Reducing negative impact of project changes with risk and change management

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JEL Classification Codes: L29 , O22, D22, G32

Abstract
Changes have proven to be one of the crucial causes of project deviations. This paper presents theoretical and empirical researches whose goal was to examine how to reduce the negative impact of project changes. Basically, we investigated whether changes can be foreseen or even prevented. Should that be done in the context of risk management, and does risk management reduce the negative influence of changes on a project at all? How important is formal change management? Theoretical research examined risk management and change management. Based on the study a "Project Risk & Change Management Model" was developed and verified after conducting empirical research in Slovenian enterprises. The research confirmed that change foreseeing reduces their impact; while formal change management ensures the effective implementation of changes. The combined functioning of both areas ensures effective project execution.

Keywords: project, project execution, risk management, change management

JEL classifications:
L29 Firm Objectives, Organization, and Behavior; Management
O22 Project Analysis
D22 Firm Behavior: Empirical Analysis
G32 Risk Management

Introduction

The problem

Many projects exceed the planned time and costs, and changes have proven to be one of the most important causes of deviations (Harrison & Lock, 2004). It is not unusual for changes to raise project costs by 50% and sometimes even more. Sixty-four percent of the 1,000 project managers included in the »Hussain and Wearne« research on the biggest problems in project management indicated changes are some of the biggest problems (Meredith and Mantel, 2006). Further, they pointed out changes as the problem that annoys them the most. They generally hate changes because they affect plans and reduce the ability to satisfy the interests of project stakeholders (Baker, 2000). However, changes are often necessary and it is therefore necessary to establish the effective management of changes and ensure compliance with the rules in a disciplined manner. McLean found that change management is a key factor of IT project success (Putnam, 2005), while research by Lee, Thomas and Tucker (2005) found it is the second most influential project management technique (after project planning).

According to experts changes are a constant in projects (Rosenau, 1998). Since a project is a dynamic process functioning in a changing environment, a team in the planning phase of a long project cannot predict all factors (Wysocki and McGary, 2003; Frame, 2003; Andersen et al., 2004), and even an excellent project plan cannot prevent all unexpected "surprises" (Young, 2000). Even the most sophisticated plans can fail due to changes in customer requirements (Foti, 2004). One other finding is also important: the cost of change (due to a poor plan or customers making changes) rises as the project progresses (Burke, 2003; White, 2006). The later we decide to change (or discover a hidden change), the larger the impact that change will have on the (non)success of the project.

The research question

The main research question was: whether changes can be foreseen or even prevented? We conducted more extensive research into project management theory and discovered that changes and the management of them are also partly included in risk management. So the next question was: does risk management reduce the negative influence of changes on a project? Which risk management steps contribute the most (identification, mitigation, control)? In combination with ideas acquired by executing many projects in practice, we formulated a model which comprehends project risk management and the management of formal changes. Theoretically risk management should identify possible changes and prevent or at least reduce their impact, while change management should ensure the effective realisation of formally approved changes. We verified the developed construct by empirically researching Slovenian enterprises. We also wanted to find out whether risk management was more influential than the formal management of project changes? The final question was: do the approaches exclude each other or are they complementary?

Structure of the paper

After the Introduction, in the first part of the article we review and explain different types of changes and their relations. A summary of theoretical research follows where we review the traditional process of management of changes, and risk management. We pay special attention to the relations of risks and changes, and highlight risk management as a tool for change prevention. At the end of the second part, we present a construct, a "Project risk & change management model", developed for the empirical research which we then present in the third chapter. We first explain the research method, the research and analysis results, and discuss the findings. In the conclusion, we summarise the research findings, point out the research contribution to science and propose further avenues for research.

Types of changes

A detailed theoretical study and in-depth reflection based on practice led us to a systematic division of changes: changes can be direct or indirect or they can be divided according to area and duration of influence, the procedure of approval, time distance, the possibility to decide on change implementation, and cost covering.

Direct changes are "departures from the approved project scope or design as indicated by a change of any contract, drawing or specification after its approval and issue for action" (Lock, 2003).

Direct changes may result from **indirect** changes (market changes, competitors' activities, the emergence of new technologies etc.). We used the word "may" here because project stakeholders can decide whether, on the basis of indirect changes, the project plans and scope will change or not (Bonham, 2005).

