Operations architecture modeling for IT-driven organizational development of a construction company

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1 Context

The case report describes a business architecture-driven project of IT implementation planning for a medium-sized Russian construction company. The fictitious name "BuildIt" will be used for the company for confidentiality purposes. Although the project took place in 2012, many raised issues are still relevant for companies in the region. The report will describe the company at the moment when the project took place.

BuildIt company deals with design and construction of non-residential buildings (industrial facilities, schools, theaters, museums, libraries, etc.). The company's portfolio involves many unique facilities. At the beginning of the project its portfolio included five large-scale projects whose total cost amounted to $200 million.

There are about 1000 employees in the company, and the payroll budget amounts to $1.5 million per month. One should consider that this amount excludes workers (constructors) since the company acts as a general contractor meaning the very works are carried out by subcontractors, some of them dealing with windows, others doing concrete works, etc.

The company's projects are comprehensive and complicated: they involve different works related to a facility's lifetime, as well as different subsystems of a facility under construction (heat supply, electric power supply, water supply, IT infrastructure, etc.). Such projects require interaction and joint work of different divisions. Sometimes their interaction is hindered by political, administrative, and cultural factors.

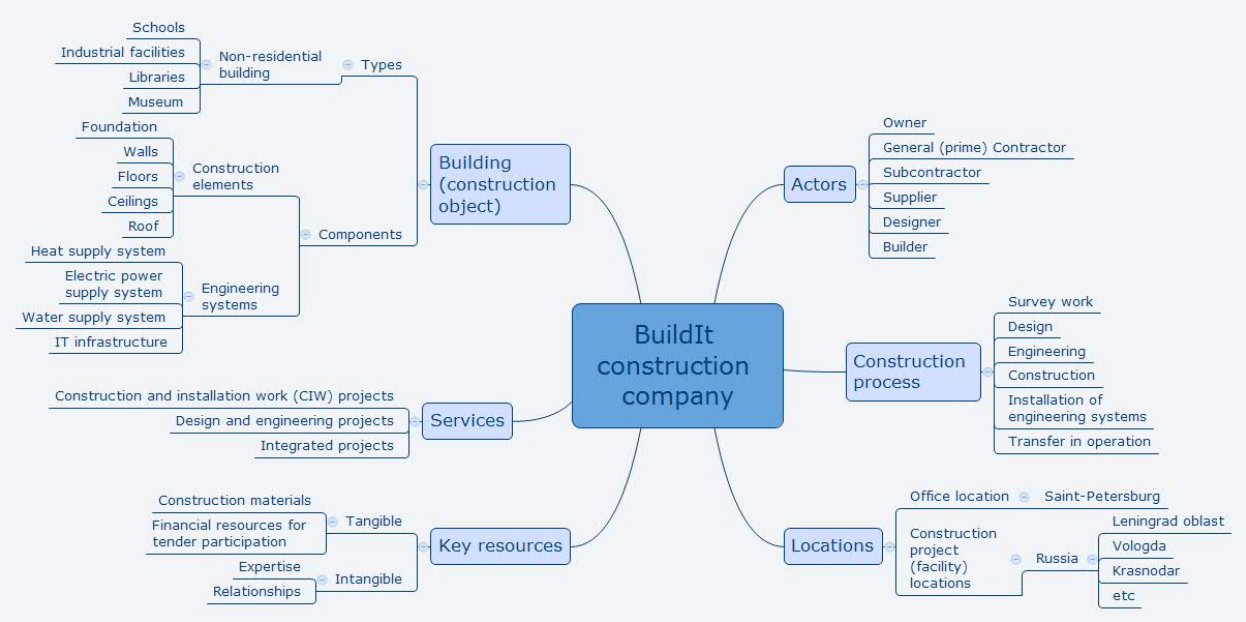

Figure 1. Company overview

The company actively masters and tries to implement up-to-date technologies in construction and buildings infrastructure including contemporary IT infrastructure provision for facilities.

The company has been developing and has grown a lot in recent years. New kinds of activity and large-scale projects have appeared. However, no qualitative changes in the management style or methods have taken place. The company has remained a "manually managed company" with one and the same owner and director.

The company has no formal or shared informal strategy – managers' positions differ with respect to the strengths of the company. The majority of orders are government orders; therefore, a relational capital has high significance alongside immediate configuration at public authorities. It is one of the reasons that neither the director general nor his inner circle sees

any sense in the Company's strategy development. However, the company has managed to develop a really unique value proposition. The closest competitor who also builds complicated facilities in the region is far behind BuildIt.

2 Problem description

Project schedules are often violated due to ill planning and weak control over the situation. The Company's Director is incapable of controlling everything and struggles for automation viewing it as a way out. Keywords: "Task management", "Task, responsible person, deadline". Management cycle is linked to weekly management meetings on various issues; tasks are set within such meetings and controlled within later meetings. Formalized processes are almost absent. Task and document management automation is the first intuitive request of the BuildIt management.

