Innovation Scorecard in an Agile Software Development Working Environment

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Abstract

Purpose of the article The paper provides a literature analysis of relationships between agile management methods and innovation management control. It considers a potential implementation of an Innovation Scorecard framework within software development organisations.

Methodology/methods The theoretical background is based on a methodical system approach: analysis, comparison and synthesis. Analysis is used to acquire new knowledge and its interpretation. When processing secondary data, the secondary analysis method was used. Professional literature, particularly foreign sources, provided a source of secondary data. Synthesis was used designing an Innovation Scorecard solution within a short term project that was based on a Scrum approach.

Scientific aim The scientific aim of the paper is to gain knowledge and analyze the present status of agile management and innovation management control as it pertains to the Czech and foreign professional literature. The objective of the article rests in the summary and presentation of results of a literature analysis of the relationship between those areas. In addition, the paper is also important in terms of innovation management, which is a field of science, and also of related disciplines, specifically strategic management.

Findings On the basis of the literature review, the process for the design and implementation of an Innovation Scorecard within an IT organization is proposed. The Innovation Scorecard methodology does not represent a static framework but can be customized according to the specific needs of an individual innovation project. When applied in Agile environments measuring gates (check-points) can be removed to fit in with that particular environment.

Conclusions The authors present the potential benefits of the Innovation Scorecard implementation. They are aware of limitations which lead to opportunities in any future research. These shortfalls will be recovered in a planned followed-up project known as 'Innovation Scorecard: Management Control Framework of Innovation Project in IT industry' no. TL02000007. This is supported through funding from the Program Éta by the Technology Agency of the Czech Republic.

Keywords: innovation, agile software, Scrum, innovation scorecard, KPIs, metrics, process efficiency

JEL Classification: M15, M21

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Introduction

The application of agile management methods within software development work environments is a topic of regular discussion. In general, agile methods have been created for application in small software development projects (Boehm and Turner, 2005). Their application in large projects is challenging, particularly in areas of planning and coordination (Dybå and Dingsøyr, 2009). There are other characteristics associated with this approach such as fast decision making, incremental working, flexible development and autonomous working practices (Austin and Devin, 2009). Drucker (2009) considers that "If you can't measure it, you can't manage or improve it". This raises the question whether it can be justified to introduce a measurement system into an innovative or Agile working environment. Many authors of related literature suggest that this is probably true to say for both areas. Efficient and user-friendly measurement systems are essential and crucial to the success of innovation work or project approached. As a result, some authors considered it important to combine the concepts of Innovation Scorecard and Agile Methodology. Agile is based on a flexible approach, is dynamic and provides fast access to solutions within software development environments. The primary advantage is its flexibility and ability to react quickly and flexibly to changes/changing work environments. The Innovation Scorecard concept works on some logical step by step process of implementation within organisations (Žižlavský, 2016).

The scientific aim of this paper is to gain knowledge and overview of recent trends in Agile management and innovation management control. It is dedicated to a potential implementation of an innovation management control framework called Innovation Scorecard within the area of process innovation within a well-established global IT organisation in Brno. It is meant to serve as an inspiration for organisations that apply Agile methods and who seek an Innovative Scorecard solution. These organisations typically operate in work environments that are at the cross-road to review their current internal processes so they can improve how they work and operate within Agile working practices including strategy management.

The paper is based on a literature review of existing Agile and Innovation Scorecard methods. System approach, analysis, comparison and synthesis (Hendl, 2012) are applied in this paper. Analysis is used as a method of acquiring new knowledge and the interpretation of that knowledge. When processing secondary data, the secondary analysis method was used. The professional literature, and particularly foreign sources, provided a source of secondary data. Synthesis is used for the Innovation Scorecard design within a short project that engages the well-known project management method of SCRUM. The first part of the paper reviews a number of definitions of what is meant by Innovation. The next section presents the Innovation Scorecard background. The third section is dedicated to the Agile methodology with its primary focus on SCRUM. Finally, the last section discusses the implementation of an Innovation Scorecard system within an Innovation Project that employs the SCRUM approach. Application limitations are presented in the Conclusion section.

