Business Architecture for a SME: A Case Study of a Manufacturing Firm in Mexico

Alicia Valdez

Research Center

University Autonomous of Coahuila

Coahuila, Mexico

aliciavaldez@uadec.edu.mx

Carlos Vega, Elias Olivares, Juan Perez

Research Center

UPAEP

Puebla, Mexico

carlosarturo.vega@upaep.mx,elias.olivares@upaep.mx, juancarlos.perez@upaep.mx

Abstract— **Enterprise architecture is a subject that has increased its importance in the Small and Medium Enterprises in the manufacturing sector of the industry in Mexico. The global competitiveness of the markets has influenced the adoption of methodologies that support the strategic alignment of the processes with the goals and strategic objectives of the firms. The components of the business architecture like mission, vision, strategic objectives, products, organizational structure, business processes, clients and geographic region, were collected from the firm of the case study for the design of the architecture. As a result of the practical application, an implementation model has been created and four strategic objectives were established for to improve productivity and competitiveness. This paper is a result of the research project of analysis, design and implementing business architecture in a medium size manufacturing company like partial architecture of an enterprise using ontologies for representing the core elements of the business architecture; the study presents clearly the importance of the strategic planning for the analysis and the detection of the main faults for the success of the achievement of goals and objectives.**

Keywords-Business architecture; SME; Enterprise architecture; Key processes

I. INTRODUCTION

Five major markets are emerging in the world, namely, China, India, Southeast Asia, Latin America and Eastern Europe, where global manufacturing companies have considered to make investments, because these regions are rapidly growing economies with great potential for business [1].

In these regions, the Small and Medium Enterprises (SMEs) are important in the development of the economy as they have a great capacity of generating jobs. In Mexico, 99% of the companies are SMEs, (for every 10 employees, 7 of these are working on SMEs) [2]; the study "Impact Evaluation of SME Programs in Latin America and the Caribbean", developed by the World Bank has mentioned some of the problems faced by SMEs, among which are [3].

- Access to financing;
- Weak management capacity;
- Lack of ability to exploit economies of scale in production;
- Poor information about market opportunities, and
- New technologies and methods of work organization.

The Enterprise Architecture (EA) is a strategic solution to improve the capabilities of these companies and respond quickly to the challenges, either business related or technological which is today's markets demand.

EA is also a way that aims to provide companies with a framework for the use of information on business processes in ways that support the business strategy [4]. Orantes, Gutierrez, and Lopez have mentioned that the company should be in a constantly evolving, redefining business processes, to achieve business process architecture, which is the basis for subsequent architectures [5].

The EA is the instrument that establishes the structure of the company, is a conceptual model of the business and information technology solutions (IT), seen as a set of pieces that involves processes, and functions that works together in a coherent and well defined way [6].

Some authors consider that SMEs have lesser tendencies to use IT for strategic purposes [7], and the success of architectures implementation depends on consistent objectives between IT strategy and business strategy [8].

The Business Architecture (BA) is a partial architecture of the EA, where the business is defined, the organizational structure is documented, and the business processes are identified.

BA analyses the business model relying on strategic planning with their areas of interest [9].

In this case study, an analysis was performed to establish: What key processes in manufacturing SMEs are included in the EA design, as well as, the practices and business modeling tools that use these companies to develop EA; with the objective of supporting them in increased productivity and competitiveness. A proposal was

developed that included EA standards, software tools, and methods [10].

The software tools [11] can provide support for this particular type of companies, that can be easy to use and implement to help them in their process of establishing enterprise architectures, while developing, a parallel process of Strategic Planning to support in setting goals and strategic objectives.

The organization of this paper is as follows; first section is mentioning the concepts and methods of the EA; the second section shows the information required for the business architecture from the company; finally, the implementation of the solution derived from the analysis is shown.

II. CONTENT

The EA started as management information systems in the early 60's in the United States Company International Business Machines (IBM) by "Information Systems, Control and Planning Staff" (ISCM) area.

The methodology known as Business Systems Planning (BSP) was considered one of the methodologies that started the EA.

John Zachman, who worked at ISCM, developed a framework for defining the architectures of information systems, subsequently became the "Zachman Framework" [12]; one of the perspectives was the business model of the company.

