Risk Management in Project of Information Systems Integration During Merger of Companies

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Abstract: As of today, reorganization of companies is one of the challenges that require close attention of administrators. Integration of businesses cannot be accomplished without integration of information systems. Project management is a tool needed to implement such integration efforts. Risk management is one of the components of project management. A risk event occurs at a random nature, so estimating the probability of change in potential timeframe of project completion taking into account the estimated probability of various risk events is an important task. This paper gives an overview of the standard list of risks for integration of information systems of merged companies. Note that this list of risks has been developed for the Russian research-and-production instrument-making enterprises under government ownership and can be viewed as an example of implementing risk-oriented approach to information management. Besides, the list can be used to assess integration risks and elaborate ways to eliminate (minimize) losses related to implementation of these risks.

1 PROBLEM STATEMENT

Current condition of information systems and their application environment at the Russian research-and-production enterprises can be described using the following statements:

- Comprehensive coverage of business-processes with insufficient modification speed according to the requirements of business;
- Non-homogeneous information media from the standpoint of both platforms, and age of implemented systems;
-Insufficient readiness to changes of staff and low level of understanding the advantages of information systems at different levels of management;
-Different degree of vendor systems implementation, wide application of in-house design systems;
-Need to resolve information security missions and provide for the functioning of critical infrastructure.

Current publications, indexable in notorious databases, contain almost no information on techniques and projects in the area of integrating large information systems of different nature during merger of companies. Publications in this area mostly deal with either technical aspects of integration (Shumsky, 2014), or international mergers and takeovers involving the need for cross-cultural interaction (Trienekens, 2014). We think this is due to a large extent of monopolization of the IT-systems market in the developed counties, and the mission of integration, staff training and installation of systems is almost a trivial one. In Russia, the companies *a priori* have different information systems with different settings, software platforms, data managers that provide for information support of business-processes with a low extent of unification.

The infrastructure of information systems is also non-homogeneous and has a different level of application due to both lack of unified IT-policy, and insufficient funding.

If we look at the classes of systems used by the companies, we can see they are also quite different. Instrument-making enterprises in general use ERP, MES, PDM, PLM, CRM and other types of systems, however, the technique and application practice can be significantly different. Standardization in the area of business-processes supported by the systems is also insignificant, e.g., product lifecycle

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management systems are used without the major changes of basic standards for product design rules, generated by the national authorities.

In general, the maturity of different information systems (Romanov, 2013) is different throughout the Russian instrument-making enterprises, as well as the maturity of organizations.

The issue of estimating the timeframe of project implementation is covered in much detail in publications (Shikin, 2002), however the estimate of risk impact on timeframe of project implementation from the standpoint of probabilistic approach is interesting and, in our opinion, not reflected in publications in sufficient detail.

2 INFORMATION SYSTEMS INTEGRATION PROJECT. RISK ANALYSIS AND ESTIMATE OF PROJECT IMPLEMENTATION TIMEFRAME

In case of affiliation of instrument-making enterprises, the mission of interaction and system integration becomes the most urgent. Operational systems, such as ERP, MES, PLM, HRM, should undoubtedly be integrated in the first turn, together with resolving the infrastructure tasks of building a unified information space. The first stage of information system integration should be completed before the legal merger, and it is worthwhile to single out the project of such activities as a stand-alone management unit. The second stage of integration missions can be resolved after the merger, but they will relate to strategic information systems, or to the systems that have not used by one of the companies at all. The impact of management models and information systems on one another should be noted: both the capabilities of the information system determine the management model of the combined structure, and the management system dictates the requirements to the information system. In the second case, the need to quickly adapt the information system to the new requirements of the management becomes the most urgent.

The projects of integrating heterogeneous information systems should use the project management methods (Rassel, 2004), (Heldman, 2005), (Lapigin, 2008), and while implementing them the risks emerge related both to the specifics of this heterogeneity, and indefinite management model of enterprise that cannot always be determined at earlier stages. The project risks must be managed, and this paper contains the list of risks together with the estimate of unwanted consequences and potential ways for their prevention by the example of one integration project.

