The Design of Interactive Training for Digital Transformation: A Practice-Oriented Case Study

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Abstract

Hybrid approaches to new product development are blurring the boundaries between established models, such as Lean, Stage-Gate and Agile. The actual implementation of the principles of these archetypical approaches seems to be contingent to the features of the product to innovate and the organisation in which the product development effort is made. This paper investigates how Lean, Agile, and Stage-Gate product development principles can foster the design, development and delivery of a training program for digital transformation in a knowledge intensive business service that delivers training by relying on a simulated, highly-realistic, digitalised business environment. The conception and execution of a new training program requires a new product development effort since it significantly departs from the current offering of the training provider and involves the coordination of multiple stakeholders. Through a practice-oriented case study methodology, this investigation examines whether a hybrid organisational method is a viable approach for new product development and assesses its practical feasibility and effectiveness.

1. Introduction

Managers and practitioners face the challenge of selecting the organisational methods to achieve excellence in product development, to build products that meet customer expectations rapidly and efficiently. Answers from theory seem to point to a hybrid model (Cooper *et al*., 2014; Bianchi *et al*., 2020), where two established methods, Stage-Gate and Agile, have demonstrated benefits in terms of project performance over some critical dimensions. Nevertheless, challenges have emerged for the implementation of those systems (Dikert *et al*., 2016; Cooper *et al*., 2018), and both theory and practice seek to clarify whether and under which conditions this novel method can provide a benefit to the product development process for the development of physical products and services. Stage-Gate practices have been long known for their ability to grant systematicity, visibility and long-term perspective to project management, while Agile has emerged as a comprehensive set of tools, enabling organisations to deliver value fast and to adapt with flexibility to a rapidly changing environment. The

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combination of the two has recently been found in the literature to be a potential source of competitive advantage, by means of combining the goods of both those methods.

Product development is a highly complex process for organisations, involving different functions and internal and external actors with extensive interactions and potential coordination issues. For this reason, practice and theory have been studying and experimenting with organisational methodologies to best manage this complex process.

New directions emerged from theory in recent years on the best alternative or synergic solutions that can be adopted when managing a product development process, with a fervid discussion on the interplay, challenges, and opportunities arising from hybrid models combining Agile and Stage-Gate, (Cooper, 2014; Sommer *et al*., 2014). Nonetheless, extensive studies (e.g., Lee and Markham, 2016; Michaelis *et al*., 2018) highlighted that firms are still largely unable to achieve satisfactory results when developing new products in terms of critical dimensions, such as the time-to-market, cost of the new products when compared to initial budgets and the products-to-idea ratio.

Several organisational prescriptions emerged in the latest years trying to address this issue, some from the manufacturing environment (Cooper and Sommer, 2018; Edwards *et al*., 2019) and some from the service environment (Bianchi *et al*., 2020). It is not totally clear which are the key success factors and conditions for a successful adoption of this novel organisational method (Dikert *et al*., 2016; Antons *et al*., 2019). This piece of research aims to understand the organisational requirements of this novel method, such as Lean fundamentals (Sonnenberg, 2011), leadership practices, learning strategies (Beaumont, 2017), and others.

Organisations providing training and development can be considered a prominent example of a Knowledge-Intensive Business Service (KIBS), that is, "services that involve economic activities which are intended to result in the creation, accumulation or dissemination of knowledge" (Miles *et al*., 1995: 18). Among KIBS, of particular relevance are 'new technology-based services' whose offering and activities leverage information and communication technologies or carry out engineering and research and development (Miles *et al*., 1995).

In this context, new product development processes have been studied to collect best practices and prescriptions on the key features and elements to consider, that a training service should possess to achieve its goals (Kontoghiorghes, 2004; Sellier *et al*., 2019). Yet, to the best of our knowledge, the processes to develop such training services have not been studied thoroughly. In this context, development is intended as the development of novel approaches to training, where technologies offer great opportunities which can also bring a competitive advantage to these organisations.

This study aims to understand how the Stage-Gate and Agile methodologies can be combined to foster the design and delivery of a training course that deals with digitalisation of business processes and adopts an interactive approach. As this study adopts a methodological stance based on the practice-oriented case study (Bleijenbergh *et al*., 2011), it pursues the goal of enhancing the capabilities of the management team of the training centre in new product development.

This article contributes to the literature on product development and specifically to the growing discussion on assessing the efficacy of Stage-Gate and Agile hybrid models. In this field, evidence is being collected through a growing body of case-studies (Cooper 2016, 2018; Edwards, 2019), but more evidence is needed (Bianchi *et al*., 2020) to systematise this recently

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born, promising organisational method, to understand its applicability and requirements fully.

This work is articulated in a literature review of organisational methods for product development which, departing from the insights offered by Lean Management, examines the Stage-Gate and Agile-Scrum approaches. This effort offers evidence about the context that gave rise to the approaches, their potential benefits, and potential sources of challenges. The article then studies the practice-oriented research as part of the case-study methodology to then analyse the selected case in the section regarding the findings, where the training centre and its product development processes are examined. The results of the analysis are then presented, based on the strategic project leadership framework (Shenhar, 2004).

2. Literature review

2.1. Lean product development fundamentals

The evolution of the product development literature has produced a wealth of theories and empirical evidence.