1 Definition of Innovation

A review of the current literature revealed that the term innovation is interpreted in many different ways and that it is subject to numerous classifications, typologies and categorisations, such as Birkinshaw et al., 2008; Fagerberg et al., 2005; Maital and Seshadri, 2007; Meeus and Edquist, 2006. It appears that disorder and chaos is revealed in some literature as far as the meaning and interpretation of innovation is concerned (Davila et al., 2009; Gailly, 2011; Yusof et al., 2010). Historically research on the classification of innovations concentrated on the technological imperative of innovation, assuming that companies carry out innovative activities through research and development (R&D). Several studies on and definitions of innovation have been produced, pertaining directly to R&D such as Gallouj and Weinstein, 1997; Mairesse and Mohnen, 2004 and Miles, 2001. According to some definitions the main characteristics of innovations are change and considerable novelty (Gault, 2013; OECD, 2005, Valenta, 1969). Another widely used concept defines innovation as a tool for creation of new knowledge (Senge, 2005). The Oslo Manual (OECD, 2005) provides a clear definition of the term innovation and this helps to demystify what is meant by innovation. It is the foremost international source of guidelines for the collection and use of data on the concept of innovation. It was prepared by experts in the field of measurement and evaluation of innovation from OECD member states. According to the more recent, broader approach of the Oslo Manual, four main types of innovation are recognised:

- Product innovation
- Process innovation
- Marketing innovation

- • Organisational innovation (OECD, 2005).

2 Innovation Scorecard

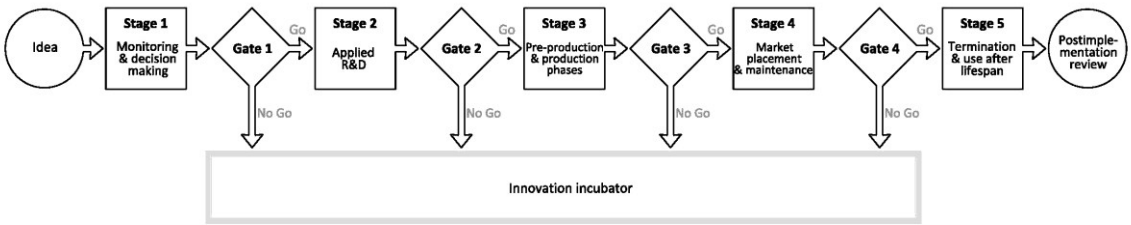
The Innovation Scorecard model was developed by Žižlavský (2016) for application within companies in the Czech Republic. His framework builds on the work of Kerssens van Drongelen et al. (2000) and also Pearson et al. (2000) by introducing already known and considered popular management techniques and methods (Table 1).

Table 1 Innovation Scorecard Background

Method	What (Author)
Balanced Scorecard	Balance between financial/non-financial metrics, short/long-term goals (Kaplan and Norton, 1996)
	Sequence "Aim–Cause&effect–Metric–Target Value" (Horváth, 2002)
	Scorecard design (Niven, 2014)
	Number of metrics (Kaplan and Norton, 1996)
	Casual links – strategy maps (Cokins, 2009)
Innovation	Innovation pipeline (e.g. Bessant and Tidd, 2011; Davila et al., 2013)
	Input–Process–Output–Outcome Model (Brown, 1996)
	Stage Gate Model (Cooper, 1998; 2008)
	Open inovace (Chesbrough, 2003)
Project management	Wingate (2015)
KPI design	Niven (2014), Parmenter (2015)

Source: Žižlavský, 2016

The theoretical background, structure (including processes) and methodology of the suggested Innovation Scorecard can be divided into a number of distinct stages including some management decision gates to aid control. The suggested Innovation Scorecard approach incorporates the core functions of leading innovative teams such as defining tasks, planning, controlling, evaluating/reviewing and supporting. This effective and efficient approach to introduce the concept of Innovation Scorecard into organisations is vital for moving innovations from the idea to launch phase in a systematic, managed and controlled way. The proposed Innovation Scorecard (Figure 1) suggests six distinct stages controlled by gates where Go/No Go decisions are made whether to proceed to the next gate: Gate 0 Concept/Idea; Gate 1 Feasibility; Gate 2 Planning; Gate 3 Implementation; Gate 4 Verification (including pilot studies/testing); Gate 5 Deployment (Roll-out or Going Live); Gate 6 Closed Down (Post Implementation Review including Lessons Learned/Knowledge Management).



