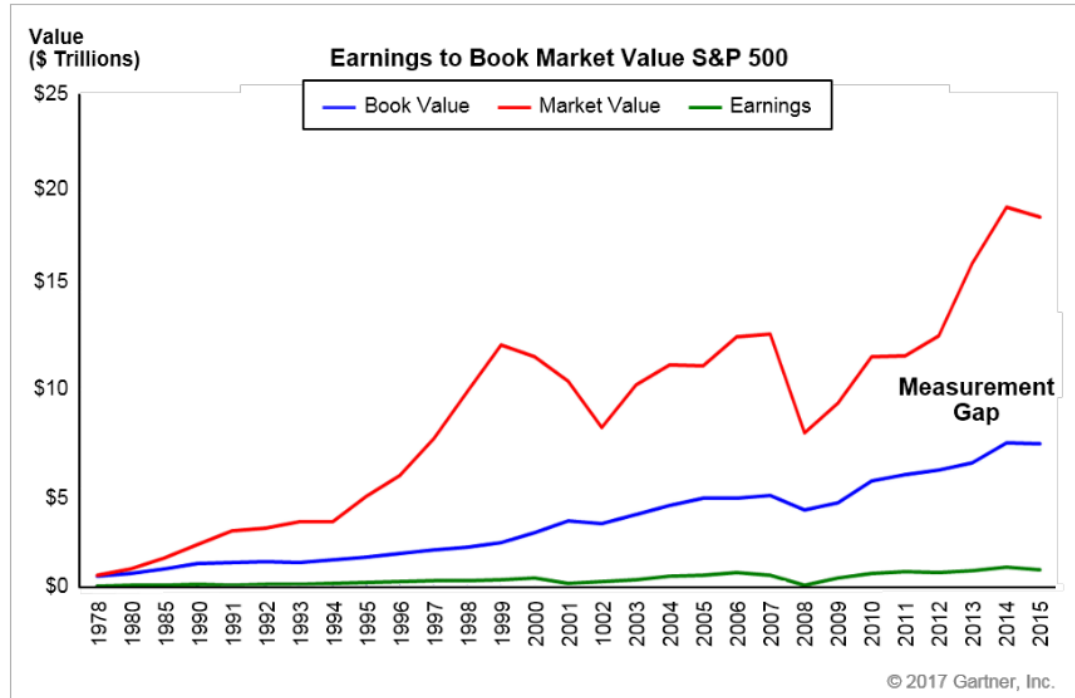
8.3.1 Description of the Gartner Business Value Model

Before using the Gartner Business Value Model as standard for mapping Business Metrics, it is worth explaining at high level its characteristics:

- This Business Value Model does not aim to compete with existing value metrics, it rather has the goal of complementing it to fill the gap on the value represented by non-accounting metrics (Smith et al., 2017, p. 7. First paragraph). In words of the Gartner’s document: *“Since 1980, these traditional accounting measures of value have not kept pace with actual value as measured by our capital markets. Consequently, the predominance of accounting metrics does not enable businesses*

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to understand and measure how value is created in their organizations”(Smith et al., 2017, p. 8. First paragraph.). This gap is depicted by the following graph, which shows metrics for the S&P 500 index:



Source: Gartner (May 2017)

Figure 35. Comparison of Standard Measures of Value to Actual Value in the US.(Smith et al., 2017, p. 7)

The S&P 500, or just the S&P, is a stock market index that measures the stock performance of 500 large companies listed on stock exchanges in the United States. Figure 35. Comparison of Standard Measures of Value to Actual Value in the US.(Smith et al., 2017, p. 7) shows the measurement gap between Market Value and financial metrics.

- The hypothesis for the existence of the gap depicted on the previous point, is that there are factors that create value for a given business. According to the graph, both

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Book Value and Earnings represent the value generated by financial factors, but the market value is increasingly higher than what the financial factors can explain, therefore there should be other factors that create this value. In Gartner's document the factors that create this Market Value, on top of the financial indicators are called **leading factors**. Remaining factors (accounting and financial) represent **lagging factors**. (Smith et al., 2017, p. 8. First paragraph.) The premise of the Business Value Model from Gartner is to create a way to identify and optimize the leading factors and align IT strategy with business with the objective of increasing total value generated. In conclusion, leading factors are those that drive value generation for the company, while lagging factors contribute to it, however they do not provide a way to understand how value is being generated by the organization.(Smith et al., 2017, p. 8. First paragraph.)

- As any structured framework, it presents generic representation of business value that can be applicable to any company. The metrics for the model were taken by industry groups like “*Supply Chain Council (SCC), the Product Development and Management Association (PDMA), American Productivity and Quality Center (APQC), the International Society of Six Sigma Professionals (ISSSP), the Balanced Scorecard Collaborative and the European Foundation for Quality Management*” (Smith et al., 2017, p. 8. Second paragraph).
- The table from the Business Value Model from Gartner, it is divided in three (3) Business Aspects, each one of them being composed by Aggregates. Additionally, there are a set of Primes that belong to every Aggregate. Primes are composed of

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several indexes measuring business performance relative to the industry in which the company runs its activities.

- **Business Aspects:** are defined according to Gartner’s document, it can be seen the relationship with a generic value chain for any company (Smith et al., 2017, p. 18). Table 4. Business Aspects as defined by the Gartner's Business Value Model framework (Smith et al., 2017, p. 18) shows the three Business Aspects defined by the framework and their respective descriptions.

| | |
|--------------------------|--|
| Demand Management | All the actionable activities involved with generating demand for the products and services offered by the organization. |
| Supply Management | All the actionable activities directly involved with supplying the products and services offered by the organization. |
| Support Services | All other actionable activities involved with supporting the organization. These services operate within organizations by providing services to internal clients. They operate on business principles and provide internal services at a cost and quality that are acceptable to their clients when assessed against alternatives. |

Source: Gartner (May 2017)

Table 4. Business Aspects as defined by the Gartner's Business Value Model framework (Smith et al., 2017, p. 18)

- **Aggregate Measures:** Aggregates will be calculated multiplying the value of the primes selected together. They also multiply each other to generate a value for Business Aspects. (Smith et al., 2017, p. 18). The Aggregate Measures described by the framework, as they fit in the model are depicted by Table 5. Business Value Model Aggregate Measures (Smith et al., 2017, p. 18).

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| | | | |
|-------------------|--------------------------------|---------------------------------------|---------------------------------------|
| Demand Management | Market Responsiveness | Sales Effectiveness | Product Development Effectiveness |
| Supply Management | Customer Responsiveness | Supplier Effectiveness | Operational Efficiency |
| Support Services | Human Resources Responsiveness | Information Technology Responsiveness | Finance and Regulatory Responsiveness |

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Table 5. Business Value Model Aggregate Measures (Smith et al., 2017, p. 18)

- **Primes:** These are a set of indexes selected by the company to be measured. Each index compares the specific performance of the company, versus the general behavior of the industry in which the company has its activities. There is a standard way to review the behavior of the industry and its by reviewing the general metric by economic activity. The economic activities are standardized by ISIC, International Standard Industrial Classification of All Economic Activities, which is recommended by the UN Statistical Commission for all Member-states of United Nations to “(a) *Adopting this system of classification as a national standard, or (b) Rearranging their statistical data in accordance with this system for purposes of international comparability*” (Nations, n.d.) It is important to note that companies are free to decide what primes are selected for every aggregate measure, according to their goals, activities and specific business.(Smith et al., 2017, p. 19)

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| | |
|------------------------------------|---|
| Definition | The Market Share Index shows the relative strength and influence of the organization in the markets in which it currently participates. ISIC figures are available from IHS Global Insight (www.ihs.com). |
| Calculation | $\text{Market Share Index} = \frac{\text{Revenue of organization's offered products and services}}{\text{Total revenue of ISIC-code-selected industries}}$ |
| Example | <p>ABC Computers sells \$31,170 million in a sample year, operating in ISIC 3825 Office and Computing Machinery.</p> <p>Market Share Index = 31,170 / 457,322.15 = 7%</p> |
| Application | Market Share Index is useful for determining important business strategies such as pricing. The income statement account most affected by the Market Share Index is revenue . |
| Potentially Affected Primes | Opportunity/Threat Index, Sales Cycle Index, Sales Close Index, Forecast Accuracy and New Product Index |

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Figure 36. Example of index(Prime) for the Business Aspect Demand Management and Aggregate Measure Market Responsiveness. (Smith et al., 2017, p. 22)

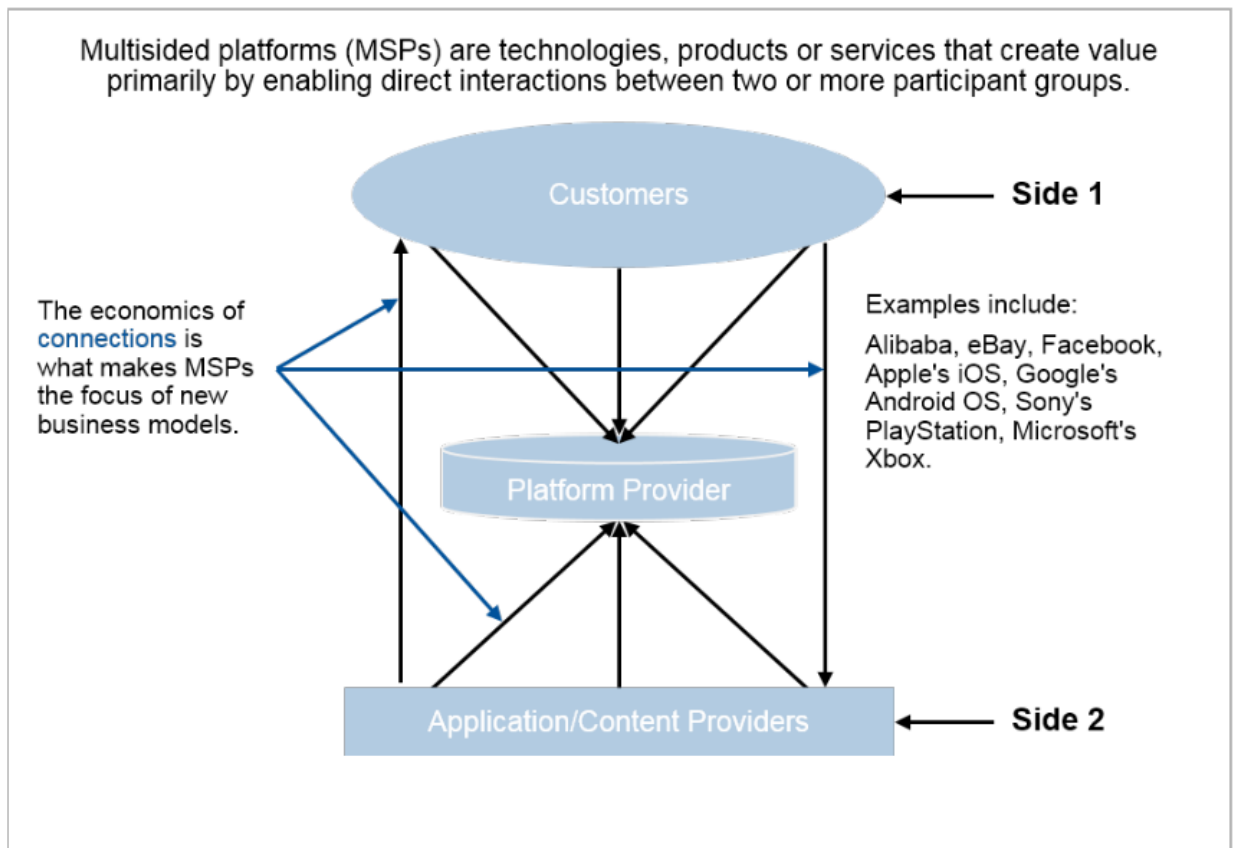
As mentioned above, a company may select a subset of the network. Therefore, for the purpose of this research, a recommendation on the indexes will be suggested, based on the Digital Businesses Leading Indicators (Smith et al., 2017, p. 92.), since it's the one that is more suited to software development companies. Furthermore, the Gartner's document mentions the concept of Multisided Platforms (Smith et al., 2017, p. 92), which makes sense for software development: Most often than not, the software provider develops for another company that does not directly make part of the set of users of the software produced, thus, the sides for the platforms created may be more than three (3).

On Figure 36. Example of index(Prime) for the Business Aspect Demand Management and Aggregate Measure Market Responsiveness. (Smith et al., 2017, p. 22), an example of a

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Prime definition has been selected to show how any Prime should be defined for the specific model to be implemented.

In the definition of a Multisided Platform, a platform provider “sets the rules for participation and pricing for each side of a platform”, and a “side” “consists of a group of participants with similar interests”(Smith et al., 2017, p. 92). An example is depicted in Figure 37. A simple Multisided Platform with 2 sides.(Smith et al., 2017, p. 93.)



Source: Gartner (May 2017)

Figure 37. A simple Multisided Platform with 2 sides.(Smith et al., 2017, p. 93.)

8.4 Using Contribution Margin method as a way of mapping Agile into Business

The Contribution Margin method is a traditional financial metric used to “*to understand how a specific product contributes to the company’s profit*”(Gallo, 2017, para. 1). In the case of Agile Projects this metric would be useful in determining how the product or result we expect from the project contributes to revenue of the company.

It’s important to note that this metric should be used carefully (i.e., mixed with other metrics; not being conclusive about project status overall) since goals for every project would be different, and for the following reasons:

- 1) Product and/or result of some Agile projects may not be directly be expressed in terms of revenue.
- 2) Product and/or result of some Agile projects may not be expressed in quantifiable terms.
- 3) For Agile projects that aim for a product or result that can be expressed in quantifiable terms, like for any other project, even though Contribution Margin is helpful would not be able to give all the information required to decide whether the project should continue or not, however gives valuable information about the goal being accomplished or not. It should be combined with other metrics to understand if the project is useful for the company and should continue being implemented (Gallo, 2017, sec. What mistakes people make? para. 2).

To understand how they can be used in the mapping from Agile to Business metrics would be helped by contribution margin method, the definition of Breakeven Analysis and Contribution Margin method are added in the next sub-sections.

8.4.1 Breakeven Analysis

The book “Breakeven Analysis” (Cafferky & Wentworth, 2014) defines this term as “*a continual way of thinking*”(Cafferky & Wentworth, 2014, Chapter 1 Introduction) and a “*way of comparing the amount of incoming value that an organization needs in order to serve its customers by delivering outgoing value of an equal amount*”(Cafferky & Wentworth, 2014, Chapter 1 Introduction).

As it can be seen from the definition of Breakeven Analysis, there are 2 ways in which this concept fits the Agile Mindset:

- 1) It’s a continuous way of thinking, just like the Agile Mindset itself and the continuous improvement elements on the Agile lifecycle.
- 2) Breakeven analysis shows the value delivered from incoming value. The Agile Manifesto states as its first principle “*Our highest priority is to satisfy the customer through early and continuous delivery(sic) of valuable software (...)*”(Beck et al., 2001), therefore, this metric is able to show quantifiable indication of how much value, in required business terms, the project is delivering by the development of the software. This would be true for those Agile projects that have quantifiable goals to measure.

The calculation of Breakeven Analysis is made taking into account the Fixed Costs for the business, over Contribution Margin per Unit , which should be equal to the minimum amount of Units to be sold so that the company is not losing its investment on the product/ project.(Cafferky & Wentworth, 2014, Chapter 1. Introduction)

$$\frac{\text{Fixed Costs}}{\text{Contribution Margin per Unit}} = \text{Breakeven in Units to Be Sold} = BE_U$$

Figure 38:Breakeven analysis example for Units to be sold.(Cafferky & Wentworth, 2014, Chapter 1. Introduction)

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$$\frac{\text{Fixed Costs}}{\text{Contribution Margin Ratio per Unit}} = \text{Breakeven in Dollars to Be Sold} = BE_s$$

Figure 39 Breakeven analysis example with Dollars to be sold. (Cafferky & Wentworth, 2014, Chapter 1. Introduction)

The formulas shown above, reflect the fact that you can represent any aspect of incoming value as part of the calculation of Contribution Margin and the Breakeven result. The calculation can be interpreted as the minimum value that should be obtained to keep the project/product relevant (worth of investment) for the company.

