ADAPTIVE MODELING OF BUSINESS OBJECTS

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Abstact. *This study examines the main points in building business models and the possibilities for their information provision. The current modeling mechanisms for business processes and the impact of the model on the implementation of software projects in the field of business management are examined. The problems of the software development of adaptive business structures, generated by the application of the existing modeling and programming technologies, are analyzed.*

The study aims to find a new approach of creating business processes which are evolving over time using non relational data bases with external logic. This type of data bases can provide flexibility and ability to make changes easily and without consequences for the data integrity. As a result we can achieve an easily maintained business object which is sustainable to drastic changes and manipulations in the course of time.

Keywords: *Business object; adaptive model of business object; information provision; non-relational database with external logic of the data.*

Introduction

The building process is always preceded by modeling, in some cases modeling may be unconscious, but there is always such a modeling process. Of particular importance is the modeling of activities carried out by automated systems, their work is unthinkable without prior clarification of the essence of the processes that are automated and the results to be obtained. One of the goals of the present work is to show the mechanisms in building efficient models so that the automated systems they perform will work as efficiently as possible.

Modeling has a relatively universal character in the sense that models can be made of any kind of processes, activities and structures from adaptive objects. In this article, we will look at the modeling and information provision built on its basis, mainly in the sphere of business activities.

1. Business Objects (BO) and Business Processes

Definition:

The business object is a unified structure that carries out external and/or internal creative activities. [1]

Business object (BO) usually identifies itself with a company (a business entity, an enterprise), but this is a very limited consideration. These structures form a large class of objects, which include not only corporate business objects but also public, state, military etc. structures. It is important to emphasize that these objects have the same behavior and are close to external (relative to the environment) and internal (relative to the single structure) reactions with similar external and/or internal effects. This circumstance makes it possible to make sufficiently precise assumptions about the possible reactions of the BO to specific external and/or internal impacts, i.e. they lend themselves to modeling and management.

Although there are no reliable mathematical models to describe them, the workings of these objects can be modeled with satisfactory accuracy based on abstract or more specific models of the processes that take place in them.

Definition:

The business process is a connected set of single and/or iterative actions that convert inbound and/or internal resources into pre-established rules to create benefits for the business site. [1]

For example, if BO is a company, then business processes cover the flow of business and commercial activities carried out by and in the company to achieve a commercial (organizational, production) goal.

2. Models and modeling of business processes.

The model, as a concept and means of achieving different goals, has always been used in practice and science.

We distinguish different types of models depending on:

- The subject area being modeled;
- The techniques used in their construction;
- The goals to be set when building them, and so on.

There are different aspects of building the business model [2]. Depending on the goals that are set in the implementation of a model, we can distinguish models of:

- Methods of doing business;
- Business architecture of the company;
- Information provision of business activities, etc.;

Often the successful work of BO - economic growth, good work with contractors, automation of its activities, is attributed to the viability of the built model.

The business model concept [3]:

- Helps to determine the goals of BO;
- Facilitates the identification of the indicators to be implemented with the BO management systems;
- Enhanced integration between the activities carried out and the tools for their automation;
- Helps to develop new IT security at BO;

An essential part of each model is the description of processes and activities that run in/from the modeled object. By analogy, processes in BO are called business processes. There are different methodologies and standards [4] that describe business processes: Unified Modeling Language [5] (UML); Process Modeling Notation Business [6] (BPMN); Business Process Execution Language [7] (BPEL), etc.

A characteristic feature of modeling is:

1) Processes that are relatively self-contained and generally do not describe the overall work (activity) of the site in which the process is performed are modeled;

2) High abstraction when describing the elements of the model;

This holds true for BO modeling - in this case it is straightforward to talk about Business Process Modeling (BPM). **The "BO model" is not used and it does not make models of the entire business object.**

3. Information provision of business objects.

The management decision to perform modeling of activities and processes in BO is usually dictated by the need to:

- increase the economic profitability of BO
- increase the quality of the activities carried out in the BO
- reduce the working time of production activities
- realize new productions
- automate current activities, etc. (economic, organizational, production, logistics tasks)

Several tools are used to implement different models, but in any case more complex models can’t be implemented without the availability of appropriate software products. For the purposes of our research under the information provision of BO we will understand the definition below.