Lean Management was the first systematic methodology to revolutionise the previous paradigms in product development. The foundational study in the car manufacturing industry (Womack *et al*. 1990) highlighted product development as a pillar of the competitive advantage acquired by Japanese car manufacturers. Lean Management brought several prescriptions to increase efficiency and improve quality of the products being developed, far beyond manufacturing itself (Liker and Morgan, 2006) by acting on a series of directions.

One of the first principles of Lean Management is coaching, which is achieved through a servant leadership approach, based on trust and clear communication about objectives, with management based on experience and mastery. People systems in this context are a crucial element, through a direct commitment and engagement of the leaders, empowering and delegating their teams also by means of creating risk-free environments (Sonnenberg and Sehested, 2011). Creating a learning culture is also a key success factor, especially in the applications to services (Liker and Morgan, 2006) and innovation programs in general (Ward and Sobek, 2014). Learning builds on *kaizen*, continuous improvement, corroborated by a strive for excellence and the engagement of employees, also achieved through celebrating success. Another tenet is creating a collaborative culture, which can be intended as self-regulative form of governance for teams (Angelis and Fernandes, 2012) and engagement for decision making and continuous improvement.

Lean principles also involve external actors by creating collaborative external networks (Tuli and Shankar, 2015), both upstream and downstream. The direct involvement of customers through engagement in the development process and the definition of customer requirements (Solaimani *et al*., 2019a) is considered fundamental in this methodology. Supplier and stakeholder involvement has also been shown to be beneficial through the development of study groups and collaborative problem solving (Tuli and Shankar, 2015).

Lean product development also relies on learning routines based on tools that can foster problem-solving and the systematisation of knowledge, such as the PDCA approach, 5-whys, *Ishikawa* diagrams, and others (Solaimani *et al*., 2019b). Another key element found in the

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literature is the systematisation and sharing of knowledge acquired through systematised knowledge sharing and transfer, also across different projects (Hoppmann *et al*., 2011).

2.2. Stage-Gate systems

The Stage-Gate system (Cooper, 1990) is a structured, systematic, and prescriptive approach, which is based on different stages alternated with decisional gates to decide which concepts should proceed to the next stage (Cooper and Kleinschmidt, 1993; Griffin, 1997). It is a cross-functional process including actors from marketing, sales and operations alongside technical personnel, and it has multiple stages spanning the entire idea-to-launch chain, from idea generation through the business case and market launch (Cooper, 2011).

The process is initiated by a new product idea, followed by a first gate consisting of an initial screening. The purpose of this gate is to keep fewer ideas, to be carried out through a detailed 'must meet' checklist and a scoring model, including, for example, the strategic alignment, feasibility, and differential advantages, but no financial criteria would be considered at this stage yet (Cooper, 1990). The Stage-Gate approach would then proceed by iteratively deepening the granularity of analyses while increasing the company's financial commitment at every decisional gate. Products passing a gate would go ahead to the next phase, while products failing to pass a gate would then be discarded or reworked in the previous phase. Stage-Gate does not assume that the same team working on a project at one stage would stay on the project for the following phases, and communication is granted through detailed information being frozen in the form of internal reports and documentation to transfer knowledge to the following steps (Sommer *et al*. 2015).

This approach has been widely adopted (Lee and Markham, 2016) and demonstrated several benefits by enforcing discipline and standardisation into a previously unstructured process. It is also shown to grant top-down visibility and simplicity in each stage, so that the overall process is understandable and provides a road map for the actual planning, the objective setting, and the tasks of the project leader (Cooper, 1990). It can enable the management to have a holistic view and to take strategic decisions across different projects, deciding to re-direct resources at each gate (Lee and Markham, 2016).

Stage-sate systems have also been revisited to adapt to externalities and environmental instability, with the development of new, lighter approaches relaxing some of its prescriptions (Cooper *et al*., 2002) and have evolved incorporating concepts of open innovation (Grönlund *et al*., 2010) to better capture customer feedback into the development process.

At the same time, some potential drawbacks to this approach have been identified. It comprises a potential risk for rework between different phases, particularly if communication has been ineffective. Contrarily to Agile and Lean, practices it also sets formalised validation and testing only after the development process, which is embedded in every development cycle. More broadly, parallel or concurrent engineering tends to be in Stage-Gate a characteristic of individual phases, such as development, rather than an inter-phase activity (Koufteros *et al*., 2001) as in Agile. In Stage-Gate, extensive documentation is produced during each phase (Sommer *et al*., 2015) and reviewed at the beginning of new phases, in which teams might change. In the development stage, this approach does not provide tools and detailed prescriptions and is prone to the risk of creating 'knowledge silos' if a strong communication commitment is not embedded in the organisational culture.

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2.3. Agile-Scrum methodologies

Some of the core features of the Agile methodology emerged as early as the 1970s (Abbas *et al*., 2008), intending to provide a faster, more reactive and more flexible response to customer needs when compared to the Stage-Gate approaches. However, these principles and practices were coherently systematised only in 2001 in the *Manifesto for Agile Software Development* by Beck *et al*. (2001).

Compared to Stage-Gate approaches, Agile focuses on individuals and interactions over processes and tools, while a working product is preferred over comprehensive documentation. Concerning product development, three principles are relevant. First, it features an iterative approach, striving to provide a prototype, or minimum viable product at the end of the development cycle (Cohen *et al*., 2004), addressing unknowns and reducing uncertainties by clarifying the desired solutions. Teams are the core of the development process, with stress on multidisciplinary to cover for all skills needed in the development process, which may imply a part-time commitment to the project, with a reliance on external partners or experts (Beaumont *et al*., 2017). Similar to the Lean methodology, the approach features the *sensei* figure, the product owner and master with a full picture of the overall process.