Scope changes relate to project products (requirements, technical solutions), while **organisational** changes relate to the project execution (tasks, project schedule, deadline, costs). However, scope changes usually cause organisational ones. Scope changes are **permanent**, the organisational ones are **temporary** – permanent changes remain recorded in drawings and specifications, while temporary changes ensure timely execution and are in the domain of the project team (Lock, 2003).

Formal changes are considered and adopted following an agreed procedure and entered in the project documentation. **Hidden** changes occur when a customer, team member or group of stakeholders decide on certain changes to the objectives or a different way of implementing the project without informing the others or without receiving authorisation to carry out the change (Heldman, 2005). Hidden changes cause one or more linked tasks to be reworked, along with delays, increased costs, reduced productivity, and they affect the relationships between those participating in the project (Howes, 2001; Milosevic, 2003).

Unlike formally **requested** changes which are approved or rejected, **necessary** changes must be carried out if the team wants to meet the objectives of the project. Therefore, the team does not decide whether to implement the change or not but has to find out the best way of bringing it to a reality it (Hällgren, 2007). Typically, necessary changes are organisational – they cause schedule changes (the way of task execution, technology). Necessary changes are often caused by errors and problems such as equipment problems, the absence of team members, or contractor delays (Karvonen, 1998; Young, 2000).

Funded (usually scope) changes are requested by the customer, which then also covers the costs of making the change. Funded changes result in schedule, specification and contract changes. On the other hand, **unfunded** changes are those whose sources are problems and errors and/or are proposed by team members. The additional costs of changes are covered by the contractor/project owner (Harrison and Lock, 2004; Charoenngam et al., 2003).

All types of changes and their logical connections are shown in Figure 1. We ranked both sudden and announced changes within expected changes because we presume that the majority of changes can already be expected in the project planning phase.

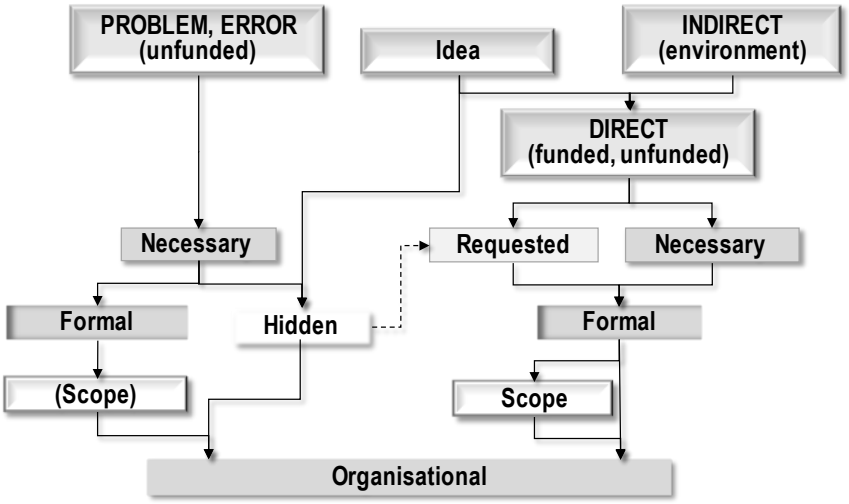

Figure 1: The sequence and cohesion of various types of changes

Presumably a hidden change already causes some damage to the project (additional work and thus a delay and increased costs), so it is first and foremost an organisational change because we have to change the plan of subsequent activities. However, if a change detected early seems reasonable it can be formally discussed and approved or rejected (as indicated above with a dashed arrow).

