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A model-driven framework to support strategic agility: Value-added perspective
Konstantinos Tsilionis, Yves Wautelet *
KULeuven, Belgium

A B S T R A C T

Context: The Covid-19 pandemic has shown the entire world that the habits of work, freedom, and consumption can change quickly and significantly for an undetermined amount of time. A dynamic environment such as this, prompts organizations to move fast in order to leverage changing circumstances as sources of opportunity rather than deadly threats. Drastic changes in work organization, consumption habits, compliance, etc., may require firms to quickly adopt new technology delivering all sorts of added value.

Objective: The development and adoption of new technology – structurally impacting the way the organization conducts its activities – requires a considerable amount of effort in a short time frame, thus rendering it a governance decision where the alignment of the technology's adoption and use to the long term strategy needs to be evaluated. The short time frame requiring fast response implies that agility should not remain a development or management/operational concept but should also be adopted onto the strategic layer.

Method: Design Science Research (DSR) has been applied to build-up a framework supporting strategic agility in a model-driven fashion called Strategic Agile Model Driven IT Governance (StratAMoDrIGo). The relevance, rigor and design cycles of DSR have been applied and presented.

Results: StratAMoDrIGo is based on the identification of sources of value for the organization's strategy, its stakeholders and the users of the implemented/adopted technology. Relevant concepts are consolidated in an ontology of which the application uses the NFR Model at strategic-level and the i* Strategic Rationale Model at management-level. The proposal is applied on the case of an hospital facing the Covid-19 pandemic.

Conclusion: The value brought by strategic opportunities’ adoption to the organization, stakeholders and users can be evaluated ex ante through conceptual models.

1. Introduction

Governance and strategic decisions often face a lack of concrete data or formalisms supporting them [1]. Unstructured and fragmented information leads to a vision limited in many ways. Such information indeed fails to provide an ex ante evaluation of the consequences of IT adoption on the long term competitive position of the organization and the fulfillment of stakeholders’ best interests. Furthermore, all type of IT related decisions (including strategic ones) need to be taken on short notice because of the rapidly changing socio-economic environment. Indeed, recent years gave rise to unexpected events deeply impacting the economy and stakeholders’ (e.g. customers, employees, shareholders, …) behavior in a very short time frame and without any notice. For example, we can cite (i) the Covid-19 pandemic stipulating new ways of working/consumption habits; (ii) the 2008 financial crisis impacting the budget formulation processes and overall financial management of organizations, or (iii) random terrorist attacks disrupting civil liberties and worker mobility. When taking place, such events act as game changers and reactive measures, impactful on the organizational strategy, need to be assessed and implemented almost in real-time.

Conceptual modeling involves building a representation of selected phenomena in some domain [2]. Some conceptual models to support strategic decision making based on goal-driven representations (e.g. [3–6]) have been developed and validated lately. Such models are able to incorporate organizational goals at a very high level of abstraction but also the goals of a wide variety of stakeholders together with their intentionality. Their use is significant to highlight, study, and evaluate the global impact of a new software or system development and deployment.

This paper depicts the research aimed to build a framework, instantiated through conceptual models, allowing to quickly evaluate (when the business context changes rapidly) the impact of IT adoptions in terms of strategic, stakeholder and user value. By strategic value we mean, in the context of this paper, every development, adoption,
deployment of technology that enhances the long term position or the organization's products and services. Similarly, stakeholder value refers to any kind of support resulting from technology that increases the level of quality of life of the stakeholder in a specific business context. Finally, user value essentially concerns furnishing functional and non-functional elements to an end-user helping him/her to more efficiently perform its private or business activities. Since the framework depicted in the paper focuses on the evaluation of the impact of technology adoption on an extended range of values on the one side and on rapid development/deployment in changing environments on the other side, it is aimed to support strategic agility through conceptual models.

The developed framework extends the Model Driven IT Governance (MoDrIGo) one of [6] to include a broader range of potential technologies on which governance-level adoption decisions need to be taken. These are purely based on (added) value evaluation to sustain agile principles; we thus call it Strategic Agile MoDrIGo, in short StratAMoDrIGo. MoDrIGo uses conceptual modeling to support the IT governance process especially for business and IT alignment evaluation when adopting IT services. In that sense, StratAMoDrIGo is more general (not focused on IT services only but on a broader range of (significant) technological adoptions) but also covering more aspects (because it allows to overview the impact of the adoption on stakeholders and users) while being also flexible (different configurations can be edited beforehand). StratAMoDrIGo is intended to be applied “on the fly” when the business context changes and new technologies can be adopted while MoDrIGo is applied in a classical service portfolio approach when IT services are to be developed to replace decommissioned ones or address new needs. The main research questions the paper is answering to is “How could conceptual modeling be applied to highlight strategic, stakeholder and user value within technological adoptions in a fast moving business context?”. The main contribution of this paper is the enhanced framework (StratAMoDrIGo).

The proposal is applied on the case of an hospital facing the Covid-19 situation. This hospital has been used for full validation of a previous framework in which the one presented in this paper takes roots (see [6]). We here study the impact of the development of 2 (software) applications driven by the Covid-19 pandemic on the hospital’s strategy, stakeholders and application’s users. The impact of the pandemic on the hospital strategy has been, for the research team, an opportunity to chart the notion of agility in a wider organizational perspective by promoting and reinforce initiatives encouraging a rapid response to internal/external organizational challenges [9,10]. However, despite the proliferation of the importance of agility when crafting organizational goals, the former does not necessarily constitute a panacea to every issue related to organizational effectiveness and efficiency. For one thing, agility is by nature a multipurposed conceptual term, open to many definitions and action strategies even within the same organization [11]. Sambanurthy et al. [12] illustrate the multidimensionality of agile by differentiating between some of its co-variants such as customer agility (leveraging customer insights to expedite innovation), partnering agility (exploiting strategic partnerships and business networks to discover competitive opportunities) and operational agility (swift redesign and co-creation of business processes with the synergies of customers/developers for maximized business value delivery). The last variant has become prominent in the field of software development after the emergence of the so-called ‘Agile Manifesto’ [13] invoking the simplification of certain code-producing principles/attitudes and the disavowal of plan-driven rigidity for the attainment of user-oriented functions that yield maximized value. Operational agility lies into the use of the existing business model (i.e., improving the accuracy and quality of software to deliver a better product or service), however, up-scaling operational agility towards the achievement of strategic agility (i.e., creating new software developments, exploring new markets, making new products by the exploitation of opportunities [14]) is not self-evident.

Progressively, there has been a lot of seminal work in the effort to chart the notion of agility in a wider organizational perspective by customizing specific ‘command and control’ mechanisms to software development teams (i.e., setting-up specific Key Performance Indicators (KPI), interventions and team coordination tactics) [15,16]. However, works as such do not consider how agility can be adopted at strategic level.

Approaches found in literature to achieve strategic agility are most often a collection of advices or practices to be implemented (see for example [17]) or inherent qualities – like strategic sensitivity, resource fluidity and leadership unity [18] – to have to make the organization's environment agile at a strategic level. According to several authors (e.g. [19-22]), dynamic capabilities – that were originally defined for sustaining a competitive advantage in an increasingly interdependent environment – can be used for achieving strategic agility. Ordinary capabilities are operating routines concerning the business processes of an organization [23] while dynamic capabilities are more abstract ones implying a modification of the operational processes and enabling the business to evolve and expand using innovation [21,23]. Strong dynamic capabilities are required when organizations are facing highly uncertain environments in order to favor strategic agility [21]. A dynamic capability can be defined as the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments [19]. Dynamic capabilities do represent key elements for an organization’s capacity to innovate, adapt to change, and create change that is favorable to customers and unfavorable to competitors; they...
are a specific type of organizational and managerial skills [21]. Glesne et al. [24] highlight that three main types of dynamic capabilities are relevant for strategic agility, i.e. the capacity to sense and shape opportunities (sensing), the capacity to seize opportunities (seizing) and the capacity to maintain competitiveness through reconfiguring the enterprise’s assets (shifting). The framework developed in this paper is aimed to provide support to these dynamic capabilities. The inclusion of the framework in the organization’s practices is intended to enhance the sensing (by creating an opportunity-aware culture), its use concretely helps the seizing (by offering a concrete way to evaluate the organizational impact of opportunities’ adoption) and finally supports the shifting (by highlighting how organizational resources and structures can be reconfigured for the adoption of the opportunities). All in all, the framework is intended to furnish support to reasoning for strategic agility; this is done through the use of conceptual models.

