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Approaches to Developing a Strategic Program of Company's Digital Transformation

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ABSTRACT

Russian companies are actively involved in the digital transformation. The key technologies and potential effects are defined, a lot of pilots and prototypes are successfully launched. The next logical step is to scale the concept from the level of individual processes to the level of assets, functions, holding companies and the whole enterprise. In the article, two main approaches to the formation of a strategic digital transformation programs are analyzed: an approach based on scaling of digital tools and an approach based on complex processes transformation. Both these approaches are aimed at increasing the level of digital maturity.

KEYWORDS:

digital transformation, strategy, digital factory, industry 4.0, operational efficiency, operating model, business process optimization.

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1. INTRODUCTION

The Digitalizing and Industry 4.0 Concept has gained much spread throughout the world and Russia as well. In practice exists a uniform understanding of technologies foreseen by this concept and ways of their application, their application methods; the concept itself is considered as a means of transformation of certain elements of business models. KMPG research results showed also that prominent Russian companies had implemented pilot projects on implementation one or other technology in 2017 – 2018, while some of them have developed the digital transformation program for the business for several oncoming years. Now, tasks for transferring from selective piloting of separate technologies to major implementation of digitalizaton program, which is proved by following conclusions from the KPMG research.

- ***Major Russian companies have already taken the path of digital transformation. But most of them do not have a complex digitalization program yet – those companies implement pilot projects packages on implementation of separate and often isolated digital solutions.*** Respondents are sure that they are ready for digitalization, moreover, 63% of them have indicated that they already have a digital transformation program. But most often companies regard it as an actually implemented pilot project package, and really the majority of them does not have either mid- or a long-term action plan with prioritizing of time initiatives and understanding of the target condition of the organization. Instead, companies realize short-term pilot projects on implementation of one or other technology. Such an approach gives the ability to estimate applicability of a digital solution in practice, but often leads to replacement of a focus to secondary tasks from the point of view of business, to scatteration of resources and to selective and thus suboptimal business process transformation.
- ***Companies lack maturity of current business processes and competent specialists for full-scale digitalization.*** Main obstacles on the way to digitalization faced by Russian companies are insufficient maturity of current business processes and lack of necessary skills and competence. Companies admit the necessity of increasing maturity of business processes and the fact that optimization of processes must include into transformation plans. To achieve a significant result, it is necessary to consider through business process and involve business departments (KMPG 2019).

Bauernhansl also notes the importance of gradual case distribution which showed the potential of anew technology and improved its acceptance at all management levels (Bauernhansl, 2014). Paul-Rohmer and co-authors have compiled the upper-level road map for industrial enterprises, which consists of four steps. The road map can be used by small and medium industrial enterprises which have selected the strategy of incremental improvements. Step one. Definition of the current condition and strategic position from the point of view of the intern and extern perspective. Step two. Definition of the desirable target condition including research of perspective technologies. Step three. Realization of transition via development of prototypes and a business model design. Step four. Formation of the scaling plan and management of changes for transition of all the organization to its target condition (Paulus-Rohmer, 2016). Schhuh and co-authors have offered a road map variant consisting of six steps. The map is focused on consideration of digital competences based on the available information (Industrie 4.0, 2017).

This article considers practically oriented approaches to formation of the digital transformation program. Structured and half-structured interviews are the informational basis of the research, including:

- 18 interviews with representatives of the field of consultive services on digital transformation.
- 10 interviews with representatives of Russian companies which either launch or have launched digital transformation programs.

Respondents were given questions on approaches used for formation of programs, their structure, main stages, actions during these stages and peculiarities of use of those approaches. Formation of the digital maturity program and detailed description of two practical approaches to creation of the digital transformation program were the result of the research.

2. ENTERPRISE DIGITAL MATURITY MODEL.

Digital transformation is the complex implementation of process innovations. The process innovation is "the implementation of new methods or significantly improved ones of production and delivery. This means significant changes in techniques, equipment and/or software".[1] The key complication of process innovations is connected to their system character: Changing of one part of the production system influences other subsystems and processes. Implementation of any technological innovations may lead to unforeseen technological problems, to the need in mastering new skills and increase of demands to qualification of service personnel as well as to significant changes in working processes throughout the entire production line[2]. Taking into consideration additional complications connected to implementation of new technologies and absence of a unified understanding of all peculiarities of their implementation; the scale of the problem is not clear. These complications make technological innovations a very complicated task, especially within the context of digital transformation, needing constant optimization of processes and actions excessing far beyond the preliminary scope of works on implementation.[3]

D. R. Syodin, V. Parida, M. Leksel and A. Petrovich have conducted the in-depth analysis of cases of 5 automotive production plants in their article "Smart Factory Implementation and Process Innovation", and, as a result, they systematized challenges which are faced by companies implementing digital plants by dividing them into three categories:

1. ***Staff:*** employees of a factory often do not have enough vision and understanding of the concept of digital plant and means of its realization. Besides, employees have perceived amounts of changes and the need in development of own skills in various manners. Additional complications appear in connection to devotion to the previous generation of production technologies and the expected threat to existing competences, i. e. factors of resistance to changes.

