Torun Business Review

A case-based model for assessing the readiness of IT organizations for agile transformation

Abstract:
The aim of the article is to present a model for assessing the readiness of IT organizations to support decision-making processes in organizational transformations. The issues of agile transformation (AT) and the need to change these organizations in the era of changing conditions of modern business were presented at the beginning. The need to use adequate metrics, methods and models to support these processes was indicated. The assumptions for building the model were presented, pointing out the complexity of the transformation processes and the need to use modeling methods adequate to this complexity. Therefore, after discussing process and object-oriented modeling as well as those based on flows, the Case-Based Reasoning modeling method, which was used to build the AT process support model, was presented. The next chapter presents the transformation process support model developed by the authors. The processes of building the model and the possibilities of its use for organizations undergoing AT processes are shown. The summary of the article describes the verification processes of the developed model and recommendations for project managers to use this model to support AT.

Keywords: agile transformation, case-based reasoning, Case-Based Reasoning

JEL Codes:
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1 Introduction

Modern companies are forced to change their way of functioning to meet market requirements. As before, they do not focus only on the production of hardware, but they see their strength in services and the software supporting these services. Software development determines the company's position on the market and its production methods indicate the maturity of the IT organization. The use of agile approaches generates significant benefits for the organization. The characteristics of these benefits mainly indicate the advantage of agile methods over classic software development methods.

Agile methods were originally used mainly in small organizations for small projects. It quickly turned out that they can also be used in large organizations, scaling small projects to large ones. It also turned out that a significant challenge for large projects were the organizational structures of large organizations, which were difficult to adapt to completely new production and management processes. These challenges were also a consequence of the existing problemsin communication between teams and coordination of their work, as well as the use of adequate measures and metrics to estimate project success.

These challenges also resulted from the lack of common initial architectures as well
from incomplete requirements and limited distribution of joint works using version control systems. Despite these problems, large organizations are adopting agile software development methodologies, seeing more benefits than problems.

A review of the literature indicates a lack of systematic research in both large and small organizations using agile methodologies. It is stated that almost 90% of the analyzed works are experience reports written by practitioners. Reports from many studies indicate that implementing agile practices helps significantly improve code quality. At Primavera company, the adoption of agile methodologies improved product quality by over 30%, while the number of defects was reduced by almost 10%. At the Yahoo, according to 54% of respondents, it was found that the use of AT improved the overall quality and usefulness of the software. It was also found that the use of agile methods improves the quality and transparency of process metrics, such as early detection of defects.

The problem of AT research results from the fact that the transformation process and project implementation take place in industry environments. These environments are often difficult to observe and require the use of specific methods to evaluate the project. The analysis of the suitability of agile methodologies then requires the use of metrics that will allow for demonstrating a broader context of the suitability of agile approaches compared to the classic ones. Therefore, great caution should be exercised in such observations and external factors of the organization should be taken into account, as they may significantly influence the course and efficiency of AT.

The analysis of the literature also indicates that comprehensive research on AT issues is being conducted. An example of such research is the Software Finland cloud - a qualitative and quantitative research project to determine the impact of agile transformation on the functioning of the organization. Project partners, whose primary goal is to define transformation metrics, are focused on defining methodologies based on Goal Question Metrics (GQM) to define indicators allowing for comparison of agile and classic software development approaches.

The research context outlined this way indicates a complex AT environment in which both the course of processes and the measures of these processes require either the use of expert knowledge or the use of a model adequate to the complexity of these processes. At this point it seems advisable to apply the famous Zadeh theorem: "As the complexity of a system increases, our ability to accurately and meaningfully determine its behavior decreases until it reaches a threshold value beyond which precision and accuracy become almost mutually exclusive properties." Therefore, in the next part of the work, the AT phenomenon will be presented, for which existing modeling methods will be shown. This approach to AT will constitute the basis for proposing modeling methods and building a model adequate to the complexity of AT processes.

2 Modelling agile transformation processes

This chapter is entirely dedicated to the discussion of AT processes. This is the chapter in which, at the beginning, the basic AT processes will be discussed and then the possibilities of modeling these processes will be indicated and the currently existing models will be shown. This is a starting point for assessing to what extent the model created and proposed in this work is an extension or complement to existing approaches to AT modeling.