The suggested integration project envisioned affiliation of an enterprise with about 500 employees (Enterprise 2) to an enterprise with 5,000 employees (Enterprise 1). The status of information systems at Enterprise 1 can be described as follows: mostly in-house design information systems on a unified platform with the support of the basic and auxiliary activities with the maturity corresponding to the maturity of the organization and a large coverage of employees (about 1,000). At the time of merger, Enterprise 2 had local historic systems capable of covering a part of business-processes without broad involvement of potential consumers. The integration project was implemented in the following sequence:

- Analysis of business-processes including determining requirements to the information system, and no other requirements than the need for data migration were determined;
- Design of the necessary interaction infrastructure via secure communication channels;
- Installation, training, and setup of management systems (ERP, HRM, BI, etc.);
- Preparation of data and migration;
- Commissioning and maintenance.

The major risk events together with the reasons and consequences are found in Table 1.

In general, the following features of the project can be mentioned: about 100 activities, implementation timeframe of 8 months, deadline for implementation – January 1, 2015.

Note that the project has been completed successfully within the set timeframe, bringing the desired results and staying within the given budget. The results of project implementation demonstrated in general the adequacy of assessment of risks found in the register. For example, the risk of low qualification of users and IT-staff of Enterprise 2 (items 4 and 5 of Table 1) turned real and demanded not just to extend the training program, but also reducing the number of system users at the new site, as well as reducing the number of fist line automation systems to complete within the deadline. However, risk of employee resignation had not been foreseen and had the effect on the project objectives: a large number of employees of the new site decided to resign being reluctant to bear extra load of the

transition period and to learn operating the new software and methodological base (about 20% of system users resigned; the overall resignation percentage at Enterprise 2 was 15%). The assessment of infrastructure risks impact can be reduced by virtue of using the available infrastructure and extra funding spent on hardware.

Brainstorm within a group of experts was the methodological base for determining the list of risks. Assessment of risk effect and probability was determined by expert evaluation; a survey was conducted among IT-experts 5 working on this project, medians of individual sampling were taken as assessments. The participating experts took part in other integration projects related to merger of enterprises and harmonization of their IT-systems in the past (Enterprise 1 had merged several smaller enterprises with the number of staff about 20%, 5%, and 10% from the number of staff of Enterprise 1 in the past three years), the list of risks was developed in the course of these activities. Impacts and probabilities of risks had not been quantified before; nevertheless the experts had the understanding of practical appearance of risks, other conditions were identical. The list below summarizes the expertise of the past projects in this area, performed within this industry in Russia. Indeed, risks not always can be precisely quantified, however they can be evaluated. For example, risk # 3, obsolete computers at enterprise, clearly has evaluative nature: if we can express its quantitative assessment through the number of computers (servers, other devices) that has to be procured so that the required number of workstations satisfies the minimum configuration of the implemented system, then it can be clearly quantified. Triggers that reflect manifestation of risk and enable measuring it are included into the list of risks for clarity purposes.

Note that the risks can be divided into the following basic types (Lelchuk, 2014), (Madera, 2014):

- Risks related to procurement procedures (the procurement system in Russia has recently been made much more complicated, leading to the increase of potential risks in the area of violating the delivery dates of subcontract);
- Infrastructure risks related to the technical features of the systems and potential equipment failures, as well as the risks of infrastructure incompliance with the requirements of implemented systems;
- Risks related to organizational behavior of the staff;
- Finance and international risks.

Risks related to estimate of change readiness are described using DVF>X (Dissatisfaction, Vision, First steps, Expenses) model (Dannemiller Tyson Associates, 2000) and can be assessed as high in the projects of integrating information systems during the merger of different legal entities.

Table 1: List of risks.

No.	Risk event	Consequence	Reason	Trigger	Effect	Probability	Measure	Method	Risk prevention plan	Risk response plan
1	Lack of supply contract within the set timeframe	Delay of the project implementation	Long time to prepare for tender	Supply contract not signed	0.425	0.3	0.1275	Minimize	Slack time for procurement	Transfer of equipment available on other projects
2	Violation of delivery date under supply contract	Delay of the project implementation	Supplier's unconscientiousness	Equipment not supplied	0.475	0.1	0.0475	Minimize	Slack time for procurement	Transfer of equipment available on other projects
3	Obsolete computers at Enterprise 2	Replacement of equipment	Inaccurate survey prior to the project	New user with computerized workstation below the minimum requirements	0.45	0.7	0.315	Accept		Procurement of surplus equipment

Table 1: List of risks (cont.).

