

# **Developing E-Commerce Strategies Based on Axiomatic Design**

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# Developing E-Commerce Strategies Based on Axiomatic Design

## Abstract

Electronic commerce is dramatically changing the traditional way of doing business and furthermore, the growth of the Internet is creating new business opportunities. Today many products, processes and organizations are complex systems that have to be designed in order to meet specific customer requirements.

Axiomatic design is a scientifically based design theory that guides designers through the process of first mapping customer needs into functional requirements, then mapping these requirements into design parameters, and then finally figuring out processes to provide those design parameters. Once the created strategies from high-level goals down to the specific area of interest are mapped with axiomatic design, it is easy to follow an optimization of the implementation process. Axiomatic design can also be defined as a theory that provides designers with decision making criteria for the entire design process.

In this paper, axiomatic design will be used to provide a framework for the e-commerce applications in electronic retailing. The high level goals and strategies will form the roots of the decomposition tree for the e-commerce strategy, and the process will continue to zig-zag back and forth between the goal domain and the strategy domain until the design is completely decomposed. The structured design and decomposition method assures that the decisions made in the strategy development are made in proper sequence.

The model developed in this working paper can be used in the strategy formulation of an internet business, as well as the organizational analysis of an e-commerce strategy in order to identify goals without corresponding strategies or strategies that have no corresponding goals. The axiomatic design approach and new relations derived during these investigations may provide a new look at the development of enterprise e-commerce strategies.

**Keywords:** Electronic commerce, strategy, electronic retailing, axiomatic design

## **1. Introduction**

The Internet is bringing profound change to the business world by enabling a new way of conducting commerce: electronic commerce. To compete in the emerging digital economy, companies need to change their business models, rethink the way they work and form new relationships with their trading partners and customers.

Marketing has always been the voice of the customer, a channel through which the rest of the company can appreciate the wishes of its customers. Whether through visits to a web site, email to customer support, or discussions on a community bulletin board, the days of one-way announcements from the marketer to the customer are over. Consumer expectations are rising faster than technical capabilities and the Internet is changing the structure of many marketing organizations. Instead of a portfolio of products, marketers of the future will have a portfolio of customers.

In the physical world, customers are limited in their knowledge of what they want, where to buy and who to buy from. Customers with misleading or incomplete information often make decisions that do not maximize their utility from a transaction. Information technology can help customers find information more easily thereby reducing the problems of imperfect information that maintains higher prices. Therefore, the Internet represents a nearly “frictionless market” for the customers [1]. For markets, the Internet is a tool for almost instantaneous customer feedback. Internet commerce will reduce the market friction of physical market transactions and while there is lower friction in many dimensions of Internet competition; branding, awareness and trust remain important sources of heterogeneity among Internet retailers [2].

### **1.1. Scope and Motivation**

The purpose of the working paper is to set up a model for developing a company’s online sales and marketing strategy based on the principles of axiomatic design [3,4]. The work will primarily be focused on answering the following questions:

- What are the key features that determine the success of an e-commerce strategy?
- How can axiomatic design be used to achieve a relation between company goals and company strategies on how to fulfill these goals?
- How can high-level company goals be mapped to the specific area of interest with axiomatic design in order to do an optimization of the implementation process of the e-commerce strategy for electronic retailing?

### **1.2. Methodology and Basis of Axiomatic Design**

Design is an interplay between what we want to achieve and how we want to achieve them [4]. Once we understand the customer’s needs, this understanding must be transformed into a minimum set of specifications that adequately describe “what we want to achieve” to satisfy the customer needs. Axiomatic design is a scientific approach to design, in which decisions are made at multiple levels of abstraction, starting at the system level and progressing in more detail until the design is completed [4,5]. Axiomatic design provides a fundamental basis for understanding decision making during design.

The aim of the work is to achieve a tight relation between the goals (functional requirements in the design language) and e-commerce strategies (design parameters) on how to fulfill these goals.

## **2. The New Economy and the New Business Environment**

E-commerce must be understood in the context of the enterprises that conduct it and the environment in which it takes place. An electronically enabled enterprise is one with the capability to exchange value (money, goods, services, and information) electronically. It must have properly designed business processes for this new way of conducting business.

To develop business strategies institutions need a deep understanding of the driving forces of the new economy, and consider e-commerce solutions as integral [6]. There is growing evidence that firms are moving their supply networks and sales channels online, and participating in new online marketplaces [7]. Firms are also expanding their use of networked systems to improve internal business processes -to coordinate product design, manage inventory, improve customer service, and reduce administrative and managerial costs.

### **2.1. How the Internet Changes Business**

The Internet continues to grow as a medium for commerce, allowing a company to conduct business everywhere, all the time. E-commerce and the Internet eliminate the constraints of time and distance in operating a business and enable a multitude of connections between customers, suppliers and trading partners [8]. The characteristics of the new economy has increased the level of competition in all the industries and the internet presents an important opportunity for even small firms to launch new products or services because of the speed and low cost of doing business. In today's new business environment, power has shifted toward consumers who demand intelligent products that deliver new dimensions of value -time and content- in addition to the current ones -price and quality [9].

Electronic marketplaces also reduce inefficiencies caused by buyer search costs to obtain information about the price and product offerings as well as the cost of sellers to communicate information about their prices and product offerings [10,11]. By assembling a network of partners that specialize and excel in the links of the value chain, it is possible for organizations to achieve new levels of quality, flexibility and cost savings.

When a company interacts electronically with customers, buying behavior can be analyzed so that the company can customize its product and service offerings to the individual customers in the new economy [12,13]. Customization is the essence of the one-to-one marketing revolution. The ability to customize products, combined with the ability of sellers to access substantial information about prospective buyers, such as demographics, preferences and past shopping behavior, is also an opportunity for improving sellers' ability of price discrimination, that allows sellers to charge different prices for different buyers [14].

### **2.2. Electronic Commerce and Competitive Advantage**

By the explosion of globalization and developments in information technologies, the Internet has become a great equalizer [15] allowing the smallest of businesses to access markets and have a presence that allows them to compete against the current competitors of their industry.

This section explains the effects of electronic commerce and its potential for competitive advantage. Michael Porter's model on industry analysis [16] will be used as a framework, and the business value components will be evaluated according to Porter's three generic competitive strategies and the five forces.

- **Generic competitive strategies**

Porter's three generic strategies are cost advantage, product differentiation and focus. Focus means concentrating on one segment of the firm's customers and providing them with an extremely well targeted set of products, excellent service, etc.

**Cost advantage:** Using electronic commerce systems offers a cost advantage through less expensive product promotion and distribution channels. This emphasizes how the Internet allows small companies to act as larger ones, by using a very low-cost infrastructure to promote their products on a global basis.

**Product differentiation:** Electronic commerce systems help a company to differentiate itself not only through price but also through product innovation, time to market and customer service.

**Focus:** Using electronic commerce systems provide various customer focus strategies through better customer relationship. Electronic commerce enables this strategy by using information technology for personalized service on a larger scale and mass-customization of products.

- **Five forces model of competitive threats**

**Buyer power:** Buyers can exert new types of threats by being able to switch supplier much more easily and possibly demanding new processes or capabilities of their suppliers.

**Competitor threats:** Through first mover advantages and improved electronic capabilities existing competitors may be able to weaken an organization's competitive position. Electronic commerce makes it possible to catch up with competitors thanks to the maturity of some technologies and learning experiences.

**Potential entrants:** Electronic commerce provides easier entry into traditionally hard to access markets, due to less expensive product promotion, new sales channels and reduced capital requirements.

**Supplier power:** Suppliers and intermediaries with control over resources, infrastructure or market share may weaken an organization's competitive position.

**Product substitution:** Product bundling and new innovative products will threaten industry profitability. Using electronic commerce systems facilitates the introduction of substitute products in a market due to product innovation.

### **2.3. Basic Characteristics of Electronic Marketplaces**

All traditional and electronic marketplaces perform three main functions: matching consumers and sellers; facilitating the exchange of information, goods, services and payments, and providing an institutional infrastructure [14]. By the latest developments in information technologies and electronic commerce tools, electronic marketplaces are having a major impact on these roles [17]. The use of Web-based online storefronts provides firms with new capabilities for competing in each business dimensions [18], such as product offerings, pricing, time to market, consumer relations and service through a chain of relationships.

The web can provide an effective channel for brand communication. While trying to create online destinations that people will come to, companies need to use the power and reach of the Internet to deliver tailored messages and information to current and

potential customers. The capacity to measure impact sets the Internet apart from other media [19]. Specific measurements will yield better insights into the effectiveness of advertising spend.

The Internet brings into existence a new way of pricing precision and flexibility [20, 21]. The ability of electronic marketplaces to reduce search costs for price and product information may significantly affect competition. Lower buyer search costs in electronic marketplaces promote price competition among sellers. Digital information goods, such as news articles, digital images or music, allow copies to be created and distributed almost costlessly via the Internet. The Internet is thus provides a significant reduction in the costs of production and distribution for these goods. This creates new opportunities for repackaging content through strategies such as bundling, site licensing, subscriptions, rentals, differential pricing, and per-use fees [22,23]. Sellers in Internet marketplaces are typically responsible for delivery to their customers, and therefore delivery providers are emerging as major Internet intermediaries.

#### **2.4. Extended Marketing Mix for Internet Business**

Traditional management tools and marketing principles may appear ineffective in the development of e-commerce strategies, if they are not used within the rules of doing business in the new business environment making use of the Internet capabilities and the new opportunities. Customer loyalty is one of the main aspects in gaining and keeping the market leadership and the web has made customer loyalty much harder to achieve than it was before [24].