AT is treated in this work as a continuous process of organizational change in which classic software development cycles are replaced by short development cycles. AT is also treated as a group of organizational change processes assessed from the point of view of the performance indicators of these processes (increase in productivity, minimization of errors related to software development as well as increase in the awareness of project teams). Agile transformation can also be the process of implementing agile project management methodologies in an organization where no methodologies have been implemented so far or the classic, cascade production model is being changed to a lightweight approach. In order to meet these challenges, organizations that have not previously used project management methodologies decide to implement an agile approach, and organizations that used the classic approach, i.e. heavy methodologies, decide to change it to a lightweight approach. This process of implementing agile methodologies in

organizations that have not used the methodologies before, as well as the transition from the classic, cascading approach of project management to agile methodologies, is called Agile Transformation (AT). Agile transformation is a complex process, so making the decision to start it without prior detailed analysis results in failure, and returning to old project management methods is a costly, long-term process that introduces temporary chaos.
AT process can be divided into stages:

- Initiation and planning – this is the stage during which the organization prepares for transformation. In this phase the planned course of AT should be described and the organization's readiness to start it should be assessed.
- Execution – this is the stage at which the transformation has begunand the lightweight approach is implemented or existing production methods are replaced.
- Improvement – this is the stage in which the end point of the transformation has been reached and the implemented agile approach is being improved.

There are also specified four perspectives of AT:

- Project – includes changes in the way projects are managed.
- Process – includes changes in existing processesin organisation.
- Organizational culture – includes changes in the behavior of employees and decision-makers.
- Technology – includes changes related to the adaptation of old and implementation of new solutions supporting production processes.

The implementation of agile project management methodologies is similar in organizations with similar characteristics. In the case of such organizations, there can be expected similar problems and the transformation process. Research conducted by the authors in IT companies and IT departments that have undergone the transformation process indicates a large pool of experience that, organized and used in an appropriate manner can be used by decision-makers in other organizations that are before making the decision to start AT or those in which transformation processes have already started.

So if it is assumed that AT includes a cycle of diverse processes divided into stages and perspectives, methods based on process modeling standards seem adequate for modeling AT processes. At this point, it is worth mentioning the existing process modeling methods based on the Business Process Model and Notation (BPMN) and Business Process Modeling Language (BPML) standards, modeling process flows, taking into account the possibility of its visualization. When using classic modeling based on the BPMN standard, defining tracks, processes, their dependencies and performance indicators, it is also possible to use semantic BPMN models. Then, performance indicators are assessed from the point of view of semantic or fuzzy measures. In parallel, far-reaching research is also being conducted on the use of object-oriented models to analyze AT. Then the case analysis so often used in AT expert description is replaced by use case models. Then, use case models constitute the basis both for implementing expert knowledge and, above all, for analyzing AT. Such models are mainly flow models showing both stages and processes of transformation. These are high-level models whose main purpose is to detail the transformation process and gather expert knowledge. They are also sets of good practices suggesting potential behaviors of those managing transformation processes. In several cases, these are informal models that do not use any process modeling standards, but are useful from the point of view of project managers. Their analysis raises the question about the directions for building AT models. The answer to this question as well as the methods of building models will be presented in the next chapter.

3. Building an agile transformation model

The starting point for building the AT model is the implementation of the presented one in this article the famous Zadeh theorem as well as an analysis of the modeling methods presented in the previous chapter. It seems that this analysis allows for the identification of two paths that could be used in the construction of the proposed model. The first is the implementation of a process approach in which process modeling standards would be used to describe transformation processes. Second approach suggests the need to look at AT processes differently - from the perspective of expert knowledge recorded on the basis of AT processes cases.

The usefulness of the model will depend on the number of these cases and the ability to gather knowledge. The more cases we collect, the more adapted the model may be to the AT process being analyzed at a given moment. Therefore, the authors of the study considered the use of methods in which cases are analyzed. Two of them were taken into account: the case analysis method and the Case Based Reasoning (CBR) method. Authors of the work want to show a model supporting decision-making processes, it seems that a model based on reasoning based on cases should be more appropriate.

This method can be used when trying to generalize cases and when selecting cases that can be used to support the decision-making process in the organization being assessed. Then the CBR method can be used to support decisions in design work not at the level of the project or a single case, but of the entire organization and answer the question whether a given enterprise is ready to start transformation processes, and if not, what corrective works should be introduced to minimize risk of failure.

Then the article is an attempt to fill the gap in the field of support for IT organizations in decision-making processes in the field of agile transformation. The authors attempted to build a model enabling the assessment of enterprises' readiness for AT. The model building process was divided into five stages. The first stage is the assumptions constituting an analysis of the suitability of the Case Based Reasoning method for AT modeling. In the next stages (second and third), a description of the generic case and a case database are prepared. In the fourth and fifth stages, a research experiment of case selection and inference is carried out using cases to verify the model.