Until recently IT didn't develop in the company. There is only a department of system administrators, which provides maintenance and support for equipment and several systems (CAD systems and some 1C modules). The company is ready to invest in IT, but is not always ready for organizational changes. Recently, BuildIt started to pay increased attention to IT as a means of performance improvement.

The company invited consultants on ERP systems implementation, but they did not manage to persuade the managers. Their proposal was limited to ERP and included a sequential deployment of ERP modules. BuildIt managers anticipated many risks and knew about many failures in complex ERP implementation, so they doubted the feasibility of standardized step-by-step deployment of a rigid integrated system at their company. Additionally, BuildIt managers heard about other types of information systems (e.g. Workflow management system) and were thinking about their usage. The implementation approach was also unclear – what modules of ERP would be based on best practices and what modules would keep and automate the existing BuildIt practices. Finally, BuildIt director invited new consultants – the authors of the paper with the team. He expected to receive a less ERP-biased approach with more solid foundations.

The final goal of the project was to implement IT in order to make the management and control system in the organization more effective.

In order to achieve this goal, it was necessary to answer the following questions:

- What should be the directions for IT development in the company?
- What should be the target state of IT support?
- How to attain the target state?

In addition to these conceptual questions, which are associated with IT strategy, it was necessary to specify requirements for the most urgent information system (IS).

3 Solution

3.1 Approach

We suggested an approach which had several important features:

1. Componentized architecture of business operations was used for comprehensive analysis of the current state and for planning the target state of the company. The analysis and planning employed an effective visual technique – heat maps;
2. A specialized modeling tool was used in order to systematize and integrate the results of the analysis and planning of enterprise architecture;
3. Special attention in the project was paid to "soft" issues: organizational culture and management style were analyzed in order to set priorities in IS implementation.

1. Componentized architecture of business operations, or simply operations architecture, as it was named in the project, was based on the paper [Sanz et al, 2011]. During the development of this architecture we also reused ideas from [Kudryavtsev, Grigoriev, 2011]. Operations architecture is a part of business architecture and was used for structuring problematic areas, identifying strategically important areas, mapping of existing IT support, setting the priorities for IT implementation, etc.

Operations component was considered as a group of interrelated activities, which are supported by the corresponding IS, resources, organizational roles, etc. Such discrete modules can be shared across the firm. The componentized architecture of business operations realizes the principle of resource aggregation and complexity reduction, thus yielding a componentized or modularized approach to business operations.

The first aspect of modularization is based on the notion of competence. For example, Upstream is a competence of a typical oil and gas industry; Water Procurement is a competence in the water segment of the utilities industry; Health Care and Environment are competences in the city government segment of the public industry; Customer Service is a typical competence where services matter, which, thus, takes place in a variety of industry segments such as banking and telecommunications; and so on. The other aspect of modularization is based on a typology of the enterprise activities. This dimension leads to a partition into four levels. These levels correspond to four broad categories of activities involved in creating the following outcomes: vision and strategy, learning and innovation, oversight and management, and production and

maintenance operations. The two-dimensional arrangement of this modularization is shown in the map of Fig. 2. Operations components appear at the intersection of each column (competencies) with each row (categories of activity).

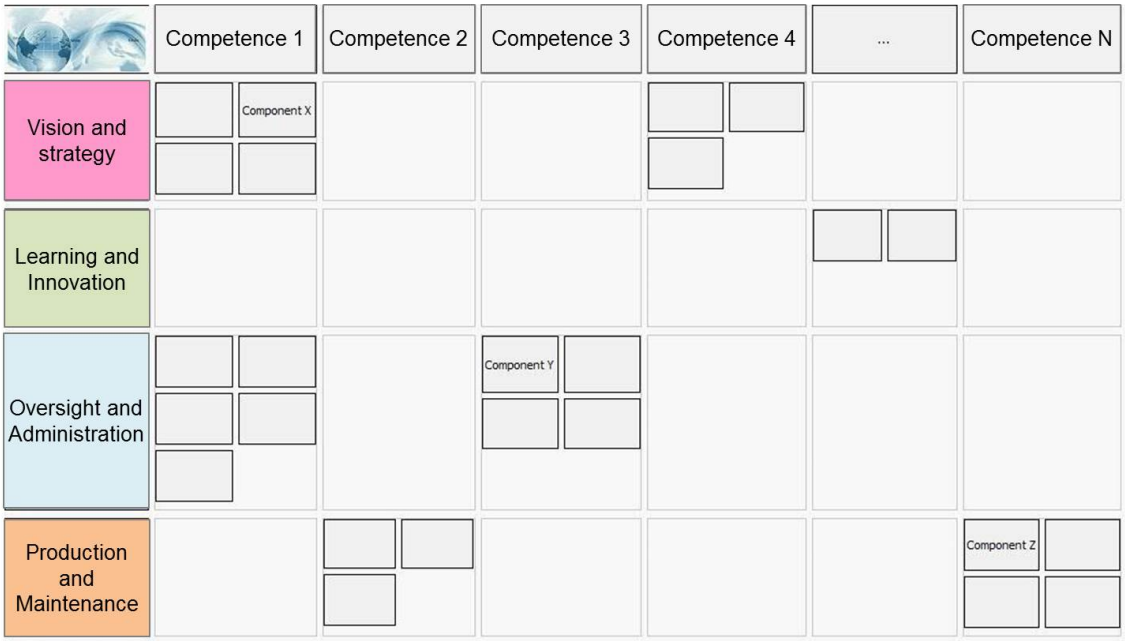

Figure 2. Componentized Industry Business Architecture – a simplified view with a few competences and components highlighted [Sanz et al, 2011]

Having identified and organized the business operations into a componentized architecture, we started to apply this model for business analysis and planning.

