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Business Process Management:

A Data Mining Approach To Analyze Business Process Simulation Data For Decision Making

VDM
Verlag Dr. Müller

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Introduction

Aim of this work is to show how it is possible, inside the context of Business Process Management (BPM), to develop a tool for supporting management in decision making. More specifically, it will be shown how to develop a multidimensional data model (data cube) to support management with their efforts in understanding, planning and improving business processes. In contrary to the traditional approach of defining a customized multidimensional data model for analyzing operational data, this work aims at defining a standardized multidimensional data model for analyzing simulation data that can be applied to any business process model.

The proposed approach will focus on the Communication Structure Analysis (CSA) modeling methodology, and more specifically on the BONAPART® business process modeling tool. The approach could be adapted to fit other modeling methods and tools, but this issue is beyond the scope of this work.

This work is divided into four chapters.

In the first chapter the concept of Business Process Management will be introduced and explained. It will also be shown how business process modeling and simulation fit into the context of Business Process Management.

The second chapter will introduce and explain the Communication Structure Analysis methodology and its simulation model.

In the third chapter, a standardized multidimensional data model for business processes and the simulation data will be developed.

The fourth and final chapter will present a summary, conclusions and thoughts for future work.

Chapter 1: Business Process Management

1.1 Introduction

Business Process Management (BPM) is about the management of business processes. It is a top down, cross-functional, process centric management approach, which deals with the design, implementation, control and improvement of the end-end process of an organization. BPM is top down because it is driven by the company's strategy and initiated at a strategic level. It is cross-functional because it involves information, decisions and participation from partners that cross the inner and outer boundaries of an organization. It is process centric because it employs a process centric view of the organization. BPM can also be defined as "*the achievement of an organization's objectives though the improvement, management and control of essential business processes*".[1] In order to understand BPM, each concept, which is part of the above definition will be explained in detail in the following sections of this chapter.

1.2 Managing

> *"the achievement of an organization's objectives through the improvement, **management** and control of essential business processes"*

First of all, BPM is about *management*. Richard Daft defines management as *the attainment of organizational goals in an effective and efficient manner though planning, organizing, leading and controlling the organizational resources*.[2]

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[1] p. 11 [JESNEL08]

[2] p. 8 [DAFT97]

There are two aspects of management addressed in the above definition. The first one is the attainment of the goals in an efficient and effective manner and the second one is the four functions[3] of management which are:

- **Planning**: Selecting goals and the ways to reach them.
- **Organizing**: Putting together the human and technological components.
- **Leading**: Using influence to motivate employees.
- **Controlling**: Monitor and ensuring that everything conforms to policies, practice and plans, if not then take corrective action.

Daft's view of the management functions is very similar to Fayol's five elements of management: **forecasting and planning** (*Vorausplanung*), **organizing** (*Organisation*), **commanding** (*Anordnung*), **coordinating** (*Zuordnung*) and **controlling** (*Kontrolle*)[4].

In a similar way but from the systems theory point of view, Deming defined the job of management as follows[5]:

- Understanding the system.
- Directing the efforts of all components towards the aim of the system.
- Being responsible for changing the boundary of the system in response to external forces.
- Governing the structure of the system.

By applying the above in the context of business processes, management of business processes can be stated as:

- Understanding the business processes of an organization.
- Organizing and directing the efforts of all elements (humans and technological) of a business process, in reaching the goals of the process specifically and the organization in general, in an efficient and effective way.

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[3] p. 8-15 [DAFT97]

[4] p. 34-83 [FAY29]

[5] p. 50-54 [DEM93]

Chapter 2: The Communication Structure Analysis (CSA) Methodology

2.1 Introduction

As explained in the previous chapter, business process modeling and design is an essential planning component for business process management. Section 1.8.1 presented the basic concepts around business process modeling. In this chapter the reader will get acquainted with the Communication Structure Analysis (CSA), which is the chosen modeling methodology. The first part of this chapter will explain the structures of the methodology (meta model) and the second part how business processes, described with the CSA, can be simulated.

