

# SAFETY CULTURE AND AGILE

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Agile methods, a perspective alternative to the traditional project management, extend across organisations gradually. Their introduction is, however, confronted with safety aspects which are an integral part of activities in each organisation. This article deals with the relation between agile methods and the safety culture of an organisation using a comparative study based on authors' research performed in the Czech Republic. It presents fundamental safety aspects, which must be respected while using agile methods and how they can be reflected namely in the agile method Scrum. The article aims to explore the prerequisites for a symbiotic functioning of agile methods and safety culture and in this way to help improve the competitiveness of organisations.

## KEYWORDS

agile methods, safety culture, safety aspect, organisation management system, agile team, Scrum

## 1 INTRODUCTION

### 1.1 Agile methods and safety culture in publications

Agile methods are defined for example by [Zikmund 2010] as: '...everything is done in partial functional units...' meaning that the procedure of production is performed in checked iterative steps. Safety culture is defined for example by [Pelantova 2015] and by [Jabor 2013], pp.30-32, as: '...culture exhibiting these 5 high-value attributes that healthcare specialists are trying to bring to life by the implementation of effective management systems for providing of the safety...'. These attributes are the responsibility to safety, the priority of safety, the learning from incidents, resources of safety and a safety system. The safety is seen as a multifaceted issue of a safety and health protection, an information safety, a safety of the environment, an economic and political safety and so on. Due to the development of management systems and organisation's surroundings the importance of safety culture increases in individual organizations as well as in the whole society. It is a vital component of the organisation's management. Moreover, it is now required by the standard. The aim of this article is to examine the relationship between agile methods and the safety culture in various contexts based on the conditions in the Czech Republic and to consider its applicability in organisations with requirements for the implementation of a management system.

Many publications demonstrate that there is a great interest in agile methods. The research from year 2013 in the article [Fitzgerald 2013] states the interest in agile methods in around 80% of organisations around the world. First, they were designed for small IT (information technology) teams and the development of so-called safety-noncritical products and applications. Subsequently, the suitability for larger teams was proved and successful applications outside of the software IT area emerged such as in [Huang 2012]. Here, an agile method was for example used for a rapid development and production

of a military spacecraft. The article [Fitzgerald 2013] states that the applicability of agile methods for the development of safety-critical products has not yet been clearly averred and faces agile specific problems. Interesting points in this context seem to be a continuous compliance and a traceability of each developed part of the product. The article [Gary 2011] proposes for example to insert requirements for the documentation into the concept and specification to satisfy the need for an extensive documentation in safety-critical products. In general, the application of agile methods for the development of safety-critical products seems still not clearly beneficial. Published use cases are rather individual and most often with specifically tailored agile methods.

The safety culture should be related to the design and the production of products, but at the same time also to the management of the organisation. The publication [McMichael 2007] proves that it is possible to implement a quality management system according to the standard ISO 9001 for agile methods. Requirements to the documentation and to the process structure of the management system in the organisation are not seen as obstacles. The publication [Thomas 2008] describes the issues arisen from the introduction of agile methods in a common IT organisation with a traditional management. Authors [Boehm 2005] also point to similar problems in other types of organisations with a traditional management. They identify three types of possible conflicts - interpersonal conflicts, development process conflicts and business process conflicts. The situation is usually easier in smaller organisations with smaller projects. The publication [Vander 2014] sees a problem of conflicts solving in a project as an integral part of the communication within the team. It suggests that tolerance and mutual learning are cultivated in organisations. This is particularly important in international organisations, where there is a wide range of cultures that need to be combined to create one competitive culture of the organisation. The author [Nassif 2013] points to the growing need for safety in organisations. Therefore, he recommends creating a position of safety specialist with responsibility to develop and implement safety programs. Risks and subsequent costs may be reduced in this way. As data leaks are one of the most serious risks, the author [Ryba 2014] promotes an increased focus on security related IT skills. He also mentions the need to increase spending on the safety in organisations. The publication [Grabowski 2007] discusses a need to establish and implement safety characteristics to prevent conflicts especially when, due to the use of IT, the teamwork is virtual.