Agile practices are often associated with Scrum, a methodology developed in the 1990s that aims at enabling team members to address complex adaptive problems in a developing environment. This methodology addresses the full product development process, greatly focusing into micro-activities to enhance productivity and creativity to deliver products fast.

Scrum focuses on developing a product through 'sprints', where each sprint is preceded by a meeting to decide how to create value for the customer, what should be prioritised for the following sprint, and which work would be needed to achieve that goal. Sprints consist of limited, short timeframes where to concentrate the dedicated effort of the team to ideally get a working product, where it is possible to show a result to the internal or external customer at the end of the sprint to align the product to the voice of the customer, checking consistency. The full product development process is then composed of a body of different sprints, each ideally resulting in a working prototype or a visible improvement in an existing prototype (Edwards *et al*., 2019).

Several potential drawbacks may arise in the implementation of purely agile practices (Dyba and Dingsoyr, 2009; Dikert *et al*., 2016), some of which might be extended to the Stage-Gate Agile hybrid models (Bianchi *et al*., 2020).

2.4. Agile and Stage-Gate hybrid models

Recent developments in the literature point to Stage-Gate and Agile hybrid models as the new perspective for product development organisational methods (Cooper and Sommer, 2018; Edwards *et al*., 2019; Antons *et al*., 2019) that overcomes the limitations of Stage-Gate and Agile. These systems try to combine the benefits of Stage-Gate and Agile-Scrum methodologies for product development, since companies in different industrial sectors are growingly interested in capturing the advantages of flexible solutions to manage external complexity while keeping the benefits of top-down visibility and long-term planning (Edwards *et al*., 2019).

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While, as mentioned, Agile was initially developed for the IT industry, manufacturing and physical products have traditionally been adopting Stage-Gate models (Cooper, 2016). Hybrid methods provide beneficial results regardless of the field of application (Sommer *et al*., 2015; Bianchi *et al*., 2020). However, the mechanisms underlying these benefits are still being studied: preliminary results suggest the efficacy of Agile tools to improve collaboration, knowledge sharing and visualisation within Stage-Gate designed processes (Sommer *et al*., 2015). Research has shown how the combination of Stage-Gate and Agile sprints is positively associated with speed and quality performance, but that Agile specification negatively relates to speed performance (Bianchi *et al*., 2020), possibly for the conflict existing between freezing specifications early in Stage-Gate practices opposed to the constant adaptation to changes in specifications that is advocated by Agile at the end of every time-boxed sprint.

Micro-planning seems to be improved in this hybrid approach while increasing flexibility by incorporating customer feedback into the development process, contrarily to purely Stage-Gate models (Cooper, 2016). Additional benefits deal with the macro-planning level, allowing for higher visibility, transparency and risk mitigation in comparison to purely Agile models (Karlstrom and Runeson, 2005).

3. Research design

3.1. The practice-oriented case study methodology

Case studies have long been known as a valuable tool to disentangle the relations between actors in product development (Bonaccorsi and Lipparini, 1994) and methodologies to foster this process (Liker and Morgan, 2011), confirming a need in this rapidly evolving field for recurrent in-depth analyses to validate and test new advancements being made in the theory and new practices developed in companies and organisations.

The practice-oriented research methodology (Dul and Hak, 2007) was found consistent with the goal of this study as it (Bleijenbergh *et al*., 2011: 148):

> […] aims at a group of problem owners or stakeholders of a problem in their task of taking an adequate decision or formulating an efficient solution to a problem by means of making use of participatory strategies.

This study aims to strengthen the design development and delivery of innovative training modules in a training centre focusing on digital technologies. Specifically, the study aims at understanding *how* the principles of Stage-Gate and Agile methodologies can be combined to strengthen the efficacy of developing a new service in a KIBS.

3.2. Case selection

This study investigates the case of the introduction of a new line of service within the offering of a centre specialised in experiential training for managers and professionals.

This case was selected on theoretical grounds, as it represents an extreme case. Training is a category of knowledge-based services characterised by the prevalence of intangible features

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and its value is highly dependent on the interaction between producer and user. The service design poses additional challenges to the producer, that needs to anticipate the variability of the forms of interaction. These challenges are augmented when the training service builds upon an interactive approach that combines teaching with physical artefacts.

The study of this case is expected to provide insight into the suitability of a hybrid approach with specific regard to highly challenging product development initiatives.

3.3. Validity criteria

This practice-oriented research builds on data collected through an in-depth qualitative analysis of a single case study. This method builds upon the case study methodology (Yin, 2015) and relies on principles developed for theory-oriented research (Crook and Garratt, 2005; Bleijenbergh *et al*., 2011), including four criteria to assure rigour of the research process: internal and external validity, construct validity and reliability (Gibbert *et al*., 2008). These four criteria have been received and aligned to the context of practice-oriented research, in which some additional criteria have been considered, such as comprehensibility, acceptance, and holism (Bleijenbergh *et al*., 2011).

Data collection has been performed aiming at applying data triangulation to increase the quality of the research performed (Denzin, 2009; Yin, 2015). To achieve triangulation, different data sources have been considered. Unstructured interviews were performed with different actors from the organisation for the project being studied, among which development team members, middle management, and managers from the steering committee. External actors were considered in the study as well, with interviews performed with technological partners. The participant observation technique (Noor, 2008) has been used to observe some key moments in the process, such as daily scrum meetings, periodic steering committee review meetings, and delivery to the clients. Documentary resources and other resources have also been analysed, including the documentation presented during steering committee review meetings, development team coordination tools (online Kanban boards), and client feedback modules collected at the end of the product testing phase.