No.	Risk event	Consequence	Reason	Trigger	Effect	Probability	Measure	Method	Risk prevention plan	Risk response plan
4	Low qualification of users	Delay of training	Insufficient training in the past	User cannot cope with the training program	0.45	0.7	0.315	Accept		Prepare extended training program
5	Low qualification of IT-department at Enterprise 2	Delay of software installation and infrastructure setup	Insufficient training and labor remuneration	IT-department cannot setup new software	0.6	0.5	0.3	Accept		Start training earlier
6	Delay in establishing communication channel	Incapability to complete activities in all areas	Technical issues at the service provider	Channel not functioning	0.65	0.5	0.325	Avoid	Slack time	Deploy system with replication via the Internet
7	Increase in the number of potential users	Greater labor intensiveness of training, extra costs for equipment and licensing	Poorly prepared project	Application for additional users	0.4	0.7	0.28	Minimize	Appoint the task to the functional services for determining needs	Larger number of employees working on the project
8	Additional requirements to the systems during implementation	Greater labor intensiveness	Specifics of administrative arrangements at Enterprise 2	Additional functional requirements	0.45	0.9	0.405	Accept		Allocating additional resource
9	Absence of key IT-experts on the project (illness)	Longer duration of activities	Incident	Sick leave	0.5	0.3	0.15	Accept		Allocating other experts
10	Lack of interest of customers in the system implementation	Longer duration of activities	Customer does not understand advantages of IT	Managers of departments show no interest in the project	0.55	0.1	0.055	Avoid	The project should include only the subsystems, demanded by the customer	Meeting with the manager of the involved department in order to change the project
11	Resistance of the users	Longer duration of activities	Users do not understand the urgency for new system	No active (daily) use of the systems	0.4	0.7	0.28	Accept		Use methods of change management

Table 1: List of risks (cont.).

No.	Risk event	Consequence	Reason	Trigger	Effect	Probability	Measure	Method	Risk prevention plan	Risk response plan
12	Embargo for supply of foreign software	Incapability to use the document circulation system	Global political situation	Additional licenses are blocked	0.35	0.1	0.035	Accept		Change the project goals
13	Increase of equipment cost due to currency exchange rate	Extra costs, smaller number of users	Exchange rate fluctuations	The final price is larger than expected	0.3	0.3	0.09	Accept		Request to increase budget
14	Funding cut on the project (sequestration)	Smaller number of users	General economic situation at the enterprise	Decision on sequestration	0.325	0.1	0.0325	Avoid	Provide reserve at the start	Readiness for sequestration
15	Additional requirements to the systems from the external organizations	Higher burden on key experts outside the frames of the project	Requirements of external regulators	Legal changes	0.3	0.5	0.15	Accept		Demand additional resource for the project, if the available experts are distracted

The aforesaid risks can have impact on implementation timeframe of both individual activities, and the project as a whole at various stages of implementation. One of the characteristics of a risk is the probability of its occurrence that determines the probabilistic nature of time estimate of the project implementation as a whole. Besides, the risk prevention measures require increasing the planned implementation time and extra costs. After implementing the risk reduction measures, the probability either becomes 0, or goes down (takes a new value), and this probability depends on the cost (the nature of function is non-linear, however we can assume the monotonous nature of the function: the bigger the costs, the smaller the probability). Thus, one of the objectives of the project management can be to minimize the costs for achieving the target probability of guaranteed implementation of activities before the deadline. Note that estimating the nature of the project implementation timeframe distribution is a stand-alone mission and is not the topic of this paper.

Let

S - multiplicity of project stages;

N - number of project stages on the critical path;

s_i - i^{th} number of project, $i=1..N$;

t_i - implementation time of i^{th} project stage, $i=1..N$;

R - multiplicity of risks;

M - number of risks;

r_j - j^{th} risk, $j=1..M$;

p_j - probability of j^{th} risk occurrence, $j=1..M$;

K - association matrix of j^{th} risk with i^{th} stage;

$$K_{ji} = \begin{cases} 1, \text{ j}^{\text{th}} \text{ risk can occur at i}^{\text{th}} \text{ stage,} \\ 0, \text{otherwise} \end{cases} \quad (1)$$

Since all the project activities on the critical path (Shikin, 2002) are executed one after another, then the overall time of project implementation equals:

$$T = \sum_{i=1}^{N} t_i \quad (2)$$

and the probability of project completion (Ventcel, 2005) before the deadline equals:

$$P = \prod_{j=1}^{M} (1 - p_j) \quad (3)$$

For the aforesaid project, the probability of completion on time was 0.0000098, i.e. a negligible quantity. A number of measures could increase this value, but that would require extra costs, and the timeframe of executing the project stage could increase as well.