As already discussed, strategic agility has been mostly explored in strategic management sources in a very abstract manner via the exploration of qualities an organization should have to be strategically agile or via the experimentation of specific practices. To the best of the authors’ knowledge, no formal framework has been proposed favoring agility independently at a strategic level. The SAFe 5.1 framework [25] drives operational developments by value streams identified at strategic level but does not see agility as an independent aspect/quality of the organization. Also, SAFe’s software developments are driven by strategic value flows but no ex-ante evaluation of the development’s impact can be realized with the framework. A detailed comparison between SAFe and StrAtAMoDrGo can be found in Section 8.1. At operational-level, methods like Scrum and XP favor agility in software development; however, such frameworks do not include conceptual models natively and focus solely on the employment of user stories for requirements elicitation [26]. Thereby, the goal, as presented in the present paper, is to build a framework allowing to represent business/organizational situations in which rapid change is necessary by focusing on the delivered value (the key component of agility). Thereby, the framework is purposed to evaluate the consequence of the adoption of strategic opportunities (mostly new technology) onto the organizational setting as a concrete approach of how to deal with a changing environment. Traditional (IT) governance frameworks also exist; frameworks like ISO/IEC 38500 [27] or Cobit 5 [28] provide guidance for a proper IT governance but do not encompass principles/processes/concepts to deal with changing environments and recommending immediate action. The framework developed in this paper covers these two gaps by being driven by conceptual models and allowing an integration of the strategic, tactical, and operational levels; strategic and operational agility can ultimately come together with the support of a structured approach.

2.2. Towards stakeholder-driven governance

The key concept of stakeholder-based governance lies on the fact that strategic decisions are not taken to maximize value for shareholders only but rather for all of the stakeholders of the organization [29]. The group of stakeholders is, by definition, much larger that the shareholder one since it may include C-level executives, middle and lower-level managers, users of an IT system, administrative employees, clients, suppliers, etc. Proper stakeholder-based governance means that when fixing strategic objectives and taking decisions to fulfill them, all of these individual groups should be taken into account to maximize shared value.

Samavi et al. [30] highlight that most modeling techniques that are used to draw useful business insights may be focusing on maintaining and reinforcing the existing structure and functions of transactions in a value-driven network. They, however, do not engage in a fully-fledged stakeholder-based governance which would imply, by definition, the consideration of the intentional dimensions of the stakeholders participating in a business. This may lead to representational inefficiencies given the fact that creation and exchange of value in a business ecosystem is triggered and influenced by the goals/intentions/motivations of a multitude of stakeholders.

2.3. Related work

Lara et al. [31] regard governance from a design science perspective where they discover that most software modeling constructs favor the portrayal of elements from the strategic apex in full concretization without necessarily incorporating their operational-layer technologies. As a solution, the authors introduce a set of new modeling elements which essentially extend ArchiMate [32]. This enables a better operational imprint of the Enterprise Architecture (EA) but increases by far the number of inter- and cross-layer connections without providing a clear contribution in improving the business and IT strategic decision-making structures when facing rapidly evolving requirements. Comparatively, Souza & do Prado Leite [33] try to bridge the representational disassociations across strategic, tactic and operational layers by proposing a model-driven methodology which merges i* [34] and BPMN [35]. In this way, inter-layer traceability is ensured by using relationships in places where these modeling languages intercept each other. The authors claim that integrating fit-for-purpose modeling constructs for each organizational level is bound to improve their inter-alignment, at least in a vertical perceptive. However, their contribution seems to be entailing a meticulous up-front design effort for all organizational tiers. This is seemingly at odds with the paradigm of using strategic opportunities where only coarse-grained features are defined to allow businesses to react rapidly to internal or external change.

Juhnyoung et al. [36] propose a value-centric, model-driven approach that is meant to identify business and IT gaps during the exploration of new business opportunities. The approach strives to map IT functions and capabilities to business performance while facilitating the demonstration of the delivered value of IT and services. It is comprised of these key modeling elements: first, a multi-layer model represents the linkage between business and IT semantics and enables IT and services to reflect their yielded business value. Second, a business modeling component provides a strategic-level business view of the entire enterprise and enables business analyses based on value and risk assessment elements such as KPIs and other operational metrics. Even though the approach aspires to yield an end-to-end integration of business value with the main IT enablers, the former is defined only in terms of cost metrics influencing the corporate governance view from the perspective of the shareholder.

Thomas & Vom Brocke [37] describe a conceptual modeling-based methodology to assess and determine valuation metrics of Service-Oriented Architecture (SOA) deliverables. The study aspires to traverse the gap between the flexibility that a SOA brings to IT integration and the leverage of the former to achieve (business) strategic objectives by providing support to those responsible for the design-decision of these services. Conceptual models provide with individual, factually documented, design alternatives evaluated with regard to their long-term economic viability. There are some points of attention with this approach with the first one being that value is considered solely insofar to its economic significance, disregarding in that sense some service which may be costly to design/implement but holds nonetheless the potential of solving crucial functional and/or strategic concerns. Second, the methodology describes the setup of a governance decision-support center for the design of specific services but does not depict the framework by which this center transmits the design-decision implications to the other layers of the organizational spectrum.

Khurum et al. [38] acclaim that the existing value-construct contributions act in isolation from each other in software product development processes. Consequently, the study presents a consolidated software value map which introduces essentially a balanced scorecard approach that considers various internal/external factors before a final software product development decision can be taken. Similarly, Mendes et al. [39] detail a methodology that calls upon the improvement of decision-making activities associated with the development processes of software intensive products and services. This methodology can be
3. Research paradigm, method and approach

This research follows the precepts of the Design Science (DS) paradigm [40]; DS is meant to build generic solutions for identified issues. The output of a DS-driven research can be a solution in the form of an artifact, terminology, methodology, engineering tool, and so forth. In the present research, an attempt has been made to build artifacts to improve the handling of strategic opportunities for the benefit (i.e., provided value) of all stakeholders in a highly dynamic business context. These artifacts aim to solve an unresolved issue or a problem considered being in a precarious state. More precisely, we furnish a tool to overview the impact of the adoption/deployment of strategic opportunities on (i) strategic objectives (to evaluate strategic value), (ii) stakeholder goals (to evaluate stakeholder value), and (iii) technological features (to evaluate user value). To answer the research question given in the introduction and, in accordance with the DS research cycles defined by Hevner [41], we are communicating an analysis of the Relevance Cycle in Section 3.1, the Rigor Cycle in Section 3.2 and the Design Cycle in Section 3.3.

3.1. Relevance cycle

The Relevance Cycle concerns the identification of opportunities/problems in the application domain. In our context, we identified the problem referring to the lack of a framework being able to adopt strategic opportunities in short time frames through the evaluation of the value they offer on a strategic, tactical and operational level. The problem has been identified in practice within a partner organization (that had already been in collaboration for the build-up of [6]). The former had been implementing an IT governance framework that was in a state of disruption with traditional (IT governance) frameworks for allowing the evaluation of larger technological developments and their added value on multiple levels; however, the framework was not agile enough to deal with changing business contexts. Even though agility was a major area of concern, together with the quest for integration with operational agility approaches, their existing framework offered analysis abilities through the use of conceptual modeling. The latter also contributed to the creation of an archetype for the evaluation of the strategic opportunities while maintaining uninterrupted the daily mode of operations within the organization. The recognition of the aforementioned problem along with the creation of the artifact occurred iteratively. The final release of the artifact had to satisfy each sub-sect of this problem.