2. ***Technologies***: high grade of uncertainty and complexity of digital technologies complicate the process of evaluation of potential economic effects, thus creating a multivalued business substantiation for implementation. In fact, the system character of implementation of the digital plant concept creates uncertainty regarding specific changes that could be needed in other technologies, processes and employees' skills connected hereto. A very high price of realization of a digital plant, especially during first years, is worsened by the uncertainty because benefits from investments will be received within an indefinite time in the future.

3. ***Processes***: Product companies face difficulties when changing traditional procedures and processes for completion of digital transformation. Plants often lack a systematic approach to implementation of modern design models which promote receiving more flexible and adaptive results and faster entering the market. Production processes are often completed practically the same way throughout the extensive period of time and become an inseparable part of the daily practice. This inflexible culture is hard to change. Modern business transformation models are needed in this context as for transformation provision, so for attracting competent staff for its support.

Within these three branches – employees, processes and technologies – researchers managed to systematize maturity levels during transition to digital production as well as to classify key activities which are the basis of digital production.

The model must also be supplemented and amended taking into consideration the result of semi-structured interviews conducted by the author. 9 people out of management one of Russial oil companies took part in the interview. The final model is given in Table 1.

3. APPROACHES TO DIGITAL TRANSFORMATION PROGRAM FORMATION: DISTRIBUTION OF EXISTING INSTRUMENTS

Distribution of instruments presumes availability of a set of pilot technologies at an enterprise, which demonstrate positive results and are characterized by a certain degree of versatility, i. e. these technologies may be used in many similar processes of a company. This approach significantly refers to correctly compiled maturity model, which has initially designed levels. The example of preparation of maturity model within the view of technologies applicable to distribution, is given in Table 2

A set of technologies at each maturity level is selected individually for each enterprise/function.

Drawing up a program of digital transformation initiatives based on technology distribution can include following stages:

Stage 0. Preparing a register of digital tools and filling a maturity assessment model

Stage tasks:

1) analyze digital tools already used at the enterprise and offered by experts as best practices as well as select relevant tools offered by suppliers on the market;
2) describe potential effects of tools;
3) describe technical conditions of implementation of tools;
4) distribute tools by maturity model levels.

Results:

– register of digital tools;
– digital maturity model for the enterprise.

[1] OECD 2005, p. 9.
[2] Gopalakrishnan, Bierly, and Kessler 1999.
[3] Robertson, Casali и Jacobson 2012.

Table 1
Digital maturity levels of the operational model

Maturity level	Processes	Technologies	Employees
Level 5. Adaptivity. Implementation of the system having corrective impact onto equipment either independently or within the corporate system for maximizing efficiency.	– development of processes for autonomous decision-taking by systems. – development of processes for regular forecasting and planning future production	– integration with external shows of these suppliers and purchasers; – usage of artificial intelligence systems	– development of perpetual improvements and innovations culture – implementation of persons responsible for the relevant direction of predictive analytics and adaptability
Level 4. Predictivity. Predictive systems/adviser allowing to forecast future conditions, were introduced.	– development of processes for analysis of historical and current data and use of the obtained information for optimization; – introduction of procedures for regular optimization initiatives	– implementation of real-time systems for analyzing activities that automatically perform analytics, generate warnings and recommendations; – implementation of digital counterparts for testing of prototyping and optimization	– organization of cross-functional sessions and data exchange sessions to work on current problems and optimization methods based on new data; – attraction of additional data analysts
Level 3. Transparency. Key process indicators are visualized on dashboards and tracked in real time.	– formalization of data flow management processes; – creation of processes for active exchange of knowledge and data between all participants of the process; – creation of a cross-functional data exchange network	– improving the accuracy and analyticity of data, reducing the amount of useless information; – implementation of data mining systems; – integration of data exchange systems, for example, integration of BI visualization systems with data sources	– training employees to work with data systems, various devices and interfaces; – "digital" skills improvement; – development of a knowledge management culture
Level 2. Connectivity. Operational data of the process is entered into the system automatically, without human intervention. Adjoined systems integrated. Control actions are carried out remotely	– formalization of digital plant implementation processes (system and detailed description); – processes of attracting participants external in relation to the plant, and stakeholders to ensure connectivity	– elaboration of areas of integration of existing systems and technologies with future elements of the digital plant; – formation of a single information and data flows space, connecting systems	– formation of a culture of inclusiveness, involvement of employees into development of a target vision; – separation of roles and responsibilities; – attraction of employees with competencies in business, IT and production
1. Computerizing. The process is automated by any IT-system. Entering data into the system is carried out manually	– Exclusion of paper forms and carriers; – completion of processes through system interfaces; – automatic data transmission	– introduction of basic production and enterprise control systems; – integration of automated data transmission systems	– employees proficient in operating systems within the zone of their responsibility.
Level 0. Basic infrastructure Technologies having no business effects themselves, but necessary for introduction of advanced technologies.	– there is no direct influence onto processes implied	– creation of infrastructure for subsequent introductions: industrial WiFi, local networks	– employees do not need additional digital competences