There are two techniques to consider [Pohle et al, 2005; Business Architecture Guild, 2015; The Open Group, 2016]:

1. Heat mapping the componentized architecture of business operations itself;
2. Mapping the relationships between the operations components and other business and IT architecture domains.

Heat mapping helps identify opportunities for business improvement or investment. It visually highlights components that are performing at a sub-optimal level, or that might not exist in a form that is required to meet some future strategic need.

The second approach helps to strengthen alignment across different parts of the business, ensuring that what the business wishes to do is: reflected in the company's strategic and operational objectives (the why); supported by the appropriate systems, processes, information, and organizational structure (the how and where).

These techniques were used in BuildIt for identifying priority areas for IT implementation, planning target IT support, and structuring the expected impact of development projects.

2. Specialized modeling tool ORG-Master was used in order to systematize the results of diagnostics and planning of the enterprise architecture [Grigoriev, Kudryavtsev, 2013].

Fig. 3 demonstrates the main objects of the enterprise model we used. It includes business operations components, goals & objectives, information systems (IS) and their functions, etc. These objects are represented using classifications (hierarchical lists). Relationships between the objects of different types are represented using matrices (linking two or more hierarchical lists) – for example, operation components help achieve some objectives.

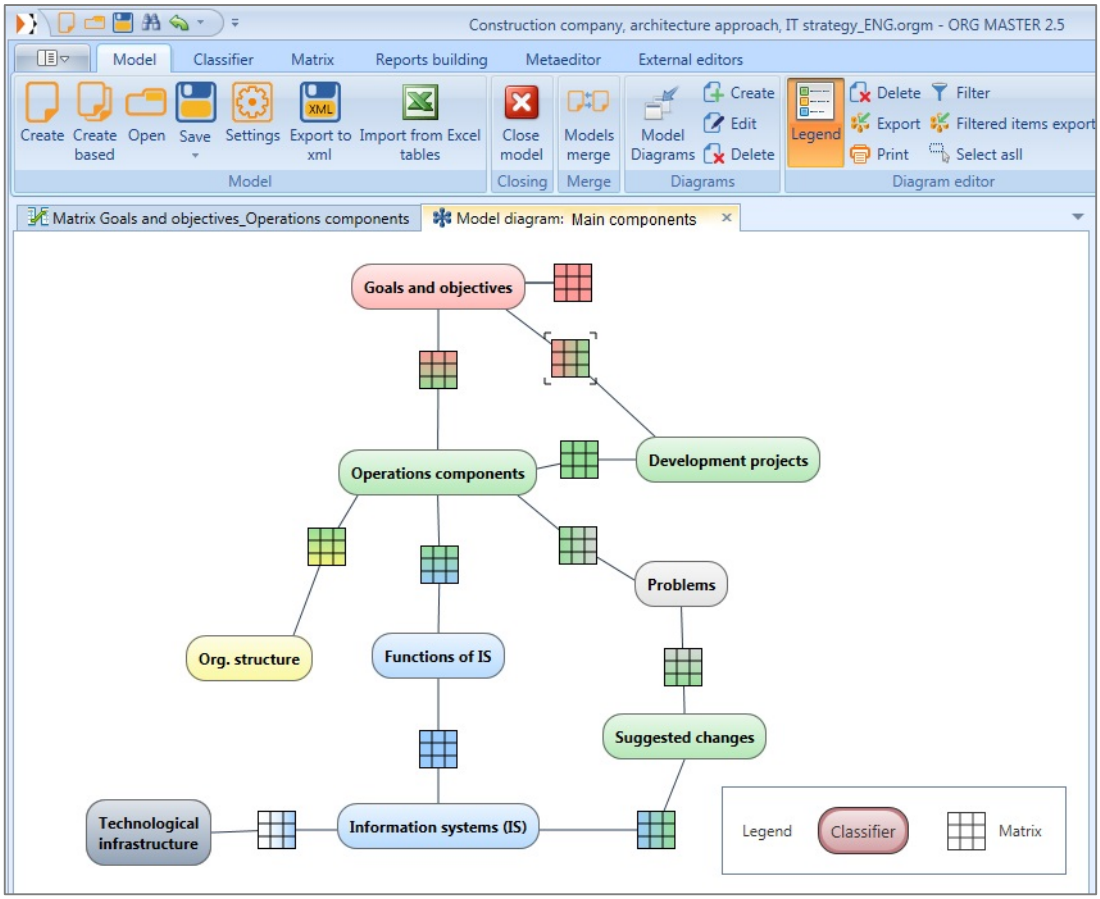

Figure 3. Enterprise architecture modeling as information support for the project

The developed model provided multifaceted representations of BuildIt enterprise architecture and enabled the generation of different reports, which became the foundation for heat maps and final recommendations. The usage of a specialized modeling tool significantly improved the speed and quality of diagnostics and design of the target enterprise architecture.