The practice-based case study research approach required identifying a unit of analysis that was representative, complete, and manageable during the study. To achieve these objectives, one of the several workstreams being pursued in the greater context of the selected group needed to be identified. The unit of analysis needed to be a typical case (Yin, 2015), representative of other present and future projects that would be endeavoured by the group. This representativeness had been identified with the group of problem owners (Bleijenbergh *et al*., 2011) with the selection of a workstream regarding a topic where previous experience from the group was negligible, where at least two external technological partners would be involved, and where all three elements comprising the offer of the centre would be included: a lecture-based learning module, a simulation exercise, and at least two digital use-cases.

Data was collected striving to follow three principles from Yin (2015): (1) the use of multiple sources of evidence, (2) the creation of a case study database, and (3) the maintenance of a chain of evidence. The use of multiple sources enabled the triangulation of both in-source triangulation, for example the comparison of different answers given in open-ended interviews by multiple interviewees, in the case of the evaluation of some areas of the strategic project leadership framework (Shenhar, 2004, 2015) adopted, and for triangulation between

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different source categories, for example, the triangulation of information from focus interviews to the management and from surveys to trainees in the case of the evaluation of the overall success of the process developed. The convergence of evidence from different sources triangulated led the conclusions formulated.

The principle creating a case study database was followed by organising all evidence by the main source category (interview, direct observation, documents and records, tabular materials coming from surveys). Data have then been reduced, by archiving information not related to the case studied, such as technical documentation strictly related to technical details of the solutions being developed by the team rather than on their organisation, coded across the areas of the strategic project leadership framework and coded into strengths and challenges observed by each area.

In order to maintain a chain of evidence, the case study results have been articulated into the areas of the selected framework, with the aim to achieve a collectively exhaustive report of the project analysed to assess the success or unsuccess of the studied organisational method within the case observed. These results were derived from the database, where specific evidentiary sources have been coded according to the framework observed, with a direct link created in the findings through the use of direct citations. Ultimately, case study questions and requested documentation were originally collected aiming at covering the areas identified by the selected framework.

Although the validity criteria of qualitative research are also relevant in practice-oriented research, they have lesser importance than the practical relevance. As Bleijenbergh *et al*. (2011: 146) state:

> […] we argue that these [traditional] criteria are not adequate to meet the specific needs of research that is directed at solving practical problems. For practice oriented research external validity is of less importance than for theory building, since the knowledge is primarily developed for a specific case. Also reliability is less significant, since repeating a measurement is practical not feasible. In contrast, the practical utility of these research results is much more important than in theory oriented research. Criteria are needed to evaluate the quality of practice oriented research in general.

In this perspective, to grant verifiability and transparency, the strategic project leadership framework (Shenhar, 2004, 2015) has been adopted as a protocol of analysis to map key success factors and challenges identified. The framework has been selected for its fit as a comprehensive approach to project management. This framework is built around five main areas, described in the following paragraphs.

Strategy covers a missing link between the business strategy and the project plan. It is defined as a clear vision and direction on the objectives of the process as well as the process to achieve them, to gather the best value from the project outcome. Spirit describes how leaders formally bring their teams to overcome obstacles, energise and create excitement with an inspired state of mind focused on a project expected achievements. Organisation describes the adopted organisational methods, as well as the implicit or explicit trade-offs encountered and managed. Processes deal with the activities performed based on different knowledge areas, such as communication, information, monitoring, control and review. Tools in this framework

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are intended as subordinate to the previous elements to serve in the different processes and help streamline and manage the activities.

4. Findings

4.1. Research context

This paper studies the case of the development of a learning module on the application of digital technologies in research and development, which is part of a course on digital transformation directed to professionals and executives. The course is offered by an experiential training centre that allows trainees to interact in a hyper-realistic environment, i.e., to interact with people and machinery that closely reproduce the processes of a real company. The goal of the centre is ultimately to build team capabilities for participants and to help train internal experts while acting as a testbed for new Industry 4.0 technologies, formulating best practices, and achieving performance breakthroughs. To pursue this goal, the centre focuses on the development and delivery of experiential training sessions, with a vision to "instil in everyone the awareness of their potential and strengthen the capacity for continuous improvement", and a mission to "provide to manufacturing and service companies the expertise needed to achieve operational excellence and to successfully implement the digital transformation through an effective combination of scientific approach and a hands-on experience."

This centre was founded in 2011 by a trading association and a consultancy practice as a centre for competence building to instil critical skills for process improvement, mainly through the deployment of Lean practices. Subsequently, it provided training for digital transformation in all business processes. This strategic change involved a large-scale effort that relied on financial, human, know-how, and other intangible resources from institutions, partners, and companies to build learning modules aimed at creating skills and competencies and increasing the efficiency and effectiveness of the end-to-end processes in the value chain of a company. The input to start the development of these products was given by a clear vision, shared by both institutional partners, to broaden the scope of the training centre, which was initially focused on operations management only, across an ideal end-to-end value chain, spanning from research and development to aftersales support, to meet growing requests from actual and potential customers and partners, and to ultimately consolidate and grow a distinctive competitive advantage in its training capabilities.