8.4.2 Contribution Margin Method

As it can be deduced from the calculation of Breakeven analysis, the value of Contribution Margin (per Unit), or the Contribution Margin Ratio are required to solve the Breakeven value.

The meaning Contribution Margin or Contribution Margin Ratio formula could be explained by first looking at the Total Cost Method. The Total Cost Method considers all the costs of the company, comparing them to the Total Revenue to find the Breakeven value:

- “*Total Costs for Period = Total Revenue for Period = Breakeven*” (Cafferky & Wentworth, 2014, Chapter 2. Total Cost Method)
- This equivalence can be re-written as:
“*(Fixed Costs + Variable Costs) = Total Revenue = Breakeven.*” (Cafferky & Wentworth, 2014, Chapter 2. Total Cost Method)

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- Or rewriting, once again:

“(Fixed Cos (Fixed Costs + Variable Costs) = (Quantity Sold × Unit Selling Price) = Breakeven.” (Cafferky & Wentworth, 2014, Chapter 2. Total Cost Method)

Thus, interpretation of Total Cost Method is basically to equate the Total Costs as the Minimum Revenue expected to find the Breakeven point, which is a very intuitive way of calculating if a project or product is producing enough revenue to be viable.

On the other hand, Contribution Margin Method calculated like this:

- *“Contribution margin = revenue – variable costs”*(Gallo, 2017, sec. How do you calculate it?), and it considers the variable costs instead (as compared to Total Cost Method). The consequence of this calculation is that it gives more information on investments made to produce each unit, because it does not consider taking out the fixed costs. For example, in the calculation for a specific product:
- Contribution Margin (product) = Selling price per Unit – Variable costs per Unit (Cafferky & Wentworth, 2014, Chapter 3. Contribution Margin Method). For example:

Another consequence of the formula for Contribution Margin Method is that the company will have to determine clearly which costs are fixed and which are variable, which is not trivial (Gallo, 2017, sec. How do you calculate it? para. 2).

8.4.2.1 Link between Contribution Margin Method and Agile

Even though Contribution Margin Method has been a traditional metric, the concept can be used specifically for a project (Agile or not) to measure in terms of variable costs, how is this project delivering value. It even can be used by applying it to concepts different from financial, replacing

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the price vs cost by functions on other variables, for instance, number of users with free promotion (variable cost), versus new users obtained after the inclusion of the promotion (if the promotion was a new feature delivered by the Agile team).

In that way, this simple concept would provide a value comparison: before and after the deployment in production of a feature, delivered by an Agile software development team.

8.5 Mapping Agile Team Health and Happiness metrics into Business metrics

Some Agile methodologies consider the Agile team health and happiness as important metrics, providing specific techniques and visualizations for these. It is the case as the Spotify Model's Quarterly Survey (Kniberg & Ivarsson, 2012, p. 4. Quarterly Survey) and Kanban's Niko-Niko Calendar (Agile Alliance, n.d.), which represent the mood, opinion, and mental state of the members of the team. These more than metrics are visualizations of team health that allow to verify potential problems and be proactive. Team's health and happiness are important to companies, given that this can affect productivity and influence employee engagement, however as a business metric, it is not common to find it, for now it does not. In order to create a mapping, a new metric, coming from the Agile world to the Business one, should be created.

Descriptions of what these models (Spotify and Niko-Niko Calendar), are and how they depict Agile team mood are presented in the following paragraphs:

8.5.1 The Spotify Model and its Quality Survey

The Spotify Model, created by Spotify, as its name states, is an implementation of Agile that uses its own elements, combined with other Agile methodologies (principles from Scrum,

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Kanban, Lean Startup and others) (Kniberg & Ivarsson, 2012, p. 2). Even though it uses elements from other Agile implementations, the Spotify Model defines its own elements, and these features are mostly about team conformation : They use **Squads** that can be related to Scrum teams, although each Squad defines the kind of methodology they are going to use(Scrum, Kanban or any other). A Squad works *“like a mini-startup”*(Kniberg & Ivarsson, 2012, p. 2) in the sense that the team is accountable and responsible of all the activities until the software is set to production and that they represent *“a self-organizing team, with direct contact to stakeholders and no-blocking dependencies to other Squads”*.(Kniberg & Ivarsson, 2012, p. 4)

A Squad belongs to a **Tribe**, which are sets of teams that work for related areas, that can be related to a feature or functionality. There are also **Chapters** and **Guilds** in which the same members of a Squad, may belong to a different set of skills, in the case of Chapters; or may have common interests, in the case of **Guilds**, which *“can be seen as “communities of interest” in which people want to share knowledge, tools, code and practices”*(Kniberg & Ivarsson, 2012, p.

10)

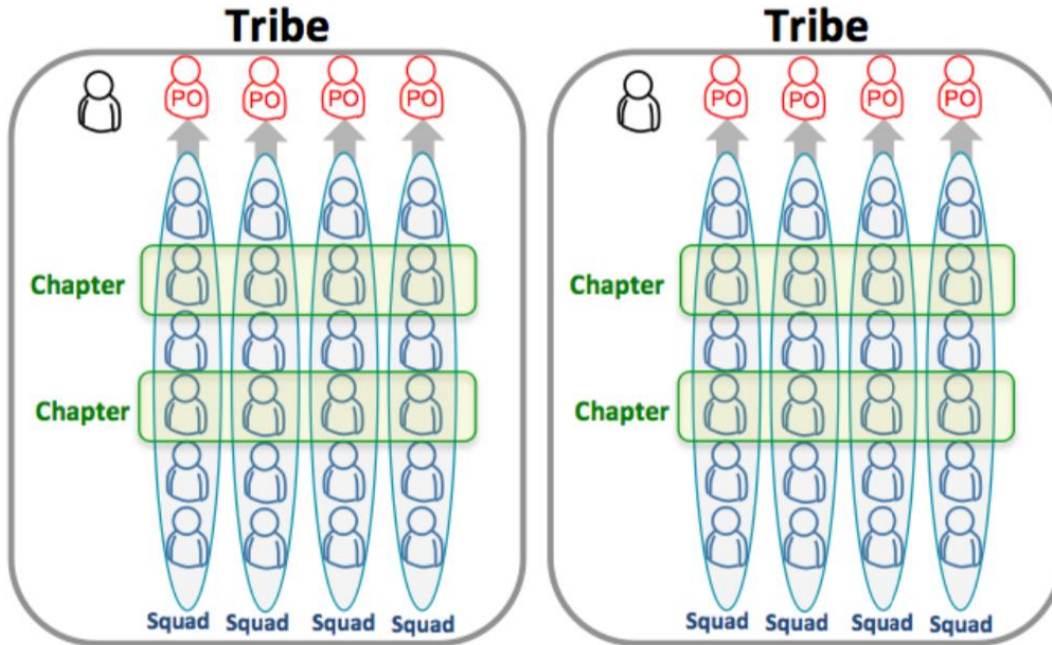


Figure 40. Squad, Tribe and Chapter conformation, defined by the Spotify Model. (Kniberg & Ivarsson, 2012, p. 8)

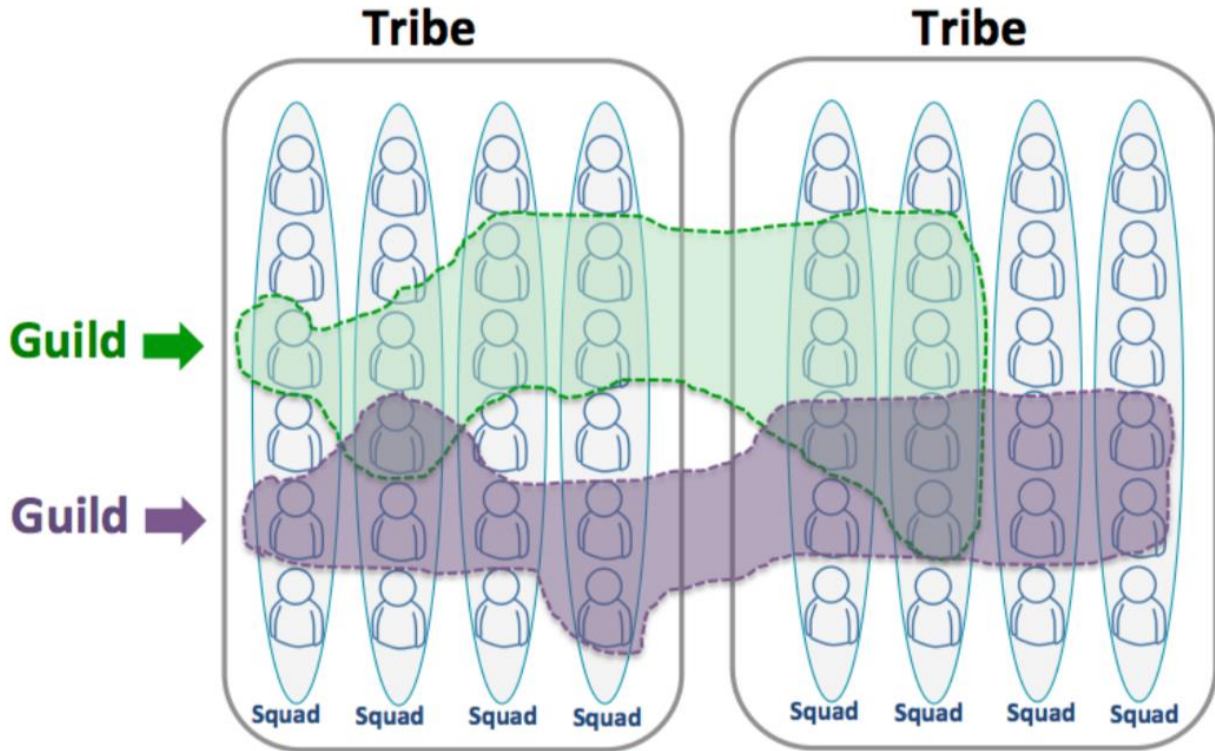


Figure 41. Guilds are communities of interest in the Spotify Model: Anyone can join. (Kniberg & Ivarsson, 2012, p. 10)

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As can be seen from the description, the Spotify Model focuses more on the team conformation, leadership and interaction than in defining specific ways of working. However, it defines an interesting practice from the point of view of measuring or visualization of team happiness, health and engagement: the quarterly survey. Figure 40. Squad, Tribe and Chapter conformation, defined by the Spotify Model.(Kniberg & Ivarsson, 2012, p. 8) and Figure 41. Guilds are communities of interest in the Spotify Model: Anyone can join .(Kniberg & Ivarsson, 2012, p. 10) show respectively the conformation of Tribes and Guilds, according to the Spotify Model.

8.5.1.1 The quarterly survey

The quarterly survey is a technique to focus improvement efforts and find what kind of organizational support is needed. The information is gathered in 1-1 meetings with the Agile Coach, whose role is to remove blockings from the day to day work of the Squad. The summary of a survey for each Squad is represented like the example depicted on Figure 42. Visual summary of a quarterly survey (Kniberg & Ivarsson, 2012, p. 4)

| Area | Squad 1 | Squad 2 | Squad 3 | Squad 4 | Squad 5 |
|------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Product owner | Yellow circle, Green arrow | Green circle, Red arrow | Green circle, Black arrow | Yellow circle, Black arrow | Yellow circle, Black arrow |
| Agile coach | Green circle, Green arrow | Green circle, Green arrow | Green circle, Black arrow | Red circle, Green arrow | Red circle, Red arrow |
| Influencing work | Yellow circle, Green arrow | Yellow circle, Green arrow | Yellow circle, Black arrow | Green circle, Green arrow | Green circle, Green arrow |
| Easy to release | Yellow circle, Green arrow | Green circle, Green arrow | Red circle, Red arrow | Red circle, Black arrow | Yellow circle, Red arrow |
| Process that fits team | Yellow circle, Black arrow | Green circle, Green arrow | Green circle, Green arrow | Green circle, Green arrow | Yellow circle, Green arrow |
| A mission | Yellow circle, Green arrow | Green circle, Red arrow | Yellow circle, Red arrow | Yellow circle, Red arrow | Green circle, Black arrow |
| Org. support | Green circle, Black arrow | Green circle | Yellow circle | Yellow circle, Black arrow | Yellow circle |

Figure 42. Visual summary of a quarterly survey (Kniberg & Ivarsson, 2012, p. 4)

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This visualization uses the intuitive concept of Amber, Red Green to represent of each one of the aspects on the left. The arrows on each one represent respectively the trend of this aspect: if the arrow is going up, it shows an upward trend, meaning that this aspect is showing signs to improve; the opposite is represented by the arrow pointing down; and finally an arrow pointing to the right represent that this aspect is not showing any sign to change.

Considering that this is the summary of team's perception, it may be used as a base for representation of team happiness and engagement, related to the aspects defined. This concept can be translated and even extended to other aspects in terms on any aspect that the business would like to visualize in terms of employee/team perception. The power of this tool is that every member of the team gives their perception and not just the ones that tend to be more vocal, given that the data is collected in 1-1 meetings and then the result is summarized by Squad. This last realization implies that any level can be used for aggregation: Squad, Agile Team, Chapter, Guild, Tribe, or the whole organization if needed. This conclusion may be used to create a new indicator or visualization for the Business, that was not being considered before, to put this in terms of the mapping of the present research.

8.5.2 The Niko-Niko Calendar

The Niko-Niko Calendar is one of the Information Radiator visual boards. It registers the mood of every member of the team every day of the calendar (Sprint/Iteration) in a way that is visible for the whole team and managers. This practice was proposed by Akinori Sakata (Sakata, 2006) in a web article, and although it has its detractors (Son, 2016), it can still serve as inspiration for a way to gather team morale and find out trends of behavior, caused by decisions taken from management,

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or events happened on the project. It can also help prevent losing members of the team, given a specific situation that can be affecting their morale.

| Sprint 33 | Mon | Tue | Wed | Thur | Fri | Mon | Tue | Wed | Thur | Fri |
|-----------|-----|-----|-----|------|-----|-----|-----|-----|------|-----|
| Lucinda | 😊 | 😊 | 😊 | 😐 | 😐 | 😊 | 😊 | 😐 | 😊 | 😊 |
| Theodore | 😡 | 😐 | 😡 | 😡 | 😡 | 😐 | 😊 | 😐 | 😡 | 😐 |
| Virginia | 😐 | 😐 | 😐 | 😐 | 😡 | 😊 | 😐 | 😊 | 😊 | 😊 |
| Olga | 😊 | 😊 | 😊 | 😐 | 😐 | 😊 | 😊 | 😐 | 😊 | 😊 |
| Elliot | 😊 | 😊 | 😊 | 😐 | 😐 | 😊 | 😡 | 😊 | 😊 | 😊 |
| Suresh | 😐 | 😊 | 😊 | 😐 | 😐 | 😊 | 😊 | 😐 | 😐 | 😊 |
| Emile | 😐 | 😡 | 😐 | 😐 | 😐 | 😊 | 😡 | 😐 | 😐 | 😊 |

Figure 43. Niko-Niko Calendar example (Agile Alliance, n.d.)

Even though it can feel condescending,(Son, 2016, sec. This isn't Kindergarten) this idea can be modified and extended into visualizations that the business could use to have information about team's health, happiness and morale. An example of Niko-Niko calendar is shown on Figure 43.

Niko-Niko Calendar example (Agile Alliance, n.d.)

9. PROPOSAL FOR CONCEPTUAL FRAMEWORK TO TRANSLATE AGILE METRICS INTO BUSINESS METRICS

The purpose of this chapter is to answer the last research question 5 “*How to generate a framework to link agile metrics to business metrics in a way that it gives relevant information to business and upper management?*”, as well as to provide a result for [OR4] “*Design a proposal for a conceptual framework that allows to obtain business metrics from agile metrics of a software development project*”. For achieving this goal, elements from the theoretical framework about Agile and Business metrics are taken and are related to the gaps found on the survey results and have been put together in a set of recommendations compiled in a conceptual framework. This proposed framework set the basis, starting by Business characteristics on the context of the company, and that of the Agile project and team. Then, the framework proposes a set of Agile metrics by gathering those found on literature review, as a recommended set for projects. Afterwards, a way to map the selected subset of proposed Agile metrics for a specific project against a set of Business metrics is designed. Finally, alternative techniques for visualizing and mapping value from the Agile project to Business are presented.