3.2. Rigor cycle

The Rigor Cycle refers to the theories/methods that are used to ground the construction and evaluation of our artifact. Our framework is built upon an existing framework for IT governance validated in previous research. In order to support the contribution of this paper, we created a so-called 'pseudo-ontology' [30,42] (i.e., not a fully-fledged ontological construction but the creation of an informal user friendly ontology). Indeed, we use a restricted and structured form of natural language to state and clarify the definition of its concepts. A Unified Modeling Language (UML) class diagram [43] is used to formalize the concepts of our ontology as well as the links between these concepts. The ontology and its application, through the use of existing models, constitute a contribution to the knowledge base of agility. More precisely:

- For the **strategic layer** we started from the MoDrIGo framework which was applied for the IT governance of the partner organization. More precisely, the strategic-layer concepts started from the ontology of MoDrIGo. The latter is aimed at defining key concepts for a governance situation where development/adoption decisions need to be taken for IT services. We were interested in linking the strategic layer with the overall organizational (business and/or IT strategy) so we used MoDrIGo for the representation of the business (and IT) strategies because of its specific purpose of evaluating business and IT alignment out of conceptual models for service-based systems. The business situation we aim to represent here is nevertheless slightly different than in the traditional MoDrIGo framework. We have reviewed a series of papers for the identification of relevant concepts for strategic agility. Unfortunately, and as said before in this paper, we mostly found sources negotiating it in a very abstract manner through qualities or practices to align to but never in the form of a framework that can be instantiated. Therefore, the concepts had to be refined from the domain of strategic agility but also driven by traditional agility (thus focusing on value). The framework indeed focuses on any technological adoption driven by a moving business context (which could also be an IT service); we have thus included the ones of business context and **strategic opportunity**. Finally, with respect to MoDrIGo, the concept of **Business IT Service** (by nature also very abstract thus represented at strategic-level, see [6,44]) has been removed; the **strategic opportunity** can nevertheless be a **Business IT Service** even if the former is broader so can be a broader range of technological means;
- For the **tactical layer**, the concepts are driven by stakeholder analysis so we tried to incorporate/represent the impact on stakeholders and the value provided to them by the adoption of the **strategic opportunity**;
- Finally, for the **operational layer**, we link the tactical concepts to the notions of **Epic User Story** and **User Story** (these concepts are defined in [26,45,46]) to point to the agile (operational) development of the strategic opportunity; this nevertheless remains an optional part and is left for future work.

3.3. Design cycle

The Design Cycle refers to the construction and the evaluation of the artifact. Our framework (which we refer to as the artifact developed in this research from a DS perspective) has been constructed as an evolution of existing approaches that have been adapted to support agility on multiple levels due to the underlying focus on value. The evaluation is done through a case study onto an organization where the impending problem has been identified. The framework focuses on value through the triptych: **strategic**, **stakeholder** and **user**. The visual representation of the levels and the respective value brought is made using existing models and following

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1 We use here the term ontology because we depict a representation of the relevant concepts to deal with an agile situation at strategic and management levels. The pseudo-ontology is then supported by two existing models for graphical representation. Thereby, it is not a meta-model as such because it is instantiated using two different models.
the principle of separation of concerns. This means that although the ontology is presented here as a unified set of concepts, instantiations are done through the use of different models to illustrate/treat the different aspects of the problem separately. This allows to keep the problem manageable; we can also deal better with scalability when evaluating strategic opportunities having a large impact on the organizational setting or the representation of situations with the adoption of multiple strategic opportunities. More specifically:

- **At strategic level**, an Non Functional Requirements (NFR)-like diagram [47] is used to represent the benefits of the strategic opportunity(-ies) on the business objectives to identify strategic value. Such diagrams were originally used to represent non-functional requirements but have later evolved to represent high level (very abstract) strategic objectives and trace the impact of functional developments (called operationalizations) on these kinds of developments (see for example [6,48]). This level thus allows to isolate the strategic objectives and the strategic opportunities as coarse grained elements to study instantly the impact of the later on the former without tactical-level details (i.e., details on the impact of the deployment of the opportunity on the organizational setting);

- **At tactical and operational levels**, a Strategic Rationale Diagram (SRD) [34] is used to represent the stakeholders and identify stakeholder value. Although it is called strategic, the SRD allows to represent a tactical-level situation where the goals of individual actors (i.e., stakeholders) and the means for their realization can be documented. It allows to study the organizational impact of the adoption of a strategic opportunity and, consequently, the induced value for these stakeholders (so stakeholder value, at tactical-level). Finally, end users of the technology constituting the strategic opportunity can be represented in the SRD along with their goals and tasks to identify the value, provided by this technology, for them (so user value, at operational-level).

To show how the ontology can be dynamically used/applied in practice and supported with existing models, we also depict a process fragment, i.e. a set of process elements out of which concrete process instances can be composed when executed. The latter illustrates how to apply the framework as a method or within an existing (software) development method. It has been built generically to highlight the roles and activities that are performed in the context of a strategic opportunity evaluation for adoption decision. The constituting activities are customizable in function of the project and the process fragment should only be taken as a guidance for application; it is not meant to be used as a turnkey process but as a plug-in to technology development/adoption methods and/or agile methods; it has been formalized using the process fragment concepts of [49] and represented graphically in \( i^* \) [50] in the same fashion as in [51,52]. We chose the formalization of \( i^* \) because it highlights the social dependencies between the actors/roles without it being sequential. Indeed, we did not aim to document a sequence of activities in the process fragment because of the high variability existing in the sequence and/or parallelism from business situation to business situation. This also shows implicitly the flexibility in the adoption of the process fragment by an organization. Indeed, multiple activities can be performed simultaneously, some can be omitted while others can be added and the sequence can be chosen in function of the field requirements/constraints. Workflow-based notations – that are more directive in terms of sequence – do not highlight social dependencies and are less tailorable/customizable, thus less relevant. Conversely, the \( i^* \) notation accounts for the variability in the activities’ execution and selection.

The validation of the framework has been made through a case study in a Belgian hospital already studied in previous work (see [6,53]) but with the new context of the Covid-19 crisis as the cause of a changing business environment. The same organization had already applied the MoDrIGo approach (see [6]) but needed a more flexible approach to deal with crisis situations like for example the Covid-19 pandemic. More specifically, new technological developments helping to deal with the Covid-19 situation are evaluated through conceptual modeling to identify the value provided at various levels. For illustration purposes, we take the examples of a videoconferencing system and a Covid-19 self assessment app considered here as the strategic opportunities. This is fully detailed in Section 7. An expert opinion on the framework and its application has also been gathered for a better appraisal of the contributions.

4. Ontology

Fig. 1 depicts our reference ontology documenting the concepts required for dealing with strategic agility.

For the description of the ontology, we will first start with the strategic-level; strategy is one of the most important aspects of corporate governance [54]. Strategic agility essentially delivers its full potential in a dynamic business environment where the context changes without notice and unexpectedly. We refer to this as the Business_Context which is represented as a class in the ontology. An example of an instance could be the Covid-19 pandemic, the 2008 financial crisis, the 2015/2016 terrorist attacks in Paris and Brussels, or other kinds of game changing events like a merger, new trends in customer habits, new behavior in employees’ work, etc. The core strategy may be impacted by the business context; we represent this by the drives relationship link between the Business_Context and the Strategic_Objective class (the latter can be in nature a Business_Objective then part of the Business_Strategy or an IT_Objective then part of the IT_Strategy). In parallel, a changing Business_Context can drive one or more Strategic_Opportunities; these have a Type attribute that identifies the form it takes, e.g. an IT Service (see for example [44,55] for a characterization), an entire software system, a single mobile application or any technological device. These are represented by the Strategic_Opportunity class in the ontology; what matters is that the development/adoptions of the Strategic_Opportunity requires an amount of effort/resources having a significant impact on the organization’s performance jeopardizing its competitive position in the long run. The adoption of the Strategic_Opportunity can thus sustain pre-existing Strategic_Objectives and/or new ones driven by the Business_Context. When a Strategic_Opportunity sustains a Strategic_Objective it delivers Strategic_Value to the organization.