3.1 Assumptions for building the model

Case Based Reasoning (CBR) is a problem-solving method that allows you to find similarities between the organization being assessed and historical cases. The authors chose to use case-based reasoning for two reasons. Firstly, the CBR method is based on verified and confirmed knowledge and experiences of other organizations that have already undergone transformation processes. Secondly, this method is based on the principle of continuous learning by adding new cases to the database after that, as soon as the problem is solved. The CBR cycle consists of four stages, which are presented graphically in Fig. 1.

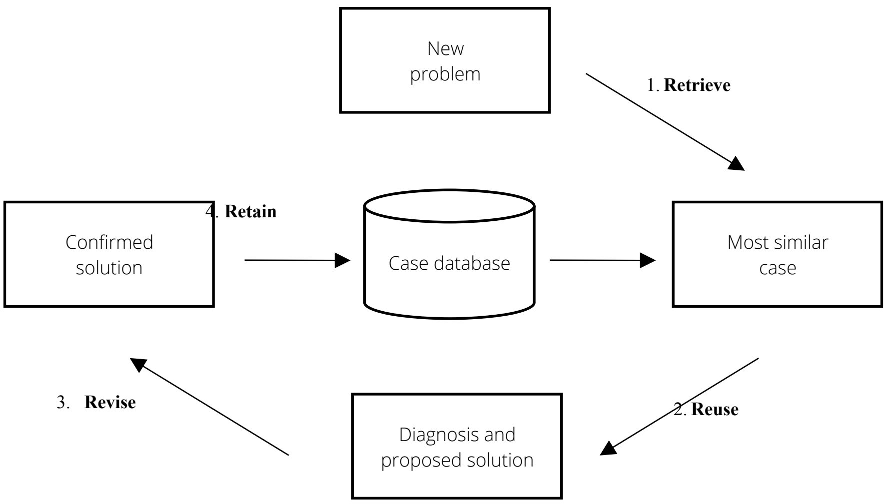


Fig. 1. CBR Cycle[1]

The CBR algorithm includes four steps also known as the 4Rs:

- **Retrieve** – the system searches for the most similar cases to the analyzed one (the given problem can be described e.g. using a vector). They are downloaded from the case database and forwarded for further processing.
- **Reuse** – the system analyzes the cases selected in the first stage in terms of solutions to the given problem. If required, the historical case is adapted to the analyzed one. At the adaptation stage, the proposed solution to the given problem is already known.
- **Revise** – the solution from the adaptation stage is assessed in practice. At the validation stage, it is checked whether the proposed solution actually contributed to solving the given problem.
- **Retain** – the last stage of the CBR cycle, in which a new case is saved to the database. It can be used to solve another new problem.

Thanks to basing on historical experience and continuous learning and feeding the database with new cases, the authors decided to use this method to support the decision-making process in the field of agile transformation. The authors' goal is to prepare a model using case-based reasoning that can support decision-makers in organizations when making decisions related to starting or postponing the agile transformation process.

[1] Own study based on: AAmodt A, 1994

3.2 Model building stages based on prototyping

During research work on the model, the authors used an iterative approach, which allowed for modification of assumptions during the work. As a result, three prototypes of model assumptions were created - IM_I, IM_II and IM_III. A generic case was created based on the IM_III model, which was considered the final version. The key assumptions for each prototype and the generic case are described below.

- **Prototype of IM_I assumptions**

As part of the work on the first version of the prototype assumptions, the authors analyzed the literature and the ISBSG (International Software Benchmarking Standards Group) database. It is a database containing the characteristics and description of 1,582 IT projects implemented by various IT organizations, containing information on the degree of project success depending on the project management methodologies used (including agile approaches). Based on the above analysis, the first assumptions for the model were prepared:

- **Input layer:** measurement instrument, set of questions regarding the characteristics of the organization, internal processes and project management methodologies used.

- **Processing layer:** assessment of the level of processes and their degree of maturity. At this stage of the research, it was decided not to attempt to define them independently and the described definitions were used within ready-made standards:
  - **For service organizations:** CMMI (*Capability Maturity Model of Integration*)
  - **For product organizations:** ITIL (*Information Technology Infrastructure Library).*

- **Output layer:** the organization's level of readiness for agile transformation.

The IM_I prototype is presented graphically in Fig. 2.