Before the Internet and e-commerce started to play their roles in the economy and business world, companies had been planning marketing processes focusing on two main factors; identifying customer needs and defining a value proposition that will meet them at a profit. The value proposition must then be delivered through the right product or service and the right channels, and it must be communicated consistently. In order to create a winning business strategy, companies have to rebuild the traditional marketing strategies around the facts of the new business environment and the Internet. In the traditional economy, the marketing mix was could be explained with the 4P's that are product, price, place and promotion [25,26]. In the new business environment and the network economy, a new marketing mix including 4P+7C (content, customization, convenience, connectivity, communication, community and customer care) should be considered. The companies that desire to rank among the leading ones in today's competitive marketplace should adopt these factors successfully into their corporate goals and implement the essential strategies efficiently.

### **3. Fundamentals of Axiomatic Design**

#### **3.1. Design Process**

Design has been defined in a variety of ways depending on the specific context or the field of interest. Whether the design solution is a tangible product, service, software, process, or something else, designers typically follow these steps [4]:

- Know their customers' needs.
- Define the problem they must solve to satisfy the needs.
- Create and select the solution through synthesis
- Perform analysis to optimize the proposed solution.
- Check the resulting design solution to see if it meets the original customer needs.

The design process is the development and selection of a means to satisfy objectives, subject to constraints. The questions that a designer has to think about in developing a design of an object, a process, an organization or a system may be stated as follows:

- What are the main goals that the design solution should achieve?
- What are the design parameters (DPs) that are needed to satisfy the functional requirements (FRs) of the design subject?
- Is this a good design? Why is this design better than others?
- Why didn't it work? In which phase of design has the problem occurred?
- Which parameters have to be changed? How should be the design re-organized in order to reach the optimum solution?

#### **3.2. Axiomatic Design**

Axiomatic design provides a framework for describing design objects that is consistent for all types of design problems. Thus, different designers can quickly understand the relationships between the intended functions of an object and the means by which they are achieved. Design involves a continuous interplay between what we want to achieve and how we want to achieve it [3]. Therefore a rigorous design approach must begin with an explicit statement of what we want to achieve and end with a clear description of how we will achieve them.

The ultimate goal of axiomatic design is to establish a science base for design and to improve design activities by providing the designer with a theoretical foundation based on logical and rational thought processes and tools. Axiomatic design is a process for creating new designs and for diagnosing existing designs. In the words of Professor Nam Suh of MIT [4], the inventor of this process, "The goal of axiomatic design is manifold: to make human designers more creative, reduce the random search process, minimize the iterative trial-and-error process, and determine the best design among those proposed."

#### **3.3. Axiomatic Design Framework**

The underlying hypothesis of axiomatic design is that there exist fundamental principles that govern good design practice. It is a general theory of design, which provides a scientific basis for designers to make design decisions. Axiomatic design theory can be applied recursively throughout the design hierarchy. Design problems are stated; solutions are proposed and analyzed; and decisions are made. The components that distinguish axiomatic design from other design theories are domains, hierarchies, zigzagging, and the two design axioms: independence and information.

### 3.3.1. The Concept of Domains

The world of design is made up of four domains: the customer domain, the functional domain, the physical domain, and the process domain (Figure 3.1). The domain on the left relative to the domain on the right represents “what we want to achieve”, whereas the domain on the right represents the design solution of “how we propose to satisfy the requirements specified in the left domain”. The definitions of the key expressions in the concept of domains are:

- **Functional requirements (FRs):**

FRs are a minimum set of independent requirements that completely characterizes the functional needs of the product (or software, organizations, systems, etc.) in the functional domain.

- **Constraints (Cs):**

Cs are bounds on acceptable solutions. There are two kinds of constraints. Input constraints are imposed as part of the design specifications. System constraints are constraints imposed by the system in which the design solution must function.

- **Design parameters (DPs):**

DPs are the key physical (or other equivalent terms in the case of other fields) variables in the physical domain that characterize the design that satisfies the specified FRs.

- **Process variables (PVs):**

PVs are the key variables (or other equivalent terms in the case of other fields) in the process domain that characterizes the process that can generate the specified DPs.

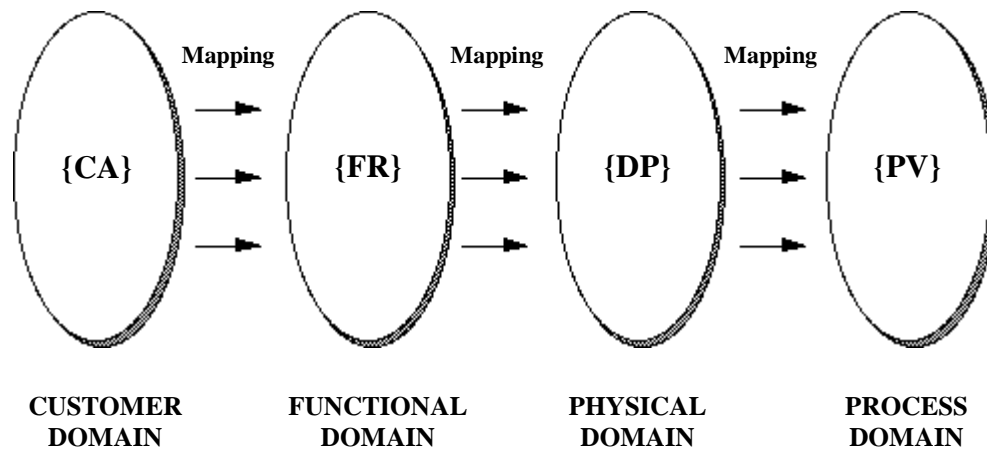


Figure 3.1. Domains of the Design World

The customer domain is characterized by customer needs (or the attributes) the customer is looking for in a product, process or system. In the functional domain, the customer needs are specified in terms of functional requirements (FRs) and constraints (Cs). In order to satisfy the specified FRs, we conceive a design described by design parameters (DPs) in the physical domain. Finally, to produce the design product specified in terms of DPs, we develop a process that is characterized by process variables (PVs) in the process domain.

### 3.3.2. Mapping from Customer Needs to Functional Requirements

The design of a product, system or an organization begins with understanding the customer needs and expectations. Once designers identify and define the perceived



customer needs (or the attributes the customer is looking for in a product or system), they must be translated to functional requirements.

### **3.3.3. Decomposition, Zigzagging and Hierarchy**

The design process progresses from an abstract system level to levels of more detail. This may be presented in terms of a design hierarchy, and a design object is composed of hierarchies in each of the functional, physical and process domains. The decisions that are made at higher levels affect the statement of the problem at lower levels.

At a given level of the design object, there exists a set of functional requirements. Before these FRs can be decomposed, the corresponding design parameters must be selected. Once a functional requirement can be satisfied by a corresponding design parameter, that FR can be decomposed into a set of sub-FRs, and the process is repeated. The designers go through a process whereby they zigzag between functional, physical and process domains, and process-in decomposing the design problem. The result of this zigzagging is the creation of hierarchical tree for both FRs and DPs.

### **3.4. The Design Axioms**

Designers follow a design process in which decisions are made about a design object with high level, system decisions and progressing to levels of increasing detail. In following this process to synthesize new designs at each level of detail, the steps through which the designer progresses can be described as a problem formulation, synthesis and analysis. The design axioms provide a tool for evaluating designs, particularly during conceptual design. The two axioms may be stated as follows:

- **The Independence Axiom (Axiom 1):**

Maintain the independence of the functional requirements (FRs).

Alternative statement: In an acceptable design, the DPs and the FRs are related in such a way that specific DP can be adjusted to satisfy its corresponding FR without affecting other functional requirements.

- **The Information Axiom (Axiom 2):**

Minimize the information content of the design.

Once a set of FRs has been formulated and possible sets of DPs have been generated, the two design axioms are used to evaluate the proposed designs (the design axioms can also be applied to analyze relationships between DPs and PVs).

Independence axiom states that, during the mapping process from the FRs in the functional domain to the DPs in the physical domain, a change in a particular DP must affect only its referent FR. According to the information axiom, among all the feasible designs that satisfy the independence axiom, the one with the minimum information content is the best design.

The mapping process between the domains can be expressed mathematically in terms of the characteristic vectors that define the design goals and the design solutions. At a given level of the design hierarchy, the set of functional requirements that define the specific design goals constitutes a vector {FRs} in the functional domain. Similarly, the set of design parameters constitutes a vector {DPs}. The relationship between these two vectors can be written as:

$$\{FRs\}=[A] \{DPs\} \quad (3.1)$$

where [A] is defined as the design matrix that characterizes the design and shows the relationships between the FRs and DPs at a given level of the design hierarchy.

There are two special cases for the design matrix: the diagonal matrix where all  $A_{ij}$ 's except those  $i=j$  are equal to zero, and the triangular matrix where either upper or lower triangular elements are equal to zero as shown below.

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & X & X \\ X & X & X \\ X & X & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \quad \text{Coupled Design} \quad (3.2a)$$

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & 0 \\ X & X & 0 \\ X & X & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \quad \text{Decoupled Design} \quad (3.2b)$$

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & 0 \\ 0 & X & 0 \\ 0 & 0 & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \quad \text{Uncoupled Design} \quad (3.2c)$$

To satisfy the independence axiom, the design matrix must be either diagonal or triangular. When the design matrix [A] is diagonal, each of the FRs can be satisfied independently by means of one DP. Such a design is called uncoupled design (Equation 3.2c). When [A] is triangular, the independence of FRs can be guaranteed if and only if the DPs are changed in a proper sequence. Such a design is called decoupled design (Equation 3.2b). Any other matrix (Equation 3.2a) is known as a coupled design. In these equations, an X represents a strong effect by a DP on a FR, while a zero indicates a weak effect, relative to the tolerance associated with the FR.