In previous chapters, the main literature gathered about Agile Metrics and Business Metrics are mostly segregated by one or another. Even though lately there are Agile Metrics that are directly Business ones, like is the case of the Cost related project metrics, and few on the Product Development Category on a recent listings like (Cleff, 2017), which includes metrics like

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“Customer Value Delivered” and “Sales Velocity”, as part of the set of Agile metrics proposed for a team. In summary, and independently from the metrics suggested by methodologies like Scrum (described above in section for Agile Metrics), there is not consensus about what are Agile Metrics, since almost every blogger and author recommend a different set, giving as result that there is not an official listing of Agile Metrics.

This is mainly the reason why there is not a theory on translating Agile metrics to Business Metrics: As companies transform into Agile companies, it seems there is no difference between them. However, the present thesis is that there is a gap in those metrics that has been sensed by companies, stakeholders and Agile teams, and the purpose with this document is to visualize that gap, and create a proposal design for a conceptual framework that can help translate metrics from the Agile world into the Business one, and from the project perspective, into the organizational, and even interorganizational one, depending on the stakeholders planned for a project.

The design of such framework consists on the following elements:

9.1 Defining the context of the Business

- Establish the multisided platform for the business, platform and Agile project, as defined in the Figure 37. A simple Multisided Platform with 2 sides.(Smith et al., 2017, p. 93.), this allows a better insight for the following considerations.
- Define what stakeholders are on every side of the platform, according to what sides have been identified.
- Having the set of stakeholders, determine what represents value for them. If it is useful, a tool like empathy map can be used, to identify the expectations of each type of stakeholder. This can be used at the level of sides of the platform.

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- According to the value in which stakeholders are interested to receive from the project, determine what measures that value, by giving data that is accurate, simple and meaningful to them. At this point, it is best to have fewer metrics that are meaningful than a set of many metrics, for clarity.
- Once the set of metrics, related to each side and/or stakeholder is defined, provide a context and timing in which those metrics are to be gathered and reported. Also, it should be useful to report and communicate these metrics to the interested stakeholders, in such a way, that each stakeholder has a view that contains only the metrics that are relevant to them.

9.2 Determine the context of the Agile project

Any project (Agile or not), is created by a business need or opportunity, then the first step in the determination of the context for the Agile project is to identify its main goal formulated in business terms.

1. Establish the main goal of the Agile project and formulate it in business terms. The project may have many goals; however, it is important to identify the main one, specifically determine the one that business values more. For acquiring this information, the following techniques are recommended:
 - i. Sometimes the team starts the project and they know the reason why the project started, if so, keep the goal clear, written in business terms, in a location where the team and stakeholders keep it visible.
 - ii. Read the base documentation for the project.

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- iii. Interview briefly the key stakeholders of the project about it, after that document the main goal of the project.
2. Once the main goal of the project has been established, determine how to verify if the goal has been achieved or how close is the project to achieve the main goal:
 - i. Determine a criterion (or criteria) that serves as trigger to determine the goal has been achieved.
 - ii. Define a metric that allows to verify when the main goal has been achieved and how close the project is to achieve it: what does the project need to achieve the goal? More developers? More time? More investment? if so, how many developers are required? how much time? Or how much money?
3. About other goals of the project: follow previous recommendations: determine criteria to verify if the goal has been achieved and define metrics to measure if the goal has been accomplished at a given point in time. The only difference between main goal and others is the importance given by stakeholders, and the fact that when the main goal has been achieved, the project may end even though other goals have not been achieved.
4. Evaluate the Agile project in other business dimensions it may touch upon:
 - a. **Functionalities that provided by the product, give value to the users/clients in unexpected way:** Given that this new feature is on production, customers buy more; Users are joining because of this improved payment service; the page is getting more views because of display features provided by the project; etc.
 - b. **Knowledge acquired:** The people involved on the project has learned specific details of the project; or has acquired technical skills that add to the

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resources and reputation of the company as an employer where people want to work for.

- c. **Creation of new capabilities:** With the development of the project, the business has discovered that can create a new capability that can be a new line of business currently or in the future.
- d. **Reduction of operative costs:** The result of the project may automate manual tasks that make easier the day to day operation, making it more efficient and reducing costs, therefore raising the operating margin for the company / clients.
- e. **Creation of competitive advantage:** The project has created an exclusive position for the company in its market in terms of technology capabilities, products offering, logistics, market skills, etc.
- f. **Financial efficiency or gains:** The project is directly generating profit by raising revenue, costs or value for shareholders: For instance, the product or result of the project has created a good reputation for the company in a way that the share price has raised.

The evaluation can be made in other dimensions, and should be periodical, by every iteration, sprint or cycle or development. Here scenario planning and options thinking may be applied. For instance: By the end of the iteration: what skills have we developed? What impact the deployment of current features has had on these dimensions and what can we potentially achieve if the progress follows the same behavior in the future?

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5. For every dimension, determine the metrics that can provide a visualization of the impact on the business and the opportunities unfolding from the Agile project. These metrics are useful to communicate to the team and stakeholders and all the sides of the platform about the value the project is generating. These metrics may be used periodically, but this depends on the usefulness and also the periodicity of the impact generated: for example, the competitive advantage may be created just once, and maybe the metrics gathered as follow up do not depend on the Agile project, anymore.
6. At the end of every development cycle (iteration, sprint, etc), preferably on retrospective ceremony, determine if the Agile has had any additional impact not expected at the beginning of the project or the iteration. As usual, determine a way to communicate it, visualize it and/or measure it, to make it evident to project stakeholders.
7. Define roles related to keep and discover impact and metrics, as well as finding trends and insights on those metrics. This definition of roles is optional, since Agile teams may be working as X-teams in which all the team is responsible for these activities, however it is important, in that case to select a time on the retrospective or planning ceremonies to reflect on these aspects.

9.3 Reaching consensus about Agile Metrics

As part of the development of the framework, first step is to find consensus about what Agile Metrics mean. For that purpose, the Agile Metrics gathered from theoretical research are analyzed and a new set of metrics is proposed: not to replace them, but to complement them and to find links that can provide information to the business.

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Complementing the set of Agile Metrics, however, does not avoid the activities of finding some equivalence with Business Metrics in upcoming steps.

On the process of proposing a list of Agile Metrics, the input from the chapters 6.10 Agile Metrics and 8.MAPPING BETWEEN AGILE AND BUSINESS METRICS have been used to analyze the most common metrics used for Agile Software Development . Additionally, some of the metrics have been discarded because of lack of a way to provide a clear definition in quantitative or qualitative terms. Some metrics have been added, usually inspired in previous ones, with metrics that are more up to date with current practice, or because their definition could be complemented or made more tangible. With the goal of obtaining the definitive list, some metrics have been defined in a more detailed way.

Moreover, the set of metrics have been compared with the rules, originally enunciated by (Appelo, Krebs, & Commons, 2014) in his book about Metrics Ecosystem for Management 3.0.

Looking at the proposed set of Agile Metrics on this study under this light, the consequence is that it is only a set of recommended metrics, and every team should evaluate at every step if a metric is being relevant or not for the project at hand.

9.3.1 Definition of Agile Metrics

To provide an initial list of recommended Agile Metrics, a basic definition must be provided. Such definition is as follows:

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Agile metrics for software development are metrics that concern the Agile development team, in their day to day activities and dry their interactions towards to delivering high quality software. The team is owner of these metrics, and is entitled to add them, maintain them and remove them from their periodic use when the team considers it relevant. These set of metrics can show the quality of the product delivered; the efficiency of the software development process; the technical quality of the software developed; and the quality of team in terms of well-being and interactions. The proposed framework, recommends an initial list of Agile metrics, but the goal is to make it a living list, fed and maintained by the Agile community through an implementation that could be extended and even kept in a DLT (Distributed Ledger Technology) network, as a way of keeping consensus, and, at the same time, access for all interested members that are willing to give their contribution.

9.3.2 Defining the recommended list of Agile Metrics

The set of Agile Metrics on Table 6. List of Normalized Agile Metrics has been standardized by taking as input the respective set of Agile Metrics from (Kupiainen, Mäntylä, & Itkonen, 2014b); (Nee, 2010) and (Cleff, 2019, sec. 30+ Metrics for Agile Teams). Each one of the metrics has been analyzed in such a way that some have been renamed; some have been eliminated; those that are common, related metrics and have been found in at least 2 authors, have been mapped to a new metric with a more convenient or a more complete name and definition. This process has been called “normalization”, and the resulting set of Agile Metrics are “normalized Agile metrics”.

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Table 6. List of Normalized Agile Metrics. Source: Own elaboration

| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|---|-------------------------------------|---------------------------|-------------------------------|---|--|
| Amount of revenue a customer is willing to pay for a feature | Leading | Yes | Iteration Planning | Quantitative | Currency |
| Effort estimation metrics used to size the feature | Leading | Yes | Iteration Planning | Quantitative | Man/hours, Function Points, Number of features to be developed |
| Velocity metrics to calculate how many features the team can complete in an iteration | Leading | Yes | Iteration Planning | Quantitative | Number of story points expected per development cycle |
| Effective available hours from team members, useful to select tasks for an iteration | Leading | Yes | Iteration Planning | Number of story points expected per development cycle | Number of work hours available from every member of the team |
| Number of artifacts completed | Lagging | Yes | Iteration Tracking | Quantitative | Number of artifacts |
| Number of work items (Stories, epics, tasks) completed. Percentage of completed vs committed. | Lagging | Yes | Iteration Tracking | Quantitative | Number of completed and acceptable work items. It is used as a percentage of items completed and acceptable, vs committed. |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|--|------------------------------|--------------------|------------------------------|--------------|--|
| Number of work items that the team delivers per iteration (Average number of work items delivered per iteration) | Lagging | Yes | Iteration Tracking | Quantitative | Number of Story points actually delivered in development cycle |
| Feedback from product demonstrations | Lagging | Yes | Iteration Tracking | Qualitative | Accuracy of the solution to comply with expectations, improvement opportunities on the solution delivered, usefulness of the feature, etc. |
| Build status | Lagging | Yes | Anytime in Current Iteration | Qualitative | Passed/Failed |
| Time to fix a failed Build | Leading | Yes | Anytime in Current Iteration | Quantitative | Hours/minutes |
| Product Size | Leading | Yes | Anytime in Current Iteration | Quantitative | Number of automated tests |
| Number of defects | Lagging | Yes | Anytime in Current Iteration | Quantitative | Average of defects found per development cycle |
| Time to fix defects | Lagging | Yes | Anytime in Current Iteration | Quantitative | Average time to fix defects found per development cycle |
| Work in Progress | Leading | Yes | Anytime in Current Iteration | Quantitative | Number of tasks/stories in WIP status at any given point of the development cycle |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|---|------------------------------|--------------------|------------------------------|---------------------------|--|
| Lead time | Lagging | Yes | Anytime in Current Iteration | Quantitative | Amount of time (Weeks, days, hours, minutes) required to release the product to production environment. It can be represented in number and average. |
| Flow efficiency | Lagging | Yes | Anytime in Current Iteration | Qualitative | Ratio of time spent working on an item vs. time the item waits (to be worked on). |
| Static Code Check Metrics | Leading | Yes | Pre-release | Quantitative | Average /Number of errors or warnings presented by static code check |
| Product test metrics | Lagging | Yes | Pre-release | Quantitative /Qualitative | Number of unconformities to test metrics. For the qualitative part, it can include recommendations |
| Number of (automated) tests written before code | Leading | Yes | Pre-release | Qualitative | Metric cannot be defined in one way. Discarded. |
| Technical debt | Lagging | Yes | Pre-release | Quantitative | In time (days, hours, minutes) , necessary to fix the amount of errors and warnings found by static code check. |
| Customer Satisfaction | Lagging | Yes | Post-release | Quantitative /Qualitative | It is often represented as a percentage, but it may have qualitative elements |
| Quality Indicators | Leading/Lagging | Yes | Post-release | Quantitative /Qualitative | These depend on the project |
| Customer metrics | Lagging | Yes | Post-release | Quantitative /Qualitative | These depend on the project |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|-----------------------------------|------------------------------|--------------------|--|--------------|--|
| Escaped defects | Lagging | Yes | Post-release | Quantitative | Number and or average of defects that reached production. |
| Change requests sent by customers | Lagging | Yes | Post-release | Quantitative | Average / Number of change requests by customers |
| Product Net Promoter Score | Lagging | Yes | Post-release | Quantitative | "(NPS) is used to measure the response to the questions: Would you recommend this product to a colleague?" |
| Predicted Defect count | Leading | Yes | Expected for next iteration | Quantitative | Number of defects to be found in next development cycle |
| Expected Maintenance effort | Leading | Yes | Expected for next iteration | Quantitative | Number of man hours required for maintenance |
| Expected deferred defect count | Leading | Yes | Expected for next iteration | Quantitative | Number of defects expected to be deferred to next development cycle |
| Budget at Completion (BAC) | Lagging | Yes | Release Planning | Quantitative | Currency; Total money spent in this release |
| Actual Weeks (AW) | Lagging | Yes | Anytime in Current Release or Project | Quantitative | Number of development weeks elapsed to date |
| Planned Percent Complete (PPC) | Leading | Yes | Release Planning | Quantitative | Percentage; AW /PW |
| Actual Percent Complete (APC) | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Percentage; CSP/PSP |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|----------------------------------|------------------------------|--------------------|--|--------------|---|
| Actual Cost (AC) | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Total budget spent to date |
| Planned Value (PV) | Leading | Yes | Release Planning | Quantitative | Budgeted cost of the story points that were scheduled to be completed as of today. $PPC * BAC$. |
| Earned Value (EV) | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Budgeted cost of the story points actually completed as of today. $APC * BAC$. |
| Cost Variance (CV) | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Currency; Amount (money) Difference between planned budget and actual spent. $EV - AC$ |
| Schedule Variance (SV) | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Time difference between planned schedule and actual time spent. $EV - PV$ |
| Cost Performance Index (CPI) | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Percentage; How is the project behaving in cost terms. EV/AC |
| Schedule Performance Index (SPI) | Lagging | Yes | Anytime in Release or Project | Quantitative | Percentage; How is the project behaving in cost terms. EV/PV |
| Estimate to Complete (ETC) | Lagging | Yes | Anytime in Release or Project | Quantitative | Based on current performance, how much budget is required to complete the release. $(BAC - EV)/CPI$ |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|----------------------------------|------------------------------|--------------------|--|------------------------------|---|
| Estimated at Complete (EAC) | Leading | Yes | Release Planning | Quantitative | Based on current performance, what the total cost of release will be. |
| Estimated time to Complete (ETC) | Lagging | Yes | Anytime in Release or Project | Quantitative | Based on current state, the time required to complete |
| Cumulative Flow Diagrams | Lagging | Yes | Anytime in Current Iteration, Release or Project | Visualization | Cumulative times of all stories in every status: Lead time, WIP, QA, etc |
| Control Charts | Lagging | Yes | Anytime in Current Iteration, Release or Project | Visualization | Lead and cycle time (amount of time needed to complete an item): average, rolling average and standard deviation. |
| Time Blocked per Work Item | Lagging | Yes | Anytime in Current Iteration or Release | Quantitative | Number of weeks, days, hours or average Time. Measures the amount of time that an item was blocked during its completion and is used to determine the cost of delay & propose proactive mitigations avoidances. |
| Blocker Clustering | Lagging | Yes | Anytime in Current Iteration or Release | Quantitative - Visualization | Frequency (number of times or average number of times). Grouping of items that block work items, which help to identify the largest sources of delay and propose common mitigations. |
| Escaped Defect | Lagging | Yes | Post-release | Quantitative | Time. Amount of time (Weeks, days, hours) |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|-----------------------------|------------------------------|--------------------|--|--------------|--|
| Resolution Time | | | | | to resolve an escaped defect. |
| Release Success Rate | Lagging | Yes | Post-release | Quantitative | Ratio of accepted vs rejected releases from the customer. |
| Time Since the Last Release | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Display the amount of time since the team last released to production. |
| Release Net Promoter Score | Lagging | Yes | Post-release | Quantitative | Net Promoter Score (NPS) is a customer loyalty score, ranging from -100 to 100, calculated by asking customers one question: “On a scale from 0 to 10, how likely are you to recommend this product/company to a friend or colleague?” Same principle applied to the Release quality. NPS is calculated by subtracting the percentage of customers who answer the NPS question with a 6 or lower (known as ‘detractors’) from the percentage of customers who answer with a 9 or 10 (known as ‘promoters’). https://www.hotjar.com/net-promoter-score |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|-------------------------------------|------------------------------|--------------------|--|---------------------------|---|
| Release Adoption /Install Rate | Leading | Yes | Post-release | Quantitative | Number, average, percentage. Measures the number of existing users that have upgraded; Number of new users gained from release. Used to assess ROI on product development and validate business /market assumptions. Does ROI meet or exceed business assumptions? Identify users that have not upgraded – determine why. |
| Customer / Business Value Delivered | Lagging | No | Post-release | Quantitative /Qualitative | "The amount of Business Value delivered by each completed work item, epic, feature or release." This one is difficult to put in one single metric. For now, it is discarded as Agile metric, and will be considered as part of the translation to the Business Metrics |
| Risk Burndown | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Amount of known and unmitigated risk shown across time. |
| Push / Pull | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | "This is the ratio/count of work items completed vs. work items added." |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|-------------------|------------------------------|--------------------|--|----------------------------|---|
| Product Forecast | Leading | Yes | Release Planning | Visualization | "Future trend lines (best-case, worst-case) based on the historical performance of work item completion. Used to predict when future work will be completed using the work item count. Can lead to stable performance to allow for better forecasting." |
| User Analytics | Leading | No | Release Planning | Quantitative / Qualitative | This metric represents a set of metrics related to the user interaction with the product. Although there are some classifications in which appear to be an Agile metric, this study considers them as part of Business Metrics. |
| Test Coverage | | Yes | Anytime in Current Iteration | Quantitative | Percentage of coverage of code by automated tests: User acceptance, Integration and unit tests. However, it is measured basically on Unit tests. |
| Build Time | Leading/ Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Measures the time to perform a build, therefore the time that takes for the team to obtain feedback from the latest build, from the latest changes on the Version Control System. |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|----------------------------|------------------------------|--------------------|--|---------------------------|--|
| Code Churn | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Number of lines of code changed to complete a work item. It can be taken per item or as an average for the items delivered in one iteration. This can tell about maintainability of existing code. |
| Code Ownership | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Frequency (number of times or average number of times) that team members change or commit to each area of the codebase. |
| Code Complexity | Leading | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Number of dependent blocks of a program. The higher this number, the more complex the software is. |
| Coding Standards Adherence | Leading | Yes | Anytime in Current Iteration, Release or Project | Quantitative /Qualitative | Set of metrics by tools like Sonar, that give several recommendations about coding standards that are not met by the software. It can be measured as a percentage, taking the recommendations still pending to comply with as the negative percentage to be subtracted from 100% |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|-------------------------|------------------------------|--------------------|--|------------------------------|--|
| Crash Rate | Lagging | Yes | Post-release | Quantitative | A log of incidents that make the application crash. Measuring as a rate it can be the number of times the system has crashed over the time of being in normal conditions |
| Happiness | Lagging | Yes | Anytime in Current Iteration, Release or Project | Visualization / Qualitative | Team morale visualization in the style of Niko-Niko calendar, or the Spotify's model quarterly survey. |
| Learning Log | Lagging | Yes | Iteration or Release Retrospective | Quantitative and Qualitative | Listing of the items that the team has learned, however quantitative measures can be by amount of technologies learned, or average of capabilities generated. |
| Team Tenure | Leading | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Amount of time (Months, Weeks, days, hours, minutes) each member has been assigned to the team. It can also be used as an average amount of time. |
| Phone- A-Friend Stats | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Number of times a member of the team has to be contacted for assistance. |
| Whole Team Contribution | Lagging | Yes | Anytime in Current Iteration, Release or Project | Quantitative | Percentage of team members that contribute to a work item throughout its lifecycle. |