Definition:

The set of software products, information technologies, computer hardware and network hardware, as well as the relevant human resources used in the management and operation of a business site, will be called information provision of BO.

There are various tools to build the BO models, but when it comes to providing information on the work of the BO there are not always ready information solutions. It is then necessary to develop and implement appropriate software with the appropriate supporting IT solutions.

The business information process of the business object is cyclical (Figure 1) and in this respect the rules of the traditional approaches and technologies for software development (Extreme Programming - XP, Adaptive System Development Method (DSDM), Adaptive Software Development (ASD) Feature Driven Development - FDD, Kanban, Scrum). From the diagram shown in Figure 1, it can be seen that the better the business object model, the better information tools for management and work will be obtained, so exploring the opportunities for creating good business models is essential.

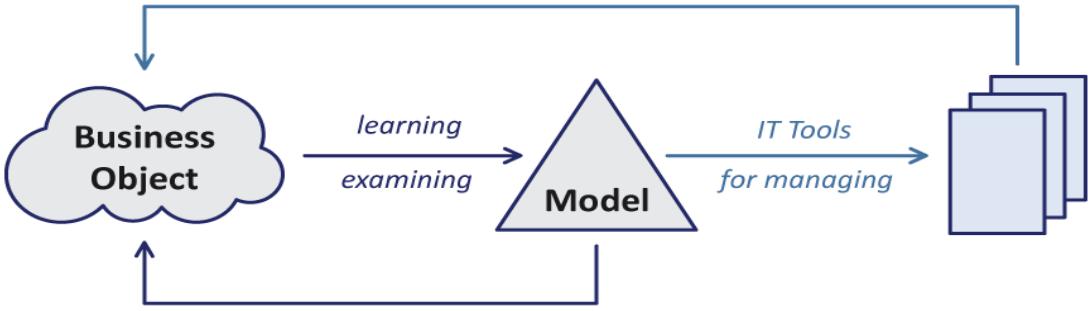

Figure1. Process of Information provision of Business Objects. [1]

Building support software puts more specific and strict requirements to the previous model. In this case, the model should be sufficiently detailed, accurate and consistent with the IT capabilities to build its informational provision, including instructions on the format, type, and functionality of the user and programming interface.

4. Problems in building BO models

The increased requirements in the implementation of quality information provision of BO to the contents of the model show some shortcomings in the existing approaches and modeling tools.

4.1. A complete model of BO can't be built

The construction of the model is considered as "Simplified description and presentation of a complex entity or process" [3].

This belief is confirmed by the actual design of the model. BOs are complex structures, and in their study (modeling) the abstraction and generalization principle is applied to facilitate modeling work. When a model of an object is made, it is practically modeled not the object itself - as it is, but something more abstract and with more limited functionalities, which, although it resembles the model object, is not it.

No matter how well a business object model is built, it is at some point. Over time, conditions and parameters change, and the original model no longer fully corresponds to reality. The business activities and processes are dynamic, i.e. they change over time for various reasons: financial, technological, legal, target, etc. This dynamics also needs to be taken into account when modeling the processes and in practice means that the BO model should change over time if we want to have some good match between the model object and the model.

Because of the great complexity of processes and volume of parameters, it is not possible to build a complete business model. Hence there are some serious limitations, inaccuracies and discrepancies that contradict the goals of creating its software base and are an obstacle to building quality service software.

In all cases, the built-in BO model has a high degree of abstraction. Under these conditions, it is difficult to assess the quality of the model obtained, the extent to which it corresponds to the BO, and how accurate the conclusions of such modeling are. This approach may well be good for some types of models, but models are not good for building information security. For example, as much as the cycle to do in building the business information (Figure 1), there will

always be something different in the service software that needs to be completed and/or build(either due to a change in time or due to an inaccurate description).

4.2. The data model has a significant impact on the modeling capabilities of BO

Each model (including the business site) consists of two relatively independent parts (Figure 2):

- model of business processes;
- data model;

It is important to build an accurate model of business processes in BO, because in the process of building the information provision the business process model directly affects the type and functionality of the user interface of the software products built on its base (Figure 2).