In 1994, the Department of Defense of the United States of America [13] created the Technical Architectural Framework for Information Management (TA-FIM), based on Zachman framework.

In 1996, the Congress of the United States of America passed a law called "Clinger-Cohen Act of 1996", which specifies that federal agencies should improve the efficiency of investment on information technologies, establishing the Council of Managers of information Technology (CIO's Council) group, which originated the Federal Enterprise Architecture Framework (FEAF) [14].

TAFIM was withdrawn by the Department of Defense and the association donated to The Open Group, who later developed The Open Group Architecture Framework (TOGAF) standard [15].

TOGAF is an enterprise architecture methodology and framework, used in organizations to improve business efficiency [16], based on the Architecture Development Method (ADM); ADM is divided into 9 phases, an overview of the architecture describing how the new capacity going to align business goals and strategic objectives with IT. Fig. 1 shows the phases of the ADM Method.

In the firsts two phases, preliminary and "A", the principles of the architecture and the architecture vision are defined.

In the "B" phase, the BA with the fundamental business organization and its goals, objectives, business processes,

functions, services, human resources, organizational structure, the principles governing its design and evolution are analyzed.
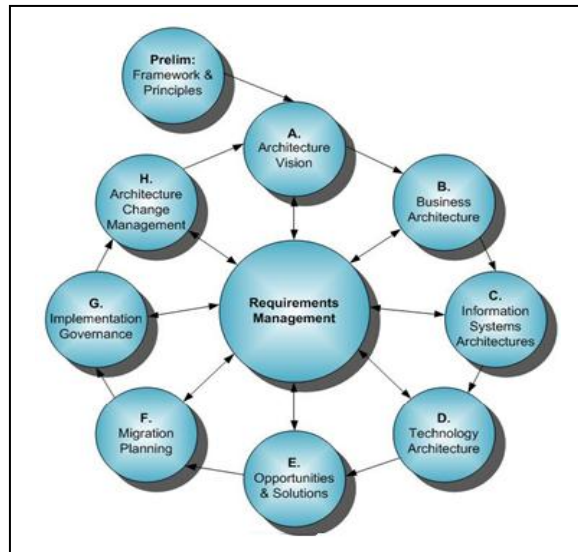

Figure 1. Architecture Development Method Phases

The metal mechanic industry is representative of the northern of Mexico, which provides raw material to the automotive cluster with some important firms like General Motors, Chrysler, and other important companies.

The suppliers of the cluster are mainly SMEs; this case was developed in SME of the metal mechanic industry and the flow of the information of the study case is shown in Fig. 2.

Beginning with the collection of the information required, this information was captured in the ontology editor; from the editor were obtained reports and maps, and flowcharts of the processes were built; after these activities, the design of the BA was realized, and finally, the implementation of the design.

The results showed some opportunity areas for improvement, in the company.

A. Information of the Business Architecture

The BA involves some elements of the company like mission, vision, objectives, goals, values and policies, business processes, procedures and functions, organizational structure, situational analysis, customers, markets, products and long, medium and short strategies.

Tables I and II show the data of the BA elements, processes like distribution, finance, human resources, production, quality, sales and marketing, information technology, and product development.

Each process has a set of activities; for example, the product development includes production cycle program, cutting, marking, machining and forming of steel plates, and

profiles. All processes were collected from the company and recorded in software tools.
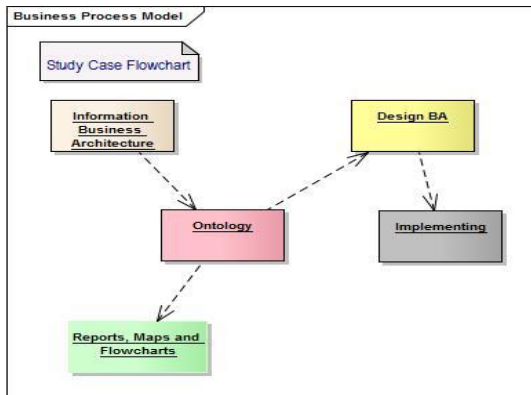

Figure 2. Flowchart of the case study

This information served as base for the next architectures, application and technology, where each process are linked with a software application and technology that supported it.