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| Normalized Metric | Indicator (Leading /Lagging) | Included (Yes /No) | Normalized Agile Phase | Type | Units |
|---------------------|------------------------------|--------------------|--|-------------|---|
| Agile Fluency Model | Leading | No | Anytime in Current Iteration, Release or Project | Qualitative | This is a set of metrics to determine Agile Fluency, called the Agile Fluency project. This works as a maturity model of the team in terms of Agile and not a as metric per se, so it is discarded. |

This list is not extensive; it is meant to serve as a basis for the proposed framework. The idea is to be able to understand the qualities of Agile Metric, so the teams can determine the characteristics of a new one to be added. Agile Metrics rely on the specific team and its needs, and every team is different, thus, this set of metrics should be a set of recommendation, rather than a standard to be enforced. It is expected to be shared, so software development teams propose new metrics, but only apply those that are meaningful to their specific needs.

It is important to highlight the characteristics of Agile metrics, that become conditions to add to the Normalized Agile Metrics set:

- An Agile Metric must be one that the Agile team has visibility upon or has control over the factor measured. Examples: Code coverage, Build time, Lead Time, etc.
- An Agile Metric should provide motivation or perspective on the goals that the project the team is working on: Customer Satisfaction, Product Forecast, Product Net Promoter Score, etc.

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- In summary, Agile Metrics are to be seen from the perspective of the Agile Development Team and should be defined considering that it is meant to provide visibility, perspective and motivation to the team with respect of their influence on project goals.

9.4 Defining the set of Business Metrics

Even though, this document has reviewed methodologies and frameworks to define Business Metrics, it is important to summarize a conclusion on this kind of metrics, with the aim to set the basis for the proposed framework, as it was done for the Agile Metrics, on the previous section.

Business Metrics have been discussed at length, as the theoretical framework shows, however, the information gathered about the is diverse, in the sense that some sources define methodology or framework designed so that companies determine which are the goals and metrics to measure their progress upon like(Kaplan & Norton, 1992), others are a specific set of metrics like the one gathered by (Kemell et al., 2018), and others are the combination of the previously mentioned like Gartner Business Value Framework (Smith et al., 2017).

The theoretical elements that are going to be used to build a definition of Extensive Business Metrics is listed on the Table 7. Extensive list of Concepts for building a set of recommended Business Metrics. The Balanced Score Card, KPIs, and KRI methodology(Kaplan & Norton, 1992) has been used traditionally to determine the main metrics of a company, however in this case, and since the Gartner Business Value Framework is equivalent, the proposed framework will be based in the latter.

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Table 7. Extensive list of Concepts for building a set of recommended Business Metrics. Source: Own elaboration

| Concept | Elements | Reports / Visualization Associated | Source |
|---|---|--|--------------------------|
| Financial Metrics | Book Value | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Earnings Per Share | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Balance Sheet Statement | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Net Income Statement | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Cash Flow Statement | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Total Cost of Ownership | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Public Return on Investment (Public ROI) | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| | Net Present Value | 10k - annual report; 10Q- quarterly report; 8K- current report filling | (Brodersen & Pysh, 2014) |
| The Art of Business Value | Cost of delay | No Report recommended by this source | (Schwartz, 2016) |
| | Scenario Planning | No Report recommended by this source | (Schwartz, 2016) |
| | Options Thinking | No Report recommended by this source | (Schwartz, 2016) |
| Balanced Score Card Key Performance Indicators and Key Result Indicators | KPIs, KRIs | Dashboard with KPIs and KRIs represented | (Kaplan & Norton, 1992) |
| Start Up Metrics | See the explicit listing of metrics gathered by (Kemell et al., 2018) | No Report recommended by this source | (Kemell et al., 2018) |

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| Concept | Elements | Reports / Visualization Associated | Source |
|---|--|---|----------------------------------|
| The Gartner Business Value Framework | Business Aspects | Table with Aggregates and Primes. This is not recommended by the Framework. | (Smith, Apfel, & Mitchell, 2017) |
| | Aggregate Measures | Table with Aggregates and Primes. This is not recommended by the Framework. | (Smith, Apfel, & Mitchell, 2017) |
| | Primes | Table with Aggregates and Primes. This is not recommended by the Framework. | (Smith, Apfel, & Mitchell, 2017) |
| | Digital Business: Leading indicators specific to this form of Business | Table with Aggregates and Primes. This is not recommended by the Framework. | (Smith, Apfel, & Mitchell, 2017) |
| | Multi - Sides Platform Framework | Diagram (not specifically recommended by the framework) | (Smith, Apfel, & Mitchell, 2017) |

Then, the methodology to use these sources to be used as bases for the new framework is proposed as follows:

- **Financial metrics:** are taken literally. These are traditional metrics that every company (at least public companies) already use, therefore they are mandatory to be included in the set of Business Metrics. These are **specific metrics**.
- **The Art of Business Value:** These are techniques to obtain the value coming from an Agile project, that have a projection on Business topics, and from which new Business Metrics can be derived. One example of this is a software POC built inside an Agile project. At the time of its development, it does not have any Business value, however, having implemented this POC, and in a few months of development, it can transform into the new competitive advantage for the company. The previous,

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is an example of Options Thinking: how much does this result in the project represent today? and what option give the Business for the future? These are **techniques** to obtain Business perspective from Agile projects. These set of **techniques** have been defined by (Schwartz, 2016).

- **Balanced Score Card Key Performance Indicators and Key Result Indicators:** This is a **methodology** and set the basis for distinguishing between KPIs and KRIs. It helps in the determination of the business goals for the company. However, the same purpose is more detailed for the Gartner Business Value Framework (Smith et al., 2017).
- **Startup Metrics:** This is the extensive list of Startup Metrics found by literature review made by (Kemell et al., 2018). This can be an example of **specific metrics** recommended for the case of a company that is a startup. This case is very useful, since it will be used to illustrate how to use the mapping in a case where the whole set is already defined from the Business side and how it relates to the other concepts, as well as how it relates with Agile metrics.
- **The Gartner Business Value Framework:** This is a **framework** to determine the specific metrics and indicators to be used by the company, to measure its business value at a given point in time. Inside the definition of this framework, the concept of Multisided platforms is defined.

9.5 Definition of a Framework to Translate Agile Metrics into Business Metric

This definition of the proposed framework for the translation from Agile Metrics into Business Metrics, is made through the exemplification, taking as instance the set of Startup Metrics as recommended list and the set of Normalized Agile Metrics defined previously.

The process to illustrate the framework is planned as follows:

1. Since set of Startup Metrics is considered as the list of specific Business Metrics, then the first step is to map these metrics one by one with the with the Gartner Business Value Framework (GBVF) Business Aspects, Aggregate Measures and Primes. From this step we know how accurate the GBVF is in reporting a defined set of aspects to measure value in a company, and if there are any gaps. Startup metrics have been selected because it was a documented set of metrics of a study collecting the review of more 100 papers, however, any other type of company would have been used.
2. After that, find the detail of Multisided Platforms, by the gaps in the metrics from Startup to GBVF and by the analysis, considering that our Business is Software Startup Company. These sides provide the sets of participants interacting with the Business Platform and give perspective about what Business Value they would find on the company.
3. After the relation with the GBVF is found, a representative set of the list of Normalized Agile Metrics is defined to be translated representing an impact on

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the specific subset of Startup Metrics it touches, therefore showing a possible impact on the Business Aspects, Measures and Primes for the GBVF.

From Steps 1 and 2, it is realized that most of the Startup metrics are not mapped into a the GBVF. The GBVF framework is described as to visualize and measure the metrics that provide Business Value to the company. Of course, it has a part of the framework that describes how to add new elements for those that are not included, but in this case, the set of Startup Metrics is the result of literature review of 100+ cases of companies that have elements in common, which are relevant enough to have a fixed set of Business Aspects, Aggregates and Primes, also taking into account the growth of this kind of companies in world economy (InMind, 2019).

On the other hand, by analyzing the structure of the GBVF(Smith et al., 2017), the IT (Information Technology) Aggregate Measures and Primes have been classified as Support Services, only adding Primes about Service Performance, Service-Level, Cost, and others. This means that it does not consider companies in which IT and software development are the primary activities in their value chain. In the case of Startups, most of them have software and IT as core part of their value chain, that is the reason for finding metrics like “Development Time”, “Stability” (Frequency of software crashes), “Intent to use” (as “Data indicating that a new user is about to start using the software. E.g. imported custom data”(Kemell et al., 2018)) ; among others.

Additionally, for startups and other software companies, the participants like “User”, “Visitor”, “Customer” and “Leads”, have enough metrics related to be relevant, in contrast with traditional companies, in which there was only a “Client” at the end of the structure for their value chain.

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9.5.1 Step 1

With the first mapping from Startup (Business) Metrics into GVF, it is found that most of them are not able to be mapped to a GBVF Business Aspect, Aggregate Measure and Prime.

For that purpose, each metric has been assigned an Amber, Red, Green classification: Green, if the GBVF is the same metric as the one on the Startup list, or with little modification it can be adjusted to the GBVF metric; Amber if there is certain equivalence between both metrics, but the calculation is the opposite or big modifications need to be made to make both equivalent; and Red if there is no equivalent metric on the GBVF for the metric on the Startup side.

This equivalence creates 3 (three) partitions on the set of Startup Metrics like this:

1. Metrics that have GBVF equivalent. This means that for them, the GBVF metric fit is Amber or Green.
2. Metrics that are Financial Metrics, then they cannot be in the GBVF, since this framework aims to fill the gap between Financial Metrics and others that can provide value. These metrics have GBVF metric fit of Red, and other fields do not Apply.
3. Metrics that do not have a GVBF equivalent and they are not Financial metrics. These are useful, because it what the GBVF is currently missing. These also give information about sides of the platform that are being seen by Startups, but not for the GBVF.

These three partitions are represented in tables Table 8. First Partition: Equivalence between Startup (Business Metrics) and the Gartner Business Value Framework Business Aspects, Table

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9. Second Partition: Startup metrics that are Financial Metrics and Table 10. Startup Metrics with no GBVF equivalent and the possible sides on the Multisided Platform network.

