Architecture and Simulation for the Fault Tolerance of Information Technology Difficulties

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Abstract: - The topic of this paper is focused on better information technology (IT) implementation and easier work with data. IT products have an important place in people's everyday activities. IT users work with data via a number of applications. They use computers, mobile devices, tablets as well as cloud solutions. Information technology includes verified methodologies, methods and tools for optimal IT implementation. Architecture plays the key role, but there are still controversies. The problems are budgets, time, aims and quality; therefore, many IT users run spreadsheets, such as MS Excel, for data analyses via sensitivity analyses, contingency tables or summaries. Implemented software must mirror the high level of diversity and variety of relations in the global information society, and also offer an intuitive interface for immediate use. In this situation, actively merged architecture and simulation help. Contribution this paper is the design of complex work with data based on a simulation via available intelligences. Specified innovation is focused on searching unexpected relations between data. There are created objects working with available intelligences as artificial, business, competitive, customer, swarm and computational. Designed solution was applied to "Open Case Duration". Such an approach offers a better support of fault tolerance of mistakes and errors in IT implementation and data processing. Simulations and intelligences show hidden changes in stored data and IT designers with data scientists better understand new relations.

Key-Words: - Architecture, data science, information technology, intelligence, simulation.

1 Introduction

Information technology (IT) creates an important field for the support of realised activities and work with data. IT users run applications and tools in many versions. Default support is focused on communication and queries via a web interface. Data, information and knowledge have close links to decision-making based on good orientation within the topic.

The volume of processed data is large and big data, data science or data intelligence require IT support. The default place for data storage is a database system. [15] Database systems are implemented in various forms as SQL databases, non-relation databases, object databases or cloud databases. The object databases [33] are based on an inspiration of objects from programming. The benefit is synergy between data and designed methods using this data. There is also a place for relation database systems [34] and their expansion regarding work with objects. A good example of such a database system is Oracle.

Data and databases are only one type of useful and natural relation. Modern society needs other approaches for working with big data via data science and data intelligence. [24] The reason is analyses and prognoses using the accessed data. Organisations, firms and individuals (IT users) prefer a certain level of stability and quality, but the global information society is a very dynamic and changing society. The default question is: "How should we use stored data for better knowledge and orientation in the market?"The answer to this question is related to unexpected and hidden information. [37] Business Intelligence and CRM (Customer Relationship Management) software helps, but there is not one universal solution. Information technology offers a wide spectrum of available products and systems.

IT users have good knowledge about the IT field. They easily run available applications and utilities

via the Internet and achieved knowledge is published in blogs, discussion groups or surveys. This reality helps in better IT application with the support of computers and intelligences. [40] IT users select the required software according to their own preferences, and also according to the recommendations of other IT users from the Internet. They prefer an easy approach, instant implementation and intuitive navigation based on visualisation. [2]

One basic requirement placed on IT products is stability and intuitive navigation (orientation) in the interface for quick and high-quality work with data. Every IT product offers help pages for optimal orientation in the application and implemented methods. Difficulties begin to appear with various preferences and interests of IT users. Many IT designers use defined standards and recommendations as verified methods and methodologies. Optimal inspiration is based on intelligences [29], multi-dimensions [4], objects [36] and simulation [19].

Working with data is a key area. First-level work with data focuses on supporting customer and supplier contact, orders and invoices, with links to stores and banks. There are many verified solutions, from easy to complex software. Second-level work with data focuses on analyses and prognoses from the stored data. There is no universal solution. IT designers and data scientists seek optimal implementation and design of the realised work. The optimal design of IT products is a responsible matter. Traditional work relies on data and a functional approach with supporting simulations in complexity. [23]

Objects, the multi-dimensional approach and intelligences integrated into one unit as a simulation must bring extremely sophisticated solutions with a minimum of mistakes and errors. Unfortunately, IT users have other experiences. Many IT specialists monitor existing problems and difficulties from IT users based on experiences from implemented software and work with data. [32]

Mistakes happen and fault tolerance to them is not at a maximum level. Basic hardware errors are solved extremely quickly based on a redundancy of hardware components, but there are challenges from the software area and work with data. [42] For default work with data, the IT user needs an operation and database system linked to a selected application like a CRM or Business Intelligence information system. The available operating and database systems are in good condition. IT products from CRM and Business Intelligence also create an optimal base for basic work with data. IT users have interrupted access to data. This reality is based on the adopted architecture and realised simulations. To carry out this work, IT designers and data scientists must possess optimal skills and knowledge gained through the cooperation with other IT users.