3. In addition to enterprise architecture modeling and analysis, we decided to pay attention to "softer" issues. Initial meetings with BuildIt representatives demonstrated that it was necessary to take into account the organizational culture, management style, and level of capability maturity when selecting the IT implementation policy/conception. Rigid formalization and control (which is necessary for an integrated ERP system) is not suitable for all companies or may be limited. In order to mitigate these risks, we evaluated the corporate culture of BuildIt using Cameron & Quinn [2006] method (see Fig. 4) and analyzed the current and the desired style of work organization.

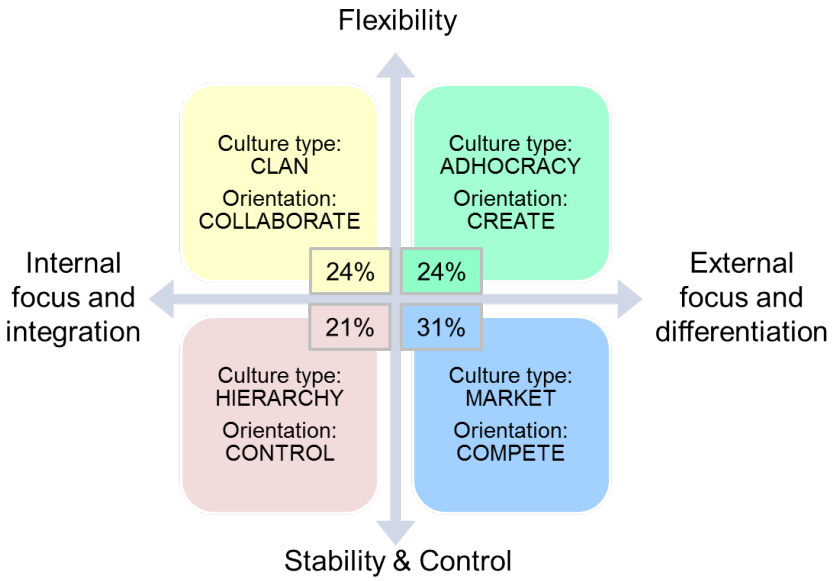

Figure 4. The evaluation of BuildIt culture using Cameron and Quinn [2006] method

With respect to all the aforementioned features of the approach, we suggested the following way of working– see Fig. 5.

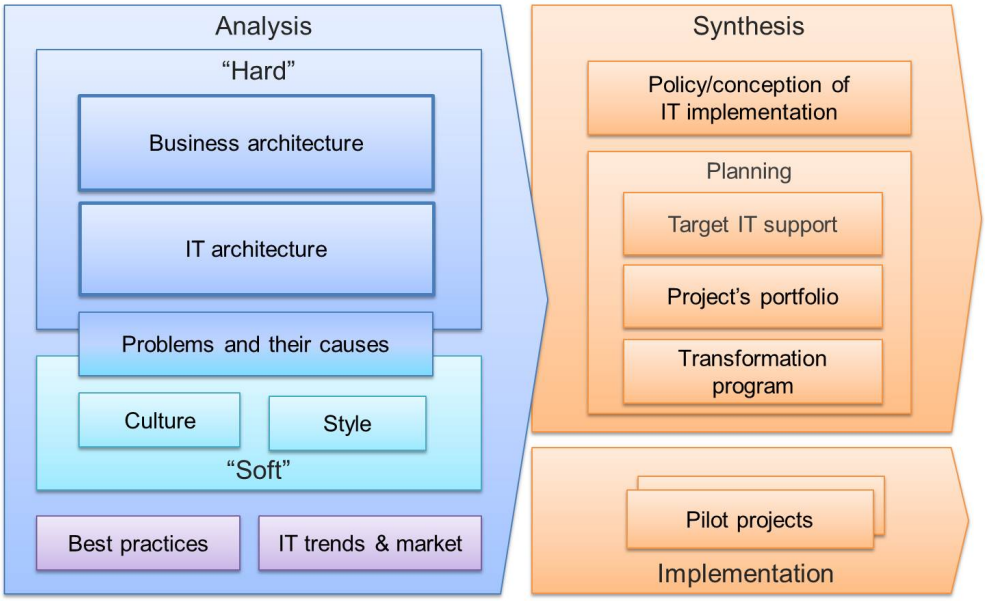

Figure 5. Main steps and deliverables of the suggested approach

IT-driven transformation program and requirement specifications for pilot projects were the most interesting deliverables for managers since the goal of the project was to implement IT in order to make the management and control system in the organization more effective. In order to receive these deliverables, it was necessary to analyse/diagnose the current state of BuildIt business and IT architecture, organizational culture, and management style, identify problems and their causes. Best practices and IT trends were also analysed in order to reflect world knowledge and experience in BuildIt plans. Planning included both conceptual decisions (e.g. about the priorities in the categories of IS) and more specific issues – what operations components should be supported by IT first of all, what IS categories and specific vendors can provide such a support, what development projects must be initiated, and how to implement them.