Table 8. First Partition: Equivalence between Startup (Business Metrics) and the Gartner Business Value Framework Business Aspects. Source: Own elaboration

| Startup Context Business Metrics (Kemell et al., 2018) | | Gartner Business Value Framework (Smith et al., 2017) Equivalent /Financial Metrics | | | GBVF Metric Fit (Red, Amber, Green) | Comments | Multisided Platform application | |
|--|--|---|-----------------------|--------------------------|-------------------------------------|---|---------------------------------|---|
| Abandonment [12] | Transactions abandoned before completion | Demand Management | Sales Effectiveness | Sales Close Index | Amber | The startup metric is related to the Abandonment of transactions, and Sales Close Index is (Successful prospect sales decisions / Total prospect sales decisions), then the metric in this case have to be replaced by (1- Successful prospect sales decisions)/ Total prospect sales | Customer | Transactions |
| Acceptance Rate [12] | Avg. no. invites accepted by new users | Demand Management | Sales Effectiveness | Sales Opportunity Index | Amber | The GBVF metric is a calculation on Contacts by prospects last month over a function on the average of contacts over the last year. Contacts can be replaced by likes on this calculation. | User | Number of invites accepted by new users |
| Active User Growth Rate [12] | No. new active users in a time period | Demand Management | Market Responsiveness | Target Market Index | Amber | The market in the startup case is in terms of users, whether they are paying or not. However, the GBVF is calculated in terms of revenue. | User | Active |
| Amplification Rate [25] | No. shares on social media per customer | Demand Management | Market Responsiveness | Opportunity/Threat Index | Amber | The metric can be used in terms of number of shares of the market (replacing it on the Market Share Index for top revenue leaders as it is defined now) to comply | Customer | Shares |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Gartner Business Value Framework (Smith et al., 2017) Equivalent /Financial Metrics | | | GBVF Metric Fit (Red, Amber, Green) | Comments | Multisided Platform application | |
|--|---|---|-------------------------|-----------------------------|-------------------------------------|--|---------------------------------|----------------|
| Annual Contract Value [13, 17, 22] | Avg. annualized revenue per customer contract | Demand Management | Market Responsiveness | Channel Profitability Index | Amber | The calculation could be another index called "Customer profitability index" and replace the costs by channel, by the costs incurred in servicing each customer. | Customer | Contract |
| Average Time on Hold [12] | Time user spends on hold when calling support | Supply Management | Customer Responsiveness | Service Performance | Amber | Metrics do not correspond entirely: The startup metric is more fine-grained than the GBVF one. The new metric can be calculated as Time on Hold/ Time of service and as an average per user. | User | Hold |
| Compounded Monthly Growth Rate [13] | Avg. % growth per month since inception, or another start point for measuring. | Demand Management | Market Responsiveness | Market Coverage Index | Green | The metric on GBVF is calculated by total revenue over the whole industry. The measure is the same but in the case of this startup metric the global accumulated average is used. | | |
| Facebook Likes [5] | Number of likes on firm Facebook page | Demand Management | Sales Effectiveness | Sales Opportunity Index | Amber | Likes in Facebook can be translated into traditional contact prospects, in which the calculation is made for the Sales Opportunity Index. | Ads | Facebook Likes |
| Intent to Use [28, 34] | Data indicating that a new user is about to start using the software. E.g. imported custom data | Demand Management | Sales Effectiveness | Sales Opportunity Index | Amber | From the data gathered, contact prospects can be inferred, in which the calculation is made for the Sales Opportunity Index. | User | Intent of use |
| Operation Efficiency [15, 18] | Comparison of firm expenses by source | Supply Management | Operational Efficiency | Asset Utilization | Amber | The startup metric refers to cost per area, while the GBVF refers to the revenue vs cost of assets as Operational Efficiency. | | |
| Platform Risk [13] | Dependence on a specific platform or channel | Demand Management | Market Responsiveness | Configurability Index | Green | Configurability index measures the revenue by product options; thus the metric applies well to the startup one. | | |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Gartner Business Value Framework (Smith et al., 2017) Equivalent /Financial Metrics | | | GBVF Metric Fit (Red, Amber, Green) | Comments | Multisided Platform application | |
|--|--|---|-------------------------|---------------------|-------------------------------------|--|---------------------------------|--|
| Sell-through rate [13] | No. units sold in a time period in relation to the no. items in inventory at its beginning | Demand Management | Sales Responsiveness | Forecast Accuracy | Green | Forecast accuracy metric applies well, since it measures how well the sales function predicts demand over actual sales. | | |
| Stability [9] | Frequency of crashes in software use | Support Services | IT Responsiveness | System Performance | Green | The metric from GBVF is actually the other way around: a ratio of the total available time for the system, over the time it should be available. The startup metric should be 1-System Performance to find, not the frequency, but the percentage of unavailability of the system. | | |
| Total Addressable Market [13, 17, 50] | Total hypothetical market size | Demand Management | Market Responsiveness | Target Market Index | Green | These 2 metrics correspond 100% | | |
| Uptime [40] | Percentage of time software or website is available and operational | Supply Management | Customer Responsiveness | Service Performance | Green | This metric corresponds exactly with GBVF one. | | |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

Table 9. Second Partition: Startup metrics that are Financial Metrics. Source: Own elaboration

| Startup Context Business Metrics (Kemell et al., 2018) | | |
|---|--|--------------------------|
| Annual Recurring Revenue [13, 22, 41] | Predictable revenue annually (e.g. subscriptions) | Financial Metrics |
| Annual Run Rate [13] | Projected annualization of monthly recurring revenue | Financial Metrics |
| Billings [13] | Current quarter revenue plus deferred revenue from previous quarter | Financial Metrics |
| Breakeven Analysis [3] | Analysis to determine the point where revenue covers the costs of receiving it | Financial Metrics |
| Burn Rate [8, 15, 18] | Rate at which available capital is used | Financial Metrics |
| Capital Raised to Date [23] | Amount of investment capital raised in total | Financial Metrics |
| Cash Flow Forecast [3] | Forecast of financial liquidity in a period of time | Financial Metrics |
| Cash on Hand [19] | Available capital | Financial Metrics |
| Committed Weekly Recurring Gross Profit [45] | Percentage increase in profits weekly committed recurring profit | Financial Metrics |
| Cost of Goods Sold [23] | Cost of products or services sold (e.g. hosting) | Financial Metrics |
| Deferred Revenue [13] | Revenue received in advance of earning it | Financial Metrics |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | |
|---|--|--------------------------|
| Fixed vs. Variable Costs [3] | A measure of total spending split by source. | Financial Metrics |
| Gross (Cash) Burn [13] | Monthly expenses and any other outlays | Financial Metrics |
| Gross Margin [7, 13, 15] | Total revenue compared to cost of goods sold | Financial Metrics |
| Gross Profit [13, 17, 22] | Total revenue minus cost of goods sold | Financial Metrics |
| Payback Time [25] | Time to recoup from an expense via revenue | Financial Metrics |
| Profit Margin [17, 25, 30] | Revenue minus cost divided by revenue for a product. Different ways to measure for e.g. Software-as-a-Service companies. | Financial Metrics |
| Revenue [5, 17, 22] | Total Revenue | Financial Metrics |
| Revenue Growth Rate [41, 43] | | Financial Metrics |
| Revenue Run Rate [11, 15] | | Financial Metrics |
| Total Contract Value [13, 17, 22] | Value of one-time and recurring charges | Financial Metrics |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

Table 10. Startup Metrics with no GBVF equivalent and the possible sides on the Multisided Platform network. Source: Own elaboration

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|---|---|--|---------------------------------|
| Activation Rate [8, 13, 25] | Number of visitors or users performing a specific action such as registering or installing Active | Visitor/User | Actions |
| Ad Inventory [12] | Total views of each ad in a time period | Ads | Views |
| Ad Rates [12] | Value of each ad. inventory | Ads | Value |
| Avg. Revenue per User [13, 15, 25] | Avg. revenue per user over a time period | User | Revenue |
| Avg. Revenue per Customer [13, 17, 25] | Avg. revenue per customer over a time period | Customer | Revenue |
| Bounce Rate [8, 40] | Percentage of visitors leaving website quickly | Visitor | Number leaving the site quickly |
| Campaign Contribution [12] | Added revenue from an ad campaign | Ads | Revenue |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|--|---------------------------------|--------------------------------|
| Churn Rate [1, 15, 17] | Lost users or customers over a time period | User | Lost in Period |
| Click-Through Rate [12] | Visitors that clicked a specific website link | Visitor | Clicked in link |
| Content Creation [12] | No. visitors that interact with website content | Visitor | WithWe bContent |
| Conversion Rate [1, 8, 17] | No. visitors that become users or customers, or no. users that become customers. | Visitor | To User/ Customer |
| Customer Acquisition Cost [3, 7, 8] | Average cost of acquiring a paying user. | User | Cost of having paying users |
| Customer Acquisition cost to life-time value ratio [11, 30] | Customer Acquisition Cost vs. Customer Life-time Value | Customer | Acquisition Cost/Value |
| Customer Concentration [13, 31] | Revenue from largest customer vs. total revenue | Customer | Largest Revenue/ Total revenue |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|---|---------------------------------|--------------------------------------|
| Customer Count [39] | Total number of customers (paying users) | Customer | Total number of customers |
| Customer Retention Cost [25] | Amount of spending on customer retention | Customer | Retention Cost |
| Daily Active Users [9, 11, 13] | No. users who use the software daily | User | Active Daily |
| Daily Active Users to Monthly Active Users ratio [25] | A more detailed measure of user activity | User | Active Daily to Monthly Active Ratio |
| Development Time [18, 39] | Time it takes to implement a new feature | Development | Time |
| Direct Traffic [13] | Traffic coming in directly | Visitor | Direct |
| Downloads or Installs [22] | Total amount of downloads or installs | Customer/User | Download/Install |
| E-mail Conversion Rate [34] | Number of recipients that e.g. became users | Ads | Email Conversion |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|---|---------------------------------|--------------------------|
| E-mail Open Rate [34] | No. mailing list members that open an email | Ads | Email Open |
| Frequency of Logins [17] | Average frequency of user logins | Customer/User | Login Frequency |
| Frequency of Visits [25] | Average frequency of visits to e.g. website | Visitor | Frequency |
| Gross Churn Rate [13, 37] | Total users lost | Customer | Churn |
| Innovation Metabolism [14] | Number of build-measure-learn cycles | Team | Innovation Metabolism |
| Invitation Rate [12] | Avg. no. invites sent per existing user | User | Avg shares |
| Launch Rate [12] | No. downloaders that launched the software | User | Downloaders & Installers |
| Leads [29] | An estimate of prospective customers. | Customer | Prospective |
| Lead-to-Customer rate [29] | Number of leads converted into customers | Customer | Lead to Customer rate |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|--|---------------------------------|--------------------------------|
| Life-time Value [3, 7, 8] | The average total revenue a customer generates | Customer | Average total revenue |
| Likes per Post [34] | Likes per social media post | Ads | Likes per post in social media |
| Number of Logins [5, 13] | Logins per user over a period of time | User | Logins Per Period |
| Number of Transactions [39] | Number of transactions made in a time period | Customer/ User | Transactions |
| Office Morale [5] | How motivated the team is | Team | Morale |
| Organic Traffic [13] | Unpaid traffic from e.g. Google search results | Visitor | Unpaid Traffic |
| Payment failures [45] | Number of failed transactions from users | User | Transactions Failed |
| Prospects [12] | Number of users that might become customers | Customer/ User | Users to become Customers |
| Purchases [12] | No. purchases made by a user in a time period | User | Number of purchases in period |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|---|---------------------------------|--|
| Recency [21] | Days since last visit of user | User | Days since last visit |
| Referrals from current users [8, 27, 31] | How often current users refer new users | User | Frequency of referral |
| Referral rate [1] | Volume of referred users or purchases | User | Number of referred users |
| Registered Users [17] | Total number of registered users | User | Total registered users |
| Repurchase Rate [23] | No. customers that made a purchase during the previous and current period of time | Customer | That made a purchase last and current period |
| Retention Rate [1, 7, 8] | Percentage of users or customers still using the service after a period of time | Customer/ User | Percentage using the service in a period |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|---|---------------------------------|--|
| Retention by Cohort [13] | % of original user base still using the software or conducting transactions in it | User | Percentage from original user base still using the service |
| Return on Advertisement Spending [7] | Profits divided by advertisement spending | Ads | Return |
| Reviews Considered Helpful [12] | Number of reviews considered helpful | Ads | Helpful Reviews |
| Reviews Written [12] | Number of reviews written | Ads | Reviews written |
| Session Interval [17] | Average time between software use sessions | User | Software session interval |
| Session Length [17] | Length of average software use session | User | Avg session length |
| Social Media Reach [34] | Post reach within e.g. Twitter or Facebook | Ads | Post reach on Twitter / Facebook |
| Sources of Traffic [17, 27, 31] | Source and volume of user traffic per source | Visitor | Traffic sources |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|---|---------------------------------|---|
| Time to Customer Breakeven [12, 30] | Time it takes to recoup from Customer Acquisition Cost | Customer | Breakeven (Cost-Value) |
| Time to First Purchase [12] | Avg. time users take to become customers | Customer | Avg time to first purchase |
| Top Keywords Driving Traffic to You [12] | Search terms used by visitors to find your site | Visitor | Top Search Terms to find site |
| Top Search Terms [12] | Both those that lead to revenue, and those that don't have any results. | Visitor | Top Search Terms that leave revenue / With no results |
| Total Ad Clicks [12] | Number of advertisements clicked by visitors | Visitor/Ads | Clicked by visitors |
| Total Number of Customers [8, 32] | | Customer | Total number |
| Total Number of Users [5, 50] | Based on e.g. registered user accounts | User | Total number |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| Startup Context Business Metrics (Kemell et al., 2018) | | Multisided Platform application | |
|--|---|---------------------------------|---|
| Traffic [1, 5, 18] | Total number of website visits (non-unique) | Visitor | Total number of not unique visits |
| Traffic-to-Leads [1] | Total traffic in relation to potential customers | Visitor | Visitor to Lead |
| User Acquisition Rate [5, 9] | Total new non-paying users in a time period | User | Total new non-paying users in period |
| User Demographics [5, 9] | Avg. age, gender distribution, location etc. | User | Demographics (age, location, distribution, gender) |
| User Engagement [9, 17, 28] | Measured through e.g. login frequency. Definition depends on context. | User | Engagement |
| Unique Visitors [11] | Unique website visitors during a time period | Visitor | Total number of Unique Visitors in a period |
| Viral Coefficient [11, 13, 32] | No. new customers each existing one converts | Customer | Number of customers that every existing one converts. |

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

9.5.2 Step 2

From Table 10. Startup Metrics with no GBVF equivalent and the possible sides on the Multisided Platform network, a set of sides are listed. Even though, sides from the metrics are being depicted, there are also sides that are not represented in the metrics.

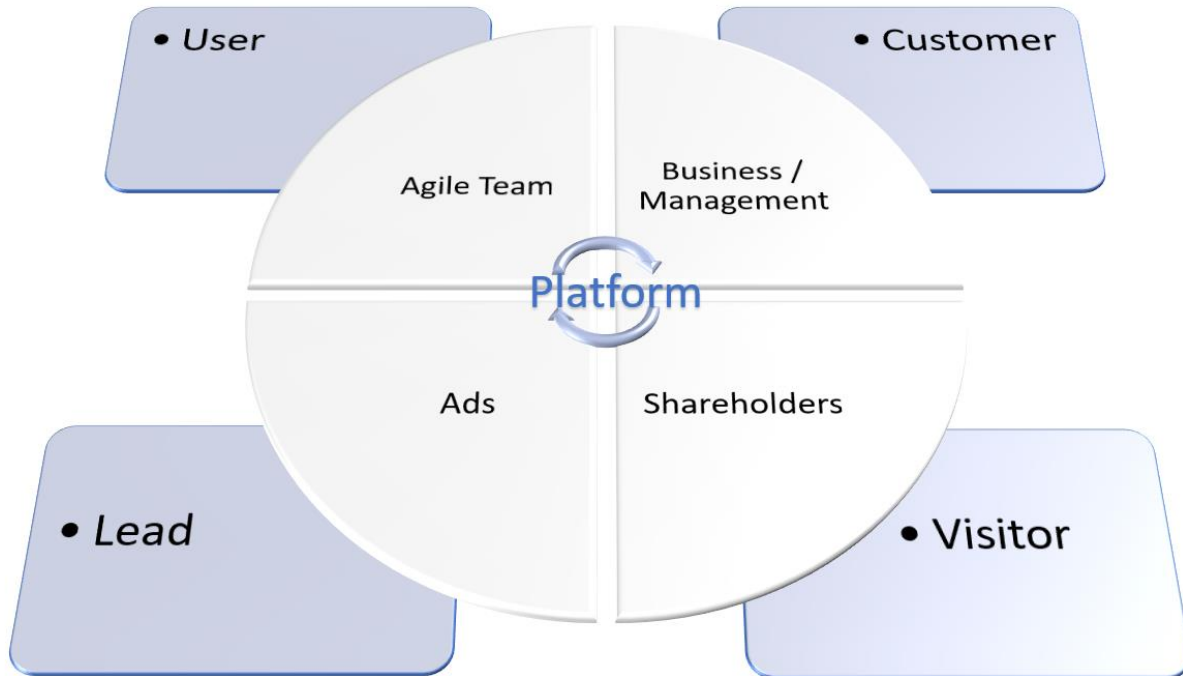


Figure 44. Sides for the platform modeled after the Startup Metrics analysis. Source: Own elaboration

As an extension of the “external” sides of the platform, “internal” sides of the platform were added.

External sides of the platform are composed of those stakeholders who do not have direct control over the platform, whereas **internal** sides are composed of those stakeholders who are in control or make part of the platform, then are those stakeholders/elements that belong to the company that develops the system at hand.

