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DIGITAL TRANSFORMATION STRATEGY DEVELOPMENT IN AN ENTERPRISE ARCHITECTURE CONTEXT

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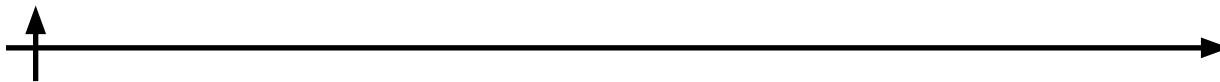
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Abstract. Currently, the transition to digital economy opens up new opportunities for business and entrepreneurial activity, but and new challenges as well. Companies are looking for ways to transform digitally, often without sufficient information about digital technologies, as well as without a consistent approach in developing and implementing a digital strategy. Nowadays there are a number of approaches to the digital transformation, based on cross-disciplinary view, but there is an imperative for particular models and tools for digital transformation strategy development. The paper proposes framework, based on Enterprise Architecture, Capability Driven Development approach (CDD), and strategic models. Authors propose using of the developed ontologies and IT-projects portfolio management system architecture for successful digital transformation strategy development and implementation.

Keywords: Digital Transformation, Enterprise Architecture, Capability Driven Development approach, Balanced Scorecard, IT-project portfolio management system

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РАЗРАБОТКА СТРАТЕГИИ ЦИФРОВОЙ ТРАНСФОРМАЦИИ В КОНТЕКСТЕ АРХИТЕКТУРЫ ПРЕДПРИЯТИЯ

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Аннотация. В настоящее время переход к цифровой экономике открывает новые возможности для бизнеса и предпринимательской деятельности, но и также новые вызовы. Компании ищут пути цифровой трансформации, зачастую не имея достаточной информации о цифровых технологиях, а также, не имея последовательного подхода в разработке и реализации цифровой стратегии. В настоящее время существует ряд подходов к цифровой трансформации, основанных на междисциплинарном подходе, однако существует потребность в конкретных моделях и инструментах для разработки стратегии цифровой трансформации. В статье предлагается фреймворк, основанный на таких дисциплинах как архитектура предприятия, подход Capability Driven Development (CDD) а также моделях стратегического менеджмента. Авторы предлагают использование разработанных онтологий и архитектуры системы управления портфелем ИТ-проектов для успешной разработки и реализации стратегии цифровой трансформации.

Ключевые слова: цифровая трансформация, архитектура предприятия, подход к разработке на основе развития возможностей, сбалансированная система показателей, система управления портфелем ИТ-проектов

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Introduction

Currently, digital technologies are becoming widespread, transforming the tools of social interaction, changing its scope and creating new opportunities and challenges for economic and social development. Many digital technologies have been around for a long time, but they are being introduced extensively nowadays, largely due to their increased functionality and decreased cost.

The number of Internet users over the past twenty years has rapidly increased, according to (ITU-T, 2022), in 2019 it exceeded 4,1 billion people, amounting to 53.6% the total population of the Earth (fig.1).

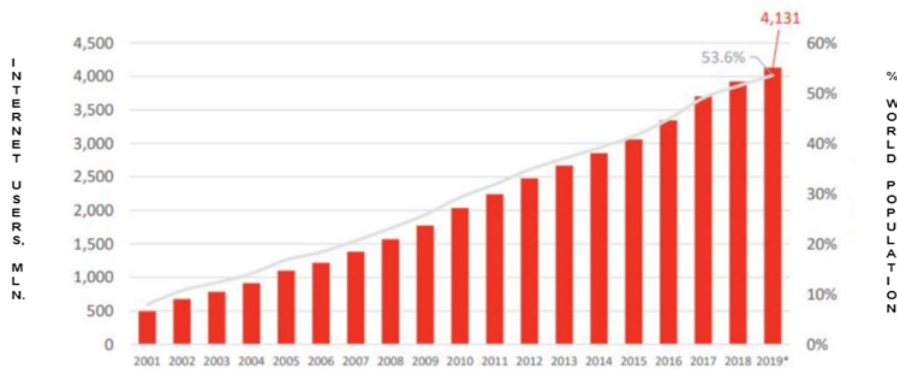
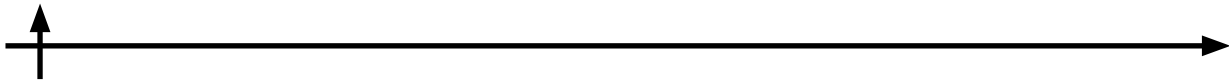


Fig. 1. Quantity of Internet users and their share in the Earth population

According to Accenture (Accenture, 2019), “...between 2009 and 2019, the cost of data processing decreased by 10%, costs - bridge of data transmission channels – by 40%, cost of sensors and measuring equipment – on 0.5%”. Statistically, “the average cost per sensor in 2010 was 66 cents (\$0.66), while it is projected for 2020, it will decrease further twice – up to 0.29 dollars” (Statista, 2023).