We used the following data collection methods at BuildIt:

- Interviews with top managers and relevant specialists of the company;
- Surveys – several online questionnaires were rolled out (about BuildIt problems, their causes and possible solutions; organizational culture; work organization and management style);

- Observation and ethnography (e.g. participation in weekly management meetings, meetings at different construction objects, etc.);
- Analysis of documents (regulatory documents, etc.) and BuildIt website.

Multiple sources of evidence and data gathering in "triangulating fashion" helped to take into account the interests and interpretations of different stakeholders – this enabled us to develop a balanced transformation program and minimize risks.

3.2 Application of the suggested approach

According to the suggested approach we developed the componentized architecture of business operations for BuildIt (Fig. 6) and used it for the following analysis and planning.

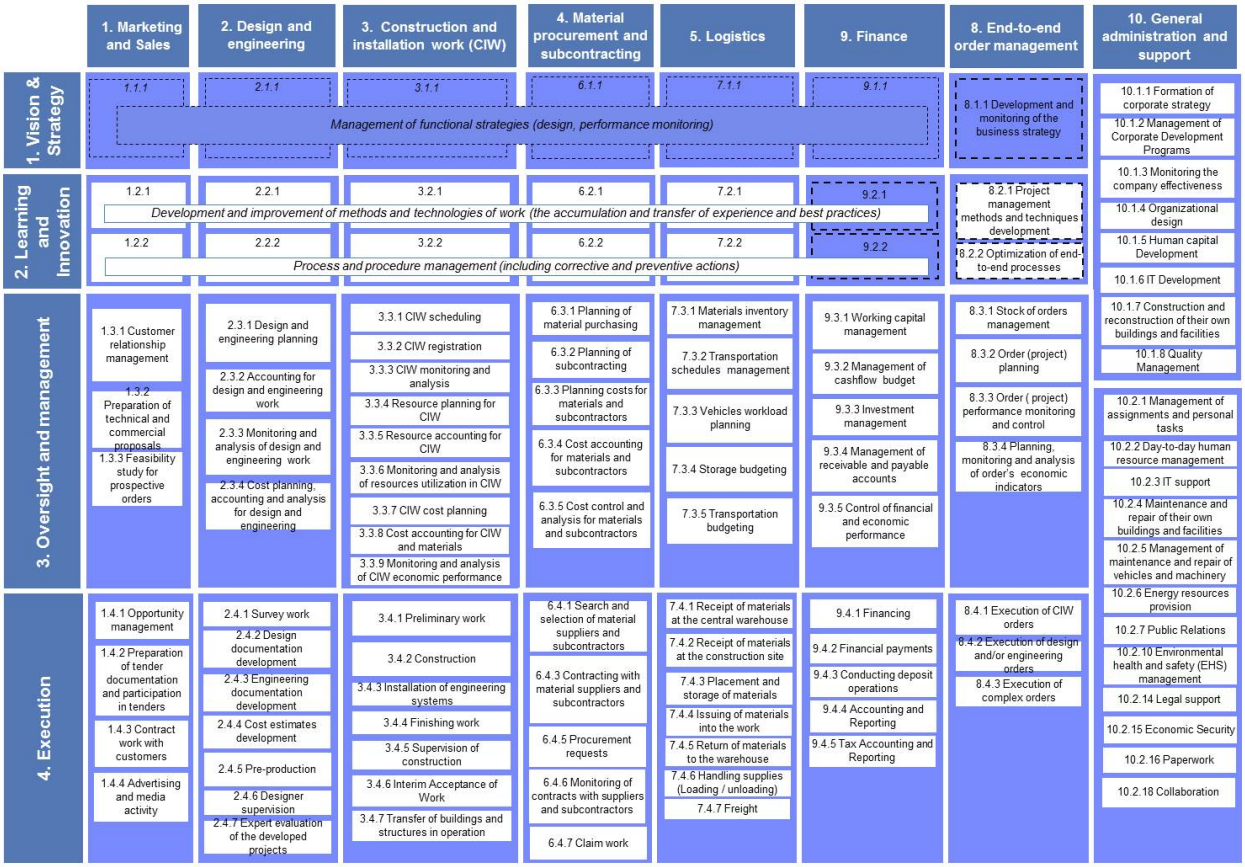

Figure 6. Operations architecture of the construction company BuildIt

This analysis and planning applied heat map and relationship mapping techniques and included several interrelated steps (Fig. 7). In the beginning heat maps for problematic and strategically important areas (components) were developed. They helped to define critical areas (problematic and strategically important ones). Then the potential for IT support was evaluated for critical areas. On the other hand, the analysis of the existing IT architecture resulted in a map which demonstrates relationship between operations components and IS – existing IT support. Priority areas (components) for IT implementation were defined by taking into account criticality, existing IT support, and potential for IT support. Prerequisites and dependencies were also considered. Finally, IS (mostly categories, but also modules of 1C:Enterprise[1]), which can support priority areas, were mapped to the componentized architecture of business operations. This mapping became the basis for creating the project portfolio, identifying quick wins, and planning transformation.

