Abstract

Construction projects are inherently high-risky. The crisis of the construction project is generated by gradually accumulated risks or by a sudden risk outbreak. Existing methods of construction risk management very difficultly distinguish the level of risk exposure to different segments of construction project management in the new conditions, in which construction projects arise. Because even small crisis can undermine the objectives of the project and subsequently damage the good-will of construction enterprise, an effective crisis management should be initiated as soon as possible. In order to improve the level of these procedures, it is necessary to search in the risk and crisis management systems a setting of an appropriate early warning system for detecting the symptoms of crisis of a project.

Early warning system for detection of the symptoms of the crisis is one of the most important factors in the success of proactive crisis management. Its essence lies in the monitoring of negative trends in the project. The early warning system allows the management of a construction company and management of construction project to monitor symptoms and indicators of crisis situations by using the management standard procedures. This system gives the control elements of the company and project the information about when the construction project is already in crisis, and when it is necessary to initiate the project crisis management.

The parameters of crisis state and defining the negative trends in the construction project, i.e. the setting of an early warning system in the various segments of the system matrix for the identification of the crisis depends on the contractual parameters of the construction project, and the system of management of construction projects and processes in a particular construction company, its strategy, its position on the market, financial stability and quality of human resources. Generally, in order to identify the symptoms of crisis, it is recommended to monitor the trends of changes, whether: Does the resulting trend correspond to dynamics of the project? Has the trend a positive or negative impact on the project? Is the trend a cyclical matter? Is the trend a consequence of another trend? Are there links between the different trends? For effective functioning of the system for the identification of the symptoms of the crisis, it is important to clearly set out who, when (at what period), where and how they will monitor the indicators and other signals, and to whom they will transmit the data.

Keywords: Early warning system; Crisis; Crisis management.

1. Different kinds of crises in construction projects, and ways of managing these crises

Products of construction contracting, i.e. construction projects, are defined by their high demands concerning financial sources, qualified network of suppliers, modern technologies, ecological and safety aspects. All these concerns together constitute a sum of conditions for the occurrence of critical situation during construction processes. Despite the fact that construction projects are liable to a number of crises due to their long-term character, current construction management is rather conservative, and does not admit that crises should arise. It is surprising that current management methods in construction projects or operational guidelines only deal with risk management, and not with the situations which arise when the risk becomes effective (Vondruška 2013). Such is the standard approach even in the largest companies. However, when a risk becomes effective and results in a crisis, the standard procedures of project management need to be stopped and replaced by crisis management. Construction project crises can be divided into four sub-groups, according to their characteristics.

Protracted crisis is a slowly developing crisis with gradual risk accumulation and worsening of project status. It is extremely difficult to identify and diagnose this type of crisis because project managers expect the situation to improve soon. (Hujňák 2010) In construction projects such crisis is characterized by e.g. change of geological foundation during project realization, deteriorating quality of work, claims, temporary financial insufficiencies, etc. Sudden crisis of a project arises as a result of a severe risk outbreak, and it puts the whole project in serious danger. It can only be faced with timely counteractions. Cooperation of the whole project team is necessary in these cases, and it has to be focused on speedy effects. That requires preparations made beforehand in the form of a continuity plan. (Hujňák 2010). Ecological breakdowns, injuries, floods, and similar instances may be stated as examples of sudden crises. Periodical project crises – Loosemore (2000) mentions the existence of the
periodical crisis category in his work. These crises occur repeatedly within intervals of various lengths. They may be caused by budget cuts, changes in company management, political or governmental changes. Moreover, we need to mention the category of Bizarre and perceptual crises, which — although generally considered marginal in sources — are very common in current construction contracting. These are crises arising from perception. They are caused by negative attitudes of the public and activists towards the project, usually supported by mass media, and based mostly on bizarre reasoning.

The efforts of any crisis-affected subject are to stop the effects of crisis as soon as possible, and eliminate its impacts. The ultimate goal is stabilization of the affected subject and its reestablishment to the level of operation before the crisis broke out. From this point of view, crisis management is considered as a set of precautions, measures, and methods whereby the affected subject actively proceeds (by their own means, or with external aid) towards minimization of the sources that led to the critical situation (i.e. correction), or whereby the subject prepares for activities needed in the state of crisis (i.e. prevention), whereby the subject averts the outbreak or escalation of crises (i.e. contraction), whereby the subject reduces the number of crisis sources, and their negative effects (i.e. reduction), and whereby the subject removes the negative results of the given crisis (i.e. restoration). (Zuzák 2004).