### 1.2 Advantages and disadvantages of agile

Advantages of agile methods are often presented. They help improve software quality, reduce the time of delivery, response better to changes or create an engaging stress-free collaborative organisational culture. The application by the publication [Thomas 2008] led to a better control of production, to the reduction of the number of changes, to more investments and to the improvement of learning in the organisation. However, the condition is the acceptance of agile way of working by all team members.

Disadvantages of agile methods are seen in a small identification of items, in the informality of procedures and in an insufficient documentation according to the article [Gary 2011]. Furthermore, a number of publications mention the genesis of conflicts during the implementation of agile methods in organisations as mentioned in the previous paragraph. The

use of these methods for safety-critical production is controversial.

## 2 DISCUSSION OF PROBLEMS

A human factor in connection with agile methods may have impact on safety aspects. The conflict of intellectual attitude towards agile methods mentioned in the publication [Thomas 2008] may lead to safety complications in the organisation and its surroundings. Social aspects such as nationality or a personality of the manager from the study [Vander 2014] are important while considering the application of agile methods and building up of a common safety culture in organisations. Safety complications, identified among others by authors [Boehm 2005], can grow not only with the complexity of the organisational system, but also with the complexity of the product. In complex systems it may be difficult to distinguish development and business processes. This just points to the complexity of the management system of an organisation. On the other hand, the introduction of a position of a safety specialist from the author [Nassif 2013] means in fact also the strengthening of the functional approach. This can present a source of conflicts for modern methods like agile.

Many studies have been written on the topic of agile methods mainly abroad. They deal most often with the possible applications of the methods in different types of organisations. The safety management is mentioned rarely, although from different points of view. For example publications [Gary 2011] and [Ryba 2014] explore this area in connection with the risks prevention. Due to the iterative nature of agile methods they enable to prevent some risks and therefore help avoid nonconformities, which would otherwise occur during the use of the product. The problematic of determining safety characteristics from [Grabowski 2007] is a very broad topic, but often neglected. It would be useful to include such safety characteristics into the system for agile methods as proposed in the case of the project documentation in the article [Gary 2011].

The interest in agile methods and in other flexible organisational structures in the Czech Republic compared to the world seems still small according to the book [Pelantova 2014].

## 3 COMPARATIVE ANALYSIS

The presented comparative study of the relationship between agile methods and safety culture is based on two sources namely results of a survey about the state of the art of safety culture in organizations in the Czech Republic by [Pelantova 2015] and practical knowledge about agile methods gain from pilot agile projects (games) at authors' workplace in 2015. In the first case, the results come from an extensive questionnaire survey, conducted in dozens of organizations from different sectors of the economy in the Czech Republic, part of which was also related to safety aspects. In the second case, it was about the observation and analysis of the behaviour of several students and university staff agile teams during projects, on which the authors intend to continue also in the future.

There are a number of agile methods. This article will focus mainly on Scrum being the leading agile product development framework used in the world [VersionOne 2015] as well as in the Czech Republic [Etnetera 2013]. According to [Schwaber 2013] 'Scrum is a framework within which people can address complex adaptive problems, while productively and creatively

delivering products of the highest possible value.' As all other agile methods it is based on principles of the Agile Manifesto [Beck 2001]. Further in the text we may use the term agile and Scrum interchangeably.

In addition, it should be noted that agile methods are applicable, according to information in the publication [Zikmund 2010], in organizations with a functional as well as a process approach. Further in the article only the process approach is considered as it is required in standards requirements including quality management systems under ISO 9001.

### 3.1 Views on fundamental safety aspects

In the following paragraphs are described the most important aspects that characterize safety culture of each organization based on a survey in the article [Pelantova 2015]. Each of these aspects is subsequently examined from two perspectives by means of a comparative analysis. The first is a summary of major findings for safety culture and the second is a characteristic from the agile point of view.