[1] 1C:Enterprise 8 is a popular Russian system, which includes ERP modules and can be used for overall enterprise automation, http://1c.ru/eng/.

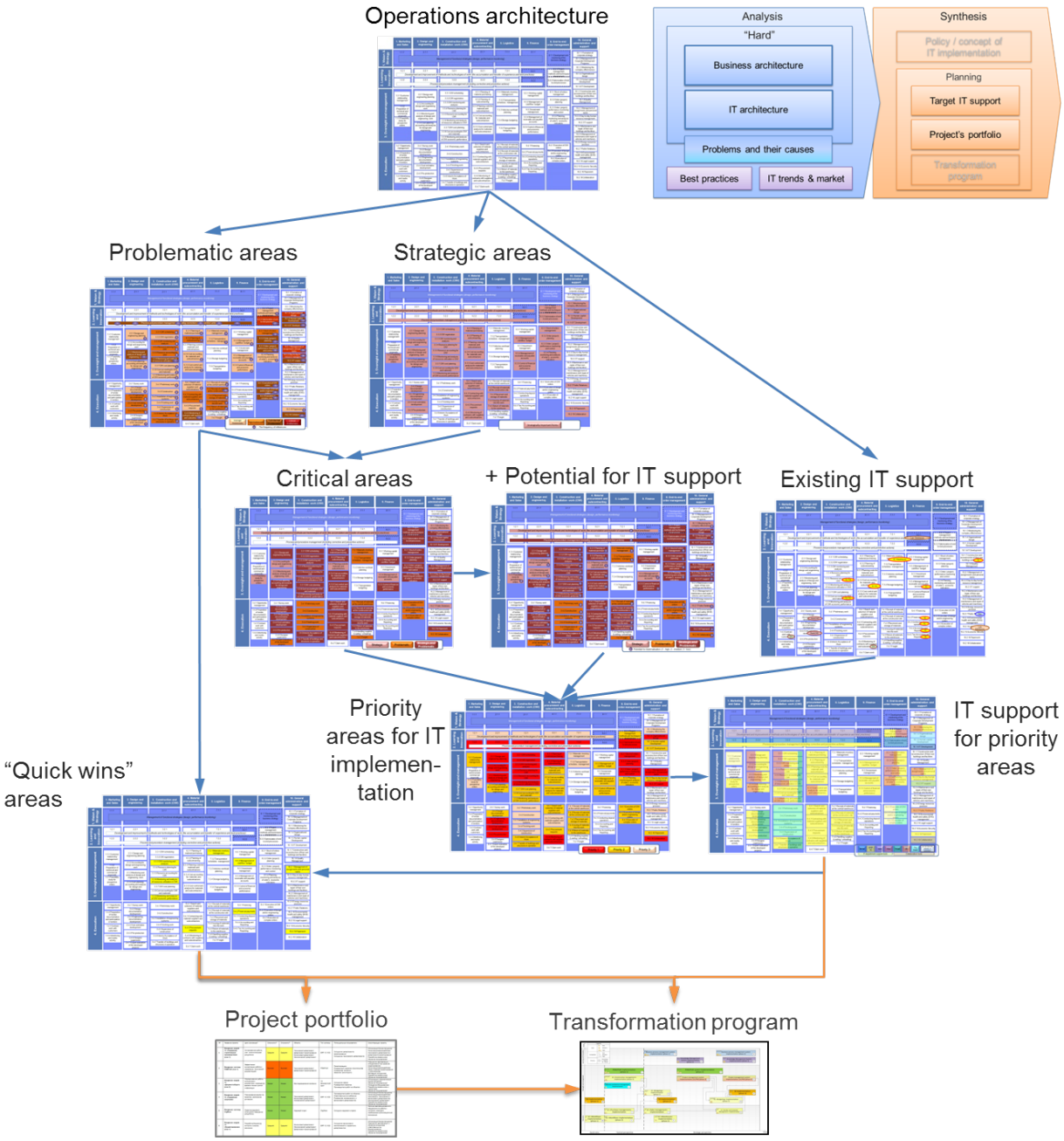

Figure 7. Heat map analysis

The evaluation of components for heat maps was done through the analysis of enterprise data (see data collection methods) and more detailed study of relationships between objects using the enterprise architecture management tool ORG-Master. For example, we identified strategically important areas (components) through the analysis of relationships between the operations architecture and objectives (see Fig. 8).