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In this case, and as depicted in the Figure 44. Sides for the platform modeled after the Startup Metrics analysis., the list of sides has been deduced from the Table 10. Startup Metrics with no GBVF equivalent and the possible sides on the Multisided Platform network and the following descriptions are assumptions about the roles of any software platform:

External sides

- **User:** Is a participant that has created an account on the platform, therefore they are able to use frequently some features, but not necessarily those that require any payment.
- **Customers:** A customer is a participant who can use advanced features because they have paid for these functionalities to be available, or they have bought the service by a periodic payment (monthly, annually, lifetime, etc).
- **Visitor:** A visitor is a participant on the platform, who just casually interacts with the most public features of it. This participant does not hold an account; thus, the specific identification data is not available on the platform, besides that the analytic tools can provide.
- **Lead:** This participant may not be a visitor, a user, or a customer on the platform, but he has been contacted by the company representatives to become a user/customer, or at least to visit the platform. For some specific, demographic or social (from reference on their social networks) reason, they are good fit to become a user or a customer on the platform.

Internal Sides

- **Agile Team:** This set of participants is the one that develops the platform and they oversee activities such as adding, modifying and removing features from the platform. They are concerned about the quality of the platform and are responsible to maintain it.
- **Business/Management:** These participants are experts in the Business in which the platform is developed. They request the Agile Team/Teams for new features or solving issues and interact with participants from the External Sides to understand and monitor their satisfaction with the platform. They also interact with investors and shareholders to obtain capital for the platform and its maintenance and evolution.
- **Shareholders:** These are investors in the Startup Company, they are interested in the dividends that the Business and its platform can provide. They provide the capital or resources to make sure the company is sustainable and keeps growing in time.
- **Ads:** This participant is a set of advertising strategies that are measured in their effectivity with respect to external sides: users, visitors, customers and leads, in a way that they obtain the information intended in their interaction with the platform, increasing their engagement and participation. Ads are not people or an active element, however there were enough metrics involved in having metrics on this aspect, that they were include as another internal side.

In summary, this sides analysis, provides perspective into what groups of participants are involved with the platform and what represent Business Value in it for them. Having this information as guide, the Business set of metrics should include a set of metrics that can provide

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useful data from them and how this Value is being obtained. It is worth noticing that, in this case, the sides have been inferred from the Startup Business metrics, however in the real life, this analysis would be performed

9.5.3 Step 3

The Figure 45. Agile Metrics vs Startup (Business) Metrics Heatmap depicts the relationship between the Normalized Agile Metrics defined in a previous section and the Startup Metrics taken as the Business Metrics that a model (ideal) Startup would have. The Heatmap has been designed to find a relationship between each Agile Metric and one or more Business Metric and vice versa. The numbers, from 0 to 5 in magnitude, represent how much the metrics are related. For instance, if one metric definitely impacts the other, the magnitude of the relationship is 5; on the other hand, the Agile Metric would have a mild impact on the Business Metric, the magnitude is 3; or finally, if they don't have any relationship whatsoever, the magnitude is 0. Additionally, the magnitudes have a negative value if the metric are negatively related with one another: for example, if the measure of one metric is supposed to increase, the other will have to decrease. This, based on the nature of the metrics, like for instance, if the altitude raises, the temperature decreases for altitude climatic zones.

Just as a clarification, the figure represents only a subset of the Business Metrics, but it can be extended to any length, preferably the whole set of Metrics. The use of this Heatmap can provide visibility from the team about their impact on the organization; and from the Management and Business to understand how aspects like Technical Debt, Quality Metrics, and Team Morale could affect Profitability, Revenue, etc.

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Even though it uses numbers, this Heatmap is not standard, it is supposed to be created at the beginning of the Agile Project, with both the Agile Team and the Business, Managers, and Stakeholders. The values on this Heatmap depend on the actual Business, for example, the Business Metric “Total views of each ad” may involve a feature developed from the actual Agile project, for instance the development of the component in which Ads are added. In that case, the Number of defects; Code Complexity, and Technical Debt of the Agile side, may have more impact, than another project in which the Ad component is not included in the set of features for the project.

EQUIVALENCE OF AGILE METRICS AND BUSINESS METRICS

| | | Startup (Business) Metrics | | | | | | | | | | | | | | | | |
|--------------------|--|--|--|---|---------------------------------------|---|-----------------------------|---|---|--|--|--|--|---|--|--|---|---|
| Agile Metrics | | Abandonment [12] | Acceptance Rate [12] | Activation Rate [8, 13, 25] | Active User Growth Rate [12] | Ad Inventory [12] | Ad Rates [12] | Amplification Rate [25] | Annual Contract Value [13, 17, 22] | Annual Recurring Revenue [13, 22, 41] | Annual Run Rate [13] | Avg. Revenue per User [13, 15, 25] | Avg. Revenue per Customer [13, 17, 25] | Average Time on Hold [12] | Billings [13] | Bounce Rate [8, 40] | Breakeven Analysis [3] | Burn Rate [8, 15, 18] |
| Metric Description | | Transactions abandoned before completion | Avg. no. invites accepted by new users | Number of visitors or users performing a specific action such as registering or | No. new active users in a time period | Total views of each ad in a time period | Value of each ad. inventory | No. shares on social media per customer | Avg. annualized revenue per customer contract | Predictable revenue annually (e.g. subscription s) | Projected annualization of monthly recurring revenue | Avg. revenue per user over a time period | Avg. revenue per customer over a time period | Time user spends on hold when calling support | Current quarter revenue plus deferred revenue from | Percentage of visitors leaving website quickly | Analysis to determine the point where revenue covers the costs of | Rate at which available capital is used |
| 1 | Amount of revenue a customer is willing to pay for a feature | 0 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | -5 | 5 |
| 2 | Effort estimation metrics used to size the feature | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 0 | 3 | 3 | 3 |
| 3 | Velocity metrics to calculate how many features the team can complete in an iteration | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| 4 | Effective available hours from team members, useful to select tasks for an iteration | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 5 | 5 | 5 | 0 | 5 | 0 | 3 | 3 |
| 5 | Number of artifacts completed | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 0 | 0 | 0 | 0 |
| 6 | Number of work items (Stories, epics, tasks) completed. Percentage of completed vs committed. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 0 | 0 | 0 | 0 |
| 7 | Number of work items that the team delivers per iteration (Average number ofwork items delivered per iteration) | 0 | 3 | 4 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 0 | 0 | 3 | 3 |
| 8 | Feedback from product demonstrations | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Build status | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| 10 | Time to fix a failed Build | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| 11 | Product Size | 0 | 0 | 4 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | Number of defects | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -5 | -5 | -5 | -5 | 0 | -4 | 0 | 0 |
| 13 | Time to fix defects | 0 | 0 | -3 | -3 | -3 | 0 | 0 | 0 | 0 | -5 | -5 | -5 | -5 | 0 | -4 | 0 | 0 |
| 14 | Work in Progress | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -4 | 0 | 0 |
| 15 | Lead time | 0 | 0 | 3 | 0 | 3 | 3 | 3 | -4 | 3 | 3 | 3 | 3 | 3 | 5 | 0 | 0 | 0 |
| 16 | Flow efficiency | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 0 | 0 | 0 |
| 17 | Static Code Check Metrics | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | Product test metrics | 0 | 0 | 3 | 0 | 3 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | -5 | 0 | 5 | 3 | 0 |
| 19 | Number of (automated) tests written before code | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 5 | 0 | 5 | 3 | 0 |
| 20 | Technical debt | 0 | 0 | -3 | 0 | 0 | 0 | 0 | -5 | -3 | -3 | 0 | 0 | -5 | -3 | -3 | -5 | 0 |
| 21 | Customer Satisfaction | -3 | 3 | 4 | 0 | 4 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | -5 | 4 | 4 | 5 | 0 |
| 22 | Quality Indicators | 0 | 0 | 4 | 0 | 4 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | -5 | 4 | 4 | 5 | 0 |
| 23 | Customer metrics | 5 | 0 | 5 | 5 | 4 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | -5 | 0 | 4 | 5 | 0 |
| 24 | Escaped defects | 0 | 0 | -4 | -5 | -4 | -3 | -3 | -5 | -5 | -5 | -5 | -5 | 0 | 0 | -3 | -5 | 0 |
| 25 | Change requests sent by customers | 0 | 0 | 5 | 3 | 4 | 3 | 4 | -5 | -5 | -5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 |
| 26 | Product Net Promoter Score | 4 | 0 | 5 | 5 | 5 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | -5 | 0 | -5 | 5 | 0 |
| 27 | Predicted Defect count | 0 | 0 | 0 | -3 | -3 | 0 | -3 | -5 | -5 | -5 | -5 | -5 | 0 | 0 | 0 | 0 | 0 |
| 28 | Expected Maintenance effort | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -5 | -5 | -5 | -5 | -5 | 0 | 0 | 0 | 0 | 0 |
| 29 | Expected deferred defect count | 0 | 0 | 5 | 3 | -3 | 0 | -3 | -5 | -5 | -5 | -5 | -5 | 0 | 0 | 0 | 0 | 0 |
| 30 | Budget at Completion (BAC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 5 | 0 | 5 | 5 | 5 | 0 |
| 31 | Actual Weeks (AW) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | Planned Percent Complete (PPC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | Actual Percent Complete (APC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 45. Agile Metrics vs Startup (Business) Metrics Heatmap. Source: Own elaboration

9.6 Finding equivalence between Agile metrics and Business metrics through Proposed Framework elements

In the previous section, elements from the theoretical framework have been used to find a mapping between Agile and Business metrics, however, the purpose of having a framework is also to address those gaps that have been found both in literature and in practice (from survey data) about managing Agile Metrics and their relationship with Business. This section aims to fill these gaps, proposing additional elements for an Agile – Business Metrics Equivalence Framework.

9.6.1 Depict the Agile Software Development Value Chain

One of the gaps to be able to visualize metrics from an Agile Project in Business Metrics, is the fact that the IT and Development activities are Support Activities, even for companies in which their core activity is to provide Software Development services. Since the model Value Chain show them on the Support Activities section, it looks as it is not considered as part of Primary Activities, as shown in the set of Business Aspects, Aggregate Measures and Primes of the GBVF. This fact makes difficult to consider them in the right dimension and to make the metrics from the Agile team with the importance they deserve on the set of Business Metrics.

Even though, there are already depictions of Software Development Value Chain, one of the proposed elements of the framework is this diagram, specific for a company in which the main source of value is the Agile Software Development. The Figure 46. Proposed Agile Software Development Value Chain shows a proposal for an Agile Software Development Value Chain.

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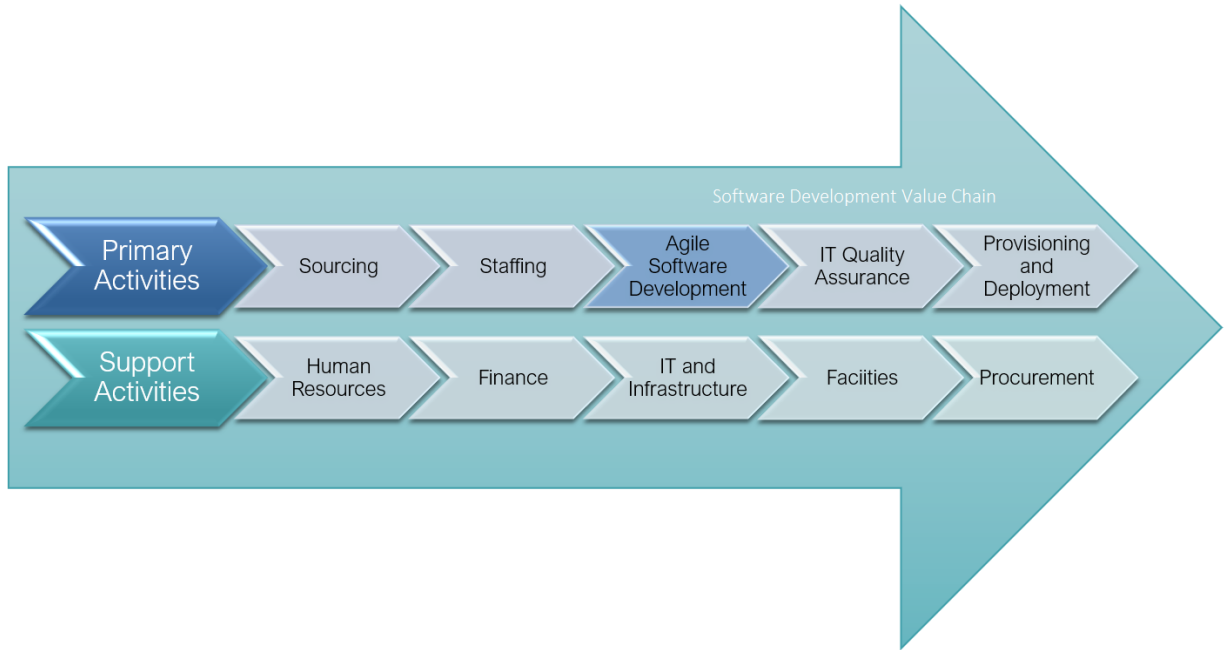


Figure 46. Proposed Agile Software Development Value Chain. Source: Own elaboration

9.6.2 Complement the GBVF with fixed Business Aspect, Aggregates and Primes for Agile Software Development

A consequence of having Agile Software Development in the set of the Primary Activities, is that we can add Aggregate Measures and Primes specific for each activity that are relevant to create value for the Software Development company. As the Figure 47. Gartner Business Value Model Adjusted to Agile Software Development Companies., shows, The GBV Model can be adjusted to the Primary and Support Activities specific to the company, therefore the set of indexes are those that describe the value for this kind of companies.

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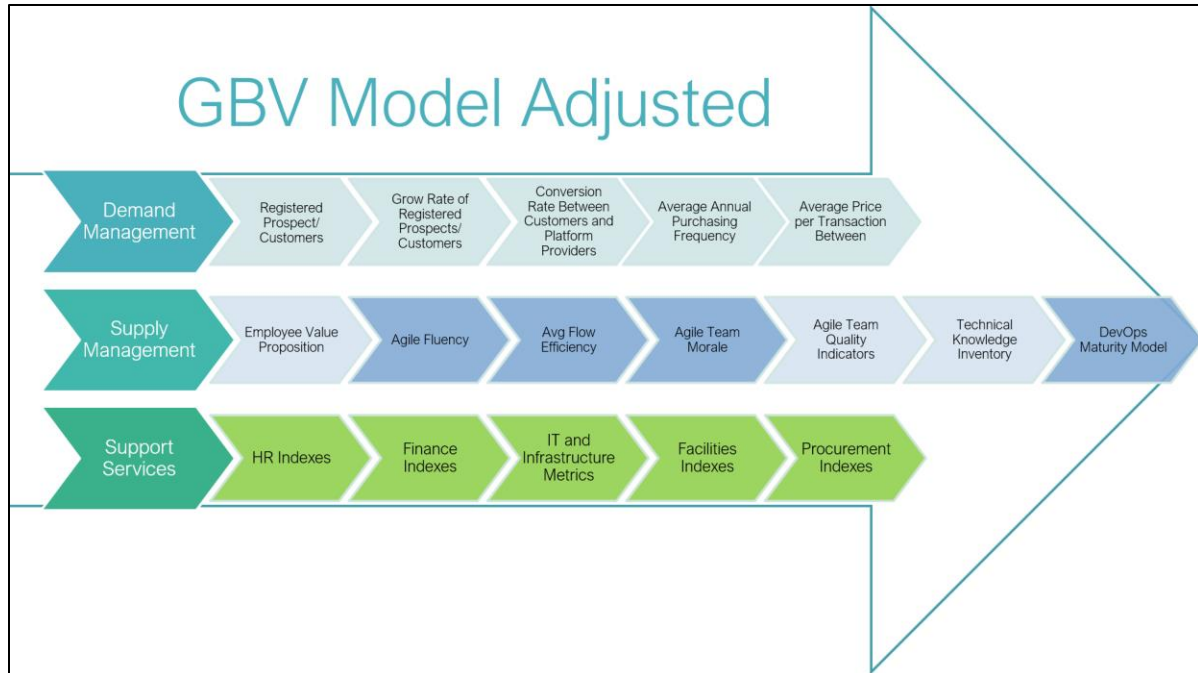


Figure 47. Gartner Business Value Model Adjusted to Agile Software Development Companies. Source: Own elaboration

In this example from the Figure, The Demand Management are a subset of the metrics from the Leading Indicators for Digital Business from the GBVF (Smith et al., 2017, pp. 195–196); in the Supply Management section, new indexes have been created to be able to show the value of the core activity Agile Software Development, Sourcing and Staffing, IT Quality Assurance, and Provisioning and Deployment; and for the last part, the Support Services have been portrayed in a generic manner as a set of indexes that maybe represented in this adjustment.