Change management

The traditional process

Some authors consider change management as part of scope control (Newell, 2002; Burke, 2003; Milosevic, 2003), whereas most of them treat it as an independent process. In so doing, they generally focus on changes that are directly related to the objectives and implementation of the project. As we had expected, our research of the literature revealed that authors mostly discuss changes proposed by individuals and treat within the formal approval process. Partly they also address the detection of hidden changes, but rarely address broader changes. The typical change management process has four steps:

- **change requirement**: identification and documentation of the proposal (Burke, 2003); recording the need for change (Kliem, 2004); a review of the requirements for scope/organisational changes and identification of activities that are affected by changes (Meredith and Mantel, 2006); and the identification of areas of change (Verzuh, 2005);
- **change evaluation**: assessment of the impact of change on the schedule, scope, budget (Deeprose, 2002); rating changes, the establishment of responsible, planning change (Kliem); evaluation of the benefits and costs of required changes (Meredith and Mantel); and a change activities proposal (Verzuh);
- **change approval**: forwarding the request to the competent people to decide whether to approve or reject the changes; and
- **realisation of change**: the change/update of the plan (Verzuh, Burke) and information share about the change (Deeprose); implementation of the change (Kliem), informing stakeholders about the change and ensuring effective implementation of the change (Meredith and Mantel).

However, many other authors suggest a relatively similar process (Heldman, 2005; Levine, 2002; Lock, 2003; Prince2, 2002; Young, 2000; Thomsett, 2002; Wysocki and McGary, 2003; and Turner and Simister, 2000).

Although the steps that follow a change request are given different names, they refer to similar actions, including an assessment of the change impact on the objectives, approval and implementation of the change. While only a few authors mention the step of developing proposed activities, we think it is appropriate to consider several alternatives of the change realisation and to select that alternative with the minimum negative impact on scope, time, cost and quality.

A dilemma appeared in defining the process steps, in particular with the step "implementation of change." If due to an approved change in the way of realising, or in the solution or objectives, a further schedule is changed then changed project execution follows. "The implementation of change" actually refers to changed objectives and schedule so we cannot talk separately about the extra implementation of change. The implementation of change as an extra step in the process can be discussed in the case of corrective actions we employ to try to continue the project according to the baseline plan as soon as possible (removal of errors, elimination of delays).

Some authors include informing the participants and the documentation of changes as individual steps in the process. We believe that documentation is to be implemented gradually in all steps, while information about the change begins with the change requirement because an expert opinion should be provided by everyone who may be affected by the change. Both the information and documentation should be supported by modern information technology and all information about the changes should be stored or published on the project's portal where project stakeholders can find up-to-date information about the new changes and give their opinions.

Risk management – the prevention of changes

We assume that many changes can be expected due to team members' experience from previous projects. Team can respond to them already in the project planning phase. The literature includes them in the project risk management process.

Most authors similarly link risks and changes – changes to the objectives, scope and execution are the biggest risk factors. If, therefore, the team is aware of potential changes already at the beginning of the project those changes must be included in the risk management process. Several authors also state that the processes of managing change and risk management have to be linked and harmonised (Heldman & Heldman, 2007; Datta & Mukherjee, 2001; Kerzner, 2004; Meredith and Mantel, 2006). Risk can also arise from the inadequate management and documentation of changes (Heldman & Heldman, 2007).

Frame (2003) believes the project team must be ready for change so that changes do not surprise them. He also indicates that ignorance of a project's environmental impacts and a lack of information in the planning phase pose a risk that changes might occur in the project. Charvat (2003) sees the problem similarly, while Kerzner (2006) indicates that the purpose of risk and change management is to reduce the number and range of surprises as much as possible. According to

Kerzner, change usually creates new risks, while the occurrence of risk creates changes that are again linked with new risks. Risks and changes therefore appear to be "hand in hand" so enterprises often set up a uniform approach to deal with both. Similar views are expressed by Thomsett (2002) and Young (2000).

We also found that both processes are integrated by the following authors:

- Chapman & Ward (1997) state that already in the context of risk management it is necessary to assess the consequences of changes to the design and plan;
- Murray-Webster and Thiry (Turner & Simister, 2000) indicate that the methods which contribute to change management are the value management approach which seeks to provide the maximum benefits to all project stakeholders in terms of the costs and benefits of change, and risk management (in terms of assessing the consequences of the change);
- Heldman & Heldman (2007) and Thomsett (2002) consider that it is necessary, when considering requests for change, to examine other potential risks that could arise were the change to be approved; and
- Oni (2008) states that change management includes the establishment of a procedure for identifying and evaluating scope changes which might affect the cost and performance (which in fact deal with risks).