The Communication Structure Analysis (CSA), in German Kommunikationstrukturanalyse (KSA), is a method based methodology for modeling business processes developed from a research project at the technical university of Berlin (TU Berlin) between 1986 and 1988.

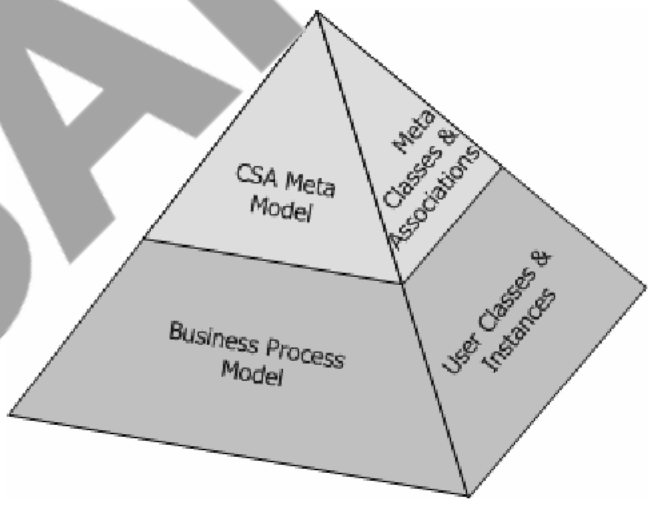

Figure 12: CSA is based on the OO paradigm.

CSA is an object oriented modeling (OO) methodology (see Figure 12) for analyzing the information flows of business processes. This means that the modeling elements (objects) are described with classes and instances.

Furthermore, it is possible to define associations between these objects and assign them attributes (see Figure 13). This allows for the classification of the elements of the modeled business processes, and therefore it simplifies the assignment of class characteristic attribute information e.g. cost rate values for a specific type of resource.

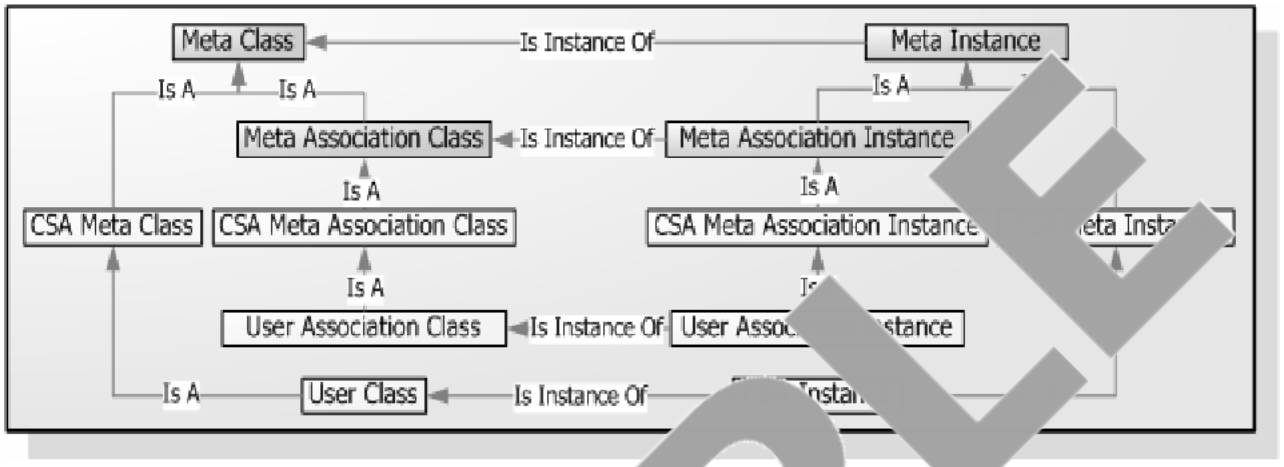

Figure 13: The CSA [illegible]eta [illegible]ta model.

The CSA methodology has a s[illegible]ed p[illegible]ure for modeling business processes. This procedure [illegible]as des[illegible]b[illegible] 1.8.1 (see Figure 9)

Furthermore the CSA meth[illegible]gy implicitly supports the simulation of the modeled busines[illegible]sses. T[illegible]mulation is a dynamic, stochastic discrete event simulation.