Such development leads to emergence of digital economy – “...internet-based digital technologies application to the production and trade of goods and services, which is becoming important part of the global economy” (UNCTAD, 2017). “The transition to a digital economy can provide a boost to competitiveness across all sectors, new opportunities for business and entrepreneurial activity, and new avenues for accessing overseas markets. It also provides new tools for tackling persistent development and social problems. However, it comes with a host of challenges – from the global digital divide to potential negative social and development impacts, and complex, internet-specific regulatory issues” (UNCTAD, 2017).

In order to survive in the digital economy, companies need to be transformed with digital technologies, but on the way of its digital transformation companies faces with critical challenges. The first challenge is to identify and define a path through all the different digital technologies that fits into the companies’ business environment and capabilities. This path needs to be identified individually. Another challenges are integration with the existing IT systems, training of employees, and especially for small and medium sized enterprises (SMEs) limited resources.

Currently, there are a number of researches on companies digital transformation, provides an approaches to its planning and execution. Thus, the Hackett Group research has developed a holistic digital transformation framework specifically for business service functions (finance, human resources, procurement and information technology) as a basis for digital capability assessment and digital operating model design (fig.2) (Dorr, 2018).

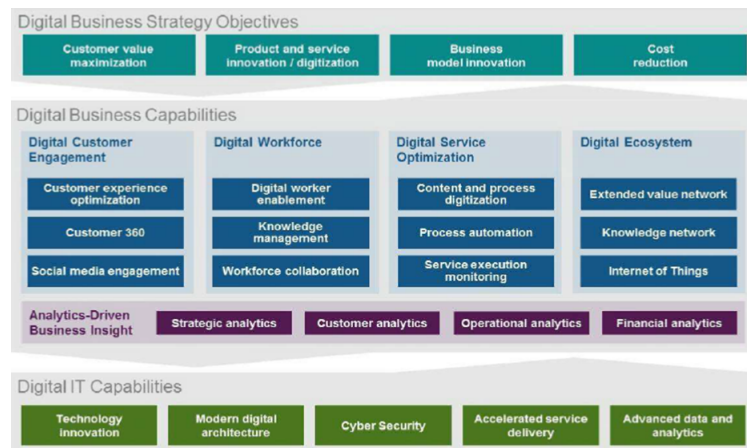
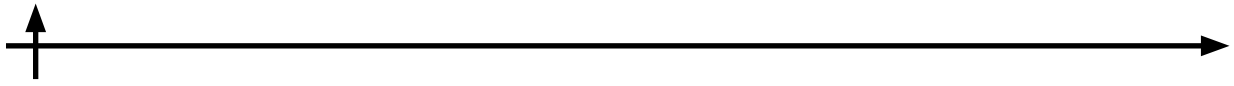


Fig. 2. The Hackett Group digital transformation framework (Dorr, 2018)

The framework’s core capabilities relate to customer engagement, workforce, service optimization, ecosystem and business insight. The objective of the business services functions is to develop digital capabilities in each of this areas. The scope, depth and priorities of these capabilities could differ for the development of various digital business strategy, but ultimately all areas will be affected profoundly.

Other researchers propose to companies to develop a coherent change of capabilities. Thus, (Lankhorst et al., 2020) describes the imperative of coordination and harmonization of the change efforts across the disciplines involved. “...To this end, organizations invest in many disciplines that are concerned with change. These disciplines need to be coordinated and aligned, addressing:

1) Aim: Where do we want to go with the organization? What are the desired business outcomes? This is the domain of strategy management.

2) Analyze & Design: What are the elements of the enterprise in its context, how are they related, and how do they evolve? Here we find enterprise architecture and its sub-disciplines such as business and application architecture.

3) Realize: How do we move the enterprise in a desired direction, where do we invest? This is the world of portfolio management” (fig. 3).