The developed model

On the basis of our classification of changes and the study of the literature, we developed a "Project risk & change management model" that is presented in Figure 2. The model is divided into two parts - risk management and formal change management.

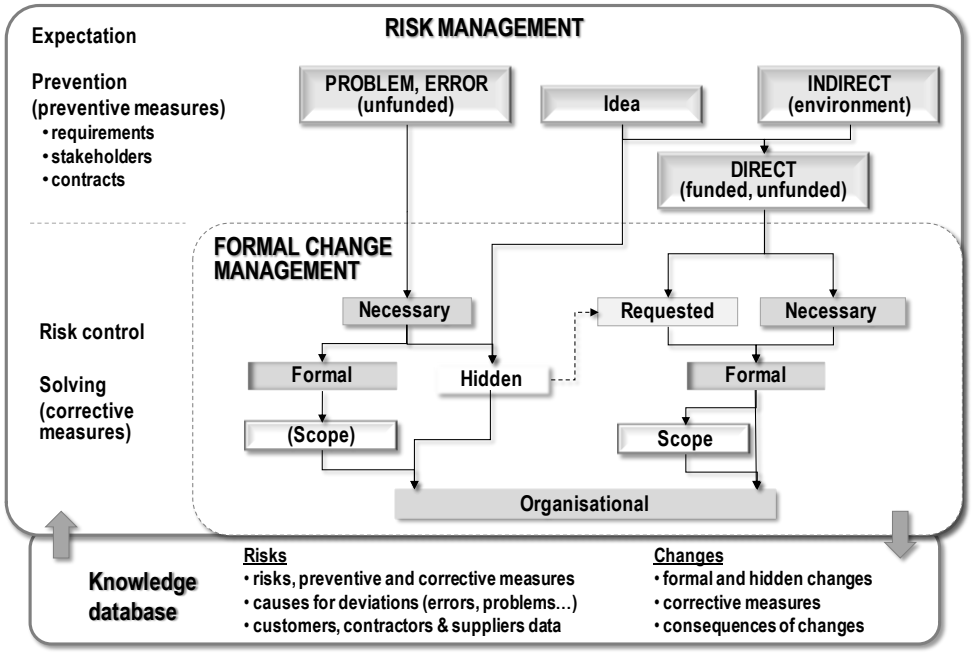

Figure 2: Project risk & change management model

Expected changes should be handled by the risk management methods. According to the theoretical research findings, all types of changes can be expected. In addition, a database of risks and changes arising from finished projects may be helpful. Experts in the risk management field recommend various measures to reduce risks. As the most effective approach is the risk (changes) prevention, we presume in the model that risk management can be used for preventing expected changes. If a team cannot find appropriate measures to prevent changes, it plans preventive measures to reduce the probability of the risk being realised. If the risk (change) emerges, the response can be faster using risk management (corrective measures can be planned in advance), while in a normal control process measures can only be defined after the identification and analysis of the problem, which takes more time.

Regular risk control effectively detects sudden direct changes (both scope and organisational) and urgent operative changes as a result of detected errors and problems. When a change is discovered, it can also be considered as requested and treated in the formal change management process (depending on the stage of realisation of the change). Mostly the subjects under discussion are unfunded changes, although sometimes changes arranged between a customer and individual team members (without the consent of the project manager) can be discovered. In the formal process, after a change has been discovered a decision is taken as to who will cover the costs of the change.

The formal change management process includes the treatment of all formally requested (direct, scope or organisational) changes and ensures their effective implementation. As mentioned, changes that are discovered early can also be treated in the formal process. However, irrational changes may be rejected.

Empirical research

Research method

The model was tested against empirical quantitative research in 137 Slovenian enterprises. The results collected in a Web questionnaire were analysed with multivariate analysis using the SPSS V17.0 software.

950 respondents (project managers, team members and other stakeholders) from various companies and the public sector were invited to participate in the survey. The criterion for selecting the participants was their project management knowledge through which we ensured an understanding of critical issues, quality responses and, consequently, better survey outcomes.