Let us denote:

Δt_j - time, by which the project implementation increases thus reducing the probability of j^{th} risk occurrence by 0.1;

d_j - costs required to reduce the probability of j^{th} risk occurrence by 0.1;

x_j - probability of j^{th} risk occurrence after the measures aimed at its reduction,

then the overall time of project implementation equals:

$$T' = \sum_{i=1}^{N} (t_i + \max_{j \in M} (K_{ji} \cdot \Delta t_j \cdot (p_j - x_j)/0.1)) \quad (4)$$

the probability of project completion on time equals:

$$P' = \prod_{j=1}^{M} (1 - x_j) \quad (5)$$

extra costs for the project equal

$$D' = \sum_{j=1}^{M} (d_j \cdot (p_j - x_j)/0.1) \quad (6)$$

In practice, it is important to estimate the project completion timeframe at probability at least 90% and minimum costs. This estimate can be performed according to expression (6) by resolving the optimization task (7)-(9)

$$\sum_{j=1}^{M} (d_j \cdot (p_j - x_j)/0.1) \to \min \quad (7)$$

$$\prod_{j=1}^{M} (1 - p_j) \geq 0.9 \quad (8)$$

$$0 \leq x_j \leq p_j \quad (9)$$

It is often required to estimate the probability of project completion on time at minimum costs as well. This estimate can be performed according to expression (6) by resolving the optimization task (10)-(12)

$$\sum_{j=1}^{M} (d_j \cdot (p_j - x_j)/0.1) \to \min \quad (10)$$

$$\sum_{i=1}^{N} (t_i + \max_{j \in M} (K_{ji} \cdot \Delta t_j \cdot (p_j - x_j)/0.1)) \leq Tz \quad (11)$$

$$0 \leq x_j \leq p_j \quad (12)$$

Estimate of costs for project implementation at probability at least 90% and minimum implementation time is also urgent. This estimate can be performed according to expression (4) by resolving the optimization task (13)-(15)

$$\sum_{i=1}^{N} (t_i + \max_{j \in M} (K_{ji} \cdot \Delta t_j \cdot (p_j - x_j)/0.1)) \to \min \quad (13)$$

$$\prod_{j=1}^{M} (1 - p_j) \geq 0.9 \quad (14)$$

$$0 \leq x_j \leq p_j \quad (15)$$

For resolving these tasks, the linear programming methods can be used (Tomas, 2006).

Using the above model, the timeframe of implementing the project of merger of Enterprise 1 and Enterprise 2 was estimated and the optimal relationship between the costs and the implementation timeframe was found.

Note that this model does not take into account the non-linear nature of function of project implementation time vs. costs of risk reduction measures, the nature of impact of various risks at individual stages, and change of the impact throughout the project implementation, as well as the risk distribution law.

3 CONCLUSIONS

Thus, use of the described approach enabled performing the integration of information systems of two industrial enterprises with different IT-infrastructure while complying with the cost and quality parameters implementing the project objectives. Risk-oriented approach gave grounds to increase the transparency of managing the integration project, which implemented the business requirements to unify the business-models of enterprises.

There is no doubt that the list of risks can be revised for specific conditions of the project,

including location, political and other factors, however, the authors believe that due to insignificant number of activities at the current stage of information science in the area of risk management, the outlined list will serve as a guide for the IT-managers when integrating information systems.

Further investigation of this subject by the authors includes collection of statistical data throughout integration projects while merger or reorganization of instrument-making enterprises in order to refine the realistic probabilities of risk events and to update their effect when needed, as well as practical use of the suggested approach in realistic integration projects. Besides, studying features of organizational behavior of employees at merged enterprises relative to information systems as a factor affecting the success of the project deserves a dedicated investigation in future.

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