The remainder of this paper is structured into five sections. Object of interest is importance of architecture in software development, existing problem and controversy, simulation for support of fault tolerance, achieved benefit with a discussion, conclusion and references.

2 The Importance of Architecture in Software Development

Architecture is an established term which is used in a number of fields. The aim is a description of the needed objects and the relations between them. Architecture is also important for information technology.

It is commonly believed that architecture is used to describe existing structures. [10] Art and science, which specify the style of design and method of construction of individual structures, has an essential place here. [43, 21] This inspirational approach defines:

- Building architecture as the art and science of designing and erecting buildings.
- Medicine as the art or science of treating disease with drugs or curative substances.
- IT architecture as the art or science of designing and delivering valuable technology strategies.

For information technology, architecture is focused on various IT products. Their authors create a design of the optimal architecture of selected objects for unique stability software and applications. There are interesting solutions for products of information technology such as operating and database systems, CRM products and Business Intelligence.

The above-mentioned list consists of only a small part of the examples where architecture has a needed usage. There are various solutions from the simple to the complex. The degree of complexity is different in terms of authors and IT products. Unfortunately, the degree of complexity does not create a mirror for the degree of stability and the quick implementation of IT products. There are major differences between the individual IT products. Additional excellent definitions of IT

architecture are, for example specification of results [14], method creating [31], way of integration of information technology [26], and style work [6].

IT users have a number of expectations with a link to software. They need immediate support without mistakes and difficulties. The problems create processes which transform data concerning knowledge for optimal decision-making. This approach is complicated and there are no unique solutions. Architecture may help in the areas of organization of strategies and processes, integration of technology projects in business, and also specification of business value based on technology. [3]

The importance of architecture is shown by the following preferences from practice. IT users evaluate higher financial improvement (saving money and available scenarios), relation to society (growth in customers and partners, increasing cooperation and satisfaction), conceptual integrity (eliminating unnecessary system), performance development (interest in growth and innovations, exploring new initiatives), and risk identification (support of sustainable development and market democracy). [1]

Based on the above-mentioned views on architecture, there are number of visions and ideas. This spectrum provides both benefits and negatives. The benefits are focused on the use of IT architecture in various conditions in respected limits. The negatives are focused on the ambiguity which may provide a source of resentment, misunderstanding or mistakes. The differences between the positives and negatives are reflected in the differences between the respected limits and mistakes. The question is "When does the presented solution evaluate within respected limits and when is this same solution a mistake?". This divergence introduces existing controversies into information technology.

3 Existing Problem and Controversy

Information technology influences all activities in various fields of human activities. It is the default tool for everyday work with data, but also information technology brings inspiration for active solution to existing problems. From this point of view, information technology is one of the most important fields. There are verified methods and methodologies for optimal IT implementation in practice with a link to major data and computational intelligence. [8] A corresponding interest is focused on IT architecture.

Information technology, in contrast, has to solve difficulties and problems. It is difficult to read that IT users and IT projects have problems and all the realized works are not successful, or that IT users prefer MS Excel over complicated software. Out of the numerous examples, a list is provided of some of them:

- Excel is powerful and has a place in business processes worldwide – based on the idea that you can do anything with a spreadsheet. [11]
- About 37% of business process projects fail in terms of benefits. [35]
- Excel is the most widely used tool – 86% of respondents chose Excel. [9]
- 45% of large IT projects are over budget, 7% over time, and 56% bring less benefits. [25]
- 75% of respondents confirm – projects are usually "doomed right" from the start. [13]
- About 50% of respondents say the project failed in the adopted aims. [22]
- Only 40% of projects met schedule, budget and quality goals. [17]
- IT projects frequently fail – a number of large projects fail between 50%-80%. [30]

A number of recommendations and advice are available in the scholarly literature and on the Internet. The main focus is on the aim [28], cooperation [38], detail description [41], methodology [12], monitoring [18], relations to business [16] and verification [5].