**Work priority** in the safety culture of an organisation is the safety as such, leaning on safety management. 'The highest priority in agile methods is a customer satisfaction through an early and continuous delivery of a valuable product.' [Beck 2001] Even though safety is not mentioned here, agile team is a part of an organization, where safety culture should be present. A detailed description how a smooth inclusion of safety requirements into agile can be achieved is described in the next section.

For safety culture, it proved that the most appropriate **kind of control** is a consultative one with the final decision of a manager. In Scrum, employees form a self-organizing and self-managed team with no internal hierarchy. There are two special roles a team member can hold a Scrum Master and a Product Owner. A Scrum Master facilitates the whole Scrum and helps removing any impediments (obstacles) that can obstruct the team's work. A Product Owner, a customer representative assures that the result of the development or the production is constantly in accordance with the customer vision of the product. Co-decision and common team responsibility with the common goal in mind eliminates safety risks given by possible negative characteristic of an individual. From the point of view of safety culture, such flexible self-organisation with defined team guidelines presents beside the above-mentioned option a second viable control possibility.

In safety culture, the **delegation of authority** in order to ensure information security, occupational health, safety of the environment, etc. should be a routine. In reality, it may often be limited and strongly depend on the nature of the person. Although, the responsibility for safety issues is not explicitly defined in agile methods, as the team is self-managed, it will take presumably a distributed form. This will allow checking safety aspects by individual team members and therefore cover a wider range of aspects comparing to a single safety specialist. On the other hand, such distribution will put more demands on the team members' knowledge.

**Internal culture** of an organization is essential for its safety culture. The occurrence of negative phenomena such as unresolved disputes, changes in management principles, distrust, etc. may subsequently lead to failures and nonconformities in the development or production and they can

even endanger the safety of persons involved. On the other side, positive shared experiences, mutual learning, trust, unstressed environment with all the needed support, promoted by agile methods, reinforce safety culture.

When safety culture in organizations was examined, following **unconformities** occurred: unconcern, no sharing of information within a team, violations of occupational safety and health at work, violations of information security, etc. Their settling was complicated by the fact that sometimes the cause was not found, the search for solutions was slow, there was a significant amount of accumulated work, the problem was downplayed, there was a poor communication, etc. For safety culture it is necessary to put in place preventive measures and learn from the incidents. In agile methods, a reflection meeting called retrospective is scheduled after each working delivery called sprint. It enables 'the team to reflect on how to become more efficient and tune and adjust its behaviour accordingly.' [Beck 2001] Any encountered **conflicts** or obstacles usually called impediments which may slow down the work or endanger a subject are raised during regular daily meetings. They are immediately solved by the team or eventually put into the impediments list in case they require additional discussion or support. In essence, the risk analysis may be part of team's work guidelines.

**Overtimes** are in safety culture, under certain circumstances, acceptable. They may allow an unstressed completion of a product or an open-ended search for innovative solutions. Agile methods 'promote sustainable development, where a constant pace can be maintained indefinitely.' [Beck 2001] They operate with fixed workload and labour cost. Overtime, therefore, usually means a deviation from agile principles.

**Learning** in a traditional organization with safety culture is based on expert knowledge gained from realised projects and preventive and corrective measures. Learning in agile team takes place continuously. This is from the safety culture point of view advantageous as it is more efficient and faster.

Unrestricted **communication** is a preferred form for safety culture. At the same time, it is necessary to comply with fundamental rules defined by safety procedures. Also in agile methods this type of communication is favoured. However, the rules should be agreed and approved by the team. In addition face-to-face conversation is highly recommended in agile.

Especially important are for the safety culture in an organization following **management systems**: occupational safety and health, information security and environmental safety. These systems need to perceive and fulfil expectations and requirements on safety of all stakeholders. For this reason, an organisation should build an adequate organizational structure, allocate appropriate resources and maintained documentation with procedures, emergency plans and records. In agile methods a strong emphasis is put on 'continuous technical excellence and a good design' [Beck 2001] in order to accommodate frequent changes in requirements and at the same time to meet customer requirements associated with the quality management system. By definition, agile methods honour as well certain aspects of information security management system. The organisational structure is replaced with the communication and relationships, allocation of time and capacity resources may be restricted and the documentation is limited to pre-agreed work guidelines. Substitutability of a team member may be achieved thanks to

frequent communication, continuous knowledge sharing, team's work tracking and common responsibility.