The modeling technologies used, the model of processes and the data model are practically two separate models. They differ not only in the syntax of their description (Figure 3 and Figure 4), but also in influencing the end result of the modeling process - the development of information provision of the BO. Practically, the data model directly affects the process of implementing the serving software. The process model should be reflected in the data model because whatever processes we have, if they are not provided with the relevant data, the implemented software will not serve the quality parameters set in the process model.

From a practical point of view, the data model is leading to the end result of the business model. If the databases can’t provide the appropriate quantitative and qualitative characteristics of the data needed to process the process, no matter how good the process model is, the service software will not be good and the corresponding goals in the business model will not be achieved.

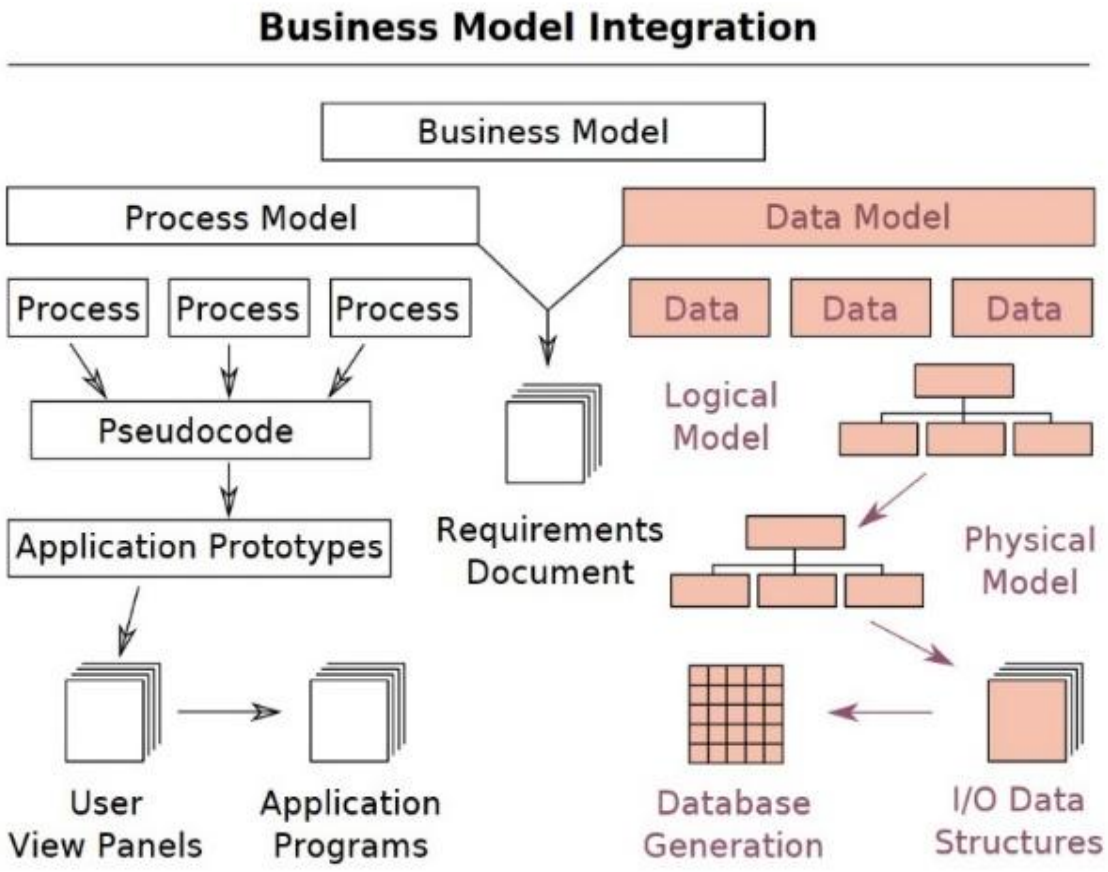

Figure 2. Business model scheme and relationship between process model and data model [8]