It is worth noticing, that the figure above is just an example, and does not mean to be an extensive set of the metrics for a company, but represent well how the GBVF can be adjusted to fit Agile metrics when they are the core for the value offered by a specific business. In this example, Aggregate Measures have been discarded, but let's say that one Aggregate Measure can be Agile

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Software Development, grouping the defined primes in darker blue on the “Supply Management” row; “Employee Value Proposition” may belong to the Aggregate Measure of “Sourcing” , corresponding to the activity.

9.7 Finding equivalence from Agile Metrics to Financial Metrics on the Business side

By finding the subset of Financial Metrics on Table 9. Second Partition: Startup metrics that are Financial Metrics, it is easier to verify how to map the Normalized Agile Metrics with this kind of metrics. From the results of the survey, it was clear that this is an important gap, found by the population interviewed.

Having already a partition with Business Metrics related to Financial Indicators, the technique proposed is to take each Agile Metric and finding an equivalence, or a way to connect this metric from the Agile project. In the Table 11. Mapping from Agile Metrics to Financial Business Metrics, there is a subset of the Agile Metrics defined previously as Normalized Agile Metrics and their mapping to the “Annual Recurring Revenue” Financial Metric. The purpose is not to find 100% mapping since it may not be one, however a way to contrast at a given point what is the impact for a specific project at a given time for that metric.

This can be a cumbersome work to perform, however it can be done once and kept registers periodically of the specific measures, in order to give management an idea of the importance of the project, Agile Team and Features developed, over all the financial perspectives that give value to the Business.

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| Mapping from Agile to Financial Business Metrics | Financial Metrics |
|---|---|
| Agile Metrics | Annual Recurring Revenue [13, 22, 41] |
| Amount of revenue a customer is willing to pay for a feature | Amount of revenue customer is willing to pay for a feature/ Annual recurring revenue. This can be calculated for every feature, or even by project. |
| Effort estimation metrics used to size the feature | Cost of the effort vs the Annual Revenue is expected to bring. |
| Velocity metrics to calculate how many features the team can complete in an iteration | Velocity in story points does not represent anything from the business perspective, however they can be translated into weeks by the size of the team (effort) vs the Annual recurrent revenue that a set of given features is expected to deliver. |
| Effective available hours from team members, useful to select tasks for an iteration | Cost of the available hours multiplied by the size of the team, vs the revenue of avg set of features. This can be compared with the Annual Recurring revenue. |
| Number of artifacts completed | If the artifacts completed represent something for the business this metric is worth comparing from the revenue, they are expected to create |
| Number of work items (Stories, epics, tasks) completed. Percentage of completed vs committed. | Annual recurring Revenue expected from the set of work items compared with Total Annual Recurring revenue. |

Table 11. Mapping from Agile Metrics to Financial Business Metrics. Source: Own elaboration.

9.8 Finding value of features developed by the Agile Team

An Agile Project can provide value in many ways, the most tangible way is to deliver features for the systems provided to the customers or internally to a Software Development company. One way

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to show this value in metrics that Business can visualize is to portray the features answering the following questions:

- How many features developed by the team are involved with registration of user and customers?
- How much is this feature worth in User / Customer Revenue periodically?
- How much would the company lose by day, hour or minutes when this feature is down?
- What is the Agile team cost/feature value ratio? In other words, is it worth the effort of developing or maintaining the feature versus the value it provides for the company?

The answers to these questions, make tangible the value of the work performed by a given Agile Project in terms of the features developed. The feature set developed and how effectively they have been deployed in production are a good indicator that the project deserves to be continued.

To find the answer to questions above, it is useful to know how much the value of the Agile project result is. That project result may be a component, or an entire application and the Business may have an idea of the revenue brought by the project, however it is not usual to have about the value of the project. One way to know the value of a given feature is to keep a register of the values as shown on Table 12. Calculation for feature (minimum) value and Break-even value for revenue of a component or system.

The value calculated in this table represents the minimum value represented by the application or component by feature. It is called minimum because from that point and below the company starts to generate loss in terms of resources: having the feature in production makes the investment vs cost be zero. Similarly, from that point and onwards, the feature or component start to generate

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revenue. This revenue is usually known by the Business in terms of how the functionality in the feature or the system produces for the company. This is very clear for features involving transactions: those features that immediately monetize for the company, however not so clear for other features like those involving improvements in UX, or other features that do not directly monetize.

By calculating the expected or actual revenue by feature, it may be easier, not only to prioritize tasks for the team, but also see if the feature development is worthy in financial terms for the company, and the project value throughout the development cycle.

| Feature | Value | Description |
|---|--------------------|---|
| Feature 1 | V1 | Cost of not having feature 1 on production |
| Feature 2 | V2 | Cost of not having feature 2 on production |
| Feature 3 | V3 | Cost of not having feature 3i on production |
| ⋮ | ⋮ | |
| Feature k | Vk | Cost of not having feature i on production |
| ⋮ | ⋮ | |
| Feature n | Vn | Cost of not having feature N on production |
| Total Component or Application Value | $\sum_{k=1}^n V_k$ | Cost of not having the component or application on production = Break-even value for revenue |

*Table 12. Calculation for feature (minimum) value and Break-even value for revenue of a component or system.
Source: Own Elaboration*

As can be seen on Table 13. Finding both value and Revenue by feature to monitor their contribution to total Value and Revenue by application and component., Revenue by feature can be calculated and then summed to obtain the total for the component or application.

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| Feature | Value | Description | Revenue |
|---|--------------------|---|--------------------|
| Feature 1 | V1 | Cost of not having feature 1 on production | R1 |
| Feature 2 | V2 | Cost of not having feature 2 on production | R2 |
| Feature 3 | V3 | Cost of not having feature | R3 |
| ⋮ | ⋮ | | ⋮ |
| Feature k | Vk | Cost of not having feature i on production | Rk |
| ⋮ | ⋮ | | ⋮ |
| Feature n | Vn | Cost of not having feature N on production | Rn |
| Total for Component or Application | $\sum_{k=1}^n V_k$ | Cost of not having the component or application on production = Break even value for revenue | $\sum_{k=1}^n R_k$ |

Table 13. Finding both value and Revenue by feature to monitor their contribution to total Value and Revenue by application and component. Source: Own elaboration

By obtaining these two values, it is easier to see the value that the Agile team is delivering. Since the development of the product is a variable cost, the contribution margin method is a good tool to use in this calculation. The cost of the team is the rate for each member of the team summed by developed cycle:

$$\text{Value Provided by Agile Project} = \text{Total Revenue} \left(\sum_{k=1}^n R_k \right) - \text{Cost of Team.}$$

Furthermore, this calculation can be done flexibly by the features developed by the project (it may be only a set of features within a given component or application) and it can even include features from several projects.

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These values can also be used to find the profit produced by feature or by component:

$$\mathbf{Profit (Feature } k) = Rk - Vk$$

And, of course, total profit by component/Application:

$$\mathbf{Profit (Component/Application)} = \sum_{k=1}^n Rk - \sum_{k=1}^n Vk$$

Additionally, the revenue or value delivered can be compared with that of the whole company

$$\mathbf{Revenue delivered (proejct or feature)vs Company Revenue} = \sum_{k=1}^n Rk / \mathbf{Company Revenue}$$

One interesting consequence is that the value provided by the Agile team can be calculated like this:

1. Find the set of features delivered by development cycle (sprint).
2. Calculate the value per feature.
3. Find the revenue by feature or total by development cycle (sprint).
4. Calculate the total revenue.
5. Find the average cost of the team by development cycle (sprint).

Then an equation like this can provide insight about how productive and valuable the team is:

$$\mathbf{Team Value(average)} = \mathbf{Total Value of features delivered by sprint} - \mathbf{Cost of Team by sprint}$$

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$$\textit{Team Revenue(average)} = \textit{Total Revenue of features} - \textit{Cost of team by sprint}$$

Hence, it is possible to answer most of the answers at the beginning of this section. However, a dependency on having data on how much a feature cost when being down and the actual revenue are usually metrics coming from the Business and analytics, then they are external to the Agile team. Communicating these values is important so both Business and team are motivated in improving and helping each other.

Alternatively, feature value can be measured in different ways, such as the cost of producing the feature; or how much it would return if it would be sold as a service. This is just a way to have a rough calculation of how much the feature is valued by the company.

Even though these equations have been used to calculate the impact on revenue, same analysis can be performed to calculate impact on other kind of Business metrics.

9.9 Making visible Agile Team contributions to Employee Value Proposition, Technical Capability and Competitive Advantage

Software Development companies need to be a good place to work for developers. Selecting and keeping the right talent, on top of having a reputation of a company that challenge their teams and uses the newest technologies is important, since skilled people are the equivalent of prime material for transformation companies.

The Employee Value Proposition (EVP) for a group of developers include, then, a challenging work, with top of the notch technologies, besides a nice work environment.

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The elements of the EVP for developers, and which are built continuously by their participation in interesting Agile Projects, may be visualized periodically like this:

- What is the skillset that the developers from the Agile Team have developed?
- Is there a capability to be offered externally? Examples of this are: Are there enough well qualified Automation testers to create a center of excellence that could become a Business Unit on their own? Is the team working on Big Data, able to provide services independently for other clients? etc. In these cases, an Agile project can become the source of new businesses for the company.
- How is the team morale in general for all the Agile Teams that belong to the company? Are there any common issues that are making team morale low? Does the company know what characteristics make teams eager to work on each Agile Project, and what others make them want to leave? Answers to these questions will crystallize the work environment developed by the Agile projects within the Software Development Company.

As it can be noticed, the elements as answers to these questions become assets to the company, and the degree of detail on them is useful information that can be proposed to future employees and build the reputation of the company. Another way of writing these elements is as follows:

- Skillset in software development technologies.
- Capabilities to be extended to new business units and offered to customers.
- Good working environment in terms of Team Morale.

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These three elements represent strong arguments for adding to EVP on top of salary and benefits. Furthermore, the skillset and capabilities can become a competitive advantage if the company has developed capabilities and a skillset that other companies have not achieved yet.

The analysis performed on Table 14. Analysis of skillset for an Agile Team, and its impact on Technical Capability, Competitive Advantage and Employee Value Proposition, allows to generate an insight about whether or not the Agile Team is generating a new Technical Capability, what skills are required and in what level : both for the current project and in general to generate a technical asset considered as part of the Competitive Advantage and Employee Value proposition.

The only aspect containing the “Required” column is the Machine Learning aspect, however it could be added for all technologies or the ones that can be applied at any given moment. This could lead to initiatives like training or courses for the members of the team, but that depends on how necessary it is, or how important it is for the company to generate such skills.

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| Agile Team Members | Technologies used | | | | | Emergent Technologies | | | Required skills | | Business Knowledge | | | Technical capability | | Competitive Advantage | Employee Value Proposition |
|--------------------|-------------------|-----|--------|-------|------------|-----------------------|-----|------------------|------------------|---------|--------------------|------------------|----------------------------------|---|---|---|----------------------------|
| | Java | Go | Python | Scala | Javascript | Blockchain | IoT | Machine Learning | Machine Learning | Finance | Insurance | Seniority | Technical capabilities generated | Technical capabilities expected | | | |
| | Member 1 | 80% | 50% | 80% | 10% | 100% | 70% | 80% | 50% | 90% | 80% | 50% | Architect | Blockchain development for Financial Apps | Machine Learning for Financial Apps | | |
| Member 2 | 90% | 20% | 20% | 70% | 80% | 50% | 70% | 50% | 70% | 80% | 50% | Senior Developer | | | Polyglotism in development team. | Participating in Financial projects with top technologies | |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | | | | Having a highly efficient development team that can reduce development costs | Belonging to an efficient team with an efficient process of delivery. | |
| Member k | 50% | 50% | 50% | 50% | 50% | 20% | 80% | 20% | 70% | 80% | 50% | Junior | | | Acquire good technological reputation in terms of technologies used, pioneering emergent technologies, and providing a challenging position for potential employees | Professional reputation belonging to a challenging company | |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | | | | | | |
| Member n | 70% | 70% | 70% | 70% | 80% | 50% | 50% | 50% | 70% | 80% | 50% | Senior Developer | | | | | |

Table 14. Analysis of skillset for an Agile Team, and its impact on Technical Capability, Competitive Advantage and Employee Value Proposition. Source: Own elaboration

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In general, to have clarity about how related these concepts are, giving as a result the table above, it can be said that the skillset of the members of the Agile team can become a Technical capability by the set of technologies in which they work. In some cases, it is not only the set, but also the combination of technologies that one member of the team knows.

Based on the skill set, variety of seniority and skill level a technical capability can be generated. This technical capability can become a new business unit for the company. If it does, this is part of a Competitive Advantage.

Technical skills are part of the Employee Value Proposition, given that developers should be interested in participating in projects with highly effective teams, working with the latest technologies, in a challenging environment and with a company with good reputation both in Business and Technical skills.

The relationship between these concepts can be observed in Figure 48. Relationship between Skillset, Technical capabilities, Competitive Advantage and Employee Value Proposition, taken from the analysis of the variables analyzed in Table 14. Analysis of skillset for an Agile Team, and its impact on Technical Capability, Competitive Advantage and Employee Value Proposition.

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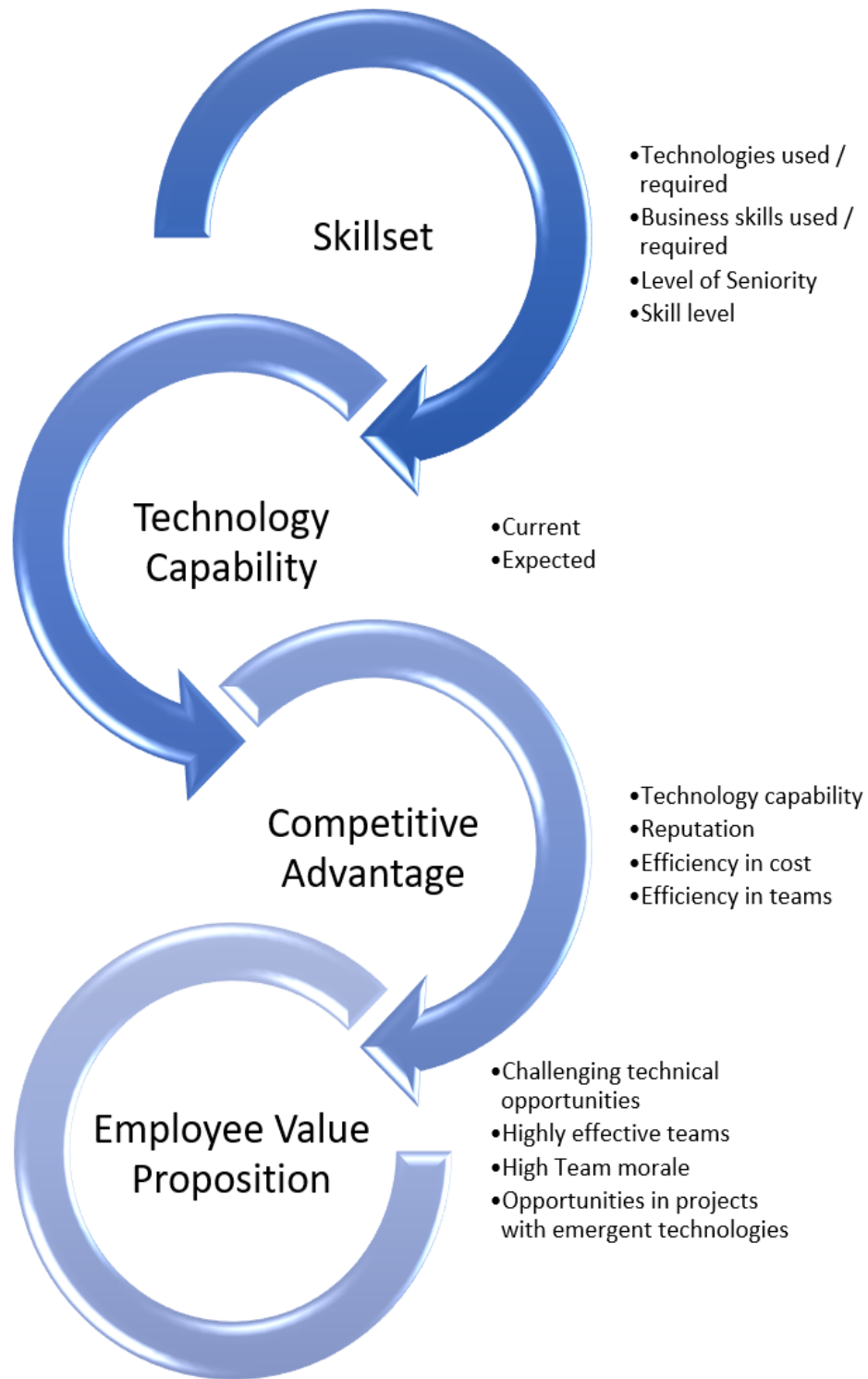


Figure 48. Relationship between Skillset, Technical capabilities, Competitive Advantage and Employee Value Proposition.
Source: Own elaboration

9.10 Proposed Framework Summary

This section sums up the set of framework elements proposed to answer main research question: “How to relate Agile Metrics to Business metrics?”. In the Table 15. Agile to Business metrics equivalence framework elements. Source: Own elaboration , each element is connected to a suggested Development Lifecycle Phase (sprint, iteration, etc); the roles that participate in its creation/implementation, modification and monitoring. Following the concept of the X-team, meaning an Agile development team and interacts directly with any level of the organization(Schwartz, 2016, Chapter 3. The Culture), the Agile team participate in most steps of the process.