### 3.5. Use and Benefits of Axiomatic Design

Axiomatic design is a theoretical basis for rational design. It provides a framework for describing design objects that is consistent for all types of design problems and at all levels of detail.

Design axioms provide a rational means for evaluating the quality of proposed designs, and the design process which is used guides designers to consider alternatives at all levels of detail and to makes choices between these alternatives more explicit. Furthermore, axiomatic design theory encompasses a design process that has several benefits for the creation of designs. The design axioms provide a means for evaluating the quality of proposed designs so that design decisions may be made on a rational basis supported by easily understood analytical results. The designer becomes more creative by understanding a clearly defined problem before design begins and identifying innovative ways to fulfill the functional requirements.

#### 4. Strategy Axioms for Business Applications

According to Kotler [25], in the strategic formulation, goals indicate what a business unit wants to achieve, and strategy is a game plan for getting there. Every business must tailor a strategy for achieving its goal.

Axiomatic design can be used as a tool for the design of non-engineering design objects, such as business plans and organizations [4,27]. The use of axiomatic design as a tool for strategic design and planning provides strong relationship between the goals and the strategies defined [28]. A successful design approach should begin with a definition of what we want to achieve and end with a clear description of how we will achieve them (Figure 4.1). The two concepts pertain to the business goals and strategies in the strategic design of the corporate plans.

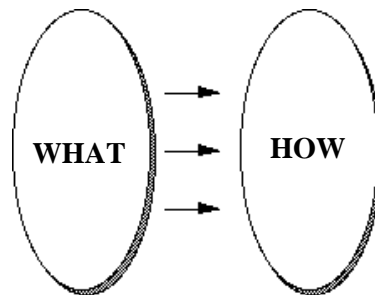


Figure 4.1. The Logic of Design

Axiomatic design provides the mapping and decomposition of these business goals and strategies in an effective way. A strategy development process based on axiomatic design guides designers through the process of first breaking up internal and external factors, stakeholder and market needs into business goals, then breaking up these goals into strategies, and then finally translate them to actionable tasks which will produce the desired results.

#### 4.1. The Design Framework for Strategy Development

The strategy development process based on axiomatic design can be explained within a continuous process illustrated in Figure 4.2. The design process begins with the analysis of the current position and the determination of the stakeholders' and the customers' needs (market needs).

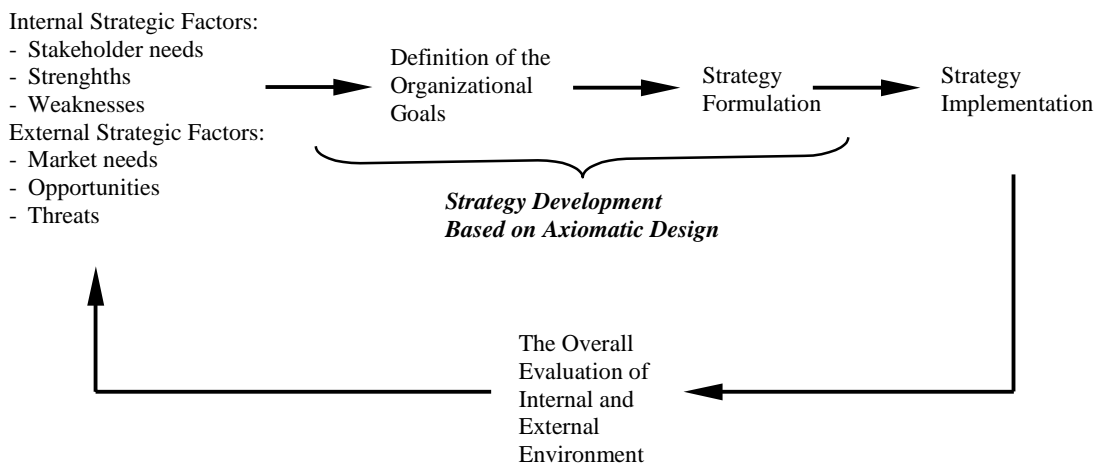


Figure 4.2. Design of Organizational Goals and Strategies

A proper definition of the customer needs and expectations represent one of the critical success factors of the strategy development. Those concepts lead to the definition of the corporate mission and the business goals. The decomposition of business goals into strategies can be realized based on the principles of axiomatic design, which make the designers go through a process whereby they zigzag between goals and corresponding strategies.

#### 4.3.1. Mapping from Business Goals to Strategies

The situation analysis that includes an analysis of internal and external strategic factors affecting the organizational performance, inputs from the stakeholders and the market needs guide the definition of the corporate goals. Strategy development based on axiomatic design starts with the setting up of high-level goals, and then corresponding strategies are defined to achieve these goals. The four domains being used during this process are the customer domain, the goal domain, the strategy domain, and the task domain (Figure 4.3).

The strategic design process progresses from a system level to levels of more detail. High-level goals and the corresponding strategies are decomposed into more detailed sub-goals and strategies in terms of a design hierarchy. The decisions that are made at higher levels affect the statement of the goal at lower levels.



Figure 4.3. Four Domains in Strategic Design

At each level of the strategy development, there exists a set of goals. Before a certain goal is decomposed, the corresponding strategies must be determined. Once a business goal can be satisfied by a corresponding strategy, that goal can be decomposed into a set of sub-goals, and the zigzagging process is repeated. This process of mapping and zigzagging must continue until the design is completed.

Hierarchy of goals and strategies is one of the major concepts of axiomatic design. The basis of decomposing high level goals and strategies into lower levels is the zigzagging back and forth between the goal domain and the strategy domain while developing the goal and strategy hierarchies.

#### 4.3.2. Design Axioms in Strategy Development

During strategy development, a strategic design process followed includes high-level decisions, which make up the corporate level strategy and progress to levels of increasing detail. The business and functional level strategies are formed in the

following levels of decomposition. The strategic design axioms provide a tool for evaluating goals and strategies facing one another. The two basic axioms may be stated as follows:

- **The Independence Axiom (Axiom 1):**

The goals should be independent from each other. In an acceptable strategic design, the strategies and the goals are related in such a way that a specific strategy can be adjusted to satisfy its corresponding goal without affecting others.

- **The Information Axiom (Axiom 2):**

The information content of a design should be minimized. Among alternative designs that satisfy the independence axiom, the best one has the minimum information content, which represents the maximum probability of success.

The two strategic design axioms are used to evaluate the proposed designs according to the independence of the goals and information content of the design. Because the company management wants to minimize the amount of resources needed to achieve the desired goals, they have to minimize repetition of decisions during the decomposition [5]. This benefit is mainly provided by the design axioms.

### 4.3.3. Evaluating the Strategic Design Matrix

As the strategy designers map “what” they want their design to accomplish (using goals) to “how” they want to accomplish these goals (using the strategies), they have to think of all of the different ways to fulfill each of the goals by identifying rational strategies. The information generated during mapping is captured in a strategic design matrix, which shows the relationships between each goal and the strategy.

A relationship between a goal and a strategy can be represented by an X when the strategy affects the goal and by an O when it does not. To satisfy the independence axiom, the strategic design matrix must be either diagonal or triangular (Figure 4.4). When the design matrix is diagonal, each of the goals can be satisfied independently by means of its strategy (uncoupled design). When the matrix is triangular, the independence of goals can be guaranteed if and only if the strategies are changed in a proper sequence (decoupled design).

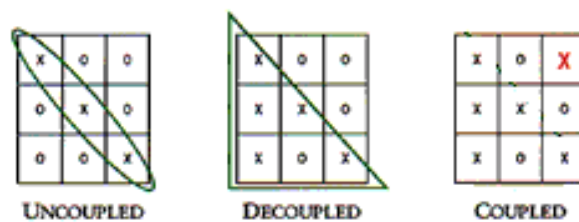


Figure 4.4. The Three Possible Design Matrix

The design with a coupled design matrix is undesirable. For example (Figure 4.4), when STGY3 is implemented, GOAL3 is satisfied, but GOAL1 is now affected unintentionally. As a result, the designers may have to iterate, adjusting STGY 1, STGY 2, and STGY 3 to satisfy the associated goals and it may even be impossible to adjust either strategy without affecting the other goals. A small change can affect several functions possibly resulting in violation of a goal or annoyance in the use of the design.

When the designers analyze an existing strategic plan and find out that it is coupled, they have two options available. Either the designers can try to decouple the design through developing appropriate strategies to satisfy the goals, or the designers can seek an operating point where the design is less sensitive to the coupling through optimization. The decomposition activities, in which the design axioms are applied effectively, lead to the best working systems, using the least resources. Design matrices contain a wealth of information about the strategic plan and are central to the application of axiomatic design by providing a tool for evaluating the success of design.

#### **4.4. Benefits of Axiomatic Design Approach in Strategy Development**

Axiomatic design helps designers with creating new business plans and strategies, and evaluating existing ones, while determining the probable causes of trouble. The structured design and decomposition method assures that the decisions made in the strategy development are made in proper sequence. The design axioms and the decomposition principles prevent the designer from setting a goal or determining a strategy without having a clear understanding of its need.

By following the axiomatic design process, which provides strong advantages in defining problems and finding corresponding solutions, the designer works in a systematic way, always completing prerequisite tasks before continuing to the next stage. For diagnosing an existing business plan, the use of axiomatic design highlights problems such as coupling and makes clear the relationships between the symptoms of the problem (one or more goals not being achieved) and their causes (the specific strategy affecting those goals).