One of the questionable things was ERP implementation. Since BuildIt organizational culture appeared distinct from the hierarchical control-oriented type (see Fig. 4) and the level of capabilities maturity was low, the project team saw high risks in overall ERP implementation. In order to mitigate these risks, it was decided to use workflow management system (WFMS) for automating some areas, especially at the beginning of active IT implementation. WFMS can support the same business processes as ERP and provide more flexibility – processes can be changed by business users and implemented in the system. In spite of this flexibility, WFMS is not a complete substitute for ERP since the latter works with structured information, can do calculations, supports data integration, and provides functionality for analytics and decision support system. So in some areas of BuildIt operations WFMS was considered as an intermediate step (e.g. making an order of construction materials), which would establish organizational readiness for more mature IT support.

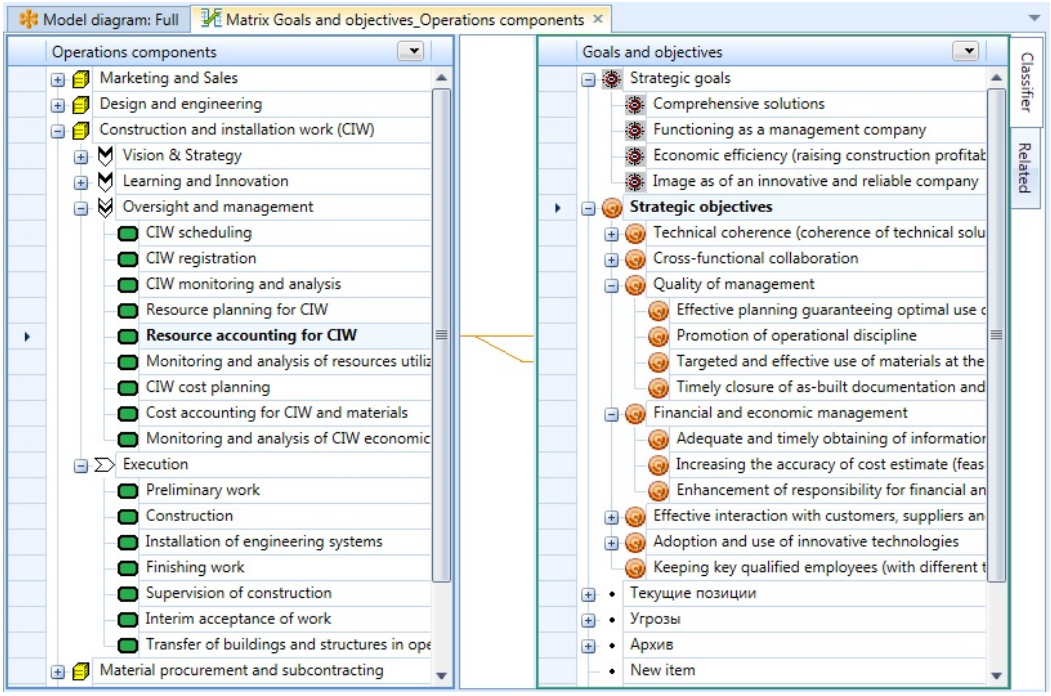

Figure 8. Relationships between operations architecture and objectives in ORG-Master tool

The suggested IT implementation projects were evaluated based on three main criteria – potential impact, implementation complexity (with respect to other organizational factors), and costs. The final project portfolio included 25 projects. Projects from "quick wins" category can be found in Table 1.

Table 1. Project portfolio from "quick wins" category

	№	Project	Supporting projects	Vendor	Goals
Document management	1	Processing and registration of incoming and outgoing documents.	Development of new regulations	1C	Ensure timely delivery, storage, and retrieval of documents
	2	Issue and control of assignments based on incoming documents	Development of new regulations, process optimization	1C	Provide performance discipline
Task management	3	Issue and execution control of tasks	Equipment with devices, development of new regulations	1C	Provide performance discipline
	4	Ordering construction materials and execution control for orders	Equipment with devices, development of new regulations	1C	Provide relevant information for applicants about the status of their material request
BI	5	Visualization of construction work plans	Equipment with devices	SAP	Raise awareness of managers and employees at facilities
	6	Visualization of statistics for task execution	Equipment with devices	SAP	Raise awareness of top managers

Finally, a transformation program was suggested – see Fig. 9. The horizontal axis represents time, and all the projects are distributed between three stages: quick wins (immediate implementation), tactical, and strategic perspective. The vertical axis corresponds to the areas of business operations.