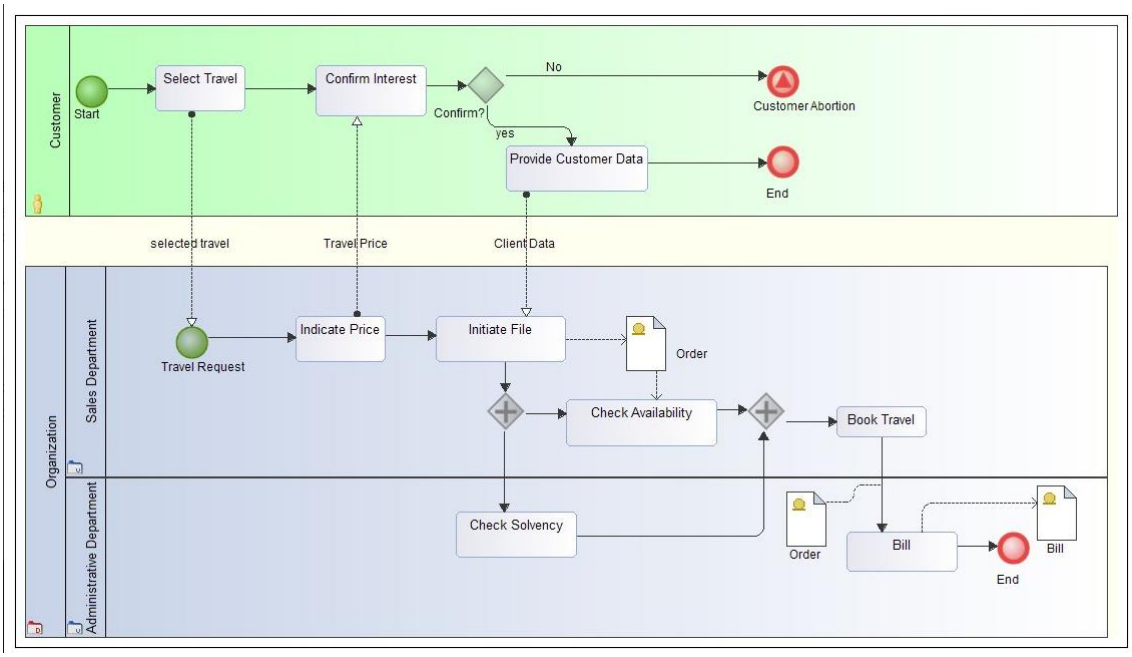

Figure 3. BPMN process model for customer orders

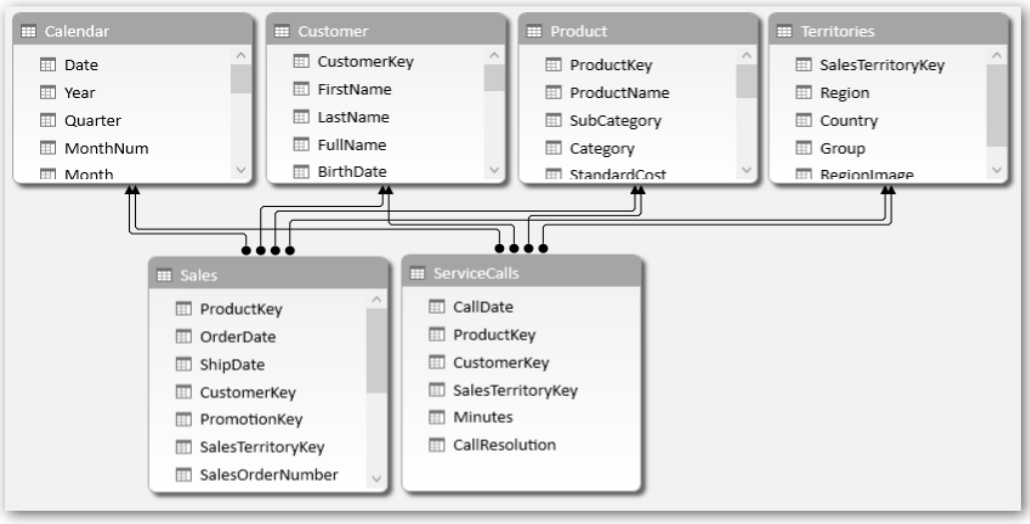

Figure 4. ERT scheme describing the data and the links between them, the sales process

4.3. Building models requires a lot of time and resources

With graphical modeling tools, complex, multi-dimensional and temporal objects can't easily be modeled. In some cases, the construction of the model takes months of work of highly qualified specialists. More significant changes to the model engage resources that are comparable to those initially built.