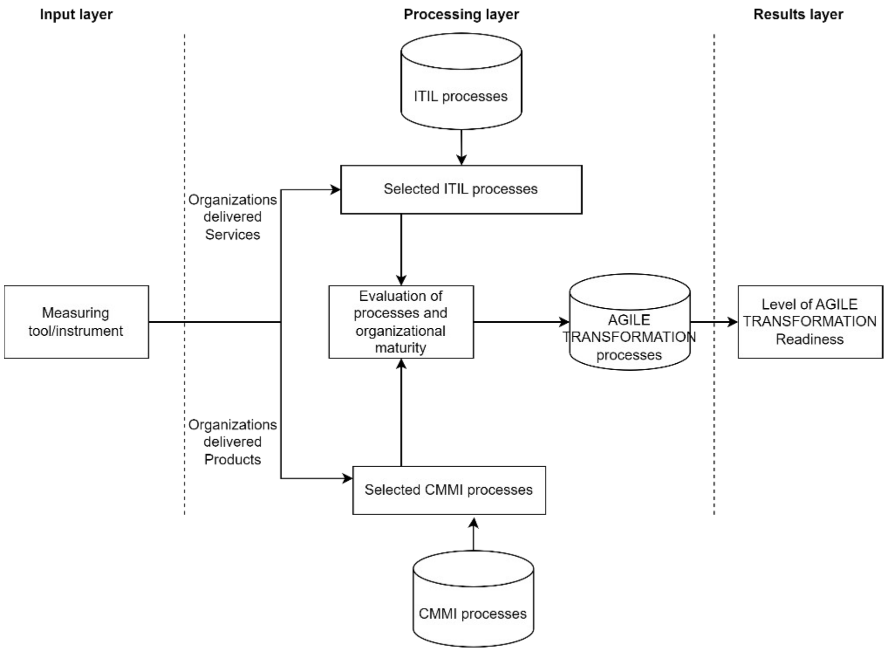


Fig. 2. IM_I prototype [2]

- **Prototype of IM_II assumptions**

Based on the prepared prototype of the IM_I assumptions, the authors decided to conduct quantitative and qualitative research to verify it. As part of quantitative research, there were conducted among IT organizations surveys asking about: the characteristics of the organization, processes and their level of maturity, project management methodologies used and the state of agile transformation. The quantitative research was then in-depth with qualitative research in the

[2] Own study

form of interviews with decision-makers in organizations. As a result of the research, a set of problems that occurred in given organizations during and after the agile transformation was obtained. Additionally, a key element for the course of AT was identified, which was not initially taken into account - transformation triggers. These are the factors that led to the decision to start an agile transformation. The authors divided them into four groups: effectiveness, enforcement, project substantive and motivational. Depending on the type, the transformation may take different course. Based on the results obtained, a prototype of the IM_II assumptions was prepared:

- **Input layer**: measurement instrument, set of questions regarding the characteristics of the organization, internal processes, applied project management methodologies and transformation triggers.
- **Processing layer**: assessment of the level of processes and their degree of maturity based on CMMI and ITIL as well as transformation triggers mapped to agile transformation processes.
- **Output layer:** the organization's level of readiness for agile transformation.

The IM_II prototype is graphically presented in Fig. 3.

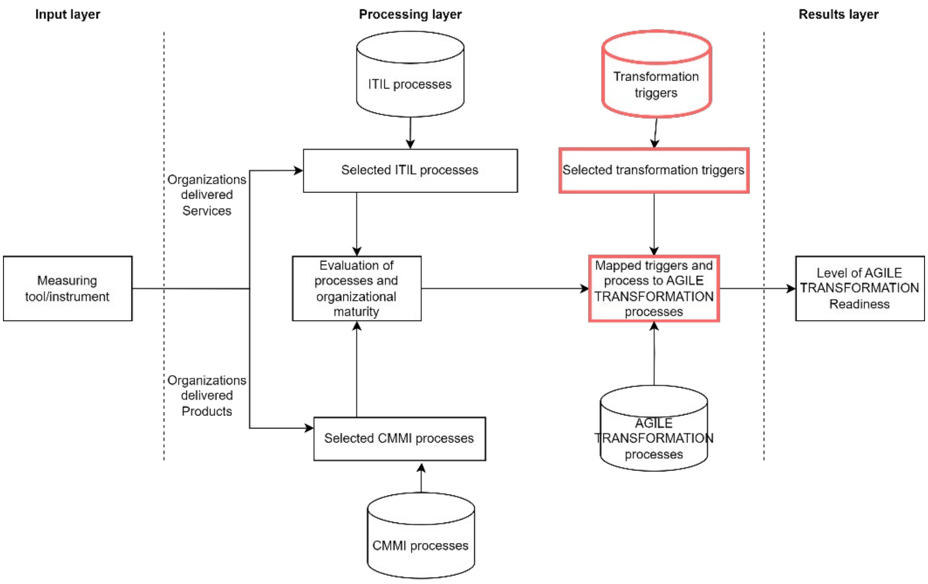


Fig. 3. IM_II prototype[3]