Axiomatic design provides an efficient project workflow; identifying tasks, setting a task sequence from the system architecture, and assign resources effectively. By using this powerful tool throughout the development of new strategies, designers can prevent coupling at any level of the strategic design process and ensure that the system they create will satisfy their customers' requirements. Briefly stated, axiomatic design provides a structured methodology that assures that all vital aspects of a business strategy are addressed in an orderly and simple manner.

## **5. Developing an E-Commerce Strategy Framework Based on Axiomatic Design**

In the new business environment, the existence of a technological and legal infrastructure are the key factors in ensuring the application of e-commerce, together with a drive for optimization of business practices. Widespread access to the Internet is an important component of this infrastructure for electronic retailing marketplace.

The development of the electronic commerce strategy of an Internet-only business or a broader cross channel enterprise that combines an Internet presence with existing retail stores, dealerships, and catalogs, requires the following issues be executed:

- Build the brand personality and evolve existing ones via the use of the Internet,
- Deploy multiple channels that integrate the Internet with an existing sales, service and distribution network,
- Address a full range of existing and potential customer needs to provide a unique customer experience,
- Develop and implement pricing strategies unique to the Internet.

### **5.1. The Application of Axiomatic Design to the Development of E-Commerce Strategies**

In this section, axiomatic design approach to the development of e-commerce strategies will be presented. The case of business-to-consumer (B2C) application, which can be accepted as an adoption of physical retail stores to the Internet (electronic retailing), will be considered and all the necessary actions will be planned, based on the principles of axiomatic design [29].

The first axiom of the axiomatic design theory -independence axiom- should be applied properly in order to obtain the strategic design hierarchy by decomposition of the goals and strategies by zigzagging, to make high-level decisions and define sub goals and strategies. The independence axiom states that the satisfaction of a goal should not affect the feasibility of another one. In other words, the specific strategies have to be designed to satisfy their corresponding goals without affecting the others. The strategic design matrix will be used to determine the state of the design - uncoupled, decoupled or coupled. Based on these principles and the decomposition hierarchy, axiomatic design will provide a tight relation between the goals and the essential strategies on how to fulfill these goals during the development of the e-commerce strategy of a company. The axiomatic design approach and new relations derived during these investigations may form a new methodology for the development of the enterprise e-commerce strategies.

### **5.2. Decomposition of the E-Commerce Strategies**

An electronic commerce strategy should include a clear view on how the organization will use the electronic marketplace. Since the electronic channel is expected to rank among the most important tools to conduct business in the near future, companies have to plan how to attract the consumers, take orders and payments, obtain the on-line security, distribute products and services and support their customers in this new business environment.

E-commerce is a new methodology for doing business in the non-physical marketplace, and a number of management level issues must be addressed in prior to deciding the implementation steps. In the decomposition of the e-commerce business plan according to the principles of axiomatic design, higher level hierarchy presents

the main goals and strategies to be realized. As the mapping from goals to strategies continues, implementation guidelines are becoming developed. During these interrelations in the strategic design process, each set of decomposition should be evaluated by using the design matrix, which shows the relationships between each goal and the strategy.

### 5.3.1. Decomposition Level 1

The high level goals and strategies will form the roots of the expansive decomposition tree for the e-commerce business plan. They provide the basis for the strategic design of the entire electronic commerce system, which will be obtained in the mid-level and low-level decomposition of the strategic design process. The main goal and strategy in an e-commerce application can be stated as follows:

GOAL<sub>0</sub>: Organize enterprise B2C e-commerce applications

STRATEGY<sub>0</sub>: Enterprise e-commerce strategy

The formulation of retail electronic commerce strategies should be done according to some basic principles. The critical first step of the electronic retailing is bringing people to the site for the first time. Building awareness among the target market is one of the goals, but the more critical issue is communicating value to the consumers. Building customer loyalty -thereby getting them to revisit the website- requires improvement in customer interaction through enhanced offerings, and targeted marketing actions and communications.

The main target in launching an e-retail store and using the Internet as another sales channel is to provide customers with a more convenient channel that delivers a quick, simple, enjoyable and secure shopping process while emphasizing the current brand personality. A successful electronic marketing plan for the web presence of an enterprise should cover all the issues stated in Figure 5.1.

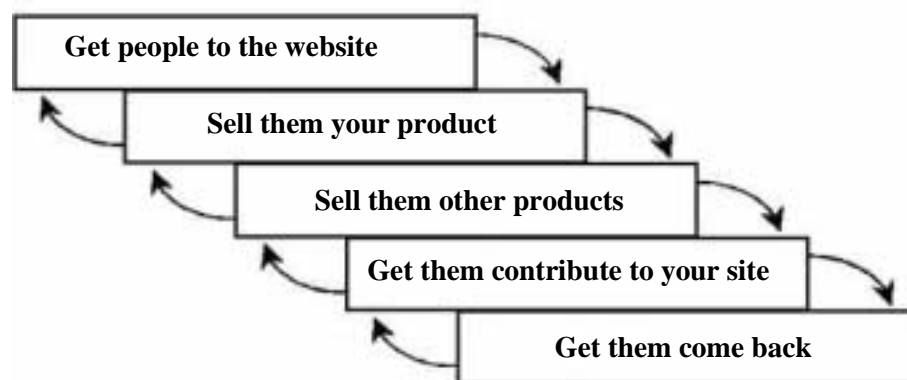


Figure 5.1. Issues in Electronic Marketing

During the decomposition of the e-commerce strategy in this chapter, hierarchical positions for each step will be shown in figures. Figure 5.2 shows the position in the strategic decomposition phase (Level 1).

In the strategic level, we have the following goals:



GOAL<sub>1</sub>: Get customers to the website  
 GOAL<sub>2</sub>: Provide the customers with easy and secure online shopping  
 GOAL<sub>3</sub>: Deliver the purchased products  
 GOAL<sub>4</sub>: Provide after sales service  
 And their corresponding strategies are:  
 STRATEGY<sub>1</sub>: Marketing strategy  
 STRATEGY<sub>2</sub>: Website development strategy  
 STRATEGY<sub>3</sub>: Product delivery system  
 STRATEGY<sub>4</sub>: Customer support

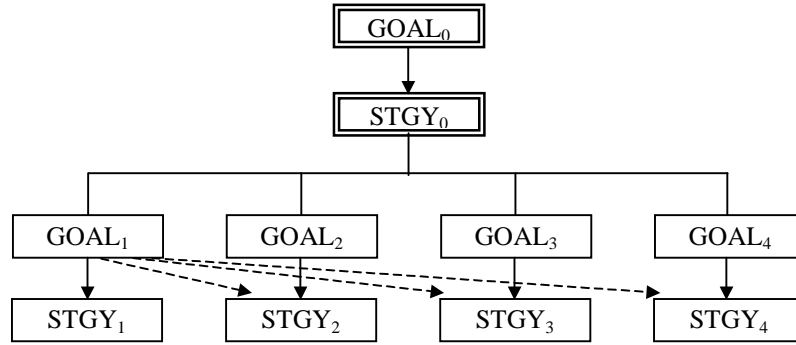


Figure 5.2. Decomposition Level 1: Strategic Level

These goals and strategies yield the strategic design matrix for this level as:

$$\left\{ \begin{array}{l} \text{GOAL}_1 \\ \text{GOAL}_2 \\ \text{GOAL}_3 \\ \text{GOAL}_4 \end{array} \right\} = \begin{pmatrix} X & X & X & X \\ 0 & X & 0 & 0 \\ 0 & 0 & X & 0 \\ 0 & 0 & 0 & X \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_1 \\ \text{STGY}_2 \\ \text{STGY}_3 \\ \text{STGY}_4 \end{array} \right\}$$

This is a decoupled system. An order in the strategies must be followed to satisfy the independence axiom. That is;

1. Set up customer support to provide after sales services,
2. Set up product delivery system to deliver the purchased products,
3. Set up website development strategies to provide the customers with easy and secure online shopping,
4. Then set up the development of marketing strategies after setting up #1, #2 and #3 to get customers to the website.

This system derived by decomposition level 1 forms a “customer focused” marketing strategy. Getting customers to the website is related with all the elements of the total e-commerce strategy. Number of customers visiting the website is influenced by changes in website development strategy, product delivery system and customer support activities. The other three goals (goals 2,3 and 4) can be achieved by conducting only the corresponding strategies and the success of these applications will affect the website visits together with the marketing strategy.

Further decomposition will be focused on marketing and website development strategies. The others -product delivery system and customer support- will be decomposed only in level 2.

### 5.3.2. Decomposition Level 2

Level 2 includes decompositions of marketing strategy, website development strategy, product delivery system and customer support organization.

GOAL<sub>1</sub>: Get customers to the website

STRATEGY<sub>1</sub>: Marketing strategy

A firm moving onto the Internet is likely to find it competing for potential customers' attention and business with hundreds of similar ones. With so many companies on the Internet offering similar products and services, creating an image and brand identity, which will separate the company from its competitors, is one of the most important challenges.