The management-level further supports the governance one through the implementation of solutions supporting the strategic decisions/ objectives. We aim here to bring value through the adoption of the Strategic_Opportunity to all of the stakeholders (represented through the Stakeholder class). The latter entails all the actors that have an interest in the organization and can either affect it or be affected by it. The approach presented here is, by nature, aimed to be stakeholder-driven and, to such an end, it explicitly identifies Stakeholder_Goals so, as a consequence, Stakeholder_Value resulting of the adoption of a Strategic_Opportunity. Stakeholders fulfill Management_Tasks some being required by the Strategic_Opportunity to be successfully adopted/deployed in the business environment. Also, they achieve their individual Stakeholder_Goals by the fulfillment of Management_Tasks. In turn, the users (represented through the User class) are a subgroup of Stakeholders that are directly using the Strategic_Opportunity in one way or another. Consequently, Stakeholder_Value is a concept that is broader than the User_Value, the latter being value given by the immediate use of the Strategic_Opportunity. More specifically, a User uses a Feature which is a special kind of Management_Task that possibly sustains, through technology, the realization of Strategic_Objectives. Stakeholders get direct (if they are Users) or indirect (if they are not Users) value from the adoption of the Strategic_Opportunity (through the use of its Features) in the specific Business_Context.

The evaluation of a strategic opportunity (in the aforementioned manner) suggests implicitly that the application of the framework is not
made to be fully top-down but rather a round-trip between the levels to identify and exploit the relevant identified sources of value at any level. Further explanation on the followed application process will be given in Section 6.

5. Model-based value representation

While the previous section concentrated on defining the relevant concepts for strategic agility and the sources of value, this section proposes an instantiation of the concepts using existing modeling notations to visualize the sources of value brought by the adoption of a strategic opportunity at strategic (governance) and management levels.

5.1. Strategic value driven by strategic opportunities: NFR approach

In accordance with MoDrIGo and, as explained earlier, to represent the strategic level (where the strategic value brought by the adoption of a strategic opportunity can be identified), we use an NFR tree [56]. Indeed, the latter is used first to build a strategic-level representation offering a decomposition of the Strategic Objectives in a refinement fashion. Note that the same modeling approach can be followed for the organization’s Business Strategy and for the IT Strategy. In both cases, Strategic Objectives are refined from top-level parent elements to more concrete leaf-level elements. In the NFR tree, Strategic Opportunities are linked to leaf Strategic Objectives through contribution links; this is both valid for the Business Strategy and the IT Strategy. Positive and negative contributions are inferred from the i* Strategic Rationale Diagram (SRD) – i.e., the management level – as task elements fulfilling a solution contributing to the realization of the Strategic Objectives (see Section 5.3).

A canonical form of an NFR tree customized for our purpose is given in Fig. 2.

5.2. Stakeholder and user value driven by strategic opportunities: i* approach

In accordance with MoDrIGo, to represent the management-level (where the stakeholder and the user value are identified), we use the i* SRD [50]. Nevertheless, the latter is slightly adapted/customized for our specific purpose. Fig. 3 depicts a canonical form of the i* SRD instantiated to outline the Stakeholders’ intentions with respect to the Strategic Opportunities (so the impact of the latter on the former) within the organizational setting.

The i* framework is a goal-oriented graphical requirement modeling notation [34]. It allows an early requirement engineering analysis in environments where social actors depend on each other for goals to be achieved, tasks to be performed, and resources to be furnished [34]. Previous researches proved the relevance and utility of i* to model organizational requirements of a “multi-agent system” [44] facilitating stakeholder’s interactions by depicting their dependencies and hence providing a mean for coordination. i* was previously used to model several organizational settings [57] like online stores [58], hospital
the Strategic Opportunity
User
The goal is rather to do the two representations together and to have a
management-level one since one needs the latter to infer the overall
Objectives (so on the business strategy).

Opportunity is represented at management-level as an actor whose
features a solution to a Strategic Objective. Similarly, the Strategic
Opportunity at management-level. The Features there
that the Strategic Objectives found in the business strategy, depicted in
5.3. Traceability between the strategic and management levels
stakeholder for its processing.

fulfill it. In that case the technology might need direct input from the
stakeholder is not necessarily a direct user of the technology but is
direct operational value from its use but also has an impact on a broader
range of stakeholders that, even if they are not direct users, need to
be somehow involved for a successful adoption. Stakeholders typically
need the strategic opportunity (through its Features) to help towards
the fulfillment of some of their goals; these goals are represented as
dependencies between the actors. So, all in all they get value from the
adoption of the Strategic Opportunity. Note that, in the canonical form
of Fig. 3, one of the goals is represented as a dependency required
by the Stakeholder (depender) but needs support from the Strategic
Opportunity (dependee); in that case the latter finishes a service like
automation, computing, etc. to fulfill the former’s referenced goal (the
stakeholder is not necessarily a direct user of the technology but is
benefitting for its deployment). The strategic opportunity then furnishes
stakeholder-value (as can be seen in the Figure). A User represents a
Stakeholder that has a direct interaction with the technology imple-
mented through the Strategic Opportunity (e.g. an application end-user).
In the canonical form of Fig. 3, the first goal dependency represents the
User as depender and the Strategic Opportunity as a dependee so
that the User needs a direct interfacing with the Strategic Opportunity
to get (user) value. In the case of the second goal dependency, it is the
Strategic Opportunity (dependee) that needs the User (dependee) to
fulfill it. In that case the technology might need direct input from the
stakeholder for its processing.

5.3. Traceability between the strategic and management levels

Fig. 4 merges the strategic- and management-level views to show that
the Strategic Objectives found in the business strategy, depicted in
the NFR graph, can be found within the scope of the actor representing
the Strategic Opportunity at management-level. The Features there
furnish a solution to a Strategic Objective. Similarly, the Strategic
Opportunity is represented at management-level as an actor whose
internal intentions can be depicted, and, at strategic-level, we only see
an aggregation of it summarizing its overall impact of the Strategic
Objectives (so on the business strategy).

The aim is not to build the strategic representation before the
management-level one since one needs the latter to infer the overall
contribution of the strategic opportunity on the strategic objectives.
The goal is rather to do the two representations together and to have a
round trip where different configurations can be tested. As an example
of how a development team can get along with the different diagrams
and collect the required knowledge, we depict in the next section
a process fragment illustrating the possibilities when applying the
framework. We would rather say that we are in a middle-out approach
than in an top-down or a bottom-up one.

6. Process fragment

As already said, to highlight the Roles involved in the process
fragment, their Work Product dependencies and their Activities, we
use a pictorial Description using the i* framework. Each Role can be
played by several individuals; similarly, an individual can play different
Roles.

Table 1 documents all of the process fragment elements defined in
Seidita et al. [49] that are instantiated onto our contribution using
i*; this mapping is taken from previous work and is further justified
in [61].

Fig. 5 depicts our process fragment using an i* SRD; the following
description systematically refers to it. We distinguish several types of
stakeholders, all having various objectives and expectations, i.e.:

- The Board of Directors (BoD) Role represents the top manage-
ment of the organization regrouped in advice and/or decision
boards [62]. The BoD is required to Set-up the Strategy and to be
Dealing with a Changing Business Context which are process Phases
so represented as Goals in the i* SRD. These Phases basically
involve the same Activities as can be viewed in the graphical
representation, so we point out that the former Phase is about
defining the strategy in normal times while the latter represents
evaluating the strategy shift when a new business context (as

We use i* in this section to depict how the framework can be used by
a consulting or professional team. i* is also used in the framework to depict
a management-level organization of stakeholders (as seen in Section 5.3). So,
i* is used in 2 very different contexts in this paper and these should not be
mixed to understand the research.
defined in Section 4) takes place. The main Activity (represented as an i* Task) required to perform these Phases is Determine Strategic Objectives. The Strategic Objectives are then a Work Product required by the Strategy Manager to perform its Activities;

- The Strategy Manager Role thus depends on the BoD Role for obtaining the Strategic Objectives Work Product; that is why it is represented as a Resource dependency in the i* diagram of Fig. 5. The Strategy Manager is responsible of the Determine Strategic Value Phase. This is done through the realization of the Evaluate Impact of Strategic Opportunities on Strategic Objectives Activity. For this, the Strategy Manager requires the Strategic Objectives but also the i-star Strategic Rationale Diagram produced by the Analyst Role in order to examine the impact of the Strategic Opportunities’ Features on the Strategic Objectives;