The natural question is "Why do such controversies exist?", and "How can these difficulties be solved by information technology?". Mistakes are often linked to human skills and poor decisions in the given environment. IT projects should lead to optimal support via installed software or applications. The basic condition is to provide the needed information.

Generally, data is stored in database systems. Modern information technology has unique tools and methods for correct solution of this task. Similarly, there are well-known query languages for selection data from a database with visualization support. Good examples from practice, advice and experiences are shared via the Internet, and the available knowledge is disseminated extremely quickly, although the difficulties bring about diversity and frequency relations.

There are many views concerning an attractive solution. Created teams of IT designers work under various conditions and communication is difficult. Various conditions are linked to the internal and external environment. Rate changes complicate the actual perception of the solution. Another difficulty is the frequency of relations. The processed data is examined from a number of contexts. It is difficult to maintain the interplay of individual differences. Existing crises indicate that people do not understand these changes and their frequency with relations. The solution may lead to the use of simulations and learning about unexpected conditions from them based on intelligences.

4 Simulation for Support of Fault Tolerance

Simulation is one of the useful tools for an analysis created view on existing reality. The benefit from simulation is based on an acceptable simplification of reality into a model (simulation). An additional positive aspect relies on active work with the created simulation. The simulation may be modified by the preferences of the author with the goal of answering the given questions.

For many development teams, simulation represents a tool for manipulation with existing data linked to a wide spectrum of relations without other costs. All the changes are realized in an environment of simulation: the created object may be deleted, a new object may be created, or the existing object may be edited by a mouse. These changes depend on the author's intuition and the courage to try a new arrangement for the adopted solution.

A similar situation applies for simulation of architecture adopted solutions for IT products. Objects with links to actual reality have an important place. The actual reality is described well by various intelligences such as artificial, business, competitive, customer, swarm and computational. Effective simulation must consequently use these intelligences for a suitable description of existing relations (visible and hidden). The visible relations between data are well-known and IT designers are familiar with them. These relations create the basis for searching for a hidden relation via intelligences. The designed architecture of such a view (simulation) is shown in Fig. 1.