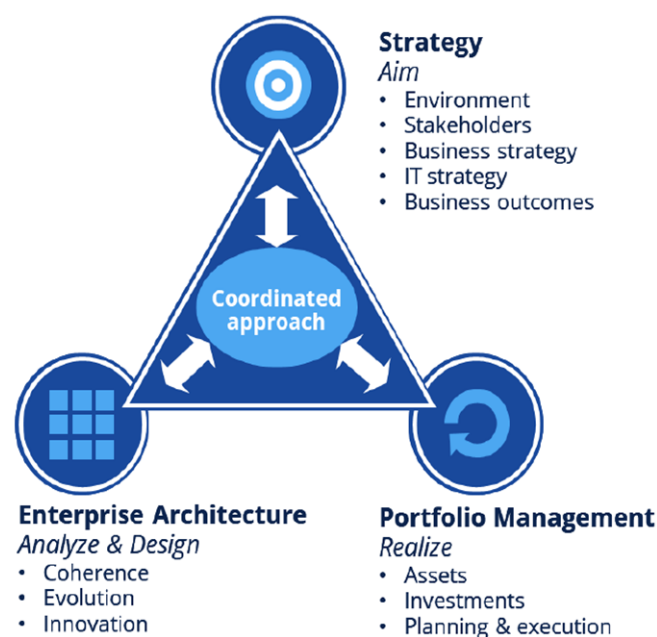
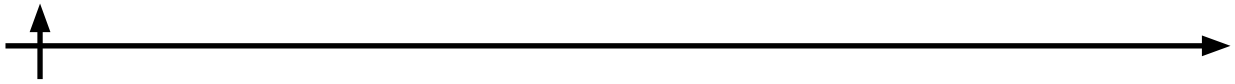


Fig. 3. The triangle between strategy, portfolio management and enterprise architecture (Lankhorst et al., 2020)



As authors had already pointed out before (Ilin et al., 2021), “...coordinated approach to the digital transformation could be provided by Enterprise Strategic Alignment Method (ESAM), based on researches results of the Twente University (Enschede, the Netherlands) and the BiZZdesign company (Enschede, the Netherlands). Scientists group represent cross-disciplinary approach business and IT-architecture alignment for the purpose of the company strategic objectives achievement. This method unites such disciplines as Strategic Management, Capability Based Planning, Enterprise Architecture and Project Management”. ESAM have refined steps of digital strategy development into “...eleven phases: visioning process, business model, environmental analysis, strategic options, strategic choices, strategy elaborations, strategic measurements, implementation design, transformation planning, implementation governance, strategy evaluation. Each of these phases contains at least one strategy model” (Aldea, 2017) (fig.4).



Fig. 4. The phases of the Enterprise Strategic Alignment Method (Aldea, 2017)

ESAM provides substantial support for the digital strategy development, but for its successful implementation all metrics and models should be integrated into special IT tools, which are capable to provide information in real-time mode and reduce manual interventions into the process.

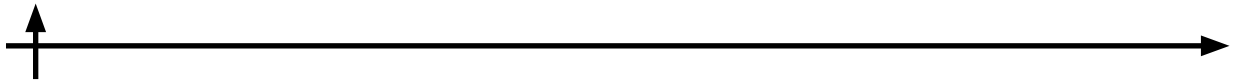
The aim of current research is to supplement an approaches to digital strategy elaboration and evaluation with particular set of tools and models, which helps companies overcome challenges during the process of their digital transformation.

Materials and Methods

The Enterprise Architecture approach is a concept of enterprise management actively developed by institutions and now widely applied in practice. Lankhorst gave the following definition to this concept: “...is a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise’s organization structure, business processes, information systems, and infrastructure” (Lankhorst, 2013). Enterprise Architecture definition first appeared in the Zachman framework of enterprise architecture (Zachman, 2002) setting the direction for the next decades.

Currently, there are several well-known approaches to EA, according to research (Aldea, 2017), the most common are:

- TOGAF methodology, an enterprise architecture methodology developed by the international consortium The Open Group;
- Zachman methodology - the very first methodology described in the architectural approach;
- Gartner methodology - enterprise architecture methodology developed by Gartner consulting



company;

- FEAF methodology - enterprise architecture methodology developed for US government organizations;

- DoDAF, an enterprise architecture methodology developed for the US Department of Defense.

Current study uses the TOGAF (The Open Group, 2018a) and the Capability Driven Development approach (CDD), an approach to the enterprise capabilities development based on Enterprise Architecture technics (Stirna et al., 2012).