TABLE I. DATA FOR THE BUSINESS ARCHITECTURE

Business Architecture	Description	
Mission	"Serve society, customers, employees, suppliers, be the best option for all".	
Vision	"Being a quality supplier of metal products, broaden participation in national and international markets"	
Values	Responsibility, loyalty, respect and quality production.	
Objectives	Improve the relationship between customers and suppliers. Minimize operation failure. Maximize the performance of the raw material.	Have better management control. Improve planning processes. Investment plan in machinery and equipment.

The organizational structure of the company has 4 levels corresponding to the position of the Chief Executive Officer (CEO) and sales manager for the level 1; head of production machining, head buyer, finance officer, and human resources manager for level 2; machining supervisor, pailer supervisor, warehouse manager, billing, and quality control for level 3; machining operators and pailer operators for level 4.

The customers belong to the local market of the northern of Mexico with Altos Hornos de Mexico, S.A. (AHMSA), TAKATA Industries, General Motors Company, Chrysler, and other companies of the metal mechanic industry.

The market is regional; the firm can compete in global markets adopting a strategy of certification in quality processes. The products of manufacturing are: General forklift parts, rotatory joints, various pieces of mechanical equipments, and assembly using Computer Numerical Control (CNC) machines.

The first strategy is to manufacture products with high quality that markets demands, the support of the IT can permit to reduce costs, and increase the competitiveness and the productivity.

With the data obtained from the company, the next step is entering data in the ontology software; for this case, we use the free software Protégé Ontology Editor 3.4 [17], developed by the Stanford University; in this software, we can have one super class called EA with some subclasses like business architecture, information architecture, applications architecture, and technology architecture.

The main components of the BA class are shown in Fig. 3, these are:

TABLE II. PROCESSES OF THE COMPANY

Company area	Processes	
Distribution	Finished products delivery	
Finance	Management company's finances	
Human Resources	Personnel administration	Detect training needs of business areas, especially productive areas for develop entrepreneurial training program
Investment Administration	Investments of the company	
IT	Provision of IT support for company's business processes	
Quality	Manufacture that meets production specifications	Testing and inspection using ultrasonic methods or industrial inspection
Sales and Marketing	Management customers. Customer service	Continuous communication with customers to identify needs and complaints.
Stock	Register the inputs and outputs of goods and raw materials.	Suppliers management.
Product development	Program production cycles	Cutting, marking, machining and forming of steel plates and profiles

- Objective (strategic alignment);
- Principle (production requires all processes);
- Domain (distribution, sales, quality, etc);
- Role (CEO, chief of sales, pailer operator);
- Capability (planning sales, machinery operator);
- Product (rotatory joints, machining), and
- Process (design products, sales management).

The BA objective is the strategic alignment between business goals and IT represented like "Strategic Alignment."

The business domains are all areas and functions of the company, like distribution, finance, sales, and others.

The principle business is "Production requires all processes." Business roles are performed by people and the business process are all the processes represented in Table II, required for the company operation.

The graphical representation of the all BA components is the link between the collected data and the software tool.
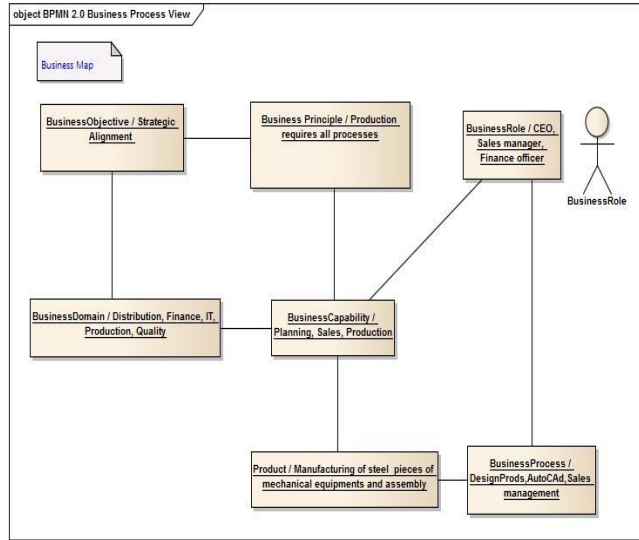

Figure 3. BA Design

Fig. 4 displays the customer's process with roles and capabilities, after entering data in the ontology editor.