Table 2.
The example of technologies upon levels of digital maturity

Maturity level	Digital technologies in production.	Digital technologies in MRO (technical maintenance and reparation)
1. Computerizing	– TP DCS (digital control system of technical processes); – MES (Manufacturring Execution System) – system of production management	– MRO DCS (technical maintenance and reparation digital control system); – equipment passing-by using mobile devices; – RMS (reliability management system)
2. Connectivity	– internet of things; – industrial robotization; – equipment manual switch automation	– internet of things; – drones – remote expert assistant based on augmented reality; – laser scanning, photogrammetry
3. Transparency	– remote centralized management of production processes; – remote workplace (MES on a tablet); – ASCAPW (Automatic system for commercial accounting of power consumption) – digital panels of visual efficiency control	– remote monitoring (equipment health center); – EDMS (engineering data management system); – technical view; – remote monitoring of equipment status by the supplier; – location of equipment and tools
4. Predictivity	– advisory models; – virtual analyzers; – kinetic models	– predictive diagnostic system and service; – reliability control center
5. Adaptivity	– systems of global dynamic optimization of technological processes; – automatic start of backup equipment	– automatic predictive formation of repair orders based on predictive diagnostic data

Stage 1. Diagnostics of the current level of enterprise maturity in the context of production/lines

Stage tasks:

1) to define:
   a) list of tools corresponding to each maturity level;
   b) success criteria of tools implementation.
2) conduct cataloging of implementing/implemented digital tools;
3) match introducing/introduced tools with maturity levels;
4) evaluate success/completeness of implementation according to previously approved criteria;
5) evaluate the current maturity level of objects according to the template.

Results:

– the level of digital maturity is determined;
– the degree of success of implementation of existing initiatives is determined;
– a heat map of success of implementation of existing tools by criteria has been compiled.

Stage 2. Formation of a map of transition to the target maturity level of an enterprise in the context of production/lines

Stage tasks:

– to determine the target level of maturity of production facilities;
– create a portfolio of tools for transition to the target level as based on the registry of tools;
– define a set of prerequisites for implementation of the selected tools;
– formation of a roadmap for implementation.

Results:

– 3-5 year roadmap for introducing digital tools;
– the image of the result of DC completion expressed in the target of maturity level.

It should be noted that processes at individual plants or industrial sites of an enterprise are the object of transformation, since they can simultaneously be at different maturity levels and strive for different maturity levels.

As a result of completion of these steps, a digital transformation program focused on distribution of digital tools, either previously proving their effectiveness in piloting, or developed at enterprises, or approved upon by suppliers, is formed.

Table 3.
Process management levels

Process model level	Application
Level 1. Defines a group of processes.	Levels 1 - 3 allow you to determine boundaries of the company's business, its functional composition, determine the process model and interrelated processes and also highlight the most critical ones of them.
Level 2. Generates business scenarios which are used as input data in processes level 3. As a result, chains of successively interconnected processes appear.	
Level 3. Processes are decomposed to the level of detailed business processes.	
Level 4. Contains models that describe the sequence of steps. A step is a specific action of a group of users, for example, formation of a document, an application, etc.	Detailing processes up to levels 4 and 5 is used, as a rule, to develop technical specifications for implementation of systems, to write standard operating procedures and user manuals for working within the system
Level 5. Discloses business process stages prior to transactions. A transaction is a simple elementary operation, for example, opening a screen form, entering data into a specific field of a card in the system, and so on.	

4. PROCESS APPROACH TO DIGITAL TRANSFORMATION PROGRAM FORMATION

The process approach involves an in-depth analysis of organization's business processes in order to identify areas for optimization. Digital transformation involves the use of modern technology as the main optimization tool. A key feature of using this approach when compiling a digitalization roadmap is the need for a detailed analysis of processes up to individual manual operations. Detailed levels and methods of their practical application are given in table 3.

Since digitalization involves the large-scale implementation of information systems, the key object of analysis in compiling a digital transformation roadmap is level 5.