As a consequence, business processes are usually modeled, but business modeling (or comparable objects) is not done.

5. Problems in the information provision of the BO.

Information technologies are widely used at all levels of management, production, public and private life. They have their well-deserved successes and achievements. The task we have set is to examine the failures in the work of these technologies and in particular in their application in the field of information security of the BO in order to analyze the reasons for these failures and to propose a mechanism for their overcoming.

There are many examples of how poor models, poorly implemented information technologies, poor performance, etc. can be found. Software projects for hundreds and billions of dollars have failed. Due to the objectives of our work, we focused on the analysis of failures due to poor modeling and improperly applied information technologies (failures due to program code errors are not subject to work).

In 2006, the US Census Bureau made a plan to use 500,000 portable devices purchased by Harris Corp. under a $ 600 million contract. After doubling the cost of devices and order problems, a representative of Miter Corp., who advises the Bureau on matters of information technology, recommends to the Bureau: "It is unclear whether the system will respond to the operational needs and the quality objectives of the census."

Extreme costs are unpredictable: immediate and significant changes are needed to save the program. However, the risks are so high considering the

time available, so we recommend immediate development of contingency plans for returning to paper operations."

In the early 1990s, FoxMeyer, a healthcare provider, was the fifth largest drug wholesaler in the United States with annual sales of $ 5 billion and about 500,000 items delivered daily. FoxMeyer decided to build a real-time ERP system for real-time sales based on SAP technology, costing $ 65 million, of which: 4.8 million for HP server configurations; 4 million are SAP software; about 35 million for consulting services; the rest for the construction of an automated warehouse. After spending over $100 million, the project is a complete catastrophe for FoxMeyer. It is reported [11] that "failure is the result of:

- Poor planning: bad selection of ERP;
- Do not taking into account the advice of other consultants;
- Lack of contingency plans;
- No end user involvement and poor performance;
- No business process restructuring;
- Insufficient testing;
- Overly ambitious scope of the project;
- Dominating the interests of IT specialists;
- Poor support for project management;
- Lack of cooperation between end-users."

In the middle of 2018 the eLWIS project was declared dead [12]. After 7 years of work, and after approximately € 500 million, Lidl and the German software company SAP have been discontinuing their joint project - building a new inventory control system across the company, which has nearly 100 billion Euros of annual revenue. The main reason why the introduction of the new software necessitates a reassessment of almost every process in the company is that the Lidl's management is not in the position to do it. In a letter to the staff, Lidl's chief Jesper Hoyer writes: "Initially defined strategic goals were not

possible at an acceptable cost." In Lidl, the desired adjustments led to extremely high costs for consultants and system integration. Changing existing software is like changing a prefabricated house, say IT experts - you can put kitchen cabinets elsewhere, but when you start moving the walls there is no stability.

On the other hand, Jean-Claude Flori, an IT manager working in the pharmaceutical industry, and also head of the DSAG SAP Consumer Group, says: "If a company wants to use standard software, it needs to adapt its own processes to the software. Responsible for the failure is the company, not the software." [13]

The German IT consultancy company KPS, which was supposed to lead the transformation, was identified as a scapegoat for the failure. SAP only provided the software - KPS had to manage the Lidl adaptation procedures. Lidl critics say KPS is too slow.

But Matthias Nollenberger, KPS Senior Manager, responsible for overseeing the eLWIS project, says his company is working too soon in relation to other similar projects and that the pilot phases of the project in Austria, the United States and Northern Ireland have been achieved on time [12].

Although SAP AG is one of the world's most popular software developers in the corporate segment, it has a brilliant image and the client can’t "go wrong" in choosing SAP, it does not yet offer the right solution for any project / company. The lack of correction flexibility, excessive use of numerous external consultants and complex performance complicate the success of the project, especially for companies that do not want to completely change their previous processes but rather "only" want to improve. And this is not typical of SAP alone.