The TOGAF is open standard which provides a practical, industry-managed way of designing EA. “The TOGAF framework enables the creation of these multi-dimensional views and categorizes them to create specific domains that enable an enterprise to consider the wider scope of their enterprise and capabilities” (The Open Group, 2018a). The TOGAF framework initially was based on Technical Architecture Framework for Information Management (TAFIM), developed by the US Department of Defense (DoD). Since its first edition in 1995, the TOGAF standard was constantly developed by members of The Open Group consortium, enabling now important benefits for more effective and efficient digital transformation of the organizations.

CDD is a new methodology envisioned to enable solutions for the emerging challenges of digital enterprises. Currently, capability development requires the solid base of business and IT domains knowledge. CDD brings together and builds up knowledge in these areas, creating best practices platform for the enterprise capabilities development.

“The Business model is a high-level impression of how an organisation is structured. It describes how an organisation creates, delivers and captures value. There are a number of viable strategy techniques that can be used to support business modelling. One of the most popular ones is the Business Model Canvas, which could be used as a shared language for describing, visualizing, assessing and changing business models” (Osterwalder and Pigneur, 2010). Authors propose Business Model Canvas application for the purpose of current paper. To determine the key performance indicators which can be used to monitor strategy implementation and evaluate the result of the implementation Balanced Scorecard, proposed by Kaplan and Norton was used (Kaplan and Norton, 1992).

Results and Discussion

In accordance with the current researches, “...digital transformation is a transition to digital business, a comprehensive transformation of the company’s activities, business processes, competencies and business models, maximizing the use of digital networks to improve competitiveness and value creation in the digital economy. As a rule, digital transformation leads to the emergence of new markets, new consumers, the creation of new business models” (i-SCOOP, 2020). As the digital transformation strategy development requires coherent approach addressing all aspects, authors suggest using framework, which could support this task (fig.5).

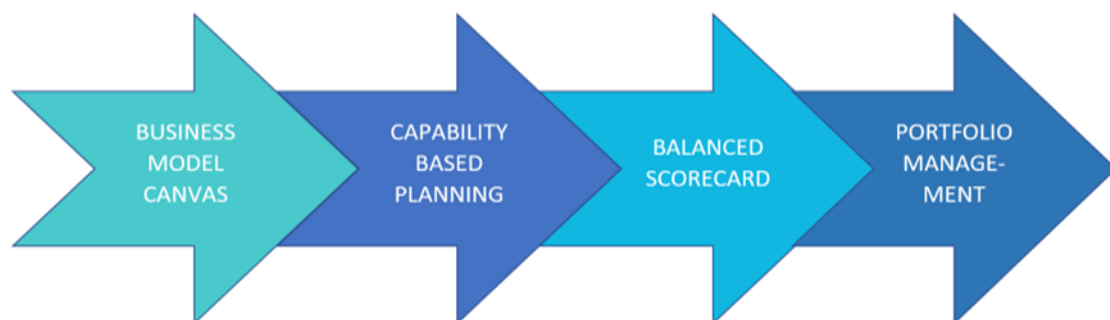
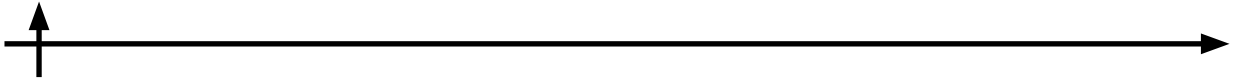


Fig. 5. Digital Transformation Strategy Development Framework



First of all, understanding of current business model and targeted one will help companies outline areas, which could be reshaped by company digital transformation. Among a number of developed business models, the most popular one is the Business Model Canvas, which describes nine building blocks, covering the main areas of company business, including customer segments, customer relationships, channels, key activities, key resources, value proposition, key partnerships, revenue streams, cost structure (Osterwalder and Pigneur, 2010). By block by block of the Business Model analysis, the company can draw conclusions about current business operations, customer structure and requirements, existing channels of interaction with customers and partners, and plan for the Business Model possible changes as a result of digital transformation. Such changes can include the following outcomes:

1. improved operational efficiency: streamlined processes, increased capital returns, supply chain alignment, extended employee involvement in work processes;
2. changing interactions with customers and partners (re-engineering of purchasing processes, improved customer service);
3. introducing a new business model (launching new products and services, generating new types of revenue, changing the product offering to customers).