- The Chief Information Officer (CIO) Role is in charge of the Evaluate Strategic Opportunities Phase. To such an end the Role performs the Activity Determine/Overview Features. The latter examines in detail the main Features brought by the Strategic Opportunity. The Analyst Role is depending on the CIO Role for the Strategic Opportunity’s Features Work Product;

- The Analyst Role is in charge of understanding the intentions of stakeholders with respect to the Strategic Opportunity. To this end, this Role is in charge of the Determine Stakeholder Value Phase which is represented as an i* Goal in Fig. 5. A means-end decomposition then allows to refine the i* Goal representing this Phase. To fulfill it, the Software Analyst Role performs the Activity Represent stakeholder’s goals and management tasks. The purpose of this Activity is to build an i* SRD representation (see Section 5.3). More domain knowledge is usually needed to fully perform this Activity so that the Analyst Role needs to discuss elements with all of the possible stakeholders (including Users) to understand their Intentions. The (Strategic Opportunity’s Adoption Stakeholders) Intentions are then a Work Product represented as a resource dependency: the Analyst performs the Determine User Value Phase. Epic User Stories are essentially mapped to the Strategic Opportunity’s Features. The Product Owner Role is also in charge of collecting the Feature’s User Stories from the User Role for an Agile development of the Feature;

- The (end) User Role is in charge of performing the Furnish Feature Requirements Activity. The result of this Activity is the Work Product Feature’s User Stories furnished to the Product Owner.

7. Framework application, evaluation and validation

This section summarizes the application of the framework on the case of the hospital. The presentation of the subsections follows a logical order. Section 7.1 depicts the context of the study. Section 7.2 depicts the data collection process, the evaluation of the representations, and the gathered expert opinion. Section 7.3 depicts the evolution of the strategy in the changing business context of the Covid-19 pandemic. New business objectives are indeed identified and exposed in the latter subsection; these new objectives, along with the existing ones, represent the elements that need to be sustained by strategic opportunities. The follow-up order explains that we need the information provided by the management-level illustrating the tactical and operational support of the strategic opportunity’s features (depicted in
Section 7.4) to be able to aggregate the overall support of the strategic opportunity on the business objectives constituting the business strategy. Finally, Section 7.5 overviews the impact of the strategic opportunities' adoption on the evolved business strategy as an aggregation. This is the reason justifying the placement of Section 7.5 as last; the presentation in Section 7.5 can indeed be seen as a roll-up of the representations of Section 7.4.

7.1. Case study background

The case study described in this section further develops the case of a Belgian hospital already used for validation purposes in [6] and whose strategy has been described extensively in [53]. The example is adapted in some parts to deal with confidentiality issues but taken from a real case. Even though the application is only partial, it is meant to be realistic and relevant. Saint-Romain is a Belgian hospital whose activities have grown exponentially in the last few years; available IT budgets have nevertheless grown only in a linear way.

The hospital has been dealing recently with a drastic change in the business context. To be specific, the Covid-19 crisis has drastically impacted Belgium causing the need for an immediate response from the authorities. This context is particularly interesting to study the impact of a few initiatives seen as strategic opportunities on their produced value at strategic, stakeholder and governance level. The examples provided here refer to a videoconferencing system and a Covid-19 self-assessment app developed as part of the measures taken to control the pandemic.

7.2. Data collection, representations evaluation and expert opinion

The collaboration with the hospital started a few years ago with the development of a new information system for the hospital (more information about the implemented software system can be found in [53]). Back then the university team did not participate in the implementation (coding) of the new software system but it was involved in the organizational modeling and design of the new system. Organizational representations using $i^*$ were realized then and validated as a continuous process with the staff members in a back and forth fashion.

The business strategy representation is an evolution of the one presented in [6] and has also been built on the basis of interviews. With respect to previous developments, the current research implied collecting new information about the impact of the pandemic on the hospital’s strategy as well as the IT developments that have (or have been envisaged) to be set-up in response to it. We consulted sources internal to the hospital to identify the impact of the pandemic on the strategy. Nevertheless, the data collection was not done in a systematic way but rather as a recollection of the impact on the basis of the documentation at disposal. External sources, including more technical documentation, were also consulted to evaluate the functions supported by strategic opportunities and to be taken as example when realizing the $i^*$ representations.

The researchers’ experience with the strategic representations and with $i^*$, the pre-knowledge on the organization as well as the available technical documentation assisted in the rapid realization of the modeling within two business days. The models were not further validated with the members of the hospital. Nonetheless, they were audited (together with the entire approach) by an external expert in digital transformation having extensive (10+) professional experience in conducting digitalization projects along with a deep understanding of academic approaches (the expert holds a PhD in business strategy). The latter confirmed the interest and value of the approach while he never made use of a structured (meaning non-textual) approach to depict a business (or IT) strategy. Similarly the structure and impact given by the management-level was pointed out as a strength of the approach; the expert pointed out such a structure is traditionally given/perceived in an ad-hoc manner (or with the use of a generic digital roadmap that is not adapted to moving contexts and very waterfall in its spirit) without any reasoning ability. He notably emphasizes it is not really about immediately identifying structural changes, it is more about bringing...
the necessary, the required bricks in order to identify required changes and be able to adapt. The interviewee pointed out that the application and adoption of such a framework in times of business variability changes the mindset of people seeking for digital innovations ...by reviewing the involved stakeholders, resources and capabilities and thinking about potentially integrating strategic opportunities on-the-fly changes your way of working. In turn, the interviewee explains that before being agile at all organizational levels, especially at a higher one, a digital maturity needs to be reached in the organization where knowledge and mastering of key components like the current IT infrastructure, the strategy, knowledge about stakeholders, etc needs to be reached. According to the expert, StratAMoDrIGo is an innovative way of reaching towards a higher level of digital maturity by becoming more efficient in IT adoption decisions. The interviewee also identified the importance of working top-down and bottom-up at the same time (so implicitly working in a middle-out fashion). By that, the expert referred to the capability of identifying the structural impact (i.e., the organization of stakeholders) of technological adoption, the end-user experience and, at the same time, identifying the strategic impact. The representations of StratAMoDrIGo can be updated and reconfigured at will and this allows to support the framework’s round-trip way of working while reasoning on business situations. Business reasoning is an important point of consideration for the interviewee pointing out the necessity to include new business models and streams of revenue which, in changing times, they can be partially studied through considering strategic opportunities as new actors impacting the organizational setting. Finally, the expert recognized the lack of a global reasoning mechanism within the framework which would act as a way to quantify value ex ante and measure value ex-post for a full governance life cycle support. The expert would also like to see a measure of risk and a cost of adoption of different configurations (i.e. scenarios) represented through the framework. These elements will be studied later even if the heaviness of quantification in hazardous times could act against the simplicity/speed required by agility at all levels.

7.3. Evolution of the business strategy due to the business context

As said previously, the Business Context in our case study is the Covid-19 pandemic; the Strategic Opportunities that pop-up in this context are the development of a videoconferencing system and a Covid-19 self-assessment app. As can be seen in Fig. 6, because of the pandemic, new Strategic Objectives have been defined by the BoD; more precisely, we distinguish 4 new ones brought by the Business Context and 2 existing ones triggered by the Business Context. As an example, we can take the new Business Objective called Establish a synchronous and asynchronous communication channel between the citizen and the health care professional which has risen because of the pandemic and needs to be further supported by new IT solutions.