2.2 E[illegible]ments [illegible] the CSA

This section brief[illegible] describes the elements of the CSA. The focus will be set on the CSA [illegible] implemented by the BONAPART® modeling tool.

The CSA consists of a predefined set of elements with which organizations can be described. The main elements of the CSA can be divided into two categories. The organizational elements, which are used to model organizational charts, and the process related elements, which are used to model processes (see Figure 14).

Chapter 3: The Multidimensional Data Model

In the previous chapter it was shown how the CSA is used to describe business processes, how these can be simulated using a Petri-net and what kind of data the simulation generates. This chapter describes how to use the business process model and the simulation, in a combined multidimensional data model for analyses and reporting, to support decision making.

Usually, analyzing the data of the simulation is typically done by using a high level programming language such as C++ or Visual basic. Code for the analysis is written in order to extract the interesting data from the raw simulation data. The current approach comes with several disadvantages such as:

- Each time a new report is required, customized code needs to be written.
- Writing the analysis requires knowledge of a high level language, something that is rarely the case with typical users of the business process model.
- High level languages are not well suited for easily formulating data queries.
- High level languages are not designed to handle efficiently (neither in terms of resource usage nor of performance) and in a comfortable way, huge amounts of data, as the ones produced by the simulation.

In this chapter a novel and innovative approach is proposed for dealing with the above issues. The basic idea is as follows; instead of using a high level programming language to perform analysis and generate reports, a standardized multidimensional model can be defined that will allow the construction of an out-of-the-box data cube for the simulation data. The data cube will allow analysts to perform efficient and effective queries, using standard querying, reporting and analysis technologies. The idea proposed is novel, because it appears, after a careful review of the literature, that the definition of a multidimensional model for business process simulation data

has never been standardized for the CSA methodology or to any other methodology up to the current date. Furthermore it is innovative not only for the above reason but, as it will be demonstrated, because it will open new ways for looking and understanding the data of an organization.

Before continuing with the specifics of the proposed multidimensional model, a brief definition of some basic terms used in this chapter is given.

Multidimensional Model: *A model that views data in the form of a data cube.*[108]

Data Cube: *It allows data to be modeled and viewed in multiple dimensions. A data cube is defined by dimensions and facts.*[109]

Dimension: *An independent entity in a dimensional model that servers as an entry point or as a mechanism for slicing and dicing the additive measure located in the fact table of the dimensional model.*[110] *Dimensions are perspective with respect to which an organization wants to keep records.*[111] *Dimensions have attributes that characterize the facts and are used in querying constrains, grouping and reporting labels.*[112] *Each dimension may have a table associated with it, called Dimension Table.*[113]

Facts: *Facts are numeric measures. They are quantities by which relationships between dimensions can be analyzed. A fact Table is a table that contains the measures as well as keys to each of the related dimension tables.*[114]

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[108] p. 44 [HANKAM01]

[109] p. 45 [HANKAM01]

[110] p. 399 [KIMROS02]

[111] p. 45 [HANKAM01]

[112] p. 19-21 [KIMROS02]

[113] p. 45 [HANKAM01]

[114] p. 45 [HANKAM01]

This chapter will propose the definition of a CSA data cube. In the proposed data cube the dimensions are defined based on the CSA meta model and the facts are defined based on the Simulation meta model. Furthermore, different measurements such as costs and time can be defined for these facts. Finally the dimensions can be filled with data from any given business process model in question and the facts from the data generated by the simulation of that business process model (see Figure 62 and Figure 63).