6. Adaptive modeling of BO

The examples presented above show:

1 The main reason for the failure was the changes in the initial model of the project and the inability to quickly implement the changes in the practical implementation of the service software.

2 Another important conclusion that can be made is that when a business process is automated in the business model, it is not only the specific process that should be considered, but it is good for the model to cover a wider area. However difficult it may be, the model should cover the whole object. Ignoring this rule leads to unsatisfactory results, and often to a complete failure of the project.

3 There is no good opportunity to rapidly change service software when changes to the original project model in the existing BO are made. The coverage of changes in already-made software in many cases leads to substantial adjustments in both the program code and the need for complex migration of databases, which, in addition to taking a lot of time to implement, is also a very expensive process. In some cases, it may not be possible to fix the software in this way and the only solution is to make a new software product.

In existing modeling technologies, there are opportunities for changes and upgrades to a built-in model of processes. We can combine different patterns, but usually this unification takes place successively, with the relationship between the two models taking place over a single point. While there may be some unification in the process model, merging two or more data models is virtually impossible, and in general, when a pattern reunion is required, a new data model is made that reflects the changes that are taking place.

It can be said that the built business models have a relatively static character and difficult to cope with reflecting changes in the modeling environment.

To solve these problems, we offer a new approach to building business models, which we will call **Adaptive modeling**.

Definition:

The possibility of a BO model to change, complement and develop over time including through the possibility of uniting two or more models we will call adaptive modeling of this BO

A prerequisite for the availability of technology that supports and carries out the development of adaptive models and their associated software is:

1 Introduce changes to the basic scheme of the static business model (Figure 2). It is necessary for the database model to lose its importance as a determinant and leader in the development of the common business model. In this regard, we propose a new approach to describe the business model in which the data model becomes part of the process model rather than separated into a separate structure. In this way, the change of the process model leads to the change of the data that serves these processes, which also allows the manipulation with several models (merging and deleting).

2 Have a DBMS with more specific data handling features available:

a) to be able to adaptively change the types (semantics) of the data

b) possibility of adaptive connections between data, i.e. which can be changed and/or created new in the operation of the serving software

3 Have a program framework available to implement such projects.

7. Information provision of adaptive models

The main reason for the emerging problems in building the information provision of the BO in the change of the initial model of the project is the use of relational databases in the work of the servicing software. Relational databases have shown their good points in relatively static models, but we can see (examples) that there are significant drawbacks when using them when a change is made to the service software already built.

Disadvantages in these cases are related to:

1 The presence of metadata in the description of the data, which is an integral part of the DBMS.

2 Hard links between data whose change becomes difficult (migrations).

3 Metadata are the basis for the implementation of data management processes.

4 Serious increase in the process of building and maintenance of software products (Figure 5), and in some cases the impossibility of upgrading the built-in software products. It is reported that the quality of the relational database models, on the basis of which the applied information systems and the corresponding user interfaces are being developed, is not good because [9]:

   – Business process rules describing how things are done at a particular location in a business site are often fixed in the structure of the data model. It follows that minor changes in the way the business process takes place lead to major changes in the information system interfaces;

   – Kinds of entities are often not identified or misidentified. This may lead to duplication of data, data structures and functionalities, as well as the costs associated with such development, correction and maintenance iterations;

- Data models for different information systems are substantially different. The result is that additional complex interfaces between the systems that need to share data need to be built. These interfaces may cost from 25 to 70% of the value of the particular systems;
- data can't be shared electronically with other business objects because the structure and meaning of the data are not standardized.