7.4. Stakeholder and user value: Graphical representation

Fig. 7 shows a management-level representation of the impact of the Strategic Opportunities onto the Stakeholders in general and the Users in particular. As discussed in Section 5.3, the Strategic Opportunities are represented as actors in the SRD (they are particularly stereotyped as agents). All of the other actors (except for the Integrated Videoconferencing for Primary and Specialized Care and Mobile App for Covid-19 Self Assessment) represent stakeholders. We see explicitly what are the intentions of each stakeholder with respect to the Strategic Opportunities and from the Strategic Opportunities to the Stakeholders through the dependency elements (i.e., goals and softgoals in this Figure). Following Yu et al. [34], a softgoal is ... a condition in the world which the actor would like to achieve, but unlike in the concept of (hard-) goal, the criteria for the condition being achieved is not sharply defined a priori, and is subject to interpretation. Within the scope of each actor, the internal goals and tasks that need to be achieved for a proper integration of the Strategic Opportunities are specified. Also, the Strategic Objectives supported by the Strategic Opportunities are cascaded into the agent’s (representing the Strategic Opportunity) scope. We can take the example of Establish a synchronous and asynchronous communication channel between the citizen and the health care professional which is a Strategic Objective cascaded under the scope of Integrated Videoconferencing for Primary and Specialized Care which is a Strategic Opportunity represented as an i* Agent. The Features are the elements of the Strategic Opportunity that support each of the relevant Strategic Objectives. Features should be seen as coarse-grained pieces of functionality requiring IT capabilities to be executed. We can for example point the Quickly furnish a meeting with the relevant healthcare professional as a Feature furnishing a (partial) solution to the Establish a synchronous and asynchronous communication channel between the citizen and the health care professional through Integrated Videoconferencing for Primary and Specialized Care which is the Strategic Opportunity. The Users are the Stakeholders that are directly using the Features. The Citizen is an example of a Stakeholder that is also a User of the Integrated Videoconferencing for Primary and Specialized Care app and that depends on it for the fulfillment of its Reduction of face to face visits goal. Features can be further developed in an agile fashion on the basis of bottom-up approach. Users are then expected to specify their desiderata with respect to the implementation content of the Features.

7.5. Strategic value: Graphical representation

The knowledge extracted from the i* SRD allows us to determine the positive impact of the Features’ implementation/deployment onto the Strategic Objectives so as to evaluate the Strategic Value of the Strategic Opportunity. We can take the example of the Integrated Videoconferencing for Primary and Specialized Care; as we have seen in detail at the management-level (so in the i* SRD), this Strategic Opportunity’s Features partially implement the realization of the following Strategic Objectives (i) Increase the continuity of care to smoothen the patient flow; (ii) Establish a synchronous and asynchronous communication channel between the citizen and the health care professional; (iii) Decrease non-essential visits of patients to the hospital; (iv) Prevent infections; (v) Avoid increases in waiting lists; (vi) Avoid stress increases in health care professionals due to not being able to attend to their patients. Within the NFR graph of Fig. 8 we can thus witness that a positive contribution link has been put between the Strategic Opportunity and the Strategic Objective. This gives a rolled-up representation useful to immediately identify the Strategic Value provided by the Strategic Opportunity.

8. Discussion

This section further discusses different aspects of the framework. More precisely Section 8.1 compares the framework with other approaches. Section 8.2 describes the lessons learned, the limitations and the applicability of the framework. Finally, Section 8.3 describes the threats to validity.

8.1. Framework comparison with other approaches

This section is dedicated to the comparison of StratAMoDrIGo with other methods covering the strategic layer with conceptual modeling or other – relevant to our context – frameworks dealing with agile development while encompassing a strategic analysis. In Section 8.1.1 StratAMoDrIGo is compared with MoDrIGo for a clear positioning of the evolution and differences between the kindred frameworks. StratAMoDrIGo is being compared to an industry-accredited agile framework (Safe) in Section 8.1.2 and a widely researched value-based modeling framework (c3Value) in Section 8.1.3. This comparison is based on a range of specific determinants (they are summarized in Table 2), i.e., (i) the frameworks’ intended purpose, (ii) ability to support strategy, (iii) the inclusion of conceptual modeling, (iv) the employed scope elements, and (v) the type of value-based modeling they support. Finally, in Section 8.1.4, each of these frameworks is used as benchmark for the examination of specific criteria to determine StratAMoDrIGo’s ability to place an organization in a state of strategic agility.
8.1.1. Comparison with MoDrIGo

The purpose of MoDrIGo is to evaluate business and IT alignment of Business IT Services when taking governance-level adoption or development decisions. As mentioned before, StratAMoDrIGo is based on MoDrIGo but constitutes a significant evolution in terms of philosophy and approach. MoDrIGo also supports the strategic level by using strategic objectives to depict the strategy but, unlike StratAMoDrIGo, it uses Business IT Services as functional high-level scope elements. Services are mostly centric in IT governance and management frameworks.

Conceptual modeling wise, the two frameworks represent the organizational strategy in a similar manner (using NFR representations). Business IT Services are ultimately the ones for which an adoption or development decision needs to be taken in MoDrIGo; their tactical and operational behavior is represented with $i^*$ (StratAMoDrIGo on the other hand uses $i^*$ to represent the impact of strategic opportunities on the organizational setting). These elements (i.e., Business IT Services) often represent commodity functions supporting state-of-the-art business processes indispensable for the organization. Such services, either align or misalign with the strategy but are never implemented exclusively for the immediate sustenance of some (or all of the) strategic objectives. On the other hand, StratAMoDrIGo allows to study the organizational impact of any type of technological deployments; thus, it is not limited to an adoption or development decision of Business IT Services (even if these can also be considered). Strategic opportunities, contrarily to Services, are often very innovative so specifically developed to furnish strategic, stakeholder and user value in moving business contexts. As a result, in MoDrIGo, strategic objectives are perceived at managerial-level into the $i^*$ representation as softgoals that elements within Business IT Services help or hamper to fulfill. In StratAMoDrIGo,
strategic objectives are cascaded, in the management-level i* representation, as (hard) goals that are immediately fulfilled by functions of the strategic opportunity. Therefore, the essence of the elements for which a governance decision for adoption or development is taken is slightly different. One could say that MoDrIGo is rather oriented on supporting business processes while StratAMoDrIGo is oriented on supporting innovation.

As far as value is concerned, StratAMoDrIGo can also be seen as broader than MoDrIGo. Value is indeed considered at multiple levels; it also supposes that not all value can be determined beforehand so that new sources of value (especially for the stakeholder and the user) will be determined and supported at the time of implementation.

8.1.2. Comparison with the scaled Agile framework

The purpose of the SAFe 5.1 framework is to furnish an approach for using the agile development approach on large development projects (i.e., to scale agility). This is not the case with StratAMoDrIGo; the latter aims to support agility at a strategic level. SAFe partially supports the strategic level; it uses value streams to determine which high-level trends need to be supported, and Epics as functional high-level scope elements; Epics (considered more abstract/coarse grained than in traditional methods like Scrum) are functions that are sufficiently large to be developed in a stand alone fashion. SAFe has a strategic alignment vision based on portfolio management rather than focusing on individual projects.

Conceptual modeling wise, no support is furnished by SAFe. As far as value is concerned, SAFe prescribes to be value stream driven at strategic-level and in that sense it partially overlaps with StratAMoDrIGo. Strategic value is driven by a value stream involving 4 (time) horizons, while Epics are defined from the portfolio in alignment with the value stream. Epics are then connected to their Program Increment (PI) planning in a top-down fashion. In fact a PI is a sequence of four different sprints where, for each individual sprint, different teams are working independently on different system parts (in parallel) by defining the Minimum Viable Product (MVP) of features that first need to be validated before further building the product. Therefore, the vision of SAFe is essentially top-down and waterfall (thus poorly agile), fuzzy in its application and very complex to trace at operational level since no unique form of conceptual modeling is suggested to support the alignment between the strategic goals and all the decision-level structures within an organization.
There is partial congruence between StratAMoDrIGo and SAFe in their exploration of ways in which governance decisions (i.e., evaluation of pending heavy IT investments) can be reconciled with the agile management of their development. StratAMoDrIGo is similar to SAFe in terms of not aiming to fund projects but strategic opportunities encompassing new major functions that need to be supplied by the IT ecosystem. However, SAFe’s strategic approach is portfolio-based while ours is strategic opportunity-based. We also embrace new IT developments by rising opportunities rather than by a horizon-driven value stream approach as, as an hypothesis, strategic value (streams) for new IT developments can hardly be anticipated and mostly appears when the business context changes (e.g. Covid-19 pandemic). We essentially follow a conceptual modeling approach where new strategic opportunities are defined and their value is evaluated but their practical implementation can be realized in a bottom-up fashion. The formal link is done at middle-out level through linking high-level conceptual entities (i.e. business objectives, strategic opportunities) with low-level ones (user features) to be able to trace (so to study) the strategic/stakeholder and user values delivered. That traceability and independence in definition is what fundamentally distinguishes the 2 approaches.