Source: Žižlavský, 2016

Figure 1 Innovation Scorecard Framework

2.1 System Design

It appears that an innovation system is considered to be able to measure anything that can be measured and that the process should be applied continuously. Measurement forms an integral and essential part of innovation and is very important for the success of the innovation process (Davila et al., 2013). When organisations decide to apply

the innovation scorecard, they expect results commensurate with effective decision making. Expected outcomes of its application should be economic and add value to the effective running of organisations. It is suggested that a reasonable complex and sufficiently developed innovation scorecard system should be deployed to achieve maximum benefit (Horváth and Partners, 2002).

Keegan et al. claim that there are three main steps in a typical measurement system. The first step is to define the strategy and associated goals of the company. The second is to develop a set of performance measures and the third goal is to focus on linking the performance management system to management thinking and expectations (Keegan et al., 1989). The essential structure of an Innovation Scorecard derives from the long-term experience of the process of implementing a Balanced Scorecard within a company (Horváth and Partners, 2002). The structure has to be developed in such a way as to guarantee the effectiveness of the Innovation Scorecard (Žižlavský, 2016).

Source: adapted from Horváth and Partners, 2002; Cokins, 2009

Figure 2 Innovation Scorecard Process

The long-term structure of an Innovation Scorecard is based on the implementation of the Balanced Scorecard from which it originates. This process involves 7 phases which provides details of the approach taken to implement the Innovation Scorecard within a company. The innovation strategy needs to be defined at the beginning and needs to contain a strategic plan, the goals of any project and how to achieve these. These need to be agreed and approved by senior management. The set goals have a direct impact on the successful implementation of the Innovation Scorecard. In addition, relevant and appropriate Critical Success Factors (CSFs) are developed based on the set goals. These are high level goals that focus on what needs to be done (and not the how). At the level below CSFs, Key Performance Indicators (KPIs) are created and their task is to inform how the company will deliver the CSFs (the how). An innovation map can help any company how to implement and apply the CSF/KPI strategy in practice. Effective communication forms a very important element of the innovation scorecard process. Those involved in developing and implementing the process need to communicate and be communicated to regularly to keep everyone informed of progress. Metrics need to be developed and rolled out and managed. They form an essential part of any innovation scorecard process. Goals should be SMART (specific, measurable, attainable, relevant and time-based). Goals need to be considered and prepared at the start of any project and their details are often presented and agreed during a project definition workshop (PDW) that is usually run at the end of the feasibility phase of a project. Goals must have target performance values and these values must be realistic to achieve (Žižlavský, 2016).

2.2 Key Performance Indicators (KPI)

KPIs measure performance, both present and future. They are specific and detailed performance measurements that will allow companies to ensure that they achieve their set performance goals and targets. They are expressed in numerical and/or % form and should be sufficiently specific in detail such as 'We will grow our customer base by 20% by 31 December 2019 by cold-calling 50 customers each month'. KPIs underpin the higher-level CSFs. KPIs can be expressed in financial terms, too, such as Return on Investment (ROI) or Internal Rate of Return (IRR). KPIs are typically measured monthly but this depends on the complexity, for example, of any project. In some instance they may need to be measured more frequently. This needs to be decided by any project manager or senior management team at the beginning of any work initiative. In addition, individuals and teams need to understand their role and responsibility to deliver KPIs successfully. KPIs are usually the responsibility of the project manager but can also be owned by CEOs of smaller companies. KPIs have a significant impact on the organisation (Parmenter, 2015). Positive KPI outcomes are a sign of success and negative KPI outcomes are a sign of failure. Regular reviews provide opportunities to identify negative KPIs and turn these around to become positive KPIs. It should also be noted that not all KPIs are automatically metrics. KPIs are very specific performance indicator and metric focus more the general performance. Both KPIs and metrics can be used in parallel as they often complement each other. This needs to be managed carefully (Kerzner, 2017). This performance measurement system forms part of any innovation scorecard system. This composition is defined by a number of authors such as Neely et al (1996) who consider this system as being a process of the effectiveness of

associated actions. The management of the system is defined as a process of managing performance, strategies and objectives (Lehner, 2016). A performance measure is defined as a metric which is used to ascertain any effectiveness of actions (Neely et al., 1996).