Namely, some preliminary researches from the beginning of the decade found that project management knowledge and a systematic project approach were not a "common practice" in Slovenia. Unfamiliarity with project methods does not provide an adequate plan of a project, resulting in a high number of changes during the project execution phase. In addition, it is impossible to estimate efficient project execution (verification of the performance in accordance with the plan). Therefore, members of the Slovenian Association for Project Management, along with those who since the year 2000 had attended Slovenian conferences on project management, obtained various project

management certificates, and been trained in the project management field at various institutions were invited to participate in the survey.

Since our basic hypothesis was: »The individual parts of the model and the entire model provide for the more efficient execution of a project«, we first defined three efficiency factors: project delay, cost surplus, and extra work hours. We used the ratio (%) between the baseline and the actual factors (indicated at the end of the project) and these became the dependent variables of the subsequent analysis. The respondents did not evaluate the individual projects, but estimated the (average) efficiency of execution of all projects within their enterprise.

Table 1: Project delays, increased costs and extra work as a consequence of changes in Slovenian enterprises

	Time	Cost	Work
Number of enterprises indicating a surplus	123 (90%)	120 (88%)	90 (66%)
Average surplus	24.6 %	14.6 %	17.9 %
Standard deviation	24.7	12.6	25.8
Number of enterprises with a surplus over 50%	25 (18%)	6 (4%)	4 (3%)
Number of enterprises with a surplus over 20%	58 (42%)	44 (32%)	29 (21%)

The research showed that in 90% of projects changes are the reason for project delays and higher costs (table 1). On average projects are prolonged in time by 24.6%, while costs are 14.6% higher. Two-thirds of enterprises stated that the actual work was higher than planned, on average by 17.9%.

The independent variables were derived from the construct. We intended to examine the impact of individual functions on efficient project execution and we therefore determined the presence of those functions in the enterprises (e.g. if certain tasks are performed, whether the enterprise has a policy or a department). Since we only observed the presence of the tools, methods and procedures, we used binary variables (element exists - value = 1; element does not exist - value = 0). The independent variables we examined were:

- risk management – anticipating changes in the project planning phase, risk identification, evaluation and planning of measures, risk control, risks analysis and database maintenance;
- formal change management – the existence of regulations on change management, the determination of who pays for the change in contracts, a report on changes in the project final report, the existence of a changes database.

To test the developed model we analysed the acquired data with a multivariate analysis, specifically by determining the correlations and regressions.

With a correlation analysis we mostly verified whether the existence of particular variables decreases (or increases) the impact of changes on effective project implementation. By calculating a linear regression of individual variables we found how much they impact on the efficient project implementation. The integrated model and its interacting parts were checked with a multiple linear regression.

Results and discussion

Formal change management was tested with three issues which showed varying levels of the systematic approach. Only a third of the enterprises had defined a systematic approach (including regulations). However, 81% of the respondents indicated that they include information about the changes in the final report, which could be used for knowledge sharing. A database of changes should have a similar function but only a third of the enterprises maintain one.

Table 2: Change management & impact of changes **(**regression summary)

	Correlation (R)	Impact level (R Square)	Reliability (Sig.)
Project delay	0.374	0.140	0.001
Higher costs	0.262	0.069	0.046
Extra work	0.220	0.048	0.242

We found that projects in enterprises where changes are systematically managed have 11% fewer delays. An even more important factor is information on changes included in the final report – delays caused by changes are 12.7% shorter (table 3), while costs are decreased by 6.9% (sig.0,027).

Table 3: Change management & impact of changes **(**regression coefficients)

Model	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	St.Err.	Beta		
(Constant)	38,835	4,446		8,734	,000
ChMan- regulations for change management	-10,976	4,648	-,232	-2,362	,020
ChAnal – analysis of changes in the project report	-12,659	5,290	-,221	-2,393	,018
ChDB- maintenance of a database of changes	-,357	4,558	-,007	-,078	,938

a. Dependent Variable: Project delay

Risk management mostly contributes to reducing project delays, a less pronounced cost reduction, while the impact on work (spent hours) is negligible (table 4).