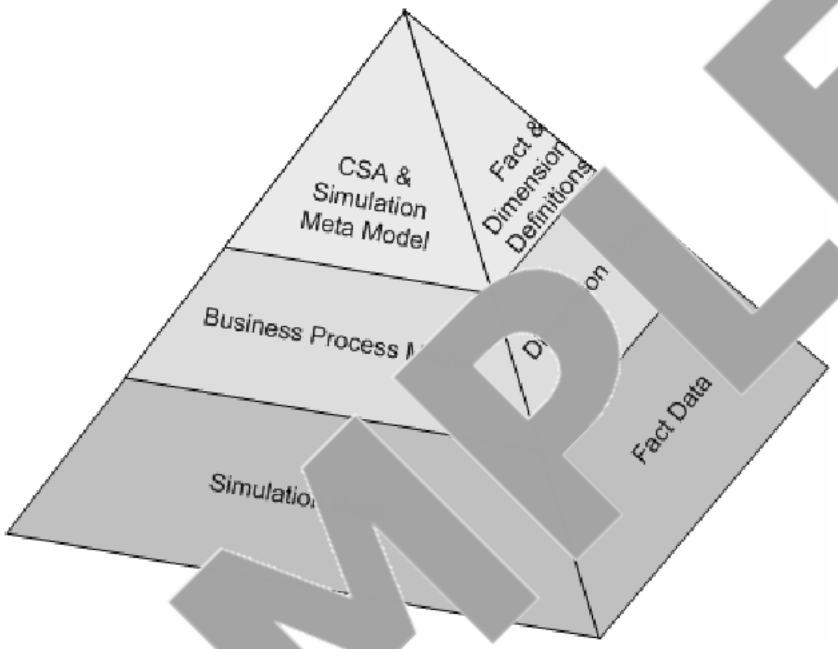

Figure 62: Mapping the business process model to a multidimensional model.

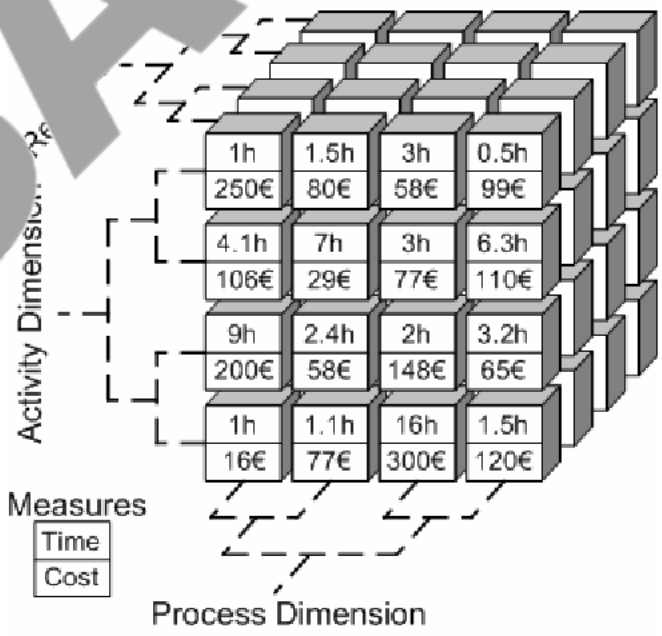

Figure 63: An example of a 3-D CSA data cube.

Chapter 4: Summary, Conclusions and Future Work

4.1 Summary

Previous chapters explain how business process management, simulation and the use of a tested methodology have complementary roles in providing businesses with useful information so that managers can make better decisions. Business process modeling, as a part of Business Process Management, provides a visualization and static analysis component that describes the context in which a set of activities occur. Simulation provides a dynamic behavior component that is able to test assumptions about all conditions that effect process performance. The CSA methodology provides a structured framework that helps model logical syntactical errors. This limits the complexity of information and thereby reduces semantic inconsistencies, by creating a confined set of building blocks and behavioral rules that can be applied to all organizations. Together, these three perspectives allow the extremely complex interactions and interdependencies within organizations to be better understood by managers, so that they can better direct their organizations. All three views are associated with traditional analyses methods that are largely not or partially integrated. Due to lack of integration, and the current cumbersome, highly technical, analysis techniques available, many critical questions cannot be easily answered or they cannot be answered at all.

This work is aimed at extending the functionality and value of BPM, CSA, simulation and data cube analysis techniques, by combining, transforming and integrating all relevant data into a data cube structure that can be easily created and queried. In the context of business process modeling based on CSA, a multidimensional model for analyzing the data generated by business process model simulations was developed. CSA, along with the simulation meta model, is used to define the dimensions and the facts for a multidimensional model. The multidimensional model developed is a generic