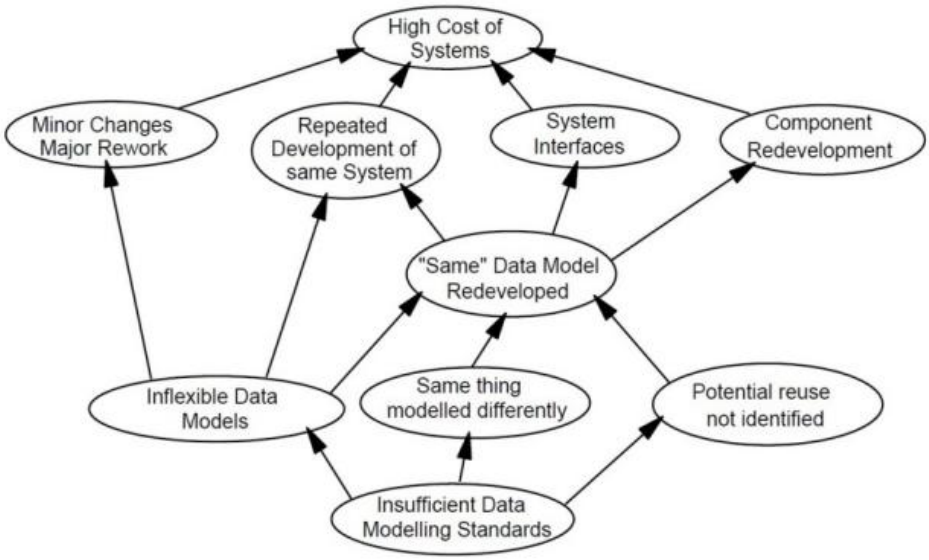

Figure 5. Some problems stemming from the current approach to the description of the data model [9]

We have found out that an appropriate tool for the program implementation of adaptive business models is non-relational databases. Essential requirement is that the data in them is not related to any additional descriptions and links (table and relationship schemes, or JSON documents and keys).

A potential candidate for such a means of realizing adaptive business models is nonrelated external logical databases [1]. They meet all the requirements mentioned above:

1. The description of the type of data is outside the scope of the DBMS. These features are defined in the programming interface and may vary or vary depending on the situation;

2. Links between data that are reflected in some way in databases are not supported. Between the data, it is possible to build dynamically connections for the specific part of the supporting software. This feature of external logic databases is reflected in Figure 6 and practically work only on a physical data level. The work of the logical and conceptual level is exported to the programming interface;

3. Access to data is done with spatial coordinates (similar to mathematical coverage of spatial coordinates). The variety of access capabilities provided in this type of database corresponds to a great extent to the requirements of dinamics and changes, both in existing structures and in the growth and integration of different models;

4. Enables easy online analytical processing (OLAP) of data;

5. It is possible to apply different mathematical algorithms for both processing and access to data. For example, the built-in natural language addressing mechanism (NLA) [10] is a powerful tool for accessing data with the same characteristics regardless of which model the request will be made to;

6. Last but not least, these databases can be embedded in the program interface of the BO service programs, which facilitates the work of both software producers and end-users;