Table 4: Risk management & impact of changes **(**regression summary)

	Correlation (R)	Impact level (R Square)	Reliability (Sig.)
Project delay	0.397	0.158	0.002
Higher costs	0.278	0.077	0.128
Extra work	0.186	0.035	0.732

The most influential factors for reducing delays are regular risk control and risk analysis (incorporated into a project final report). A minor impact on time and cost was also made by the preparation of measures to reduce risks (table 5). Otherwise, in most enterprises risk management is still less systematic since only 59% of respondents had knowledge of risk management methodology, half the respondents control project risks, while only 19% of respondents maintain a risk database.

Table 5: Risk management & impact of changes **(**regression coefficients)

Model	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	St.Err.	Beta		
(Constant)	26,137	4,897		5,337	,000
RC- risk identification	11,292	5,733	,203	1,970	,051
RC- risk mitigation	11,315	7,813	,137	1,448	,150
RC- risk control	-10,038	4,620	-,215	-2,172	,032
RA – risk analysis in the project final report	-11,934	4,885	-,249	-2,443	,016
RDB – risk database	-3,320	5,268	-,060	-,630	,530

a. Dependent Variable: Project delay

As we can see, the analysis revealed that risk identification and risk mitigation prolong a project and increase project costs in the event of changes. As we had expected unclear results, we also asked the respondents (apart from risk management questions) whether they foresaw changes and how they usually responded. 66% of the respondents confirmed they foresaw changes. 30% of them plan preventive measures, 32% plan corrective measures, while 38% only foresee changes but they do not plan any measures. We made a multiple regression only for foreseeing changes and discovered that this reduced the impact of changes on a project's duration and reduced project costs (Tables 6).

Table 6: Changes foreseeing & impact of changes **(**regression summary)

	Correlation (R)	Impact level (R Square)	Reliability (Sig.)
Project delay	0.302	0.091	0.009
Higher costs	0.275	0.076	0.027
Extra work	0.090	0.008	0.874

Pre-planned corrective actions reduce the impact of changes on the project's duration for 18%, while preventing changes provides for the cheaper implementation of projects. However, that impact was found to be smaller – probably not all the measures are the most appropriate (table 7).

Table 7: Changes foreseeing & impact of changes **(**regression coefficients)

Model	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	St.Err.	Beta		
(Constant)	30,927	3,447		8,972	,000
ChFP - Changes foreseeing, preventive measures	-2,862	5,253	-,054	-,545	,587
ChFC - Changes foreseeing, corrective measures	-18,004	5,533	-,322	-3,254	,001
ChFx - Changes foreseeing without any measures	-9,888	5,533	-,177	-1,787	,076

a. Dependent Variable: Project delay

So far we have presented an analysis of individual parts of the model. Since our idea was that all areas together influence the effective management of changes and effective achievement of project objectives, we also examined a multiple linear regression of the model and the performance deviations, as shown in Table 8. Below we summarise the main findings of this analysis.

As analysis revealed that expected changes in Slovenian enterprises were handled apart from risk identification and risk mitigation planning, we replaced both variables in the analysis with the change foreseen measures and the results moved closer to our expectations.

Table 8: Regression analysis of the model (summary)

	Correlation (R)	Impact level (R Square)	Reliability (Sig.)
Project delay	0.444	0.197	0.004
Higher costs*	0.339	0.115	0.032
Extra work	0.310	0.096	0.754

**** because of low reliability we limited the selection of variables***

On the basis of calculated reliability (Sig. / ANOVA) we concluded that the delay of a project depends on at least one of the variables involved (table 8). Although the degree of correlation is large (0.44), the variables involved can explain only 19.7% of the project delay. The detailed multiple regression analysis is presented in table 9.

The reliability of the influence of the integrated model on increased project costs, considering all of the variables, was 0.19 (a 19% possibility that the variables have no impact), while the variables affect just 11.6% of the variability of costs. With limited selection we found variables with a more reliable collective impact on costs (Table 8).