The information of the editor is sent to a graphical tool [11], functioning like repository, which is an open source software tool for the management of AE, this tool is Essential Architecture Manager 3.0 [18], requires some prerequisites software like Apache Tomcat 5.5 or above, Java Runtime 1.5 or above, Graphviz 2.26, and the Protégé Ontology Editor 3.4 or above.

This set of tools creates a graphical environment for representing the EA, and each of the partial architectures, like BA. Fig. 4 shows partially one process with the components of the BA for this process.

All the processes were represented in the software tools for purpose of completing the BA for subsequent architectures.

B. Implementation model

Figure 4. Example of process in software tool

The implementation model is centered on the client, the material resources and equipment, organization, human resources, logistics, and all that the company needs for working in his goals and objectives; so the circle represents the firm, the architectures are around the circle, and are applied to all processes, for to identify strategic changes with assessment of options tending to produce a change plan. Fig. 5 shows the implementation model described.

Some components of the BA were redesigned as a result of the analysis for implementation updating:

- Mission;
- Vision;
- Strategic objectives, and
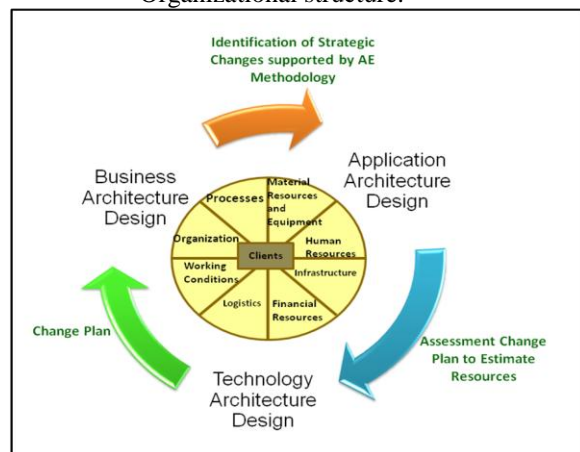- Organizational structure.

Figure 5. Implementation model diagram

Considering full knowledge of the manufactured products, identifying potential markets, and their competitive advantage, and the vision determines the strategic direction of the company. Four strategic objectives were established:

Strategic objective 1: Increase production and competitiveness to achieve better sales and increase company revenue.

Strategic objective 2: Update, acquire, and implement the technology required for increased production and competitiveness.

Strategic objective 3: Update recruitment processes and training of existing staff to increase integration and productivity.

Strategic objective 4: Secure your position with existing customers, increase local sales and find new customers in global markets.

Two areas from the organizational structure were added: Human Resources and Logistics; the justification was that the firm does not have human resources area for the training of the employees, and logistics are required for the management of the resources from the beginning of the value chain to final assembly.

Other needs identified like the strengthening of the market position, the total quality culture, and the training of human resources to achieve improved organizational climate and consequently on the productivity of the entire company.

Current management skills are not sufficient for the next five or ten years; it requires that managers, although have professionals studies in engineering, must be kept updated on the latest management techniques.

Competition modernizes its production techniques and new companies emerge, so the upgrading of equipment and technological infrastructure is vital to the long-term performance of the company.

III. CONCLUSION

The process of developing a BA in a SME in metal mechanic industry in Mexico reflects the needs of this industry sector, to upgrade their management skills to compete in global markets.

BA must be focused on the importance of the technology strategy aligned with the business strategy, to gain competitive advantage from the use of IT, to enable them to be inserted into global markets with a clear plan.

This project helped to meet the needs of SMEs companies to propose affordable solutions that make business management resources and technology to solve problems.

BA can be represented on a business ontology designed especially to support the structuring of architectural maps of the company and its relationships with strategic objectives.

It is necessary to comprehensively conceptualize strategic planning of the company to continue with the design of the ontology in the subsequent phases as application and technology.

The contribution of the paper focuses on the approach to the problems of the company, with the help of business architecture, software tools, and the implementation model.

The BA supports the strategic alignment between objectives, goals, and business processes.

In the future, this industry will be supplier of the aerospace industry in the country, and would be integrated to a more specialized chain with greater scope in the domestic and international markets.

This research project was developed in one year for a doctoral dissertation in Strategic Planning.

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