This study investigates the design of a learning module in the research and development workstream because it appears most congruent with the methodological principles for case selection. There was little, scattered previous experience regarding this function in the development group, and information needed to be researched and processed with the help of experts both external and from the founding partners. There were three major different external technology partners pre-identified for implementing of the use-cases, and all three elements comprising the centre's offer would be included: a lecture-based learning module; a simulation exercise, and at least two digital use-cases.

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4.2. Status quo analysis

The knowledge transfer approach that the centre adopts proceeds in consequent steps: creating awareness, demonstrating the potential in production systems and service operation, learning, and implementing by participants in a real context, and transferring learnings to own organisations from training participants.

Training modules typically start with an introductive briefing, in which a traditional lecture-based approach is used to transfer skills for the topic, and participants are asked to share their previous knowledge and experience. Secondly, an exploration phase starts, where participants get to explore an 'as is' process with the aid of guiding templates. Participants in this phase interact with actors, machines, tools, and documents designed to bring alive several typical issues and inefficiencies. Reflective observation and re-elaboration then start with the help of a coach, where participants analyse and conceptualise key learnings from the assessment of the 'as is' state. Later, participants experiment by applying theory to the process previously assessed and are brought to design an optimised 'future-state'. At the end of the learning journey, participants are shown a possible 'future-state' solution, where those actors, machines, and tools previously observed are now organised according to the principles transferred and, in some cases, sustained with the help of new technological solutions. A consolidation phase, where reflections upon the entire path and which concepts could be used in the participants' context of origin, concludes the journey.

In order to achieve these goals, exercises and the application of theory are built around a simulated process representing a factory that manufactures compressors for household appliances. There are two real production lines, complete with manual and CNC machinery with operators trained to bring alive potential issues, common pitfalls, and pain points of a specific function or process. It is a demonstrative site to directly experience new technologies, best practices, and successful approaches, to learn by practicing and applying concepts previously transferred through a lecture-based approach.

The extension of the training offering to the whole value chain introduced several different workstreams to cover different functional elements of a model company value-chain, altogether with staff functions.

4.3. Features of the product development project

The management team of the project adopted a phase-gate approach for the execution of the project. This methodological opportunity allows us to appreciate the extent to which the principles of the approach have been actually implemented and the nature of the deviations and hybridisation to the canonical approach.

The project was enacted through periodic steering committee meetings, occurring on average every three weeks, over a period of 14 months. This allowed governing the macroplanning, where the entire process, divided into 11 workstreams proceeding in parallel and monitored through defined phases, was managed by a definition of the main milestones to reach within a fixed time, with more strategic decisions to be taken, by workstream. This resounds with the theory reviewed, which highlighted how Stage-Gate is a preferable option to grant visibility to the decision-makers, enabling strategic decisions to be taken rapidly and more boldly.

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In the research and development workstream, individual workstream leaders were free to organise their activities if they were delivering items agreed upon at a higher level, within the milestones generated. Mindful flexibility had been granted by the Stage-Gate macroplanning approach when a deliverable was needed in advance or when the additional time was required while not blocking other important activities. The research and development module was governed by adopting an Agile approach from the development phase, setting fast sprints of one week. The team was flexible according to the deliverables to achieve within the weekly sprint, with a fixed scrum master in teams composed of 3-6 members with a diverse technical background, including business, engineering and computer science. One downside of having a team that comprehensively included skills and competencies needed to develop the service, was that some of the team members were working part-time on the project, sometimes creating coordination issues. Daily activities were facilitated through daily check-ins, and sprints were opened on Mondays with a check-in, and with check-outs on Fridays, where the product owner was also present.

To build a backlog, the team first received a list of potentially relevant use-cases identified in previous phase-gate stages by a different team. The first two sprints had then been governed in Agile, building an intense client partnership to validate the relevance of the modules under development.

After this activity, the team had a backlog repository of the different items to develop but did not assign 'story points' to the ideas in the backlog, whose effort required for the development of the different solutions had not precisely been estimated nor formalised, yet it was kept as informal knowledge from the team. This might also have been due to a bias induced by the tool used by the team to keep track of the development process, which was a popular collaborative Kanban board, which allows for the creation of Kanban tickets in different stages, in this case in the backlog session, but does not allow to assign different weights to those tickets.

This resulted later, in occasional misalignments with the product owner and the steering committee, requiring efforts to re-align on the time required. This is a potential conflict area deriving from the joint deployment of Agile and Phase-gate practices, with development team members aspiring to higher autonomy, and management more comfortable with certain milestones as in phase-gate.

From here, the team started a first 'grooming' session, where they defined their goals for the first sprint, and shared them with the steering committee for validation. The informal internal knowledge of team members played an important role in this first stage, where team members recalled some of the already existing material from courses dating back up to 5 years in advance, that could be taken as the basis for some of the items composing the training module.

Some members of the development team members have reported having felt somewhat frustrated by the frequent request from the product owner to reach out to internal and external experts to get feedback, ideas and to validate ideas being inserted into the backlog, where abstract concepts were sometimes challenging to decline into the product setting. Some of their testimonies went as follows: "*I am grateful for the opportunity we get for learning so much, but sometimes we get some general feedback, and it is challenging to apply it into the operational process to our product and context*" or "*I feel we are spending so much time in getting feedback, that we do not have time to actually get the work done. It would be better sometimes to just move on*". To triangulate these affirmations, the direct observation of the work practices revealed that formalised

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feedback tools were though in place to be sure of the alignment and morale of the team, because not only weekly team meetings were in place, but also formalised periodic surveys on team morale, work-life balance and team dynamics, showing that the team members simply needed to be encouraged and open in discussing their feelings to be able to take counter-actions.