The Internet provides an effective channel for brand communication and advertising. And also it has many tools for measuring the effectiveness of advertising activities and determining company's customer profiles. Another marketing issue is the development of pricing strategies unique to the Internet. The current position of the decomposition is shown in Figure 5.3. Marketing goals and their corresponding strategies are:

GOAL<sub>11</sub>: Perform effective advertising

GOAL<sub>12</sub>: Offer competitive prices and payment terms

GOAL<sub>13</sub>: Create an image and brand identity

STRATEGY<sub>11</sub>: Advertising strategy

STRATEGY<sub>12</sub>: Pricing strategy

STRATEGY<sub>13</sub>: Market positioning and branding

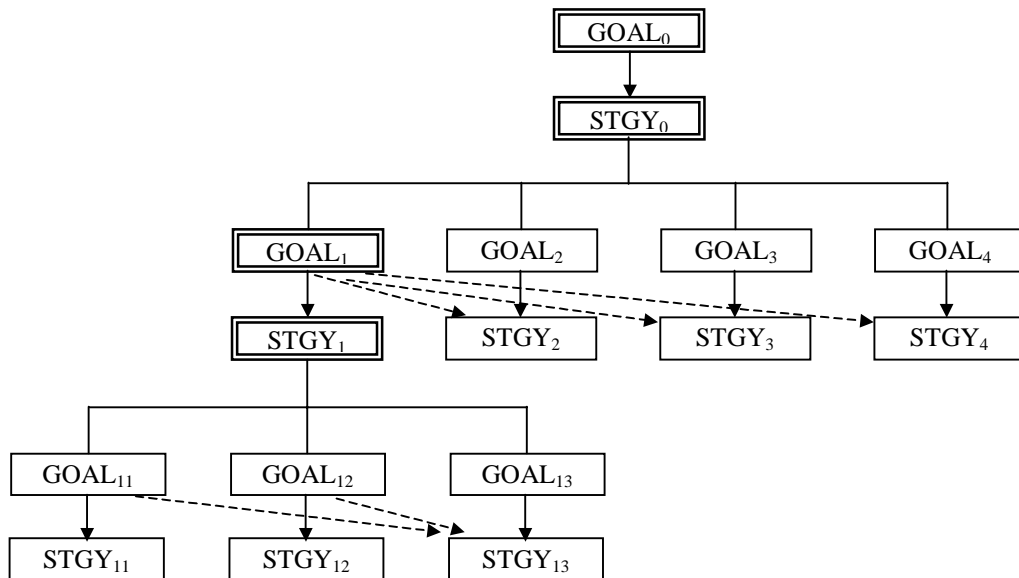


Figure 5.3. Decomposition Level 2: Marketing Strategy

The strategic design matrix for this level is:

$$\left\{ \begin{array}{l} \text{GOAL}_{11} \\ \text{GOAL}_{12} \\ \text{GOAL}_{13} \end{array} \right\} = \begin{pmatrix} \text{X} & 0 & \text{X} \\ 0 & \text{X} & \text{X} \\ 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{11} \\ \text{STGY}_{12} \\ \text{STGY}_{13} \end{array} \right\}$$

The design at this level is also a decoupled design. Market positioning and branding are critical factors that affect both advertising and pricing strategies. Therefore these two marketing sub-strategies have to be developed after the development of market positioning strategies.

GOAL<sub>2</sub>: Provide the customers with easy and secure online shopping

STRATEGY<sub>2</sub>: Website development strategy

The Internet enables companies to provide current and potential customers with a wealth of information about their products and services. Customers can browse and shop online, request and obtain product information, and check the status of their orders. Developing a secure and well organized website requires the integration and deployment of complex front and back office applications and supporting technologies as well as creative tools for the customers. Companies should also take the advantage of providing customized service to individual customers, which is one of the critical success factors of the industry leaders. Website development strategy can be decomposed into four main parts (Figure 5.4). The goals and their strategies in website development are:

GOAL<sub>21</sub>: Have a logically organized and convenient website

GOAL<sub>22</sub>: Provide customized sales constancy to the consumers

GOAL<sub>23</sub>: Set up a secure payment system

GOAL<sub>24</sub>: Set up an enjoyable website

STRATEGY<sub>21</sub>: E-store design

STRATEGY<sub>22</sub>: Customization

STRATEGY<sub>23</sub>: Online payment system

STRATEGY<sub>24</sub>: Creative website design

And the strategic design matrix is:

$$\left\{ \begin{array}{l} \text{GOAL}_{21} \\ \text{GOAL}_{22} \\ \text{GOAL}_{23} \\ \text{GOAL}_{24} \end{array} \right\} = \begin{pmatrix} \text{X} & \text{X} & 0 & 0 \\ 0 & \text{X} & 0 & 0 \\ 0 & 0 & \text{X} & 0 \\ 0 & 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{21} \\ \text{STGY}_{22} \\ \text{STGY}_{23} \\ \text{STGY}_{24} \end{array} \right\}$$

This decoupled design matrix states that the strategy of e-store development has to be set up after the organization of customization tools. Personalized services and recommendations can influence the efficiency and convenience of the website. Security of the payment process and interactive tools can be provided independently.

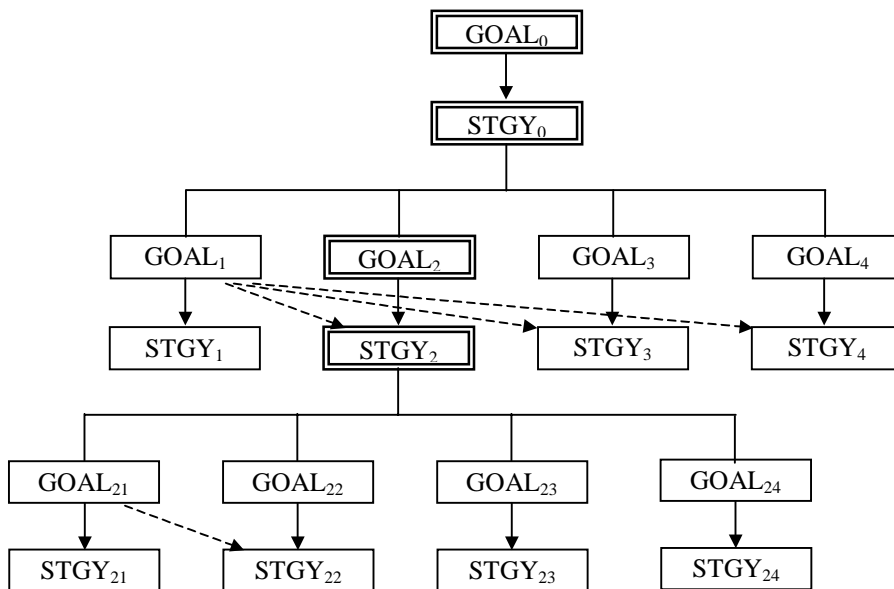


Figure 5.4. Decomposition Level 2: Website Development Strategy

GOAL<sub>3</sub>: Deliver the purchased products  
 STRATEGY<sub>3</sub>: Product delivery system

Product distribution system covers all activities which are related to deliver the product from the point where is stored, to the customer. The current hierarchical position is shown in Figure 5.5. The decomposition for product delivery system is as follows:

GOAL<sub>31</sub>: Deliver digital goods and services  
 GOAL<sub>32</sub>: Deliver material goods  
 STRATEGY<sub>31</sub>: Delivery over the Internet  
 STRATEGY<sub>32</sub>: Physical product distribution network

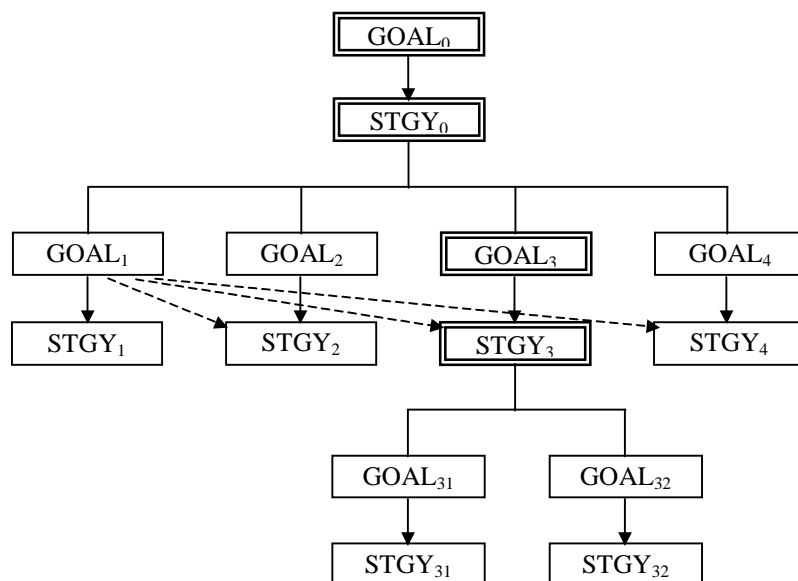


Figure 5.5. Decomposition Level 2: Product Delivery System

The strategic design matrix for this level is:

$$\begin{Bmatrix} \text{GOAL}_{31} \\ \text{GOAL}_{32} \end{Bmatrix} = \begin{bmatrix} \text{X} & 0 \\ 0 & \text{X} \end{bmatrix} \begin{Bmatrix} \text{STGY}_{31} \\ \text{STGY}_{32} \end{Bmatrix}$$

The design matrix is uncoupled at this level, thus the delivery of digital goods and physical products can be realized by two “independent” systems. Delivery of digital goods requires an online delivery system while the delivery of physical products requires a physical distribution network.