Aspiration to change current business model is supported by motivation extension, "...which includes stakeholders, drivers, outcomes, goals, requirements, principles, risks and constrains" (Ilin et al., 2021). These motivation elements are described in the TOGAF standard and could be clarified as follows:

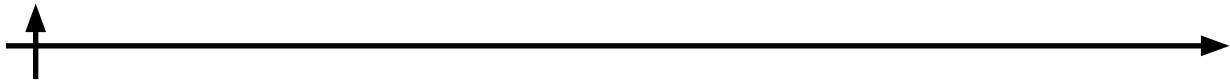
1. "stakeholder – an individual, team, organization, or class thereof, having an interest in a system;
2. driver – represents an external or internal factor that motivates an organisation to define its objectives and make the necessary changes to achieve them;
3. outcome – a final result of the digital transformation;
4. goal – a high-level statement of intent, direction or desired end state for the organisation or its stakeholders;
5. requirement – a necessity that defines a property of a particular application;
6. principle – a statement of intent defining a common property that applies to a system in a particular context;
7. constrain – a factor limiting the goals realization" (The Open Group, 2018b).

There need to draw attention to the existing problem of different stakeholder groups with different concerns, specific views and often different positions and priorities. Capability driven approach can help focus the attention of different stakeholder groups on a joint objective more detailed than a business goal but still concrete enough to fit into their local view of what the responsibility is. This makes capability an integrative concept (Sandkuhl and Stirna, 2018).

Analyzing influence of digital transformation strategy implementation on business model blocks, there could be identified necessary strategic capabilities and strategic resources. Capability is a complex component meant to aggregate some established notions such as goal, process, resource, and context, to enable more efficient solutions in terms of congruence between business and technology. From an EA and IT perspective, capability-based planning is a powerful mechanism to ensure that the strategic business plan drives the enterprise from a top-down approach.

Capability thinking also means being aware of in what context the enterprise has the capacity and ability to offer business services that contribute to achieving business goals. "...Each capability supports or is motivated by one business goal. In principle business goals can be seen as internal means for designing and managing the organization and capabilities as offerings to external customers. A capability requires or is supported by specific business processes, provided by specific roles, as well as it needs certain resources and IS components. The distinguishing characteristic of the capability is that it is designed to be provided in a specific context. The desired goal fulfillment levels can be defined by using a set of goal fulfillment indicators – Goal KPIs" (Sandkuhl and Stirna, 2018).

As authors have pointed before (Maydanova et al., 2022), "...Balanced Scorecard (BSC) indicators



are perfectly approached for this task. Financial, Customer, Internal perspectives and Learning and Growth perspective will provide completed company model, indicators should be able to be recognized, measured, and presented in a coherent way”.

Two main areas should keep in focus of the Balanced Scorecard for digital transformation: company value increase and stakeholders balance of interests.

Value-Based management theory accommodates necessary approach to company value measurement and governance. Currently, there are several models, developed for this purpose, which could be applicable. For Balanced Scorecard development it is necessary that model provides drivers, which influence company value. Such set of drivers could be developed for such company value models as Economic Value Added (Grant, 2002), Shareholder Value Added (Rappaport, 1997), Cash Value Added (Otto and Weissenrieder, 1998).

Company value drivers should correspond to principles as follows:

1. “Drivers” should be linked to value creation and have been brought to all levels of the organization;
2. Value drivers should be set as targets and measured using both financial and operational performance indicators;
3. Drivers should show both the current level of performance and long-term growth perspectives” (Ilin et al., 2021).

Another BSC area is stakeholders balance of interests. “Stakeholders of company digital transformation could be outlined as an individual, team, organization, or class thereof, having their interest in DT process and results; namely customers, partners, shareholders, specialists of different levels etc. As was mentioned before, different stakeholder groups with different concerns, specific views and often different positions and priorities. For BSC purpose stakeholders could be divided on external and internal ones. External stakeholders, drivers, goals and concerns need to be reflected in Customer perspective, and internal stakeholders ones – in Learning and Growth perspective”.

Company digital transformation process requires IT-projects portfolio management capable to determine priorities, ensure the implementation and evaluate its results. That is why all BSC indicators and risks and constrains should be considered in enterprise architecture context and with their interrelation with enterprise architecture models. These reference models need to be created as for each pilot project, and for digital transformation strategy implementation phase as well. Thus, elements of digital transformation strategy are reflected on fig.6.