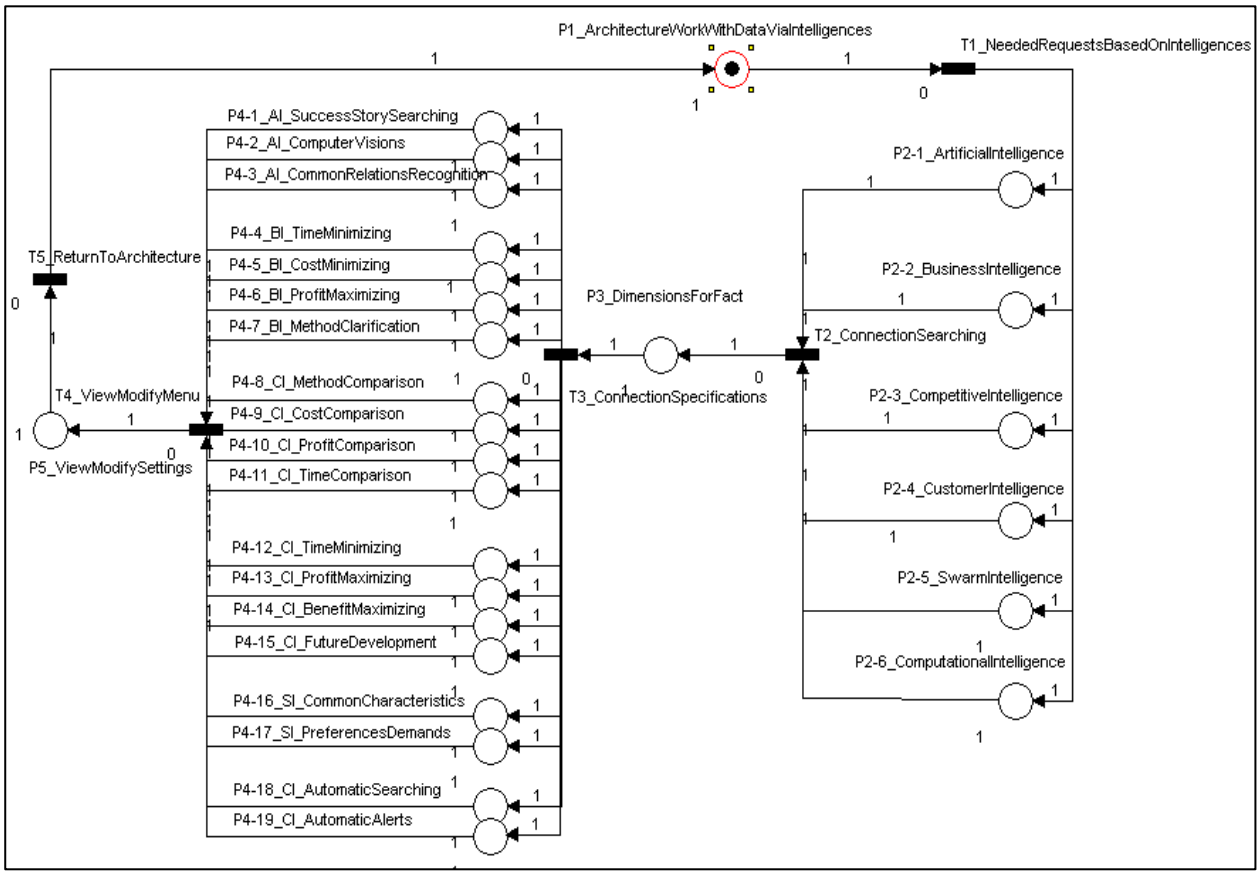

Fig. 1: An architecture of active work with data based on dimensions (intelligences) and objects.

Active work with data uses also various intelligences for description existing relations. Detail description relays on well-known rules in selected intelligence. Complications are brought about by higher requirements on the skills of the development team, continuous switching between selected intelligences, although the benefit is clear to searching for unexpected relations and setting of the fault tolerance at a maximum level.

The mentioned Fig. 1 describes the architecture of work with data focusing on selected fact – Open Case Duration. This variable describes the volume of time needed for a solution of the customer requirement. It is the default item at the centre of interest from the view of suppliers and customers. One can look at this item from the perspective of various intelligences as artificial, business, competitive, customer, swarm and computational.

Artificial intelligence is process that releases the idea for benefits and advantages. This process works with stored data and available information. Modern approaches use also artificial intelligence with machine learning. Of interest is, for example, searching of success stories, computer visions and recognition of common relations.

Business intelligence is focused on business and relations between suppliers and customers are defined for maximizing profit. Of key importance is obtaining needed information at a given time and in a suitable format for support of optimal decision-making. Of interest is, for example, minimizing solution time, minimizing cost solutions, maximizing profits for solution, or clarification of the specified method for solutions for similar cases in the future.

Competitive intelligence and competition influences all the objects in global society. Companies and individuals face major pressure from other objects which provide better services and products. The market gap and existing barriers for market entry have a key place. Of interest is, for example, a comparison of the solution of the method with competitors, a comparison of the achieved costs and profit with competition, or a comparison of the available time with other companies.

Customer intelligence is focused on better services and products for customers. The goal is higher customer loyalty, satisfaction, and an improved market position for company realization of services or sales. Of interest is, for example, minimizing the solution time, maximizing profits for solutions, or links on other benefits and future development.

Swarm intelligence is focused on an evaluation of the collective behavior of individuals in a swarm. The basic inspiration has a link to nature and the behavior of animals such as birds, fish or ants. In a global information society, people (IT users) also represent individuals who are collected into swarms via the Internet. Their activities are compared with swarm intelligence. Of interest is, for example, the common characteristic of customer behavior, existing preferences and demands. A similar interest is focused on competition and its possibilities.