- **IM_III Model**

As part of the verification of the prototype of the IM_II assumptions and the preparation of the IM_III model, the authors decided that it was crucial to verify the level of significance of all processes described under the CMMI and ITIL standards and to select only those that have a real impact on the course of agile transformation processes. Based on the quantitative and qualitative research conducted by the authors, it was determined that the correlation of ITIL processes with agile transformation is so small that this standard can be omitted in further analysis and only CMMI is focused on. Further qualitative research (online surveys) and qualitative research (in-depth interviews with decision-makers in organizations) were carried out, which analyzed all 22 processes described within the CMMI. Based on the results obtained and using the association rules method, the number of processes that

[3] Own study

have an impact was reduced from 22 to 5 on the course of transformation processes. Based on the results obtained, assumptions for the IM_III model were prepared:

- **Input layer**: measurement instrument, set of questions regarding the characteristics of the organization, transformation triggers, applied project management methodologies and processes affecting transformation processes.
- **Processing layer:** analysis of the organization's characteristics, the level of transformation processes and their degree of maturity, and transformation triggers.
- **Output layer:** the organization's level of readiness for agile transformation.

The IM_III model is presented graphically in Fig. 4.

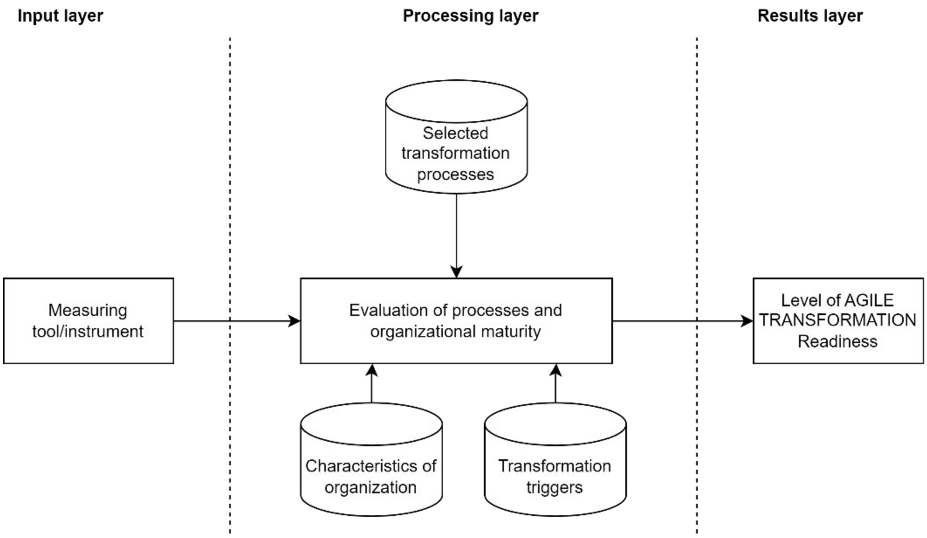


Fig. 4. IM_III model [4]

[4] Own study

Based on the prepared IM_III Model, a generic case was described and a case database used in inference processes was built.

- **Generic case**

The generic case is described as a CB_x vector consisting of 28 variables, grouped into four categories: organizational characteristics (V_x), process (P_x), trigger (T_x), problem (PR_x).

$$\overrightarrow{CB_x} = ¿PR_1, PR_2, PR_3, PR_4, PR_5, PR_6, PR_7, PR_8$$

where:

Table 1. Generic case - variables

Variable	Possible values
Organization size (V1)	Micro, Small, Medium, Large
Geographic dispersion of teams (V2)	No, Yes, but the difference in time zones is less than 6 hours, Yes and the difference is greater than 6 hours
International environment (V3)	Truth false
Number of development teams (V4)	1 team, 2 – 5 teams, >5 teams
Client type (V5)	External, Internal
Organization type (V6)	Product-oriented, service-oriented
[Process] Project monitoring and control (P1)	Truth false
[Process] Requirements Development (P2)	Truth false
[Process] Project planning (P3)	Truth false
[Process] Configuration Management (P4)	Truth false
[Process] Organizational training (P5)	Truth false
[Trigger] Need to reorganize the enterprise (T1)	Truth false