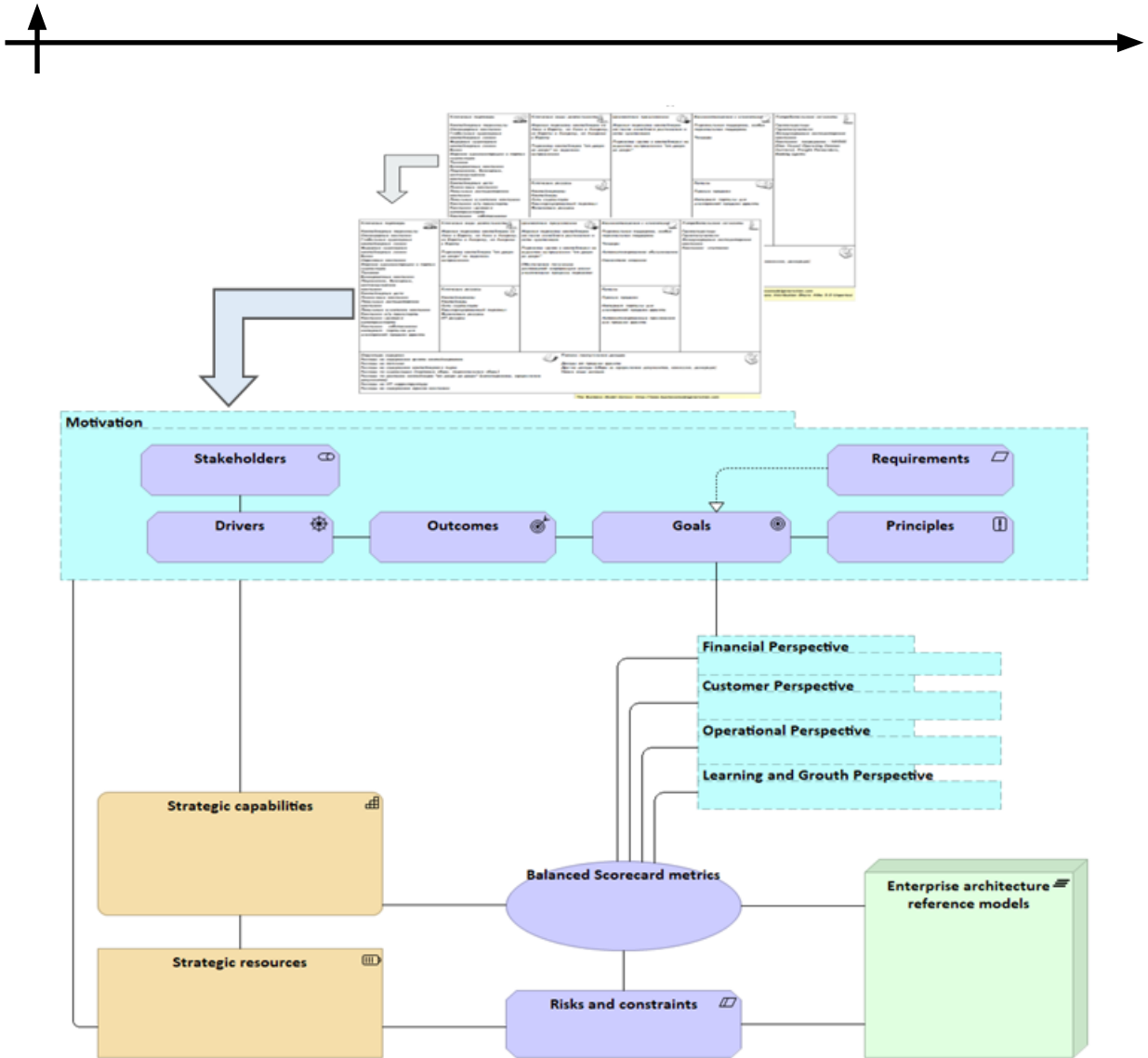


Fig. 6. Elements of digital transformation strategy

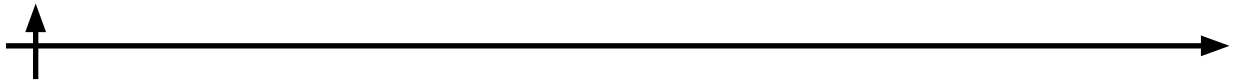
Digital transformation strategy implementation should provide strategic alignment company business and IT-architecture and strategic goals achievement in the most effective manner. To create company model for the purpose of digital transformation strategy development, it is needed to use ontologies.