GOAL<sub>4</sub>: Provide after sales service

STRATEGY<sub>4</sub>: Customer support

In the new business environment, marketing, sales and customer support services must be linked so that each is organized to respond quickly to every customer requirements. Interactive technology will also affect the speed at which retailers must respond to customer questions and requests. The goals and strategies of a customer support organization are:

GOAL<sub>41</sub>: Provide customer support at all stages of the relationship

GOAL<sub>42</sub>: Provide quick response to the customers

STRATEGY<sub>41</sub>: Integrated service

STRATEGY<sub>42</sub>: Contact management

The strategic design matrix is:

$$\begin{Bmatrix} \text{GOAL}_{41} \\ \text{GOAL}_{42} \end{Bmatrix} = \begin{bmatrix} \text{X} & \text{X} \\ 0 & \text{X} \end{bmatrix} \begin{Bmatrix} \text{STGY}_{41} \\ \text{STGY}_{42} \end{Bmatrix}$$

Customer support organization presents a decoupled design at this level. Customer support at all stages of the relationship can be provided after the response and contact systems are developed by the contact management. This means that company’s customer support activities should begin with the development of customer database system and contact management tools. After that, customer support can be provided to the customer at all stages with an integrated service organization.

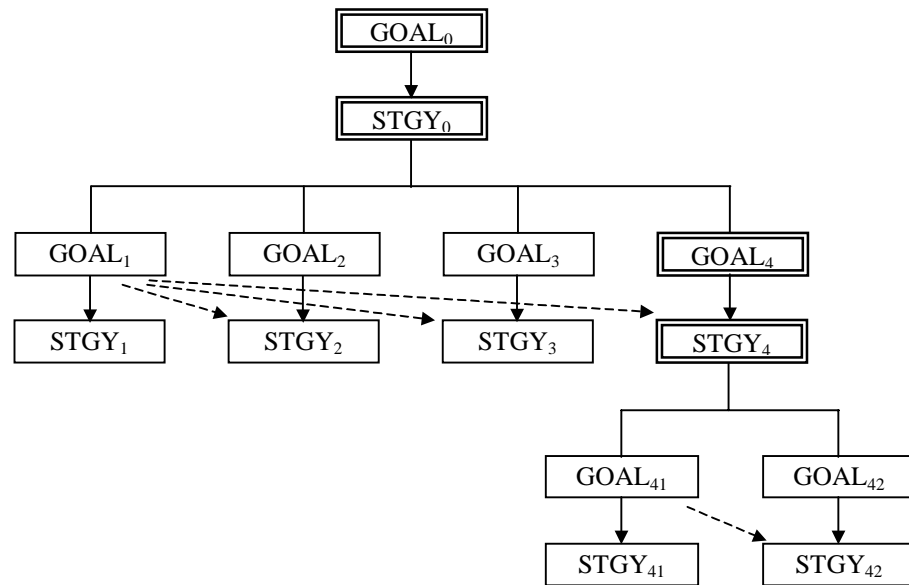


Figure 5.6. Decomposition Level 2: Customer Support

### 5.3.3. Decomposition Level 3

At this stage of the strategy development process, the pre-determined mid-level goals and strategies including advertising and pricing strategies, online sales process, e-store design, creative website design and customization, will be decomposed in order to obtain low-level goals and their strategies.

GOAL<sub>11</sub>: Perform effective advertising

STRATEGY<sub>11</sub>: Advertising strategy

Unlike mass-marketing media, the value of the Internet is its ability to enable companies to target specific markets and create one-to-one relationships with customers in the most desirable segments. Banners and targeted online messages, as well as television, magazine, and other advertising outlets, make up the channels through which companies can communicate with potential customers. The ability to establish various types of customer communities easily is another advantage of e-commerce applications. The current hierarchical position is in Figure 5.7. Decomposition of goals and strategies at this step is as follows:

GOAL<sub>111</sub>: Attract surfers on the web

GOAL<sub>112</sub>: Send e-mails to consumers

GOAL<sub>113</sub>: Establish efficient communication among customers

GOAL<sub>114</sub>: Take traditional consumers to the e-store

The corresponding strategies are:

STRATEGY<sub>111</sub>: Banner advertising

STRATEGY<sub>112</sub>: E-mail advertising

STRATEGY<sub>113</sub>: Customer communities

STRATEGY<sub>114</sub>: Traditional media and direct mailing

And the strategic design matrix is:

$$\left\{ \begin{array}{l} \text{GOAL}_{111} \\ \text{GOAL}_{112} \\ \text{GOAL}_{113} \\ \text{GOAL}_{114} \end{array} \right\} = \begin{pmatrix} X & 0 & 0 & 0 \\ 0 & X & X & 0 \\ 0 & 0 & X & 0 \\ 0 & 0 & 0 & X \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{111} \\ \text{STGY}_{112} \\ \text{STGY}_{113} \\ \text{STGY}_{114} \end{array} \right\}$$

The only coupling at this level shows the affect of the efficiency and number of customer communities in e-mail advertising. E-mail advertising tools can be used better if customer communities are well established. Traditional media and banner advertising strategies can be set up independently.

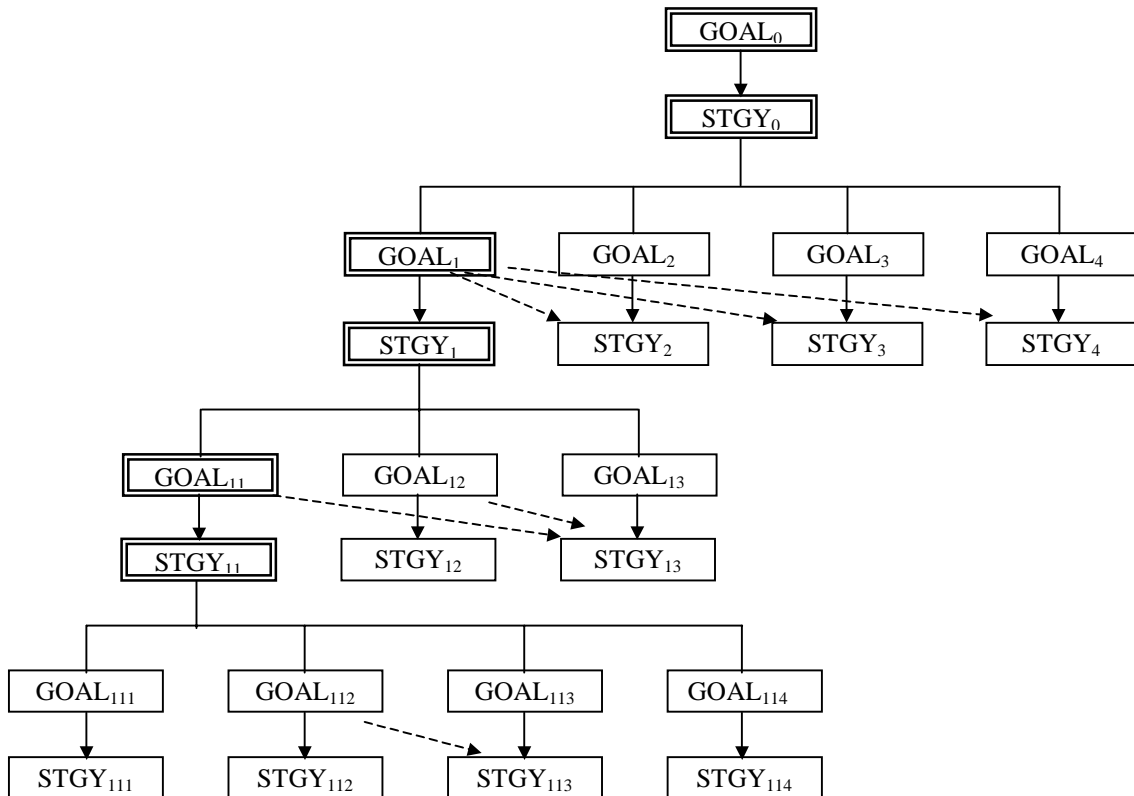


Figure 5.7. Decomposition Level 3: Advertising Strategy

GOAL<sub>12</sub>: Offer competitive prices and payment terms  
 STRATEGY<sub>12</sub>: Pricing strategy

The Internet brings into existence new capabilities for pricing precision and flexibility. Companies can easily obtain customer information on buying behavior and price sensitivity, and they will tailor their offerings and prices accordingly. Pricing goals and strategies (Figure 5.8) are stated below:

- GOAL<sub>121</sub>: Offer various payment terms to the customer i.e. delivery choices
- GOAL<sub>122</sub>: Offer special prices and/or payment terms to the re-visitors
- GOAL<sub>123</sub>: Offer special discounts and/or marketing programs

STRATEGY<sub>121</sub>: Payment options  
 STRATEGY<sub>122</sub>: Customized pricing  
 STRATEGY<sub>123</sub>: Promotions

We obtain the strategic design matrix as:

$$\left\{ \begin{array}{l} \text{GOAL}_{121} \\ \text{GOAL}_{122} \\ \text{GOAL}_{123} \end{array} \right\} = \begin{pmatrix} \text{X} & \text{X} & \text{X} \\ 0 & \text{X} & 0 \\ 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{121} \\ \text{STGY}_{122} \\ \text{STGY}_{123} \end{array} \right\}$$

This is a decoupled design matrix. Payment options, which are going to be offered to the customers, should be set after the development of customized pricing policy, discounts and other promotion programs.