The team then assembled the learning module in the form of material to support a lecture-based training delivery to transfer knowledge on organisational tools, trends, and relevant technologies to participants. Adopting a modular approach to the development of the learning path, the lecture-based learning module has been considered the platform onto which to be able to plug-in the experiential simulation-based exercise and the different digital use-cases, each one being supported by a dedicated technology-focused sub-learning module. Periodic reviews with experts have been run at this stage without the involvement of potential final customers during the individual development sprints. This feedback was collected only later, through the delivery of the lecture-based learning module, in local language, to a classroom from an innovation management training course delivered remotely. In this context, although the general satisfaction rate expressed by participants was higher than 8/10, some un-structured feedback was collected on the lecture being somewhat theoretical and lacking deeper insights on technological tools and practical applications of what learnt. The development team decided then to use the next sprint to try to address those issues, by sketching potential training agendas incorporating technology-oriented insights, and by reframing the material used for the lecture-based module in a more visual manner, adding some application examples and best practices. The lack of feedback loops from customers during some of the sprint reviews might have contributed to causing this rework, and in case incorporating customer feedback in previous moments was not possible for some reason, the team mentioned that a rework sprint might be needed and planned in the backlog. Some doubts emerged from the development team upon interviews on the use of one-week time-boxes for some of the solutions being developed, suggesting quite surprisingly to grant some flexibility to the team itself in relaxing the closed time-box for development, choosing whether the sprint would last one, two or three weeks.

4.4. Evaluation of the project outcomes

The development proceeded with the implementation of nine digital use-cases to support the observation in a showcase of an optimised version of the research and development model office that was being developed.

The different use-cases had been prioritised based on the feedback collected and the availability of tech partners supporting the development of the different solutions. Adopting an Agile approach was reportedly somewhat confusing for some of the tech partners involved in the development, as their precise commitment could not be precisely booked in advance, occasionally creating challenges in coordination.

A key success factor mentioned by the team involved, that enabled to overcome those challenges, has been to precisely design mock-ups of the solutions and their functioning logic beforehand, validating them with experts and the tech partners themselves. This made it easier for the tech partners to start the development knowing precisely what their goal was, without requiring many intermediate alignments where the use-cases needed to be discussed. Another critical success factor in the relation with tech partners has been fully embracing a Lean idea

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of client-supplier relation, based on collaboration rather than precise contracts and penalties. This led to mutual adjustments during the development, where in some cases the result coming from tech partners went beyond the expectations of the team and the management, with results that were greater and more accurate than the specifications mocked-up beforehand by the development team. On the other hand, the aforementioned degree of uncertainty in precise timing resulted in occasional delays in the expected outcomes from the tech partners, which were transparent also to the product owner and the steering committee. When such cases occurred, the product owner and management would offer to escalate the topic, directly connecting with the tech partners if needed. In most cases, this offer was not pursued further, still being able to reach the goals set by the following steering committee meeting. A key success factor mentioned was transparency and the adoption of the Minimum Viable Product approach to the development, also when prioritising the effort from tech partners. This approach was highly endorsed by the management, with a clear mandate not to waste time in preparing extensive documentation or presentations between the periodic review meetings, but to focus on real development of the learning modules and the use-case products, asking to be able to see mock-ups and drafts of the tools being developed as they were being delivered. This practical approach from the management, favoured teams working with an Agile methodology. A clear focus on delivering Minimum Viable Products with suppliers led to an "inverted" development regarding the use-cases to showcase during training sessions. The initial approach proposed by the tech partners when approaching the solutions to develop was a Stage-Gate that followed five main steps: system infrastructure deployment, backend development, database structuring and data consolidation, data analytic structure development, and frontend development.

This approach would have constrained the possibility of receiving robust expert and customer feedback, without a tangible value in showing wi-fi antennas, raw databases, or lines of code, without a graphical interface to tell the story of what was aimed with those instruments. On the contrary, the Agile approach adopted by the research and development workstream team was 'inverted', also prioritising in the effort of the tech partners, the transformation of mock-ups into frontend dashboards, then working backward to build the data analytics and visualisation on dummy data. This approach would not have been possible without a technological infrastructure supporting this approach. Critical success factors here were the possibility to develop without yet having the infrastructure required, thanks to the use of virtual machines in cloud and of remote collaboration tools such as desktop remote access and control software, enabling the development team to work remotely on machines from the tech partners, and vice versa. This approach also had drawbacks. Working on virtual machines and not on the final environment where solutions were meant to be embedded, implying that software installations had to be run twice: once on the initial virtual environment, and a second one on the final environment. This rework has been remarked as physiological by the development team, mentioning that gains outperformed the losses with this Agile approach, getting design validations from both the management and clients faster, delivering a product that was able to add value immediately.

This concept was tested several times during the development of this learning path. Showcases of the different use-cases were performed to actual and potential customers while the development was still not completed, through the deployment of intermediate Minimum Viable Products only. This enabled a more responsive service, envisioning technological solutions relevant to the customers, and to incorporating customer feedback early into the

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development process, when it was still possible to steer and adapt the outcome of the use-case. An illustrative example came from a digital twin use-case, which was showcased among others to a potential customer group, which showed great interest in the solution, yet demanding if there were any measures of the sustainability of the product, and its energy efficiency, which was not present at the time. From this feedback, the team went on to incorporate among the parameters monitored a measure of the energetic efficiency.