Ontology (in computer science) is a tool for detalization and formalization a certain field of knowledge using a conceptual scheme. One of the main advantages of using ontology is the ability to combine information obtained from various information sources. For digital transformation strategy development authors propose an ontology as follows:

1. digital transformation domain (including business model, motivation, strategic capabilities, strategic resources);
2. BSC metrics;
3. risks and constrains;
4. EA reference models;
5. forecasting methods;
6. IT-projects.

Digital transformation is an ongoing process, and companies need to experiment and model their architecture on constant basis. The ontologies usage will allow companies to accumulate knowledge about implemented technologies and be able to make a prognosis of the digital transformation projects results.

Digital transformation requires a number of pilot IT-projects implementation, but companies fre-



quently limited with tools of its management and evaluation. For the purpose of IT-projects portfolio management authors propose to use intellectual system, represented on fig. 7.

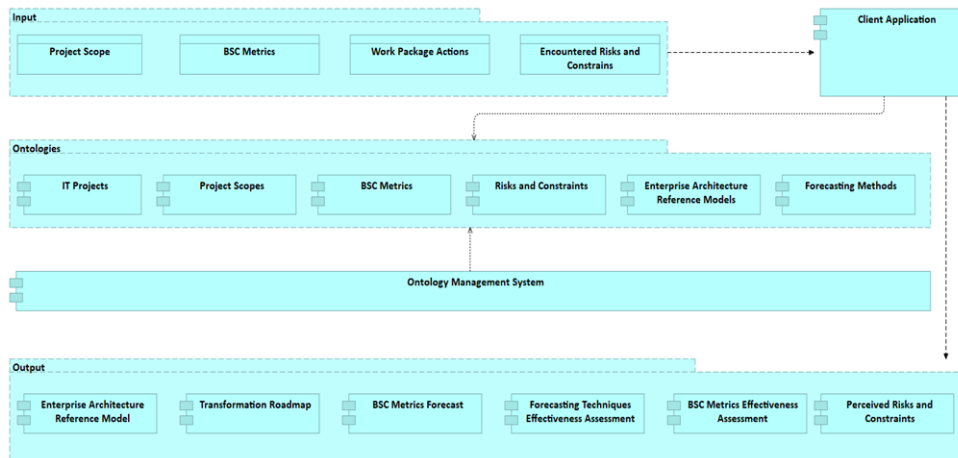


Fig. 7. IT-projects portfolio management system

As was mentioned before, companies on the way of its digital transformation companies face with critical challenges, and one of them is to define a path through different digital technologies that fits into the companies' business environment and capabilities. Intellectual system of IT-projects portfolio management provides possibility of IT-projects implementation knowledge acquisition and consists as a basic platform for company digital strategy development.

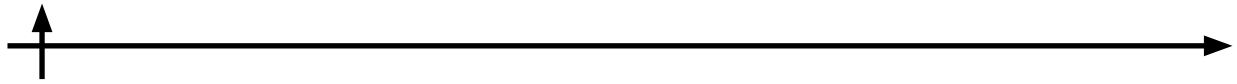
Thus, adoption of digital transformation development framework, models and IT-project portfolio management system, proposed in the current paper, will support companies transition to digital business models and comprehensive transformation of the company's activities, business processes, competencies.

Conclusions

Therefore, emergence of digital economy leads to substantial change of business environment and forces companies to change their activities, business processes, competencies and business models, maximizing the use of digital networks to improve competitiveness and value creation. Currently digital strategies are developed by a number of companies, but most of them face with absence of particular metrics and models for such development. Besides, digital strategy requires IT tools capable provide support for its development, implementation and evaluation. Suggested in current study digital strategy development framework, ontologies, and IT-projects portfolio management system have the potential to enable company digital transformation process on a new knowledge-based and technology-oriented level. It should be noted that the proposed coherent approach represents a digital transformation technology, as it offers a methodology and tools for modelling, and could provide valuable support for digital transformation strategy implementation.

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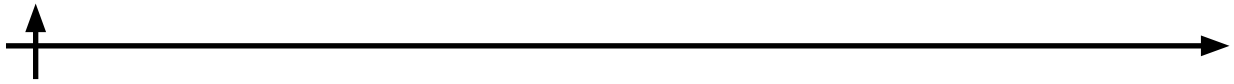
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