The word “Implement” means that the framework element is already created, however it is modified so that it describes current situation for the project. Then a specific set of Normalized Agile metrics is an implementation of the set of Agile Metrics described as part of this framework. Additionally, “Monitor” and “Update” means that these artifacts are subject to change at any point, even if it means that they should be re-implemented from scratch, just like Agile mindset states.

Similarly, it is important to note that given the dynamic nature of Agile projects, it is useful to keep the documents generated, to deliver a history for the project, in which the project value can be traced and keep it as lessons learned and assets for the company.

The Table 15. Agile to Business metrics equivalence framework elements. Source: Own elaboration, lists all framework elements to conclude with the list of contributions for the [OR4], in Table 15. Agile to Business metrics equivalence framework elements.

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| Agile to Business Metrics Equivalence Proposed Framework Elements | | | | |
|--|--------------------------------|----------------------|-----------------------|---|
| Element | Phase | | | Roles |
| | Inception | Planning | Review | |
| Steps for determining metrics | Implement | | | Scrum Master, Product Owner |
| Multisided platform analysis (Internal and External sides) | Implement | Monitor | Monitor | Scrum Master, Product Owner, Business, Management |
| Updated Value Chain for Agile Software Development | Monitor | Monitor | Monitor | Product Owner, Business, Management |
| GBVF Adjusted to Agile Software Development | Monitor | Monitor | Monitor | Product Owner, Business, Management |
| Normalized Agile Metrics | Implement | Update/ Monitor | Update/ Monitor | Scrum Master, Product Owner, X team |
| Agile Metrics and Business equivalence g by finding partitions (Financial, Multisided and Adjusted GBVF) | Implement | Update/ Monitor | Update/ Monitor | Scrum Master, Product Owner, X team, Business, Management |
| Agile Metrics vs Business Metrics Heatmap | Implement | Update/ Monitor | Update/ Monitor | Scrum Master, Product Owner, X team, Business, Management |
| Agile Metrics equivalence method to Financial Metrics | Implement / Update/ Monitor | Update/ Monitor | Update/ Monitor | Scrum Master, Product Owner, X team, Business, Management |
| Method and equations for features developed by the Agile Team | Implement | Update/ Monitor | Update/ Monitor | Scrum Master, Product Owner, X team, Business, Management |
| Method and equations for describing the Agile team value | Implement | Update/ Monitor | Update/ Monitor | Scrum Master, Product Owner, X team, Business, Management |
| Agile Project Analysis in terms of Skillset, Technical capability, Competitive Advantage and Employee Value Proposition | Implement | Implement/ Update | Implement /Monitor | Scrum Master, Product Owner, X team, Business, Management |

Table 15. Agile to Business metrics equivalence framework elements. Source: Own elaboration

10. CONCLUSIONS

Agile is not a standard or a process, but mostly a concept, therefore, considering the many sources available, it is difficult to find one single source of truth for its practices, especially, in the case of this research, one single source of truth for its metrics.

According to the hypothesis defined at the beginning of this document, hypothesis 1 is confirmed: This is an issue seen by people working on projects, including senior management. In the case of hypothesis 2, is also confirmed by the results of the survey: traditional metrics are used to measure progress and deliver status and someone from the team is in charge to perform translation into Business metrics. However, hypothesis 3 is not true: there is not a single set of metrics for Agile, and for the ones more used, Story points and Velocity are not the preferred metrics. As for hypothesis 4, the result of this study showsG that there is not either a defined set of Business metrics, even though there is more documentation available on this side. Finally, for hypothesis 5, it is confirmed that there is not a framework defined specially for finding an equivalence between Agile metrics and Business metrics. Even though, there are some frameworks useful to be the base of the framework proposed on this document, their focus is different.

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Additionally, to providing conclusion in terms of the hypothesis established at the start of this research, the following is the set of conclusions found through the development of this thesis:

1. *[ORI] Describe the state of the art in terms of Agile metrics and its impact on business today, to verify if Agile metrics need translation into business terms, from software development industry point of view:* Through the theoretical research on chapter **6.4 Agile process** description, the state of the art on Agile Metrics has been thoroughly described. On the other hand, according to literature review at least 3 articles have stated the difficulty that the lack of definition of “Value” from the Agile manifesto creates for the measurement of projects:
 - a. First the Business Value must be defined, it is not something someone from the business know, but something that it must be defined by the organization. Additionally, Business Value is not only financial goals, but it can include other type of goals like achieving the competitive strategies defined by Michael Porter (Schwartz, 2016, Chapter 1. The Meaning.)
 - b. The study by (Hartmann & Dymond, 2006, sec. 3. One Key Metric Drives the Organization), starts by describing the issue of finding what Value really means for an Agile project and remarking that, at the end of the day, people who are going to measure the success of the project at any given point are non-developers, as it is written on chapter 62
 - c. Another study pointing at the issue of lacking an equivalence between Agile metrics and business metrics is that of (Misra & Omorodion, 2011), in which, at the conclusions, and after reviewing product and process metrics, it is concluded that

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there is a need “*for a standard, agreement and acceptance of this equivalence*” in chapter THEORETICAL FRAMEWORK.

2. This document makes visible the fact that there is an issue in how the companies now can translate the progress and achievements of an Agile project for Business stakeholders and upper management. This is stated in the answers to research questions 1 and 2, as well as in the result for [OR2]. This is also supported by the survey results in which since the 59.6% percent of the population agreed that Agile metrics do not cover everything there is to know about an Agile project progress, and that in 73.1% of the cases, survey respondents consider helpful to have a standard to translate Agile metrics into Business metrics.
3. It is also notable that 57.7% of cases it is necessary a translation of Agile metrics into Business metrics from the project manager or someone from the team, to report Agile project progress, according to the survey results in [OR2].
4. This research has also found literature, useful as a base for creating an equivalence on metrics, and to visualize the impact a project may have, in the chapter MAPPING BETWEEN AGILE AND BUSINESS METRICS as [OR3]. This set of documents are papers talking about the equivalence or impact of Agile metrics or project aspects in Business metrics of aspects, or base literature for finding an equivalence through methods like Breakeven analysis and the Contribution method.
5. The most important result of this research is the design of a proposal for a framework to find the equivalence of Agile metrics into Business metrics to measure how much value Agile projects are delivering, as [OR4]. This framework design can be used to answer main research question “*How to relate Agile metrics into Business metrics?*”, as well as research

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question 5. *“How to generate a framework to link agile metrics to business metrics in a way that it gives relevant information to business and upper management?”*

6. The conceptual framework designed on [OR4] is meant to be implemented with the Agile mindset: involving the whole team and avoiding becoming an additional task for a specific role.
7. The elements of the proposed framework in [OR4] consist in the definition of Agile metrics; their mapping to a pre-defined set of Business metrics; however it also includes the use of techniques that allow teams to visualize the value provided by the Agile project to the Business in terms of Financial metrics, Employee Value Proposition, Technical capabilities and Competitive Advantage.
8. Even though there is wide set of literature about Agile, there is not a consensus about what Agile is, therefore, there is no consensus about the set of metrics in Agile. The set of metrics that a software team uses may vary as frequently as by project, and basic metrics are usually the ones described above for Scrum methodology. The framework proposed, however, considers also popular software development metrics that can add value, and have been collected by authors like (Cleff, 2017).
9. Agile metrics like Story Points and Velocity are not absolute metrics, meaning that are dependent on the team performing the job; the current project; in the current status of the project. Therefore, these cannot be used to compare with the progress of other teams, developing a similar set of features. Hence, the difficulty to transform this metrics into Business metrics. As a conclusion Story Points and Velocity are not suited to make translation of the Agile project measures and achievements to stakeholders and upper management.

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10. Agile metrics correspond to Process Metrics in software development: estimation, planning and execution of development cycles. This was a point found as feedback in the elaboration of the survey, by both respondents and collaborators. On the other hand, business metrics refer to the metrics on the product developed by the team.
11. In order to find the Business Value of an Agile Project, what has been missing is to crystalize the facts that make its impact important for the companies involved. Even when they are there, and the team and stakeholders of the given project believe in it, it's hard for both parts to agree on the specific facts that make the project (and/or its result) valuable for the organization(s).
12. An important part of the population surveyed find that there is something missing about the way Agile and Business view a project. This gap is caused because of the ambiguity in which the Agile manifesto has defined the measure of progress, and the multiple set of "Agile Metrics" that every Agile methodology proposed. Thus, this study proposes to add this detail, to achieve consensus between Agile and Business and visualize clearly the impact of one on the other.
13. An important weakness of the Gartner Business Value Framework is that it does not contain primes at the level of User, Customer, Client or Visitor, such as revenue, profitability, number, average, etc. Currently, the framework does not include a path to know how the business value is measured differently for those stakeholders. For this, the concept of Multisided platforms is described on the framework, however companies like Software Development companies and Startups are a big set of business left unrepresented by this omission.

11. LIMITATIONS AND FUTURE WORK

1. Agile and its implementations have been discussed at length in books and articles, this makes difficult to find a single source of truth for several related topics: for the case of this research there is not a standard list of Agile metrics, however there are many sets, defined by each author, but not one that provides consensus. Even though this research proposes a way for Agile metrics consensus, it depends in its utilization to be a standard.
2. Work based on this research may implement a way to achieve consensus on the recommended set of Agile metrics proposed here.
3. Survey results for this document had 52 respondents and a considerable part of them in Bogotá, Colombia. Future work can base on the survey conducted for this work but can extend it to a population that can achieve conclusive results and maybe have different findings.
4. The framework proposed as result of this document is conceptual. With the aim to complete the definition of this framework it is important to obtain feedback from its implementation in a real project. From this feedback the framework can be detailed and improved in a way that it can be more effective and adjusted to practice.

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APPENDIX: SURVEY QUESTIONNAIRE

*This survey is designed to gather information on how managers (Executives, SMEs, Business Owners, external Stakeholders, Project Leaders) look at metrics/measures of progress on Agile Software Developments projects. Your responses will help the research team understand if there are tools that allow to measure the progress of Agile projects from management point of view in an effective way; what is missing in your opinion; and, in case current metrics are not enough, propose a design for equivalence between Agile metrics to Business Metrics, so that these projects can provide enough information for any stakeholder in any point in time.

- ❖ Email address*

Valid email address _____

- ❖ What is your current work location? *

Please use the format City, Country with no accents

- ❖ Please select your role your current company (related to Agile or Traditional Projects you are related to): *

1=Project Manager,

2=Program Manager,

3=Product Manager,

4= Product Owner,

5=Business Manager,

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6=Software Manager,

7=CEO,

8=Executive

9=Investor / Shareholder

10=Technical Project Lead

11 = Member of the Agile Development Team

Other_____

❖ Type of company: *

0=Publicly traded,

1=Privately held.

2= Government

3=ONG

❖ What is the industry for which the software development (Agile or not) you are related to is targeted? *

0= Government

1=Financial/ Banking

2=E-commerce

3=Fintech

4=Insurance

5=Insurtech

6=Real Sector

Other_____

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- ❖ Is the company which receives the product or result of the project a startup? *

0=Yes

1=NO

- ❖ What is your company size?

0 = Less than 100 employees

1 = 100 to 999 employees

2= 1000 to 5000 employees

3 = 5000 employees or more

Other _____

- ❖ What is the number of Agile programs / projects you have been related to? *

0= 0

1=1

2=2-4

3=5 or more

- ❖ How long is your typical Agile program/project duration? *

0=Less than one year

1=1-2 years

2 =3-5 years

3=6 years or more

Other _____

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- ❖ How many people are typically involved in your Agile projects? (Per project) *

0=1-10 people

1=11-20 people

2=21 to 50 people

3=51 to 100 people

4=100 people or more

- ❖ Do you manage traditional (non-Agile) projects as well? *

0=Yes;

1=No;

2=I work exclusively with traditional (non-Agile) projects

Metrics

Please provide some information about how you use project metrics, in the questions below.

- ❖ Are you satisfied with the performance of Agile Projects/Programs vs the performance of traditional (non-Agile) ones? *

0= Agile projects perform better

1= Traditional projects perform better

2= Performance does not exclusively depend on project type (Agile vs. Traditional)

3= You have only managed only Agile projects

4= You have only managed traditional (non-Agile) projects

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- ❖ What do you use to measure success of Agile projects? *

0=Agile metrics/measures,

1=Business Metrics

Other _____

- ❖ How do you rate your knowledge on Agile Metrics? *

0= No Knowledge

5=Advanced

- ❖ Do you use different metrics to measure success of traditional projects? *

0= Yes

1=No

- ❖ Do you think that current Agile metrics cover all the information you need for measuring success?, or do you usually require translation of Agile project metrics into Business Metrics (or other kind of metrics) to make sure an Agile project is being successful or not? *

0= Yes, Agile metrics cover everything I need to know

1=No, I usually need to translate the progress of the Agile project into Business Metrics (time, expenses, number of involved people, NPV, ROI, etc),

Other _____

- ❖ Do you consider helpful to have a standard for translating Agile Metrics into Business Metrics for measuring Agile project success? *

0= Yes

1=No

Other _____

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- ❖ Would you say that you can explain in very straightforward manner how your Agile projects are delivering the value expected? (Checkboxes) *

0= Financial Terms

1= Number of users (logged, active, who buy)

2=Market Share

3=Technological capability generated for the company

4=Competitive advantage

Other _____

- ❖ What are the variables considered in your company to decide if one project is traditional, and another agile? *

0=Revenue expected

1=Team available

2=Number of users/clients expected

3=Technological capability generated/expected

4=Tightness of the deadline for the project

Other _____

- ❖ What are your suggestions in terms of aspects that a standard for measuring Agile projects should cover (and current Agile Metrics do not cover)? (Please select all that apply) *

1= Profitability and financial information;

2= Market Share;

3=Technical knowledge gained (for the company);

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4=Competitive Advantage

Others _____

- ❖ Defined deadline, scope, and budget are not seen as critical for many agile projects/teams - but maybe seen as critical by the business. How are deadline, scope, and budget measured or monitored by the business when the agile team does not compile this? *

0= The business receives Agile metrics and they can perform monitoring with this information.

1=The project manager makes the translation into business terms for monitoring.

2=Someone from the Agile team performs the translation and monitoring (different from project manager)

3=Business Managers and Executives work together with the Agile team and the translation is not necessary.

Others _____

- ❖ What are your suggestions in terms of aspects that a standard for measuring Agile projects should cover (and current Agile Metrics do not cover)? (Please select all that apply) *

0=Profitability and financial information

1=Market Share

2=Technical knowledge acquired

3=Competitive Advantage

Others _____