[Trigger] Crossing the design triangle (T2)	Truth false
[Trigger] Improve software development efficiency (T3)	Truth false
[Trigger] Decision makers (T4)	Truth false
[Trigger] Grassroots employee initiative (T5)	Truth false
[Trigger] Changing the company's philosophy (need to be Agile) (T6)	Truth false
Methodology used (V7)	None, RUP, MSF, PRINCE2, Other
Selected methodology (V8)	SCRUM, Agile, XP, Other
Transformation success (V9)	No, Yes, but partially, Yes
[Problem] Employee reluctance (PR1)	Truth false
[Problem] Low level of knowledge about the selected methodology (PR2)	Truth false
[Problem] Low management commitment (PR3)	Truth false
[Problem] No transformation process described (PR4)	Truth false
[Issue] Problem with the availability of development team members (PR5)	Truth false
[Issue] Missing Tools (PR6)	Truth false
[Issue] Lack of shared vision (FP7)	Truth false
[Problem] Changing the way employees think (working in iterations) (PR8)	Truth false

- **Case database**

The case database contains 12 organizations described by the 28 variables defined for the generic case. Two of these organizations were used at earlier stages of the research to verify the replicative IM_III Model. As a result of the research, the effectiveness of the model in predicting the course of transformation was achieved at the level of 88.89%.

Organization Size [String]	Geographical Dispersion [String]	International Environment [Bool]	No. of Dev. Teams [String]	Client Type [String]	Organization Type [String]	[Process] Project Monitoring and Control [Bool]	[Process] Requirements Development [Bool]	[Process] Project Planning [Bool]	[Process] Configuratio
Medium	No	false	2-5	External	Product-Oriented	false	false	false	false
Medium	No	false	2-5	Internal	Product-Oriented	true	true	true	true
Medium	No	false	2-5	External	Product-Oriented	false	false	true	true
Medium	No	false	2-5	External	Product-Oriented	false	false	true	true
Micro	No	false	1	External	Product-Oriented	false	false	false	false
Big	Yes, less than 6h	false	>5	Internal	Product-Oriented	false	false	false	false
Micro	No	false	2-5	External	Product-Oriented	false	false	false	false
Small	No	false	2-5	Internal	Product-Oriented	false	false	false	false
Small	No	false	1	External	Product-Oriented	false	false	false	false
Small	No	false	>5	External	Product-Oriented	true	true	true	false
Small	No	false	>5	External	Product-Oriented	true	true	true	false
Small	No	false	2-5	External	Product-Oriented	false	false	false	false

Fig. 5. Case database[5]

In the next chapter of this article, the authors describe an example of using the model in an IT organization to assess its readiness for agile transformation and verify the predictive effectiveness of the model.

3 Model verification processes

For the purposes of predictive verification, the model was used in October 2019 in the IT organization Autopay Mobility Sp. z o. o. It is a company based in Warsaw that provides IT solutions used for automatic payment for transport services, including highways, parking lots and fuel. The company was established at the beginning of 2019 and began operating in October 2019. The IT team then consisted of 8 people. Autopay Mobility Sp. z o. o. was separated from the structures of another company - Blue Media S.A. The decision to implement agile project management methods in Autopay was made by decision-makers based on positive experiences with their use in the company from which it was separated.

The course of the experiment was described in accordance with the CBR – 4R cycle:

- **New Problem** – Autopay Mobility Sp. z o. o. based in Warsaw

$$\overrightarrow{CB_{13(Autopay)}} = \text{¿}T_4 : True, T_5 : False, T_6 : True, V_7 : Lack, V_8 : SCRUM$$

[5] Own study

Feature name	Datatype	Weight	Scale	Inverted	Term	Search value
Organization Size	String	5	Fuzzy linear		=	Small
Geographical Dispersion	String	5	Fuzzy linear		=	No
International Environment	Bool	5	Fuzzy linear		=	false
No. of Dev. Teams	String	5	Fuzzy linear		=	1
Client Type	String	5	Fuzzy linear		=	External
Organization Type	String	5	Fuzzy linear		=	Product-Oriented
[Process] Project Monitoring and Control	Bool	5	Fuzzy linear		=	true
[Process] Requirements Development	Bool	5	Fuzzy linear		=	true
[Process] Project Planning	Bool	5	Fuzzy linear		=	true
[Process] Configuration Management	Bool	5	Fuzzy linear		=	false
[Process] Organizational Training	Bool	5	Fuzzy linear		=	false
[Trigger] Need for reorganization	Bool	5	Fuzzy linear		=	false
[Trigger] Project Triangle Exceeded	Bool	5	Fuzzy linear		=	false
[Trigger] Improve the efficiency of delivering	Bool	5	Fuzzy linear		=	false
[Trigger] Decision-Makers	Bool	5	Fuzzy linear		=	true
[Trigger] Employees Initiative	Bool	5	Fuzzy linear		=	false
[Trigger] Changing philosophy (need to be Agile)	Bool	5	Fuzzy linear		=	true
Used Methodology	String	5	Fuzzy linear		=	None
Choosen Methodology	String	5	Fuzzy linear		=	Scrum

Fig. 6. The case of Autopay Mobility Sp. z o. o. introduced into the model as a new problem [6]

- **Retrieve**

As a result of searching the database, 3 cases with the level of similarity were found: C_1=54,11%, C_2=48,70% oraz C_3=48,70%.