8.1.3. Comparison with the e3value framework

We can also analogize our model-driven strategic agility approach to other value-oriented approaches proposed in literature. We will make a comparison with e3value [63,64] as it is one of the most commonly used value-modeling language illustrating the economic value (or utility) among actors when engaged in in-between value-exchange prepositions [65]. The purpose of the e3value framework is to represent organizational business models while integrating business and IT modeling approaches by focusing solely on how economic value is created and exchanged within a network of actors. E3value partially supports the strategic level. The use of the term ‘partially’ refers to the framework’s limitation of considering economic value exchanges as the sole decision-making factor during the set-up, extension or modification of a business model.

Conceptual modeling wise, e3value was created primarily to support the requirements’ analysis stage for the creation of business information systems by defining an ontology to compromise business-oriented concepts with the required formality of information systems development modalities [63]. Right from the get-go, we experience a contrast between e3value and StratAMoDrIGo as the latter aims not only to facilitate the adoption of technological solutions that fulfill business (long-term strategic) objectives, but it does so by considering the elimination of any lag between the decision and the incorporation of these technologies within the organizational gears.

The value concept is central within e3value. Indeed, amongst its primary concepts, the e3value ontology describes the participating – in a value-exchange setting – actors; these are to be considered elementary or composite in nature, but they are strictly economically independent from each other; this independence seems to be the guarantor of any gain that might occur during the entire value-exchanging process. A composite actor is perceived as a group actor that uses value interfaces with all its internally participating elementary actors. These value interfaces group value ports that provide (or request) value objects to or from other actors. Value flows are mapped using ‘AND’ or ‘OR’ operators which attribute a sequential character within the positioning of value activities [66]. Finally, e3value modeling allocations allow actors’ compositions but no actor specializations [67]. Contrastingly, our StratAMoDrIGo approach allows for the vertical decomposition of actors according to their strategic, tactical and operational facets, which in turn attributes to them a different ‘value portfolio’. Each actor’s value portfolio is not considered in isolation and no value portfolio is considered more important than the rest. The point is to utilize parts of the i* modeling notations to map the intentionality among these different actors and determine how their overall social interactions affect these value-portfolio in response to the accumulative well-being of the entire enterprise. In this context, the value-flow from the upcoming technological adoption/development, as derived from the strategic opportunity, is being trichotomized in order to gratify the needs of all the enterprise actors by simultaneously (i) sustaining their strategic needs, (ii) accommodating their stakeholder goals, and (iii) allowing for feature implementations that will contribute towards the achievement of their strategic objectives. The plausibility of analyzing these value-interdependencies is not present in the e3value where its sequential value-flows focus on a quid-pro-quo (i.e., product for a service, product for a monetary exchange etc.) economic exchange within bilateral actor-to-actor relationships.

8.1.4. Strategic agility as the evaluation dimension

As already discussed earlier, the ability to render an organization in a state of strategic agility is construed concerning an organization’s capacity to sense opportunities in the event of changing business contexts, its capacity to seize opportunities when such events occur, and its capacity to shift (reconfigure) its assets to take advantage of strategic opportunities [24]. These 3 criteria are used as the constituents of our main evaluation dimension; in fact, we determine how the previously identified (and industry accredited) frameworks contribute to the attainment of these criteria (Table 3). The aim is to identify gaps and misconceptions compared to our current solution; regardless of the elements included in the table, a few more considerations are given in the rest of this Section for the SAFe framework and e3value.

To begin with, SAFe signifies organizational agility as the optimization of operational agile development. SAFe considers an organization to be in a state of enterprise-wide agility when front-to-back supply-chain streams (they are called operational value streams within the framework) have been aligned with the agile development of a product to maximize its delivered value. To do so, SAFe prompts a continuous engagement of all the business actors in order to identify bottlenecks that would disrupt this value creation process. Nevertheless, SAFe does not seem to support a simultaneous top-down/bottom-up ideation process that would make it susceptible to external and/or internal business stimuli. On the contrary, the optimization of the operational value streams has to be reconcilable with the company’s ‘strategic themes’.4 This limited capability in sensing changes in the business context admonishes the introduction of mechanisms for the evaluation of such changes (i.e., non-existent seizing capabilities). Overall, this asynchronous coping mechanism between the strategic and operational levels within the organizational ladder facilitates the erection of silos between development teams and the actual strategic directives ‘indocrinated’ in a top-down manner. In this sense, the actual organizational leaders (i.e., roles in a position of influence) appear to be the agile coaches (or external consultants as mediators) acting as the ‘conductors’ of the agile release trains. Consequently, one of the immediate actions that may come as a priority when implementing the SAFe framework is the harmonization of large scale agile development rather than the ability of the organization to reconfigure (shifting) its strategic assets to leverage drastic changes in the business context.

Contrastingly, e3value, aims to project the necessary organizational configurations that need to take place in order to make the release of a new product/service/technology viable economically. This is done via the evaluation of 3 distinct value-driven ‘viewpoints’ (i.e., value viewpoint for the business layer, the process viewpoint for the operational layer, and the system architecture viewpoint for the infrastructural layer); similarly to the purposiveness of Archimate, such an approach is focused on the successful governance of the endeavor that is under examination. However, e3value’s consideration of value merely on its

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4 SAFe 5.1 describes these as the company’s long-term values and a compliance evaluation process, reactive to new governmental regulations.
development (e.g. through Scrum) for user-intensive applications where the approach delivers an interesting way of implementing the feature-oriented development (which are supported scope elements that can be aligned with epic user stories which have been prioritized). Other types of information technologies (hardware, devices, off the shelf apps etc.,) being strategic in user story-based development). More precisely, features are the finest-grained level covered by stakeholders. The alignment with the IT strategy could be considered in the conceptualization of value from the strategic to the management level. Strategic, stakeholder and user value are very constrained. Through the representation of the information related to the adoption of a strategic opportunity with the identification of value, it supports communication of what to implement to the tactical/operational levels.

Table 3
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| Method       | Strategic sensitivity (sensing)                                                                 | Strategic response (seizing)                                                                 | Shifting                                      |
|--------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------|
| StratAMoDrIGo| Its application and use pushes towards a culture of opportunities adoption and value seeking (also emphasized by the interviewee). | Quickly overviews the impact of the deployment of a strategic opportunity in terms of strategic, stakeholder and user value. Several configurations can also be studied through it. | Through the representation of the information related to the adoption of a strategic opportunity with the identification of value, it supports communication of what to implement to the tactical/operational levels. |
| MoDrIGo      | No support, Business IT Services are driven by need for IT support from IT clients (internal or external) and seldom driven by the business environment. | Overviews the impact of the deployment of a Business IT Service in terms of strategic value. Poor flexibility for configuration since Services are very constrained. | Through the representation of the information related to the adoption of a service, it supports communication to the tactical/operational levels. |
| SAFe         | SAFe pushes towards a culture of taking advantage of external value streams. However, SAFe is more focused on feeding the operational Agile development. | No framework for ex-ante solution impact evaluation. | Development of software following the classical SAFe canvas, benefits are the one of large scale agile development. |
| e3value      | Limited support in sensing new strategic opportunities/threats. e3value allows top-down ideation for the exploration of IT-enabled value propositions; however, the latter are analyzed profoundly on their economic viability. | With the use of BPMN or UML activity diagrams, e3value facilitates the provision of a resource planning/allocation/release management cycle. Therefore, e3value offers the possibility of strategic response. | Limited support in shifting (reconfiguring) organizational capabilities towards the achievement of strategic concerns. |

8.2. Practical aspects and applicability

In the case study, we only considered the alignment with the business strategy. Traditional corporate governance focuses on the completion of the business strategy while IT governance focuses on the IT one. The alignment with the IT strategy could be considered in the same way. Two reasons are given here to justify our focus on the first one: (i) in a moving business context, a quick adaptation is critical to get new revenue streams or keep the current ones flowing; this is the focus of the business strategy; (ii) the hospital is considered as being in a state of readiness to exploit strategic opportunities. Nonetheless, the latter can hardly be considered as strategic since they negotiate a better allocation of resources to economize on internal cost-saving procedures rather than bringing the organization in a state of readiness to exploit strategic opportunities.