2.3 Metrics

Metrics are a tool used to measure, for example, innovation processes in organisations. In addition, they can be applied to identify or predict potential areas that would benefit from innovation. This includes the definition of the strategy and describes the steps that need to be taken to achieve this. It is often applied to clarify and translate the organisation's vision. One approach is to identify and visualize strategic objectives and produce a so-called strategy map. The strategic objectives and measures can then be linked and appropriate KPIs can now be assigned to the strategy map. This includes the setting of targets for each of the KPIs. It is a necessary requirement for the successful application of an innovation scorecard system to support the control process of implementing an innovation strategy and the impact this has on the organization. Following this process will provide learning opportunities and identify more opportunities for new and future application of KPIs and metrics (Trias de Bes and Kotler, 2011). A sample of metrics divided into various groups can be found at Table 2.

Table 2 Metrics for Innovation – Examples

Metrics	Example
Number of innovations realised	Garcia and Calantone (2002)
	Verbeek et al. (2002)
Bibliometric Indicators	Number of publications (such as books and papers in respected scientific journals)
Number of registered patents	Pharmaceutical Industry: 1 or 2 patents per year (Chiesa and Frattini, 2009)
Expense on R&D	OECD (2009)
	Return on Product/Service Development Expenses (Malinoski and Perry, 2011)
Financial indicators	Thomaschewski and Tarlatt (2010):
	Growth of competitiveness and financial health
	Profit
	Financial impact of Innovation
	Methods for the evaluation of innovation efficiency (Gailly, 2011)
Non-financial indicators	Internal process (Bessant and Tidd, 2011):
	Number of new Ideas
	Extent of Failure
	Number/percentage ratio of exceeding development time and budget (cost)
	Customer satisfaction criteria
	New Product Development implementation time

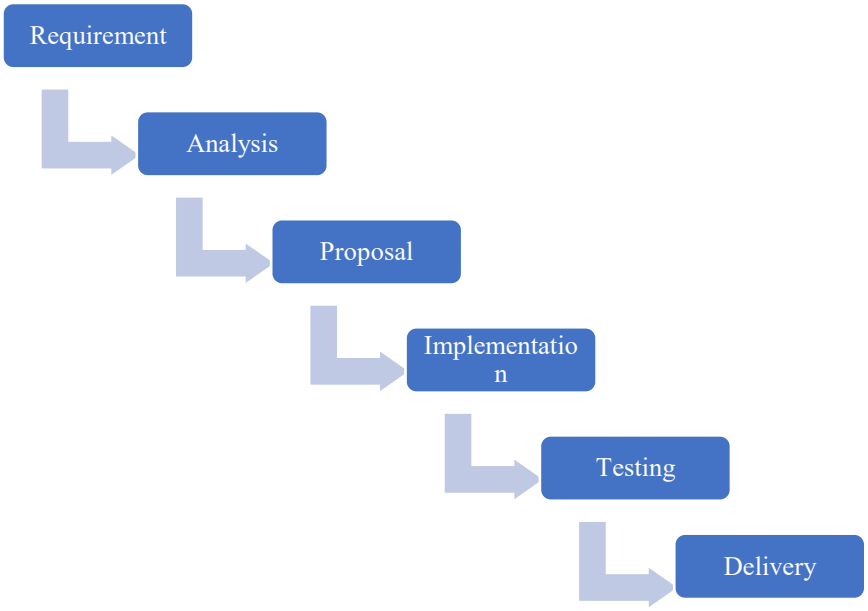
Source: Žižlavský, 2016

The Innovation Scorecard concept is typically applied to cover both financial and non-financial aspects of measuring improvements with the aim to achieve a realistic balance between the two. The importance of financial metrics is reflected in the value they add to the decision-making process within organisations. This is essential for proving that the organisation has been successful in achieving their set target performance levels. Performance metrics provide a means to ensure that set goals or objectives have been achieved. Goals and objectives are usually agreed at the beginning of any innovation process. These are included in so-called project definition documents (PDD) and need to be managed to their successful conclusion by the person in charge of the project, typically a project manager. In Agile projects, historical data can be used to aid short term deliveries of software development innovations and upgrades/updates (Kislingerová, 2008). Non-financial metrics include the effective measurement of how deployed resources are performing and to ensure that innovation goals are achieved effectively and efficiently. These metrics are sensitive to change and need to manage accordingly. They form part of internal

processes at both organisational and work package delivery level. They assist in long term decision making and as such are suitable for longer work life cycles (Bremser and Barsky, 2004).