Table 2. Case comparison result - Retrieve stage

Variable	**Test case** (Autopay Mobility)	**C_1=54,11%**	**C_2=48,70%**	**C_3=48,70%**
Organization size (V1)	Small	Small	Small	Micro
Geographic dispersion of teams (V2)	NO	NO	NO	NO
International environment (V3)	False	False	False	False
Number of development teams (V4)	1 team	>5	>5	1
Client type (V5)	External	External	External	External
Organization type (V6)	Product-oriented	Product-oriented	Product-oriented	Product-oriented
[Process] Project	True	True	True	False

[6] Own study

monitoring and control (P1)				
[Process] Requirements Development (P2)	True	True	True	False
[Process] Project planning (P3)	True	True	True	False
[Process] Configuration Management (P4)	False	False	False	False
[Process] Organizational training (P5)	False	True	True	False
[Trigger] Need to reorganize the enterprise (T1)	False	False	False	False
[Trigger] Crossing the design triangle (T2)	False	True	True	False
[Trigger] Improve software development efficiency (T3)	False	False	False	False
[Trigger] Decision makers (T4)	True	True	False	True
[Trigger] Grassroots employee initiative (T5)	False	False	False	False
[Trigger] Changing the company's philosophy (need to be Agile) (T6)	True	False	False	False
Methodology used (V7)	Lack	Lack	Lack	Lack
Selected methodology (V8)	SCRUM	SCRUM	SCRUM	SCRUM

- **Reuse**

In the adaptation phase, the model, based on comparison to past cases, selected the result of the transformation and problems that may occur during or immediately after it. Additionally, recommendations are presented for actions that should be taken to minimize the risk of transformation failure.

Table 3. Adaptation of results to the examined case - Reuse stage

Variable	**C_1=54,11%**	**C_2=48,70%**	**C_3=48,70%**	**Expected mileage**
Transformation success (V9)	Yes, partial	Yes, partial	Yes	Yes, partial
[Problem] Employee reluctance (PR1)	True	True	True	True
[Problem] Low level of knowledge about the selected methodology (PR2)	True	True	True	True
[Problem] Low management commitment (PR3)	False	False	False	False
[Problem] No transformation process described (PR4)	False	False	False	False
[Issue] Problem with the availability of development team members (PR5)	False	False	False	False
[Issue] Missing	False	False	True	False

Tools (PR6)				
[Issue] Lack of shared vision (FP7)	False	False	False	False
[Problem] Changing the way employees think (working in iterations) (PR8)	False	False	False	False

As a result of the model adapting the resulting results for three possible outcomes, the course is predicted. The IM_III model was created that the success of the transformation will be partial, meaning that the agile solution will be implemented, while not all practices or artifacts of the methods used. Two problems may occur during the update: employee reluctance to change and low level of knowledge about manufacturing methods.

- **Revise**

In the period from November 2019 to January 2020, Autopay Mobility carried out an agile transformation process, implementing an agile approach to project management. As a result of the work, it was possible to implement the Scrum methodology, but not with all of its artifacts and elements. Currently, all teams in the Company, not only development teams, have adopted an iterative approach and use weekly planning meetings and retrospectives.

During the process, a low level of knowledge about the methodology and changes introduced in teams other than production, i.e. operational, sales and marketing, was observed. Training for them was conducted only a year after the transformation began, i.e. in November 2020.

During the implementation of the agile approach, no resistance from IT department employees to the new methodology was observed, but this may be due to the fact that most of the team's employees already had

experience with the Scrum methodology. Interestingly, such reluctance was observed especially among sales department employees, who encountered the new work mode and weekly task planning by the IT team without the possibility of changing the sprint during it. Moreover, a lack of appropriate tools was observed and after the implementation of the methodology, the company decided to implement Confluence Wiki and Jira tools supporting the work
in lightweight methodologies. Table 4 shows a comparison of the model prediction and the obtained results.