Construction companies approach crisis management of a construction project in two different ways. The first approach deals with management of a crisis that is already effective and can be easily identified (natural disasters, accidents, injuries). Management of such kind of crisis is usually labeled as consequential crisis management, and it should logically have its place in construction projects only in cases of sudden and unexpected crisis outbreaks. The second approach – preventive crisis management – focuses on predictions of potential critical situation, and on preventive elimination of impending crisis. Contrary to consequential crisis management, preventive crisis management actively predicts cumulation of potential risks or risks with substantial impact to see whether the project proceedings will be capable of facing the potential crisis viably. The major issue of proactive crisis management, when focusing on protracted, periodical or bizarre crises, is finding the fine line of division between risks and crises.

![Proactive crisis management scheme](image)

**Figure 1. Proactive crisis management scheme**

### 2. Structure of crisis symptom identification

Structure of the early warning system in a project which monitors negative trends within the project should be based on identification of symptoms within the project, and external symptoms which may influence the project. While establishing the structure of the early warning system, it is necessary to take into account identification of quantifiable and inquantifiable signals.
2.1. Segment A of the symptom identification matrix

The matrix consists of four segments. Segment A accounts for quantifiable data arising from within the project. Data is assessed in consistency with past experience and is easily acquired. In construction projects, the four aspects that offer data are economic evaluation of the project based on accountancy, monitoring and evaluation of time for completion (schedule evaluation), quality evaluation, and work safety.

As each construction project in any company is a singular unit, evidence can be established for monitoring the obtained data. Individual indicators in such evidence would then be crisis symptom indicators. Such indicators need to be unequivocal, their values need to be complete and filed in a timely manner. There is also need for a qualified worker who will observe and evaluate the indicators in given intervals. Monitoring of crisis indicators is not based on observing the sum of their values but rather on the observation of trends. Therefore, while planning a construction project, it is necessary to lay down the parameters of observed indicators that would serve as guidelines for monitoring of the indicators and their proper evaluation. It is also necessary to establish initial values of the indicators that are to be used, critical values, acceptable values, and values which signify impending crisis. Design target plan may serve in this instance as both the tool for observation, and measure of evaluation of the indicators.

Using standard management procedures and company control systems

2.1.1. Managing accountancy

Progressive monitoring of project costs and comparing of these values with the planned indicators mentioned above is immensely important in any construction project. Nevertheless, the standard ways of billing and stating costs of project expenses does not offer reliable data to project management solely by the rules of standard accounting. Billing may misrepresent actual data on the grounds of securing supplies beforehand due to expectations concerning transport capacity of vendors. Contractor’s costs may also be distorted on the grounds of inadequate estimate or intentional lowering of the volume of billed works. Billing to the supplier may also be higher while lacking an adequate reason, or on the contrary intentionally lowered. This depends on a vast number of interlocked factors. We may say that the project manager disposers of a large number of mechanisms (or the manager may be forced) to influence progressive managing results concerning account balance. Moreover, the summarization of results and their final evaluation is usually carried out at the end of a very long period. A large number of cases is known when project managers profited from misleading financial data and caused severe complications to the employer or brought the whole construction company in crisis.

2.1.2. Schedule evaluation

Schedule evaluation, on the other hand, is a much more reliable indicator. How individual phases are carried out, the influence of delay on other actions, the trends towards due date of the project – all of this is easily quantifiable data. Monitoring the deviations from master schedule enables the controller to evaluate the trends of the project and indicate the symptoms of impending crisis. Deviation analysis uses standard management and evaluation procedures as described in project documentation. There is a vast array of methods for schedule management and adherence evaluation. The results of these analyses are used in costs management, time management, and support risk and crisis management as well. The goal for project management is to establish a boundary when a given trend becomes a crisis.
2.1.3. Quality evaluation

Quality control is performed as a set of established tests, measurements, inspections, and control points. These all lead to evaluation of output quality. Quality control may be performed by the contractor, the client, or a third party – usually an independent inspection organization. Quality evaluation monitors specific characteristics of project quality, their deviations from quality standards, and finding the causes of insufficient quality including suggestions for improvement or removal of flaws. Quality control in a construction project starts immediately after site acceptance and progresses gradually according to quality control plan established for project execution phase. Quality control takes place both on site and on the premises of suppliers of chosen equipment. Quality control tests fall into three subgroups:

- On-site quality test (insulation test, concrete strength test, reinforcement test, etc.)
- Inspection on the premises of supplier (proper storage, cube tests at concrete mixing plant, etc.)
- Tests of functionality (elevator test, noise parameters, emissions etc.)