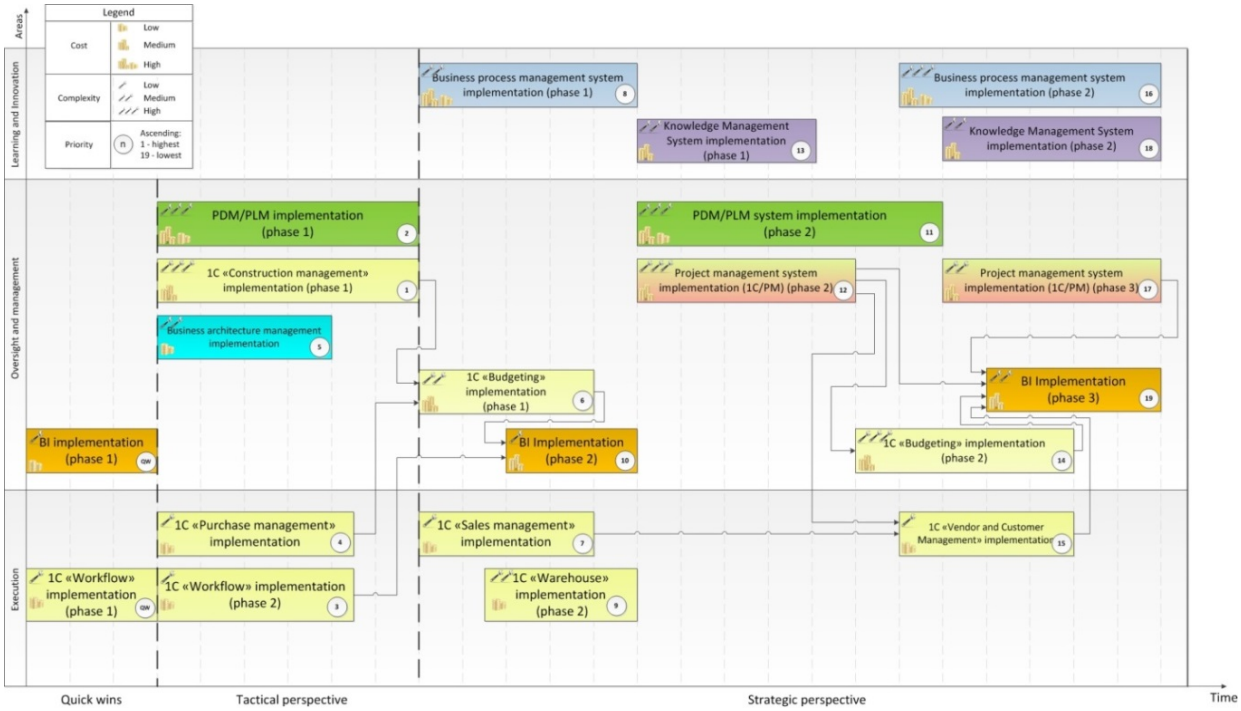

Figure. 9. Transformation program

4 Lessons learned

As far as there are no regularly measured performance indicators for internal processes at BuildIt, the effects of the described project can be assessed only qualitatively. The suggested transformation program (for IT implementation) was positively evaluated by BuildIt management. Projects from "quick wins" category were successfully implemented.

Lessons learned are the following:

1. Componentized architecture of business operations (Fig. 6) together with heat maps (Fig. 7) are good tools for communication and decision making process, which provide a common language within a project. Componentized architecture provides one-page overview of business operations and shared context for any suggested solution. Componentized operations architecture and heat map analysis provided sound arguments for the final deliverables (project portfolio, roadmap) and supported differentiated IT strategy by highlighting core and non-core competencies (Rosenberg et al., 2011). Core competencies enable an organization to outperform its rivals. These competencies, when automated and supported with an IT system, should be treated as the company's own practice (how they are organized is a competitive advantage of the company). Far too often such competencies are automated with the IT system's best practices, and therefore their uniqueness and differentiation can potentially be destroyed. In their turn, the IT system best practices are vital for cutting costs, for example, fast implementation, fewer mistakes, standardization, and less risk, because they are proven to work. To keep the cost low, a company should standardize its non-core competencies and thereby apply IT system best practices to all non-core competencies and the attached main and supporting processes. We also provided an overview of possible IS types and ERP modules for BuildIt managers, their advantages and disadvantages – componentized operations architecture became a supporting tool for their positioning and comparing.
2. The developed models are a significant investment in the management infrastructure of BuildIt. This investment must create value beyond the described IT planning project in order to receive good return on modeling. For example, BuildIt managers saw a potential of using operations architecture for efficient responsibility assignment in RACI-matrix format. The suggested approach also identified many critical areas (components) and initiatives beyond the scope of IT implementation (process redesign, change in incentive system, etc.). So it makes sense to establish business-oriented enterprise architecture management practice within BuildIt and go over to capability-based planning;
3. It is crucial to take into consideration "soft" aspects of an enterprise (like Business Transformation Readiness Assessment in TOGAF). What is important, "Soft" aspects should not only be related with HR practices (trainings, incentives, etc.) and communication, but also should be reflected in IT support. So we decided to automate some areas

using WFMS instead of ERP modules (e.g. order of construction materials). This approach provides more flexibility, enforces discipline, and establishes organizational readiness for more mature IT support;

4. We used a simplified approach for modeling and analysis of business architecture – only operations architecture instead of a combination of functions, business processes, and capabilities. It seems to be correct in the context of BuildIt – the company which hasn't got used to working with models.
5. Whereas the project was realized in not an agile way and had a big modeling part, the customer could feel unhappy seeing no practical results within several months. It is better to move from pure "waterfall" model to more iterative and incremental ones. "Quick wins" projects could be launched earlier; they help to engage BuildIt employees in further IT implementation and inspire them.

Acknowledgements

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