Finally, it is appropriate to determine and measure **safety characteristics**. In a traditional organization with safety culture, common characteristics focus primarily on the production. The same situation is in agile methods, where characteristics would be also related to the development or the production eventually to a self-assessment of the team. Nothing, however, prevent the organization management system with agile methods to include into the monitored safety characteristics for example number of impediments or types of impediments.

### **3.2 Reflecting safety culture into agile**

Standard safety culture is defined at the organisation level via its own directives and processes and as such, it should be respected and adopted by the agile team. In case there are additional specific safety issues required by the customer or arising from the nature of the product (safety-critical products or applications) again it is up to the involved team to reflect these requirements in their documents and in their work.

During the phase of building an agile team, the team members discuss and define a common set of guidelines, they all agree to follow during the work. These work guidelines include usually technical and organisational recommendations. They may specify for example a preferred set of development tools, allowed programming structures or naming conventions as well as where and when the daily meeting will be held. At this stage, the standard safety requirements should be incorporated into the guidelines. It is possible to add specific safety requirements that need to be applied across the whole project as well. Depending on the project, safety may include both types of guidelines. Examples of technical safety guidelines are recommendations on the type of encryption algorithm used throughout the project or frequency and location of critical data backups. A team member leaving the working room should be empty-handed or all the computers will be switched off at the end of the day are, on the other hand, examples of organisational safety guidelines. Safety requirements may form an integral part of general technical and organisational work guidelines or in case the safety has a high priority a separate set of so called safety guidelines may be created.

In case the implementation of some safety requirement involves concrete additional work from team members, the requirement should be treated as any other type of customer requirement and therefore inserted into the features list called product backlog. Such an example may be a request to implement always two independent methods to prove the correctness of a calculation. In daily meetings and especially during retrospective at the end of each sprint the relevant safety requirements may be subject to team review.

From this point of view in order to implement safety requirements in an agile team and build up its safety culture it is important to remember to allocate additional team resources associated with safety trainings, safety inspections and reporting.

The Scrum team is self-organising, self-managed and has the ownership of the product as a team. Therefore the responsibility for the safety will be distributed over the team as well. However, there may be situations especially while developing safety-critical applications or products to for

example backtrack the programmer/worker of a critical or key part.

In summary, the flexibility of the agile team helps naturally implement and maintain the safety culture in an organisation.

#### 4 CONCLUSIONS

The adherence to ethical rules while applying agile methods is preserved thanks to the self-organisation of the agile team. However, the agile methods focus primarily on the production. The system component is back seated due to the first point of Agile Manifesto 'Individuals and interactions over processes and tools' [Beck 2001]. As derived from the performed comparative analysis, the prerequisite for a symbiotic functioning of agile methods and safety culture is that safety requirements do not go against a flexible agile organisational structure. Further, the agile team must be willing to plan a minimum number of characteristics for the system management. Team members should regularly identify, analyse and evaluate risks and perform preventive actions to minimize them in terms of the safety management. This might be an entirely new finding for some agile teams. It is possible to create also a desired process map for the agile team and to meet standard requirements for the quality management system at least.

This article aimed to explore the agile methods from the safety culture point of view and in this way to help improve the competitiveness of organisations. From a practical perspective, it provides specific recommendations on how to interconnect the safety culture of an organization, its management system and the use of agile methods. Such recommendations have not been published in the Czech Republic yet. Their implementation should help reduce the number of possible conflict in teams and the emergence of nonconformities of products and within the management system. For the organization, as well as for the state economy it subsequently brings overall cost and time savings thanks to a decreased need to deal with incidents. In addition, a secure and flexible collaborative organisational culture significantly increases work productivity that again directly influences organisations profit.

It will be still necessary to educate the Czech organisations in this area. The practical implementation of mentioned issues is therefore a long-term affair.

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