One of the essential documents that a contractor needs to hand in after signing the contract is a quality control plan which usually consists of:

- List of all equipment and building units to be tested
- List of quality tests for each piece of equipment or building unit
- Roles of both the contractor and the owner in each quality test
- Schedule of quality control tests
- Documentation details for each test
- Person responsible for individual actions on the part of the contractor
- Person responsible for individual actions on the part of the client

The control tests serve for comparison of actual values with the ones demanded by building standards, codes of practice, or contract specifications. The outputs of this process are quantifiable, and the number of deviations needs to be observed closely. If the number of deviations tends to keep rising, it may indicate impending crisis. There is no general rule of thumb for setting a viable limit for the number of deviations, due to the fact that every construction project is unique, and the numbers may vary greatly. Furthermore, it is not even possible to set a standard for the number of deviations in the same type of structure used in different kinds of buildings. Rising numbers of sub-par items in a concrete structure used for a transportation structure will lead to different conclusions than the same number of sub-par concrete items in a retaining wall for a warehouse. Maximal number of deviations which would already signify the project’s tendency towards crisis needs to be stipulated for every individual project by the supplier’s production engineer.

2.1.4. Work and environment safety

Construction contracting is increasingly oriented towards on-site safety and environmental safety of projects. Construction companies train their employees in prevention of on-site injuries and accidents, and project documentations lay down safety rules and environmental relations and impacts of the project. Work safety proposal is processed with regard to categories of work activities within the project. This proposal specifies a category of likely injuries, and strives to ensure the best help possible. Injury logs are kept and the number of injuries is monitored. Project documentation specifies the scope and frequency of safety checks carried out by commissioned safety supervisor. Fire protection observes the progress of securing fire protection and classifies on-site activities in relation to fire protection. This category of crisis identification also uses standard procedures of project management and classifies potential crisis symptoms according to project documentation. The maximal number of safety breaches or injuries should be established by the commissioned safety supervisor.

2.2. Segment B of the symptom identification matrix

Segment B includes inquantifiable data of the project. Signals from this category are softer, weaker, more related to interpersonal problems of a construction project (relationships: designer-contractor, contractor-subcontractors, client’s attorney – project manager, project manager – workers, etc.). These signals, however, can also be processed into a checklist and their observation may be commissioned to top managers of the project (CEO, division executive officer, project manager). A checklist of crisis identifiers in segment B can consist of:
• Worsening communication with the client’s attorney
• Worsening communication with the designer
• Worsening communication with subcontractors
• Decreasing level of communication with company (division) management
• Poor communication between on-site workers
• Lowering worker initiative
• Low work discipline and morale
• Poor task distribution
• Rising number and length of staff meetings
• Centralization of decision-making
• Low respect for company standards, emergence of cliques

These symptoms develop slowly and influence the project over time. They are usually identified only when fully developed.

2.3. Segments C and D of the symptom identification matrix

Segments C and D focus on external factors which may influence project outcomes. These factors may be revealed not only by project managers, but also by stakeholders. Stakeholders in construction projects are usually banks, investors, public administration departments (Environmental Department), project participants, and activists.

Figure 3. Early warning system for revealing symptoms of crisis in construction company structure (Vondruška 2013)

3. Conclusion

Early warning system enables the management of a construction company to monitor symptoms and indicators of impending crises through standard management procedures. This system informs the managers of a company or a project about impending or full-fledged crisis in a project, and therefore about the need to turn to crisis management. Parameters of state of crisis and of negative tendencies within the project according to segment A of the aforementioned crisis are dependent on contract parameters of the given construction project. All four segments of the matrix link parameters of early warning system to project management standards within the company, to its strategy, market and financial stability, quality of human resources, and other like factors. Tendencies that may lead to crisis in one company may scarcely be noticed in the next. Keeping this in mind, it is therefore obvious that establishing crisis parameters is individual for each company and each project.

It is necessary for the early warning system to function properly to make it clear who monitors the individual signals, where, how often, and in what manner these will be evaluated, and who is going to be notified about the result of these evaluations. The system must be characterised by short and straightforward communication channels to the center or managing unit where evaluation is processed. Then a decision must follow swiftly.
about measures that need to be taken. There is no need for centralization, but if there are several centers of decision-making, cooperation is necessary so that the division are not mutually exclusive.

Acknowledgement

This work was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SGS14/016/OHK1/1T/11.

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