The StratAMoDrIGo framework is intended to be applied to organizations being in dynamic businesses by people providing support to the C-level executives. The latter are the ones that can use the framework to understand the implications of strategic decisions taken in a short time frame. Internal employees or external consultancy companies can apply the framework to furnish support and advice to a BoD (so composed of C-level executives). The process framework for the application of StratAMoDrIGo provided in Section 6 gives an illustration of how internal employees or an external consultancy team can structure themselves for the application of the framework. The framework can be used on a regular basis to identify when the business context changes and new strategic opportunities can be identified. The results do not furnish a binary true/false answer but rather a general guidance supporting C-level executives in the adoption or development decision they might have to take.

One may raise the question of the willingness of strategy consultants and agile teams to deal with a modeling approach, something they could be reluctant to. We cannot avoid making a strategic representation in the form of a diagram to ensure a proper alignment study; this is an exercise relevant for helping C-level executives to define their strategy and is independent of a software development practice (where mostly conceptual modeling is applied). In our experience from the case study of the paper but also other cases, the representations can be done rather quickly with some knowledge of conceptual modeling. Moreover strategic representations need to be done once from scratch but then it is more an exercise of updating the information to keep it consistent. In a strategic agile perspective, the important but challenging aspect is to update the strategy with the impact of a new business context. Management-level representations are more time consuming but, in any case, if a new technology needs to be adopted in a short time frame, studying the impact of its adoption/deployment needs to be done to some extend as a premise to its design. Of course, it requires more time to study the complete stakeholder impact than only the operational requirements of users; this will eventually pay off with the provision of important information/insights on the IT investment(s) that needs to be made.

innovation plays a critical role. We also point (when possible) to independent feature development and deployment; this to effectively get all the sorts of value as early as possible as well as early field feedback that can later be used for adjustments and/or relevant knowledge for other feature(s) development. The strategic opportunity is thus not necessarily an unbreakable whole but since it is composed of features all delivering value, those can be implemented and deployed in an asynchronous manner (if these are of course sufficiently independent).
8.3. Threats to validity

We discuss here the threats to the construct, internal and external validity of the StratAMoDrIGo framework and of its use.

8.3.1. Construct validity

The design of StratAMoDrIGo had to be checked in terms of its construct validity. In the scope of a model-driven framework, within the information systems’ domain, this means that the relevant concepts defined in this framework have been operationalized adequately into observable/workable elements [70]. A threat to the construct validity is that the modeling constructs are incorrectly interpreted by the modelers or any other practitioner aiming to put StratAMoDrIGo into use. This entails the risk of using the framework (and its corresponding concepts) in another way than intended. In our case, the modeling work has here been realized by the two authors of the paper and the operationalization of the modeling constructs, within the setting of the hospital-case, was discussed systematically. In consequence, every concurrent/contradicting interpretation was discussed and resolved beforehand. Overall, the threat of not being able to encapsulate exactly what is being claimed to be encapsulated can be mitigated through the use of meetings or workshops were every modeling choice is discussed by the practitioners and specialized consultants.

8.3.2. Internal validity

Through the use of StratAMoDrIGo, the internal validity concerns the objectivity of the views gathered by the subjects within the knowledge-acquisition procedure. Subjects can, during interviews, report on their personal view (as opposed to a collective consensus) when giving information on strategic or management-level aspects. This would lead to inconsistent representations. Since the specificity of each corresponding interviewee can create a partial or bounded view where some aspects of the modeled realization are (under)overemphasized, this threat to validity can be dealt with through multiple interviews and systematic comparison of the views of these actors for knowledge validation. In our case, the representations of the strategic-/management-level configurations in the hospital-case were determined based on a rigorous interview process (it is discussed in [6]) and an overall cross-reference of the subjects’ individual opinions.

8.3.3. External validity

External validity can be formally defined as the degree of support for the generalization of an ‘architectural explanation’ to a theoretical population [71]. In our case, the architectural explanation refers to the modeling constructs of StratAMoDrIGo, their in-between interactions, and the purpose they are supposed to fulfill (i.e., quick assessment of strategic opportunities in an organizational context according to the value they expose). A threat to the external validity is the misappropriation of StratAMoDrIGo when applied to different organizational settings by various supporting or consulting groups. This jeopardizes the generalized use of the framework by the corresponding information systems’ community (i.e., our population). Until now, the framework has solely been applied by the authors of this paper, by members of the research group being familiar with conceptual modeling, goal-based requirements engineering and i* (so up to 5 people) and a few consultants familiar with conceptual modeling through UML. Such experience and pre-knowledge certainly has an impact on the ability to apply such a framework correctly and successfully so not many valuable insights could be drawn in terms of its generalization. For this reason, the ability of novice modelers to apply goal-based conceptual modeling has been tested in [72,73] with other kind of formalisms. The latter showed that consistently applying goal-based frameworks with some guidance on real life problems can be done rather easily and it allows practitioners to understand requirements. Lack of experience with such frameworks can thus be compensated by proper guidance and it leads to an increase in understandability. The framework is currently being applied to other cases by external professionals under the supervision of the authors who are domain experts but no modeling experts. The application of the framework is done in an iterative manner including discussions with the authors of the framework. Typical modeling mistakes are committed notably at the level of the i* modeling. The modeling of the strategy nevertheless does not appear to cause any issue. A guide for application will be developed out of the common mistakes and issues that are identified in this process and shared through a website.

9. Conclusion

The need for an IT development approach structured around strategic opportunities yet allowing agility at all levels has risen progressively due to fast moving business contexts. The concept of value is, in StratAMoDrIGo tailored to (i) the strategic-level for the long-term competitive position of the organization, (ii) the tactical-level to ensure taking into account the broad impact of adopted solutions on stakeholders and (iii) the operational-level to practically support the end-user requirements.

At this stage, we can get back to the RQ stated in the introduction (How could conceptual modeling be applied to highlight strategic, stakeholder and user value within technological adoptions in a fast moving business context?) To answer this question, we have developed a framework called StratAMoDrIGo which is to be conceived as an evolution of MoDrIGo. It has been formalized through an ontology and its instantiation has been based on the NFR and i* frameworks. On the one side, NFR allows to model the strategic layer and to roll-up the impact of the tactical and operational layers onto the (business or IT) strategy. On the other side, i* allows drilling down to detail how specific strategic objectives are supported by the (functional) features of strategic opportunities. StratAMoDrIGo has been applied on a case in the medical sector. It has also been compared to existing approaches to highlight its focus and support to strategic agility. The latter has been depicted within the (strategic management) literature as a concept describing the capacity of an organization to sense, seize, and shift opportunities. All in all, the application of StratAMoDrIGo (i) pushes towards a culture of persistently adopting opportunities and seeking value (sensing); (ii) allows to overview the impact of the deployment of a strategic opportunity in terms of strategic, stakeholder and user value but also to possibly test several configurations with the use of i* (seizing); and (iii) allows the representation of information related to the deployment of a strategic opportunity with the identification of value, supporting thusly the communication of what to implement to the tactical/operational levels (shifting).

Finally, the framework needs to gain a higher level of maturity with the utilization of more case studies for its fine-tune. For this reason, it will be applied in the context of other case studies through the mediation of a consulting team from a private company. Even if the framework has been fabricated to be the most expressive possible by using existing modeling notations, it can be seen as requiring some technical knowledge to be adopted. Even if the expressiveness and details may suffer in the process, we aim to provide something as simple as possible to organizations to ease the adoption on the largest possible scale. Accordingly, future work also involves simplifying the framework so that models hold on a structured sheet like for the Business Model Canvas [74].

CRediT authorship contribution statement

Konstantinos Tsilionis: Conceptualization, Methodology, Validation, Investigation, Writing – original draft, Writing – review & editing.
Yves Wautelet: Conceptualization, Methodology, Validation, Investigation, Writing – original draft, Writing – review & editing, Project administration.
Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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