3 Agile Methodology

Agile software development is an umbrella term for a set of frameworks and practices based on the values and principles expressed in the Manifesto for Agile Software Development and the twelve principles behind it (Agile Alliance, 2019). When software development is approached in a particular manner, it is generally advisable to follow these values and principles and to use them to work out the right things to do in particular contexts. One thing that separates Agile from other approaches to software development is the focus on how people work and how they co-operate with each other. Solutions evolve through collaboration between self-organising cross-functional teams using appropriate practices for their context. Agile was developed by a group of software developers in 2001 and is used extensively within the IT industry. In general terms, the Agile approach or methodology has a number of intrinsic values (Fowler and Highsmith, 2001). Being able to respond in a dynamic way without unnecessary bureaucracy or other hindrance is paramount, for example, to software development project work. A system that is fast and flexible at the same time and a system that can respond to changes swiftly adds value to users of an Agile approach. Focusing on results rather than adherieng to a rigid and strict process is of paramount importance to the successful delivery of so-called Agile projects or work. This requires that those involved in Agile working, should have an Agile mindset that is reflected in their Agile behaviours. For this work well and effectively, this needs to be achieved at individual, team and corporate levels and applied consistently across the organisation. According to Šochová and Kunce (2014), communication plays an important role within an Agile work environment. It does and should not replace following necessary processes but it aids consistent understanding of what needs to be done, by when, how and by whom. Good communications complement frequent request for changes well and efficiently. One of the early models that was used in the area of software development is generally known as 'Waterfall' (Fig.3). Its design dates back to the early 1950s and in essence it focuses on sequential task completion. Ashmore and Ruuyan (2014) suggest that this approach does not contain any flexibility for stepping outside the sequential process. It appears that Waterfall is a popular linear and sequential process that contains a number of distinct phases. It is generally not possible to return to a previous phase so any newly-adopted changes cannot be applied retrospectively. This may affect long term projects where changes appear to be 'the order of the day' and where a certain amount of flexibility can reasonably be expected. McConnell (2004) reports that this could affect software development projects: changes in requirements during project execution and delivery, when not integrated into the design, will affect the end product/service in terms of customer expectation.



Source: Myslín, 2016

Figure 3 The Waterfall Process

According to Selectbs.com (2019), Extreme Programming (XP) is a software engineering methodology that forms part of a group of several agile software development methodologies. It differentiates itself from other agile methodologies by placing much higher values on adaptability rather than predictability. Proponents of XP regard ongoing changes to requirements as an often natural and often inescapable aspect of software development projects; they believe that being able to adapt to changing requirements at any point during the project life is a more realistic and better approach than attempting to define all requirements at the beginning of a project and then expending effort to control changes to the requirements. XP prescribes a set of day-to-day practices for managers and developers; the practices are meant to embody and encourage particular values. Proponents believe that the exercise of these practices—which are traditional software engineering practices taken to so-called "extreme" levels—leads to a development process that is more responsive to customer needs ("agile") than traditional methods, while creating software of similar or better quality. Generally, Extrem Programming initially recognized and accepted four values, with a fifth value being added more recently. The five values are:

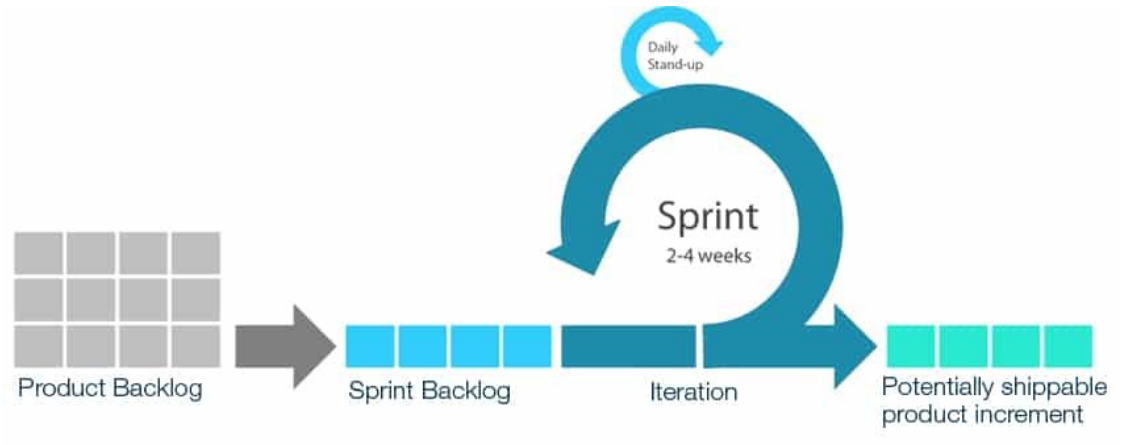
- Communication
- Simplicity
- Feedback
- Courage
- Respect

In addition, some other software development processes are used such as Feature-Driven Development. This is an iterative software development process. It is a lightweight or Agile method for developing software. FDD combines a number of industry-recognised best practices into a cohesive whole. These practices are driven from a client-valued functionality perspective. Further methods include Lean Software Development, Kanban Method, Dynamic Systems Development Method and Crystal Family.

3.1 Scrum

According to Versionone.com (2019), Scrum, for example, in software development work environments, is a methodology for managing software delivery that comes under the broader umbrella of agile project management (Fig.4). It provides a lightweight process framework that embraces interative and incremental practices, helping organisations deliver working software much faster and more frequently. The series of iterations are known as ‘Sprints’ (typically lasting four weeks and driven by goals set at the beginning of each sprint) and at the end of each sprint the team produces a potentially deliverable product increment. This approach differs from the Waterfall approach that fixes the project scope upfront, requiring the extensive creation of requirements, analysis and design documentation before development can get started. It appears that there is a difference of opinion regarding the origin of Scrum.

Some professionals believe that Jeff Sutherland, John Scumniotales and Jeff McKenna invented Scrum in 1993, others believe that Hirotaka Takeuchi and Ikujiro Nonaka invented Scrum in 1986. The Scrum approach benefits from the advantage that any changes can be accepted and integrated into the design work immediately and without undue delay. This includes, for example, the integration of constant customer requirements changes and the ability to manage these instantly. Typical Scrum activities are: Sprint Planning Meeting, Daily Scrum or daily Stand-up, Sprint Review and Sprint Retrospective. In terms of Scrum Team roles, a typical Scrum team needs three specific roles: product owner, Scrum master and the development team (Agile42.com, 2019). Scrum teams are cross-functional and this is the reason why the development team includes testers, designers, so-called UX specialists and operational engineers in addition to developers.