The final, complete learning path was released with a slight 5% shorter delivery time with regards to the overall learning modules expansion project. The final learning path was comprised of several items:

- lecture-based learning modules, serving as platforms for the following items:
- two exercises, based on an assessment of the simulated office documents and process, and based on the re-design of the office work practices and processes;
- nine use-cases to be used for participants to envision the future-state model simulated office and research and development process.

This latter element was released with two of the nine use-cases still in an intermediate minimum viable product stage yet fully viable solutions to be displayed during training sessions.

The chance to run a comprehensive final test of the learning module occurred two months after ending the development cycles. A class attending an executive MBA was invited to attend the 2-day learning path on Digital research and development. The group comprised 28 participants, with an average of 37 years of age and 10 years of experience, 82% male and 18% female. The higher title held by participants was PhD in 54% of the sample, a Master of Science in 43%, and a bachelor's degree in 4% of the sample. The composition was varied by occupation, with 32% of the sample working in academia, with the rest working for private companies.

The evaluation of the learning path was qualitative, with an evaluation performed through an anonymous survey, which received 21 responses (75% of the participants). Several satisfaction items have been considered, among which the workshop execution, the clarity of the lecturer's delivery, and satisfaction connected to the individual items delivered. The overall rating was 8.65 on a scale from 1 to 10. Open questions have been asked to understand what participants would keep, and what they would change from the learning path. 7 out of 10 respondents to the open-ended questions mentioned the simulation exercise as the top element to keep. When asked what to improve, participants mentioned particularly that characters in the simulation sometimes tended to be somewhat stereotypical, suggesting that the realism of the simulation is a key element where the development team would need to improve the product and that they would have preferred to get more time for the simulation exercise. One participant mentioned that a potential solution could be to divide the students into groups and to run the simulation multiple times, one with each group. The training delivery team also made the same observation of the lecturer and the actors performing the simulation. These insights, and more broadly the test of the learning product delivered, provided precious information on how to improve the product developed. The development team received positive feedback from both the management team and the first pilot group, which with the overall delivery time and results achieved, proved the efficacy and effectiveness of the organisational method that the team adopted.

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5. Discussion

This case has illustrated how adopting a hybrid organisational model has helped a team develop and deliver a complex product involving different functions, with an articulated environment of both internal and external actors, with extensive interactions and potential coordination issues. The analysis of this case also helped shed light on additional insights from the thorough observation and interviews that have been performed, helping to develop the discussion around organisational models based on Stage-Gate and Agile methods, and their interplay. The role of underlying Lean principles for product development (Sonnenberg and Sehested, 2011) was another critical factor in achieving success over several dimensions of the framework observed, effectively supporting the adoption of a Stage-Gate and Agile hybrid organisational model.

An appreciation of the project process and outcomes has been performed based on the Strategic Project Leadership framework (Shenhar, 2004) across its five dimensions, striving to capture the interplay effect of the Stage-Gate and Agile hybrid approach.

5.1. Project strategy

The case analysis highlighted that a thorough, formal analysis of the competitive landscape and distinctive client offer was performed before starting the development process, applying the Stage-Gate principles. This allowed for a strategic macro-planning of the overall project, becoming a key success factor of the case studied. This vision and plan were positively transferred to the team coordinators of individual workstreams inside the overall landscape, who were made responsible of outcomes and business results and helped to be leaders with their team of internal and external resources.

This vision was sometimes not capillary shared with individual team members involved in the development teams. Such partially complete vertical integration and communication confirms the results encountered when analysing Agile implementation potential challenges (Dikert *et al*., 2016), stressing the importance of managerial commitment in empowering team members and creating a shared vision to deploy strategic objective into operational change.

5.2. Project spirit

The strong endorsement from the management for the Agile approach reportedly made the team feel empowered. The adoption of the Lean concept of servant leadership (Sonnenberg and Sehested, 2011) enabled teams to see managers as strongly committed to removing obstacles, corroborating as a success factor the implementation of an Agile culture. Informal learning and development opportunities through frequent interactions with recognised field experts were recognised by the product manager and by some of the team members, effectively helping to create a learning community, evidenced as a success factor both for Lean and Agile practices (Beaumont *et al*., 2017). The team interviews, though, revealed that to frequent requests from the management to reach out to experts might be perceived as a lack of empowerment, and might show a need for reinforcing Agile culture beyond the creation of a safe environment alone, and to fully leverage the structured feedback tools and practices in place.

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5.3. Project organisation

A key success factor for the organisation was the deployment of teams with a diverse background and complementary skills, according to findings from previous studies (Dikert *et al*., 2016), enabling the team to comprehensively address complex problems.

The creation of external networks, as proposed by the Lean methods for product development (Tuli and Shankar, 2015), was reportedly positive for the organisation, confirming that a hybrid model can enable a positive mutual adjustment with external actors (Cooper, 2014).

Some challenges were reported where resources were available only for limited portions of their time, being part of more than one team, a trade-off that needed to be managed to have all competencies and skills needed inside the team. The presence of external experts as well was reportedly complex to manage, where opportunities to learn for the team, and to improve the quality of the final product, met isolated stress in managing and incorporating feedback in the development process, and decline abstract concepts into the setting framed for the product developed.