Drawing up a portfolio of digital transformation initiatives based on process approach can include following steps:

Stage 0. Detailed diagnostics of processes within the perimeter of digital transformation

Stage tasks:
- interviews with company management;
- analysis of pass-through business processes;
- timing and analysis of the structure of labor costs on individual processes;
- calculation of the cost of processes and total labor costs;
- analysis of IT architecture, information flows and IT development plans;
- internal and external benchmarking.

Results:
- detailed description of business processes;
- process performance indicators;
- potentially problematic processes;
- a description of architecture of information systems in terms of diagnosed processes, the amount of manual work of users in systems, etc.

Stage 1: Hypotheses formation

Stage tasks:
- assessment of the current value of processes;
- analysis of operational efficiency of current business processes (AS-IS);
- benchmarking of existing business processes;
- identification of priority areas and hypotheses for optimization for further study.

Results:
- the result of analysis of the current model of implementation of business processes for compliance with best international practices and companies of the reference group;
- report on a comparative analysis of the number of employees and the effectiveness of company functions with industry companies in the Russian Federation and the world;
- description and models of selected groups of business processes with reference to information systems made in accordance with the selected methodology for modeling business processes;
- results of physical measurements, interview protocols,

Table 4.
Comparative analysis of approaches to formation of a digital transformation program

Advantages	Drawbacks
Distribution of existing instruments	
– quick start of digital transformation of asset; – intensive use and development of existing digital tools; – transparency and comprehensibility of expected effects due to a lower degree of uncertainty	– potential loss of benefits associated with insufficient immersion; – high requirements for quality of existing tools and implementation team; – some problems may not be resolved
Process approach to digital transformation program formation	
– detailed study of a wide range of processes; – orientation to real-world problems; – potentially high effects in case of detection of labor intensive processes that can potentially be automated; – revision and updating of the process model; – exterior effects expressed in detecting organizational problems	– high complexity of stages completion, especially of the diagnostic examination stage; – high requirements for qualifications of methodologists conducting the research and methods used; – significant distraction of employees at stages of diagnostics; – delaying the start of digital transformation until the end of diagnostics

benchmarking of standards, KPIs of processes and other data confirming optimization hypotheses;
- calculation of the current value of processes;
- description of hypotheses for study at stage 2.

Stage 2. Hypothesis studies and initiative development
Stage tasks:
- development of top-level targeted business processes (TO-BE);
- definition of top-level functional requirements for IT systems;
- formation of a set of initiatives for automation.

Results of the stage:
- top-level description of business processes with binding of information systems (TO-BE);
- top-level functional requirements for proposed changes in automation;
- a list of initiatives for optimization of business processes taking into account their ranking by time and results of a top-level assessment of the effect of implementation of proposed initiatives;
- top-level assessment of business cases.

Stage 3. Formation of a portfolio of initiatives
Stage tasks:
- development of detailed targeted business processes (TO-BE);
- determination of functional and non-functional requirements for IT systems;
- development of a detailed business case;
- formation of projects for optimization;
- development of an efficiency improving program.

Results of the stage:
- description and models of business processes with reference to information systems made in accordance with selected methodology for modeling business processes (TO-BE);
- sets of recommendations grouped into projects with descriptions of changes, including setting tasks for automation and evaluating effects (standards and KPIs of processes (TO-BE));
- approved, calculated quantitative business cases for each project;
- operational efficiency improvement program, including an integrated implementation plan;
- communication program during implementation of the program.

The result of these steps is a digital transformation program aimed at improving efficiency and digitalization of most labor-intensive and problematic processes.

5. CONCLUSIONS

The approaches described above are significantly different. Distribution of existing tools as a "starting point" considers existing, developed or proposed digital tools, that is, this is a top-down approach. Of course, digital technologies are initially developed to solve specific problems, so effects will be obtained in any case. Nevertheless, at this approach to transformation, specific problems, solution of which with the help of digital tools can bring significant effects, may be missed, but it is absent for them and must be developed from scratch.

The process approach to the formation of a digital transformation program involves a progressive bottom-top movement, that is, a set of problems that need to be addressed is considered as a starting point. This approach can be called more fundamental, since a significant amount of work on process diagnostics is required to identify problems to the level of individual manual operations. This circumstance is a definite drawback of the approach, since it significantly postpones the start of digital transformation, which can only be started after summing up the results of a diagnostic examination (Table 4).

It should be noted that approaches are not mutually exclusive. First, in the first approach, in any case, the procedure of diagnostic examination and filling of the register of digital tools is performed before development and distribution, although it is much less detailed. Second, both approaches can be used simultaneously, that is, in parallel with introduction of digital tools top-bottom, research of process problems and search for solutions bottom-top can be carried out provided that the two approaches are synchronized.

Thus, the article considers the model of levels of digital maturity of an enterprise, approaches to formation of a digital transformation program and features of their use. The information presented in this article may be the basis for making management decisions in practice at the start of digital transformation.

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