Source: nutcache, 2018

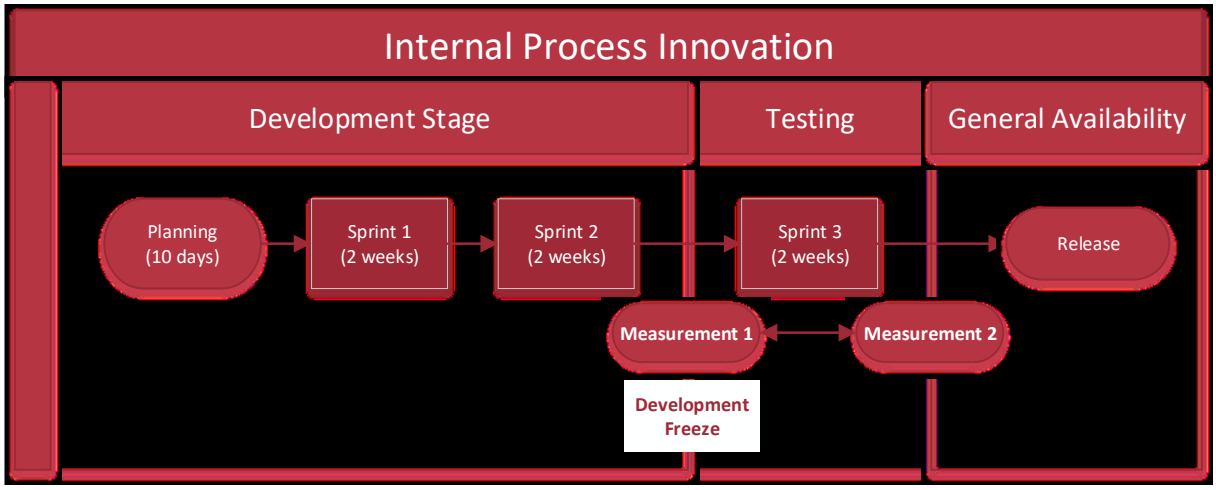
Figure 4 Scrum Sprint Process

4 Discussion

Based on the outcomes of a literature review, the considered and suggested process for the design and implementation of an Innovation Scorecard system for IT/Software Development organisations is:

- Innovation Scorecard objectives and goals are defined and agreed at the start of any initiative such as a project. This includes aligning these to the current organisation's strategy/strategic map.
- Innovation Scorecard metrics for each decision-making gate are developed/agreed and realistic target measurement values are established/agreed.
- Agreed metrics will be catalogued and entered into an Innovation Scorecard Control Data Sheet.

The Innovation Scorecard methodology, developed and established by the Innovation Scorecard team in Brno (Pavla, Ondrej and Eddie) will be updated and made 'fit for intended purpose' to meet the needs and requirements of individual organisations. Fig. 5 shows a summary of the developed Innovation Scorecard Sprint.



Source: own processing

Figure 5 Innovation Scorecard Sprint

As the innovation project is in the area of software development (including short sprints), the authors consider that the application of a 'gate process' to manage each small project is not justified as it does not add any value to the overall process. The internal process where Innovations Scorecard is going to be implemented consists of 3 sprints: 2 development and 1 testing. Any future research project will focus on process innovation in the area of test sprint. The efficiency of any process innovation will be measured at the end of each test sprint such as each 2-week period. The collected data will be compared with stated/set goals (target value) and default state (state before the launching of any process innovation) in order to identify and report any target trends such as to minimize or maximize). Inputs lead to outputs. Processes are used to get from input to output.

The purpose of the Innovation Scorecard initiative is not to improve IT organisation's current quality management system. Such a system already includes all necessary processes. The goal/purpose of the introduction of an Innovation Scorecard system is to improve the management of inputs and outputs through innovative approaches to improve areas such as job satisfaction, staff motivation and morale, customer perception and associated outcomes such as improving productivity, reduce business overheads and generate new/repeat business for chosen IT organization. In addition, the number of applied metrics needs to be reduced.

Despite Kaplan and Norton (1996) stating 'twenty is plenty', the authors consider that this number of metrics would create additional unfavourable bureaucracy. It is considered that approximately 5-10 metrics is a sufficiently large number to be able to measure the efficiency of a 2-week sprint. The quality of these metrics and their overall contribution to the successful introduction of an Innovation Scorecard system are of paramount importance.

Conclusion

This paper draws upon what is already known about management control system design, agile methods in software development and the concept of an Innovation Scorecard framework. From a managerial viewpoint the Innovation Scorecard may provide useful guidelines for focusing attention and expending resources during the entire innovation process. The following benefits can be expected after the successful introduction and roll-out of an Innovation Scorecard system:

- Higher profitability from a market and product perspective.
- Improved Return on Investment (ROI).
- Higher staff productivity levels through business change including improved organisational alignment and modus operandi.
- Improved streamlining of software development processes through the roll-out of an Innovation Scorecard System across a number of associated projects.
- Improved timely internal and external communications.

The authors are aware of a number of limitations that need to be addressed in future research. The most significant is that this study is grounded based on a theoretical secondary data analysis. The practical application of an Innovation Scorecard framework in real projects within the IT industry will be conducted. This considered project has a life span of three year and will be known as the 'Innovation Scorecard: Management Control Framework of Innovation Project in IT industry' no. TL02000007, supported through funding from 'Program Éta' (Technology Agency of the Czech Republic).

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