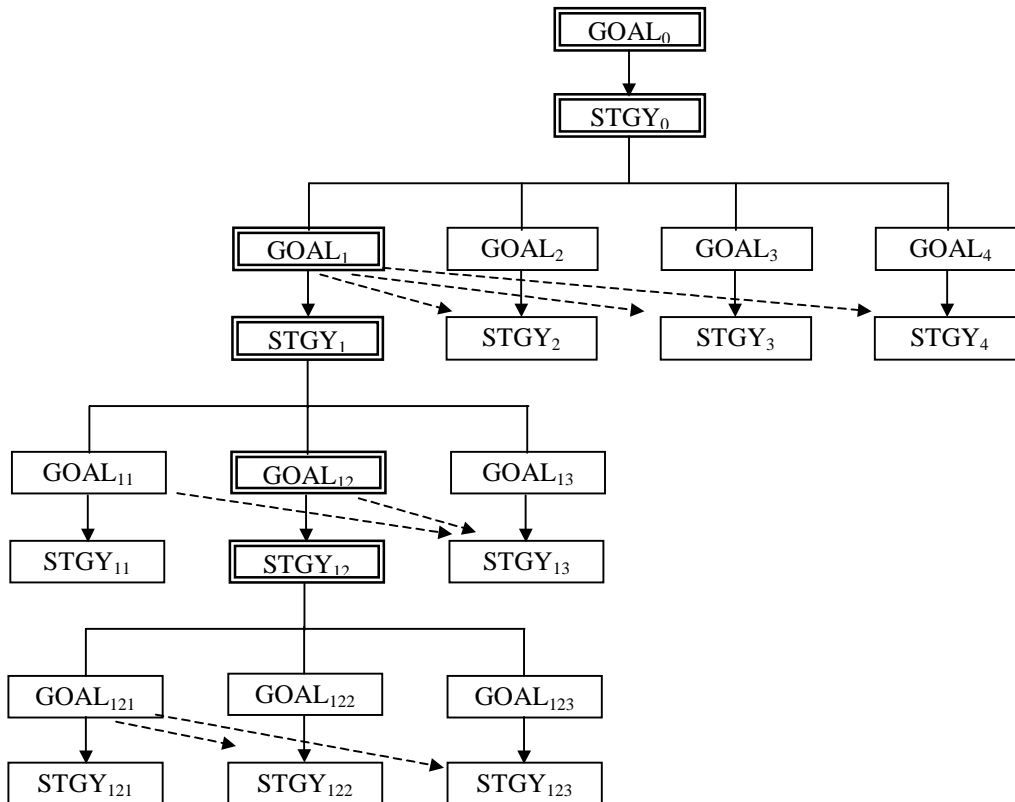


Figure 5.8. Decomposition Level 3: Pricing Strategy

GOAL<sub>21</sub>: Have a logically organized and convenient website  
 STRATEGY<sub>21</sub>: E-store design

The ability to design and create logical flows for information access and online transactions is one of the most critical factors of e-commerce applications. Technology supports the automation of business processes and enables the creation of new ones. Before going online, companies have to first map out their business processes and identify the linkages between them. Figure 5.9 shows the current position of the decomposition process.



Goals and the corresponding strategies are:

GOAL<sub>211</sub>: Arrange the products according to customer interests and/or product types

GOAL<sub>212</sub>: Provide quick loading web pages

GOAL<sub>213</sub>: Provide quick and accurate search results

GOAL<sub>214</sub>: Provide the knowledge to solve any problem

STRATEGY<sub>211</sub>: Market and product segmentation

STRATEGY<sub>212</sub>: Web page content size

STRATEGY<sub>213</sub>: Search functions

STRATEGY<sub>214</sub>: Instructions and help facilities

The strategic design matrix for this level is:

$$\begin{Bmatrix} \text{GOAL}_{211} \\ \text{GOAL}_{212} \\ \text{GOAL}_{213} \\ \text{GOAL}_{214} \end{Bmatrix} = \begin{pmatrix} \text{X} & 0 & 0 & 0 \\ 0 & \text{X} & 0 & 0 \\ 0 & 0 & \text{X} & 0 \\ 0 & 0 & 0 & \text{X} \end{pmatrix} \begin{Bmatrix} \text{STGY}_{211} \\ \text{STGY}_{212} \\ \text{STGY}_{213} \\ \text{STGY}_{214} \end{Bmatrix}$$

Decomposition at this level shows an uncoupled system. According to the independence axiom, the four functions of this level can be provided independently. Therefore, strategies at this level can be adjusted to satisfy their corresponding goals without affecting the others.

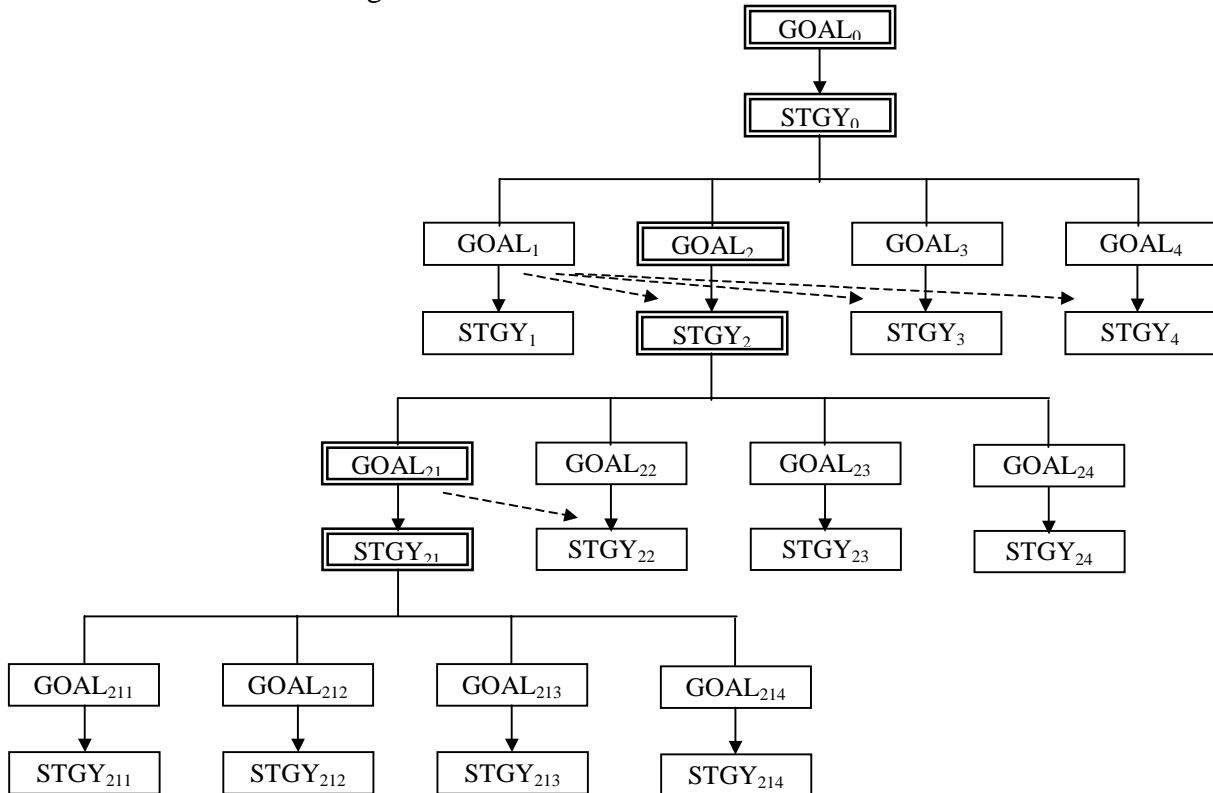


Figure 5.9. Decomposition Level 3: E-Store Design

GOAL<sub>22</sub>: Provide customized sales constancy to the consumers  
 STRATEGY<sub>22</sub>: Customization

The capability of tracking customers' interests and purchase behavior enables offering customized services to the customers. This is mostly used for making recommendations for every individual customer and providing expert opinions about the related products.

The current hierarchical position is shown in Figure 5.10. Goals, strategies and the strategic design matrix are as follows:

GOAL<sub>221</sub>: Make product/service recommendations for every individual customer  
 GOAL<sub>222</sub>: Provide expert opinions about specific products  
 STRATEGY<sub>221</sub>: Tracking customers' interests and purchase behaviors  
 STRATEGY<sub>222</sub>: Expert insights

$$\begin{Bmatrix} \text{GOAL}_{221} \\ \text{GOAL}_{222} \end{Bmatrix} = \begin{bmatrix} \text{X} & \text{X} \\ 0 & \text{X} \end{bmatrix} \begin{Bmatrix} \text{STGY}_{221} \\ \text{STGY}_{222} \end{Bmatrix}$$

Expert insights, which are used for providing information about specific products for the customers, can be available for every customer. In order to offer personalized services and recommendations for individual customers, a system for providing expert opinions about specific products should also be set up. Then, a system for tracking customers' interests and purchase behaviors has to be developed. The coupling in this decoupled strategic design matrix explains this relationship.