Table 9: Impact of the model variables on a project delay

Model	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	St.Err.	Beta		
(Constant)	42,366	5,135		8,251	,000
ChFP - Changes foreseeing, preventive measures	-2,582	5,325	-,049	-,485	,629
ChFC - Changes foreseeing, corrective measures	-8,770	6,652	-,148	-1,318	,190
ChFx - Changes foreseeing without any measures	-4,354	6,111	-,075	-,712	,478
RC- risk control	-4,764	4,433	-,102	-1,075	,285
RA – risk analysis in the project final report	-4,141	5,275	-,086	-,785	,434
RDB – risk database	-1,574	6,061	-,028	-,260	,796
ChMan- regulations for change management	-9,734	4,912	-,204	-1,982	,050
ChAnal – analysis of changes in the project report	-8,504	5,695	-,149	-1,493	,138
ChDB- maintenance of a database of changes	1,803	5,265	,037	,342	,733

a. Dependent Variable: Project delay

By calculating the reliability or probability that each independent variable does not affect the delay in the project (table 9), the most reliable variable proved to be the existence of change management regulations (0.05), while little less reliable (over the 5% limit) proved to be analysis of changes in the project report (0,14)and Changes foreseeing with corrective measures (0,19).

Analysing the **impact of the model variables on project (table 10), c**lose to reliability limit (5%) were two independent variable of the model - changes foreseeing without any planned measures (8%) and analysis of changes in the project final report (8,8%)

Table 10: Impact of the model variables on project costs

Model	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	St.Err.	Beta		
(Constant)	21,874	2,847		7,684	,000
ChFP - Changes foreseeing, preventive measures	,986	2,994	,034	,329	,743
ChFC - Changes foreseeing, corrective measures	-2,476	3,582	-,081	-,691	,491
ChFx - Changes foreseeing without any measures	-5,981	3,388	-,192	-1,765	,080
RA – risk analysis in the project final report	-1,599	2,833	-,061	-,565	,574
ChMan– regulations for change management	-1,361	2,568	-,052	-,530	,597
ChAnal – analysis of changes in the project report	-5,321	3,095	-,171	-1,719	,088

a. Dependent Variable: Project costs

In analysing the developed model's impact on an increased number of work hours, we found that the included variables only explained 9.6% of the variability of the additional hours of work, with a reliability rate of 0.75 (i.e. a 75% chance that the variable does not lead to increased work). Even if we only include variables for which the correlation showed an individual effect, the calculation showed a 56% probability that the variables do not affect spending hours at a rate impact of 3.6%.

Conclusion

Changes to the objectives and scope, as well as a changed way of implementation, are some of the more important risk factors of a project. In addition, we also discovered that the changes and risk factors could be identical. Since many changes can be expected, they can be managed by using risk management tools. The probability of change can be reduced by taking preventive measures, while the negative impact of changes can be reduced by corrective actions planned to be implemented in the event that a change occurs. The expectation of change at the same time provides intensive and more focused control which ensures the early detection of change and a rapid response.

The research in Slovenian enterprises revealed that foreseeing changes reduces project delay and cost increase, while it has no impact on extra work. Despite the lower reliability of individual independent **variables, the** reliability of the whole **model is satisfying**. We may conclude that we largely confirmed the subjects we researched:

- Changes can be foreseen and their impact can be reduced already in the planning phase.
- Risk management is correlated with efficient project execution, but, during risk identification and mitigation, teams should be more focused on changes.

- Risk management has proven to be more influential tool for decreasing negative impacts of changes than the formal change management. The influence of risk management in Slovenian enterprises could be even higher if it would be more focused on changes during risk identification.
- Both, risk and change management are complementary. The impact level of the developed model is higher than levels of individual elements of the model. However, it is not a sum of partial levels what indicates that have joint activities.

The contribution of this research to science is the developed model that was validated by empirical research. Through the combined functioning of risk and change management, the model deals with all kinds of changes – it provides the prevention, early detection and effective realisation of approved changes. Another contribution to science is the definition and systematic view of the range of different types of possible project changes. Since we have proven that the model contributes to the effective implementation of projects in practice, and consequently boosts the effectiveness of enterprises, we also highlight its high practical value.

To better understand change management we propose further research in two directions. The first should focus on human components such as resistance to change, and methods of persuading opponents of change. Further studies should also determine how much the management of change depends on the system and how much on the flexibility, ingenuity and systematic work of individuals. The second direction of research should address the problem of managing change in a multi-project environment. This study was oriented to individual projects and considered that project resources are only limited by cost and not quantity. In practice, companies have a limited number of people available so changes in one project may also influence other projects due to the limited availability of people as they are working on several projects at the same time.

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