Table 4 The result of comparing the expected process with the actual one

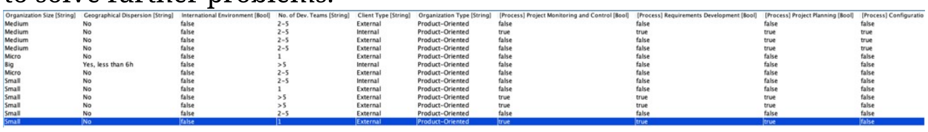
Variable	Expected mileage	Current mileage	Compatibility
Transformation success (V9)	Yes, partial	Yes, partial	**1**
[Problem] Employee reluctance (PR1)	True	True	**1**
[Problem] Low level of knowledge about the selected methodology (PR2)	True	True	**1**
[Problem] Low management commitment (PR3)	False	False	**1**
[Problem] No transformation process described (PR4)	False	False	**1**
[Issue] Problem with the availability of development team members (PR5)	False	False	**1**
[Issue] Missing Tools (PR6)	False	True	**0**

[Issue] Lack of shared vision (FP7)	False	False	**1**
[Problem] Changing the way employees think (working in iterations) (PR8)	False	False	**1**

Based on the above results, it can be seen that the IM_III Model in predictive verification was 88.88% effective. It correctly predicted the outcome of the transformation and the occurrence of problems with employee reluctance and lack of appropriate knowledge. However, it did not anticipate the lack of tools that were purchased from the Company after the transformation began. The first two problems could be prevented by following the model forecast and recommended actions. Decision-makers at Autopay Mobility should decide on greater involvement of all employees in the transformation process (both in the planning stage and in the course itself) and provide all employees with appropriate training to equalize the level of knowledge about the selected methodology before starting the TS. However, the forecast results of the IM_III Model were not known to the Company's decision-makers before the transformation process began.

- **Retain**

The case of Autopay Mobility Sp. z o. o., in accordance with the last stage of the 4R cycle known for the CBR method, has been saved to the case database and can be used
to solve further problems.



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Medium	No	false	2-5	Internal	Product-Oriented	true	true	true	true
Medium	No	false	2-5	External	Product-Oriented	false	false	true	true
Medium	No	false	2-5	External	Product-Oriented	false	false	true	true
Micro	No	false	1	External	Product-Oriented	false	false	false	false
Big	Yes, less than 6h	false	>5	Internal	Product-Oriented	false	false	false	false
Micro	No	false	2-5	External	Product-Oriented	false	false	false	false
Small	No	false	2-5	Internal	Product-Oriented	false	false	false	false
Small	No	false	1	External	Product-Oriented	false	false	false	false
Small	No	false	>5	External	Product-Oriented	true	true	true	false
Small	No	false	>5	External	Product-Oriented	true	true	true	false
Small	No	false	2-5	External	Product-Oriented	false	false	false	false
Small	No	false	1	External	Product-Oriented	true	true	true	false

Fig. 7. The case of Autopay Mobility Sp. z o. o. added to the case database[7]

[7] Own study

In this chapter, the authors presented the use of the IM_III model supporting the decision-making process of agile transformation in practice. The effectiveness of the model is almost 90%, which the authors considered a great success. The next chapter of this publication describes the conclusions drawn from the experiment and further steps and goals for research work on agile transformation.

4 Outcomes

In this article, the authors presented the possibility of using case-based reasoning to support the decision-making process in the field of agile transformation (making the decision to start it or postpone it). The result of the work carried out by the research team in recent years is a model for assessing the readiness of IT organizations for transformation, using the Case Based Reasoning (CBR) method. The first prototype of the model assumptions (IM_I) was created in 2014. As a result of quantitative and qualitative research, a second prototype of the assumptions for the IM_II model was created in 2015. The following year, the team repeated quantitative and qualitative research. Based on the results and using the association rules method, the IM_III model, a generic case and a database of 10 cases were built. In 2016, the team carried out a replicative verification of the model on the example of two organizations, achieving a forecast effectiveness of 88%. This result was considered a success, so a decision was made to conduct an experiment allowing for the predictive verification of the model.
In 2019, a study was started in Autopay Mobility Sp. z o. o. based in Warsaw, where the decision to start the transformation processes was made. Even before the ZT, the research team prepared a forecast of the transformation course using the IM_III model. In 2020, the organization completed the implementation of the Scrum methodology. The model predicted partial success of the transformation, which means that the organization will not implement all the artifacts of the selected methodology and there will be problems with employees' reluctance to change and a low level of knowledge among staff about the selected methodology. In fact, the transformation was partially successful and

both expected problems occurred. The model did not predict the lack of appropriate tools that were purchased from the Company after the transformation process. This result gives the model efficiency of 88%. This is the same result obtained during replicative verification. In the next stage of the research, the authors want to make the tool widely available for use by IT organizations and build the largest possible database of cases used for inferences.

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