5.4. Processes

The organisational method observed was a Stage-Gate process for the macro-planning, which enabled the steering committee to make decisions based on clear strategic objectives in the first phases of the process on which workstreams to prioritise, and then monitor progress transparently, being able to orchestrate by re-allocating resources when needed, and moving delivery dates when changes were needed for mutual adaptation, also with suppliers (Solaimani *et al*., 2019b).

The Agile approach was evident from the development stage onwards, consistently with observations from theory (Cooper and Sommer, 2018). Time-boxed sprints prioritised based on the backlog would be run, achieving minimum viable products that enabled the fast delivery of value, confirming the benefits of this hybrid model from theory (Cooper, 2016; Edwards *et al*., 2019), and enabling to test concepts with clients already during the development phase.

The organisational method adopted confirmed the expectations in allowing the development team to deliver the final product earlier than initially planned, achieving a satisfactory result based on the clients' feedback. This has likely been achieved thanks to benefits from the Agile methodology for the intense development stage, whereas those coordination and communication tools might have been missing in a purely Stage-Gate approach. Potential communication silos deriving from individuals (Beck *et al*., 2001) have been tackled with the Agile and Scrum techniques, such as the daily and weekly meetings registered, while the danger of having multiple teams working separately has been mitigated through the periodic monitoring of Stage-Gate.

The Minimum Viable Product approach was effective in helping to deliver value fast, as predicted (Cohen *et al*., 2004), but led to reportedly unavoidable rework when migrating from the software development environment to the final IT environment. This highlighted how in a few cases where technological boundaries were involved, the predicted contribution of this

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hybrid approach to both micro-planning and macro-planning (Cooper and Sommer, 2018) was weakened and might suggest the adoption of a more structured macro-planning to support the allocation of backlog priorities also when working with an Agile approach.

Concurrent engineering (Koufteros *et al*., 2001) and concurrent planning were sometimes unable to express their full potential as they probably would in a purely Agile approach, suggesting that in a hybrid organisational model, the full potential of this practice would be limited to an intra-functional application, rather than to the holistic process. The development team observed adopted a one-week time-box for sprints, which sometimes resulted in a difficulty in delivering a finished, working Minimum Viable Product, fulfilling the Agile-Scrum methods entirely, consistently with findings observed in theory (Cooper and Sommer, 2018). A surprising suggestion from development team interviews came in the direction of relaxing the fixed iteration time-box of a sprint, while fixing the delivery of a Minimum Viable Product, but this approach has not been experimented in this study.

5.5. Project tools

The adoption of several organisational tools, many developed within the Lean and Agile environments, has been reported; such tools helped the team to deliver consistently, as predicted from theory (Sommer *et al*., 2015), enriching Stage-Gate with more operational tools. These organisational tools were also empowered by digital technologies, which helped in streamlining and structuring communication. These tools included tracking and monitoring tools in the form of a cloud-based dashboard, virtual, ubiquitous whiteboards to help in the design phases, and virtual machines enabling parallel engineering of some of the use-cases.

Tools meant to facilitate the development team alignment sometimes created misunderstandings between the team and the management, such as in the case of a digital Kanban board to which both the development team and the product manager had access. Development advancement was measured through the number of Kanban cards moving forward only, biasing understanding because important information such as Agile story points was not included in the software platform that was used. This would suggest caution in potential biases resulting from adopting digital tools without a preliminary evaluation and sharing of results.

6. Conclusion

This study was conducted to help develop the knowledge of a group of problem owners, from a training centre around the Agile and Stage-Gate hybrid organisational model for developing new training products. A development team applying the Agile approach inside a Stage-Gate framework has been observed and studied through multiple data sources, applying the practice-based case study methodology. This research has found that this hybrid organisational method has been evaluated as effective in both reaching a satisfactory delivery time, and a satisfactory quality of the resulting training product upon testing. This result, consistently with previous studies (Cooper, 2016; Bianchi *et al*., 2020), showed the benefits of this hybrid approach to mitigating potential downsides from both the Stage-Gate approach and the Agile approach when taken individually. This hybrid approach resulted in an effective complementary compound, specifically where Agile integrated the traditional Stage-Gate

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with tools to manage the complex development stage. At the same time, Stage-Gate provided a broader view of the overall processes, enabling more punctual macro-planning. This case, though showing overall encouraging results, has also shown how some elements should be managed cautiously. Confirming previous observations regarding the challenges of adopting Agile at scale (Dikert *et al*., 2016), team communication and management commitment have shown to be critical when balancing the two approaches, particularly when fixed-time and customer specifications from Stage-Gate encounter variable development time and customer specifications as for the case of Agile.

Some elements of Lean have been observed as underlying fundamentals to collaborative product development (Tuli and Shankar, 2015), with its comprehensive set of tools and approaches to help teams in problem-solving, prioritising, and scheduling.

This piece of research can contribute to the broader literature on organisational methods, with regard to the Stage-Gate and Agile hybrid model, by providing a case of successful application in developing a training module. Limitations of this study emerge from the presence of one only case being studied in-depth, with limited generalisability, and also due to the practice-oriented methodology adopted. Focusing the scope of research on precise relations would benefit to adopt experimental approaches to the study of these organisational methods, as well as adopting comparative case-study methods to be able to generalise the findings more robustly.

Keywords:

agile stage-gate hybrids, training design, digital transformation, new product development, experiential learning, practice-oriented case study

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