Computational intelligence creates last object of interest for above designed architecture work with data. Computers are a standard device for work with data. Operating and database systems create a solid background for using Customer Relationship Management and a data warehouse with a link to Business Intelligence. Unfortunately, the volume of data is so vast that searching for relations between data and a suitable architecture of work is extremely difficult. There is no unique solution, and analytical work will increasingly rely on computers. Of interest is, for example, automatic searching of relations between data and providing advice, alerts, or recommendations based on experiences which are stored on computers and IT products.

The above-mentioned examples are only created with links to “Open Case Duration” as fact that is interested for business. There are many more existing links with actual preferences and priorities from a number of perceptions of reality.

The actual design of the adopted solution is also complicated via the spectrum of level of importance. Business intelligence is important for one solution, but computational intelligence is not a priority. Customer intelligence is important for other solutions, but swarm intelligence is not a priority. For the next solution, swarm and computational intelligence are an important part of all the solutions. A pragmatic solution to this reality is to establish the key indicators for all the intelligences. These indicators reflect an interest in the given reality from a selected dimension (intelligences) via the numbers “1” and “0”. Number “1” indicates that there is an interest in such links, and number “0” indicates that there is no interest in such links. This work design may be more transparent via a sequence of numbers from 0 to 1 by individual preferences (for example, 0.1, 0.2, 0.3, …, 0.9).

5 Achieved Benefit with a Discussion

IT products always reflect the needs of IT users by actual conditions. In a global information society, IT users work with a number of IT products with interest. For IT products, the key is the adopted architecture based on a precise work design with

stored data. There is no unique approach, but IT products may offer a better environment for work with a higher fault tolerance for mistakes and errors. One way consists of complex work via intelligences, but there are also other solutions. There is interest in:

- Complexity and international development [20]

There are differences between recognizing the complexity of a development problem. The focus is on selecting optimal methods of the academic complexity of the science to study this complexity.

- Working in Complexity [27]

The question is the complexity of science and the realized work. The complexity of science is described as the study of complex adaptive systems, and the understanding of complex problems is focused on their differences from other types of problems.

- Complexity theory and international development [7]

Available tools for programming and administration are focused on capacities and agreed goals. When these tools are used for a complex problem, however, they bring about a result which is controversial in the form of formal systems with box-ticking exercises, and where the declared goals are not met. There is also a question concerning whether "Development problems are complex?".

- Complexity in software development [39]

The complexity is evaluated as piece software which is derived from two different systems or models. There is an interest on focusing on problems of domain, technical architecture, decomposition and integration, abstraction, and other complexities with links to a system of humans, the project team and the customer team.

In all the above-mentioned studies, the complexity and existed controversies create default conditions in a global information society. These kinds of conditions have a close connection to higher entropy and the dynamics of relationships. There is no question about their importance. IT designers and scientists have to explore new relationships.

Work with data relies on relationships (connections) between data. There are verified connections for standard work with data, but many from these connections must be found. Intelligence has key place for active searching unexpected connection between data. Future work will focused on detailed work with data via artificial, swarm and computational intelligences to get instant solution. Additional intelligences will be added by preferences and improved knowledge. This work will be focused on an improved description of interactions between well-known intelligences for fault tolerance at a higher level of support for optimal IT architecture.

6 Conclusion

The history of information technology brings many successful solutions, but also many mistakes and difficulties. A positive advantage is the inspiration that information technology offers to other fields for problem solution. The challenge is to set the fault tolerance at a maximum level with support intelligences, multi-dimensions and objects integrated into simulation.

IT products rely on verified methods and methodologies for optimal application. There are standards and many IT developers use these solutions. Unfortunately, the existing diversity and frequent relations cause difficulties via various IT user preferences and market conditions. This diversity creates chaos and disorder. These negatives can be actively prevented through the use of simulations for better data analyses and predictions in the global information society.

Simulation is a standard method for verifying model behaviour in given conditions. The simulation starts with default inputs, but these inputs (conditions, preferences) may be changed by preferences and intuition. Data scientists and IT designers evaluate these simulations from various dimensions (views) with links to existing intelligences (artificial, business, competitive, customer, swarm and computational). The benefit is a complex description of existing and hidden relations for the maximum level of fault tolerance.

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