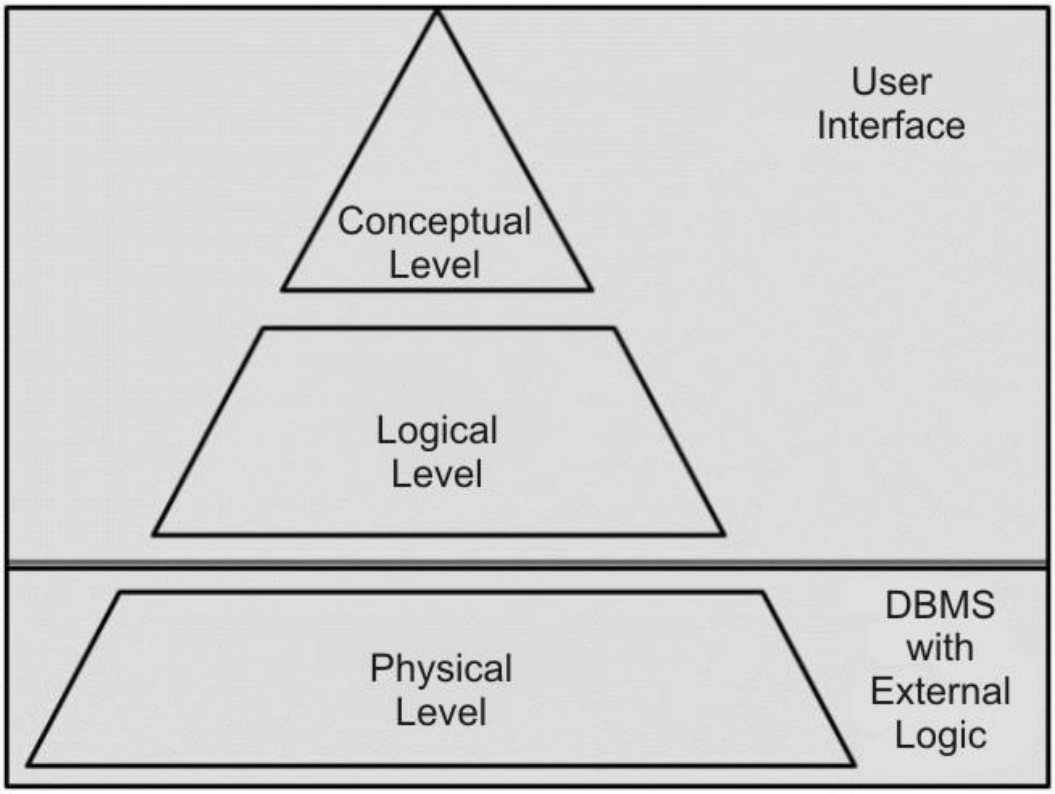

Figure 6. Scope of DBMS with external logic of data on the data model [1]

Conclusion

From the practical experience, we have in the implementation of various software projects, we think that relational databases as a tool for building models for their informational provision have significant drawbacks. Our search for new tools and technologies in this direction shows that good alternatives for building quality business models are the non-relational databases with external logic of the data.

In our next work, we will focus on demonstrating the specific advantages of these databases and comparing comparable software built with relational database models and non-relational databases with external logic. Our goal will be to show with practical examples the faithfulness of our statements in this material.

Bibliography

[1] А. Ризов, И. Митов, Кр. Иванова; Моделиране на бизнес обекти чрез СУБД с външна логика на данните; Национална конференция по информатика, посветена на 80 г. от рождението на проф. П. Бърнев, София, 2016

[2] Amy Lo and Eric Yu, From Business Models to Service-Oriented Design: A Reference Catalog Approach, ftp://learning.cs.toronto.edu/public_html/pub/eric/ER07-Lo.pdf

[3] Osterwalder, A., Pigneur, Y., Tucci, C.L. Clarifying Business Models: Origins, Present, and Future of the Concept. In Communications of the AIS, Vol. 15, Article, May 2005.

[4] http://tuj.asenevtsi.com/BIS09/BIS47.htm

[5] Petre, Marian (2013). UML in practice (PDF). 35th International Conference on Software Engineering 18–26 May 2013. pp. 722–731. The majority of those interviewed simply do not use UML, and those who do use it tend to do so selectively and often informally

[6] Ramollari, E., D. Dranidis, A. J. H. Simons: A Survey of Service Oriented Development Methodologies, In Proceedings of the 2nd European Young Researchers Workshop on Service Oriented Computing, 11-12 June 2007, Leicester, UK, pp. 75-80.

[7] http://www.service-architecture.com/articles/web-services/business_process_execution_language_for_web_services_bpel4ws.html

[8] Paul R. Smith & Richard Sarfaty (1993). Creating a strategic plan for configuration management using Computer Aided Software Engineering (CASE) tools. Paper For 1993 National DOE/Contractors and Facilities CAD/CAE User's Group.

[9] Matthew West; Developing High Quality Data Models; EPISTLE; Shell International Limited ISCL/4, Shell Centre, London, SE1 7NA, UK; 12 December 2015

[10] Krassimir Markov, Krassimira Ivanova, Vitalii Velychko, Koen Vanhoof, Juan Castellanos; Natural Language Addressing; ITHEA; Sofia – Hasselt – Kyiv – Madrid 2015

[11] https://www.exoplatform.com/blog/2017/08/01/5-of-the-biggest-information-technology-failures-and-scares/

[12] https://www.handelsblatt.com/today/companies/programmed-for-disaster-lidl-software-disaster-another-example-of-germanys-digital-failure/23582902.html?ticket=ST-1128831-bjUmxXwvozNKLII4cBNJ-ap5

[13] https://www.consultancy.uk/news/18243/lidl-cancels-sap-introduction-having-sunk-500-million-into-it

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