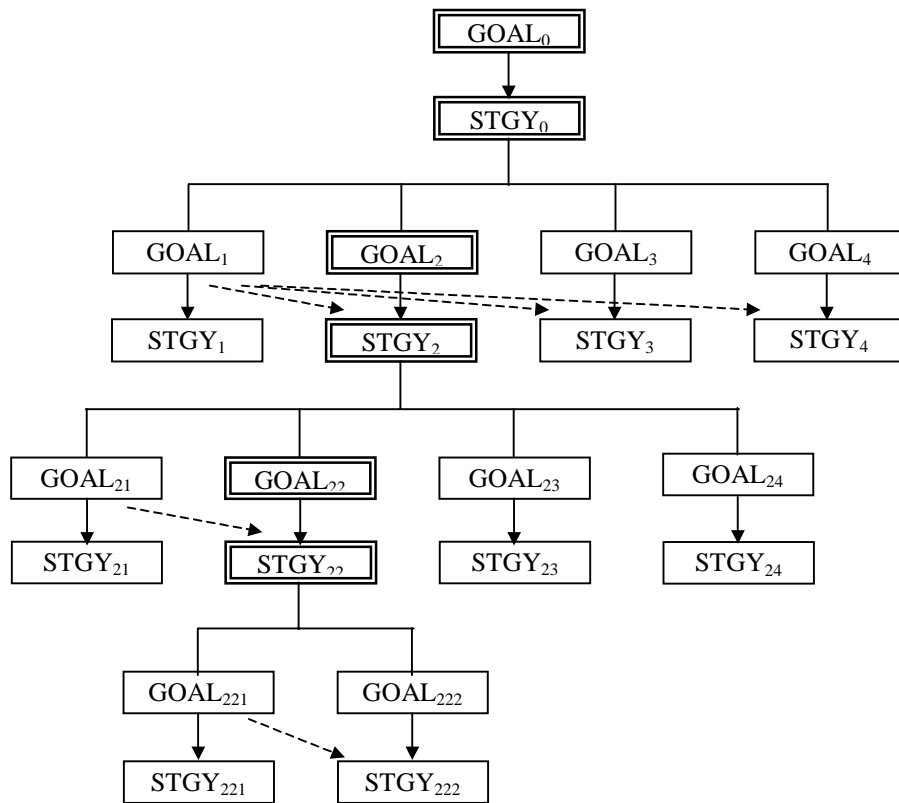


Figure 5.10. Decomposition Level 3: Customization

GOAL<sub>23</sub>: Set up a secure payment system  
 STRATEGY<sub>23</sub>: Online payment system

Providing the security of web sites, information and the systems behind them is also one of the most important factors to consider when planning, designing, and managing e-commerce infrastructures. Purchasing period and the payment process are factors affecting the overall experience and ultimate satisfaction that a customer derives from a web transaction.

The decomposition in this level (Figure 5.11) yields:

GOAL<sub>231</sub>: Get optimum personal information from the customer  
 GOAL<sub>232</sub>: Provide a secure payment process  
 STRATEGY<sub>231</sub>: Customer identification  
 STRATEGY<sub>232</sub>: Payment process

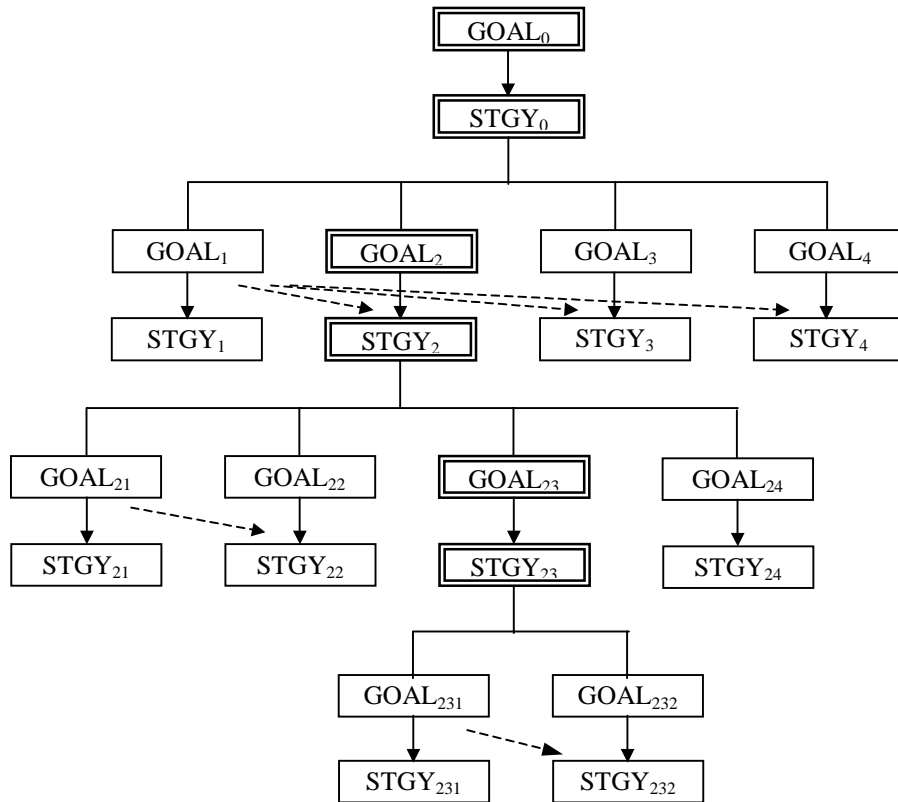


Figure 5.11. Decomposition Level 3: Online Payment Process

And the strategic design matrix is:

$$\begin{Bmatrix} \text{GOAL}_{231} \\ \text{GOAL}_{232} \end{Bmatrix} = \begin{bmatrix} X & X \\ 0 & X \end{bmatrix} \begin{Bmatrix} \text{STGY}_{231} \\ \text{STGY}_{232} \end{Bmatrix}$$

This is a decoupled system, because security features of the system should be developed before determining customer identification process. Setting a secure payment process may affect the customer identification process.

GOAL<sub>24</sub>: Set up an enjoyable website  
 STRATEGY<sub>24</sub>: Creative website design

Electronic store of a company should present the unique characteristics of their product or service offerings in the design of the website. An equivalent feel for the use of the product, even though the customer cannot touch or use the real product, has to be provided in order to encourage the customers for online shopping. Some interactive tools may also be used to make the customers stay in the website and contribute to its effectiveness.

Goals and strategies in this level (Figure 5.12) are:

GOAL<sub>241</sub>: Give an equivalent feel for the use of the products  
 GOAL<sub>242</sub>: Make the customers contribute to the website  
 STRATEGY<sub>241</sub>: Creative design  
 STRATEGY<sub>242</sub>: Interactive tools

And the strategic design matrix is:

$$\begin{Bmatrix} \text{GOAL}_{241} \\ \text{GOAL}_{242} \end{Bmatrix} = \begin{bmatrix} X & 0 \\ 0 & X \end{bmatrix} \begin{Bmatrix} \text{STGY}_{241} \\ \text{STGY}_{242} \end{Bmatrix}$$

Creativity of the website design that aims to provide the customers with an equivalent feel for the use of the product can be considered independently from the interactivity in the website. Therefore an uncoupled design matrix is formed at his step.

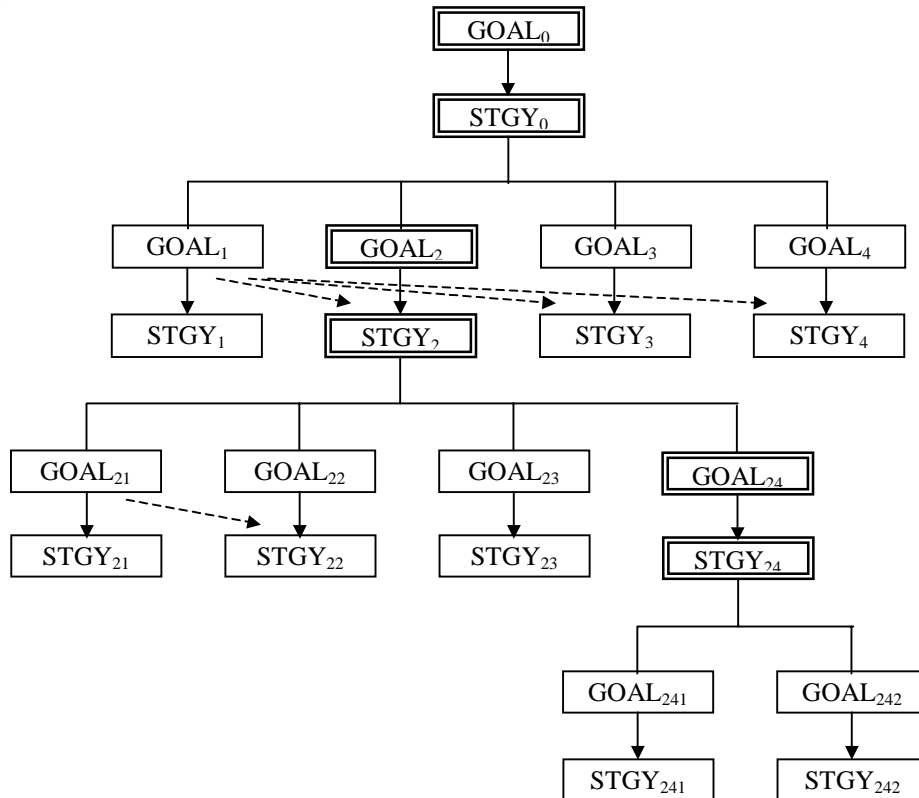


Figure 5.12. Decomposition Level 3: Creative Website Design

### 5.3.4. Decomposition Level 4

GOAL<sub>111</sub>: Attract surfers on the web

STRATEGY<sub>111</sub>: Banner advertising

There are various types of banners, such as static, animated and interactive banners that may include a game offer or a question. Banners should have the ability to invoke curiosity and use minimum text in the banner area. The goals and strategies in this level (Figure 5.13) are:

GOAL<sub>1111</sub>: Communicate a simple and focused message

GOAL<sub>1112</sub>: Give the surfer reason to click

STRATEGY<sub>1111</sub>: Banner content

STRATEGY<sub>1112</sub>: Banner objective and attractiveness

The strategic design matrix is:

$$\begin{Bmatrix} \text{GOAL}_{1111} \\ \text{GOAL}_{1112} \end{Bmatrix} = \begin{bmatrix} \text{X} & \text{X} \\ 0 & \text{X} \end{bmatrix} \begin{Bmatrix} \text{STGY}_{1111} \\ \text{STGY}_{1112} \end{Bmatrix}$$

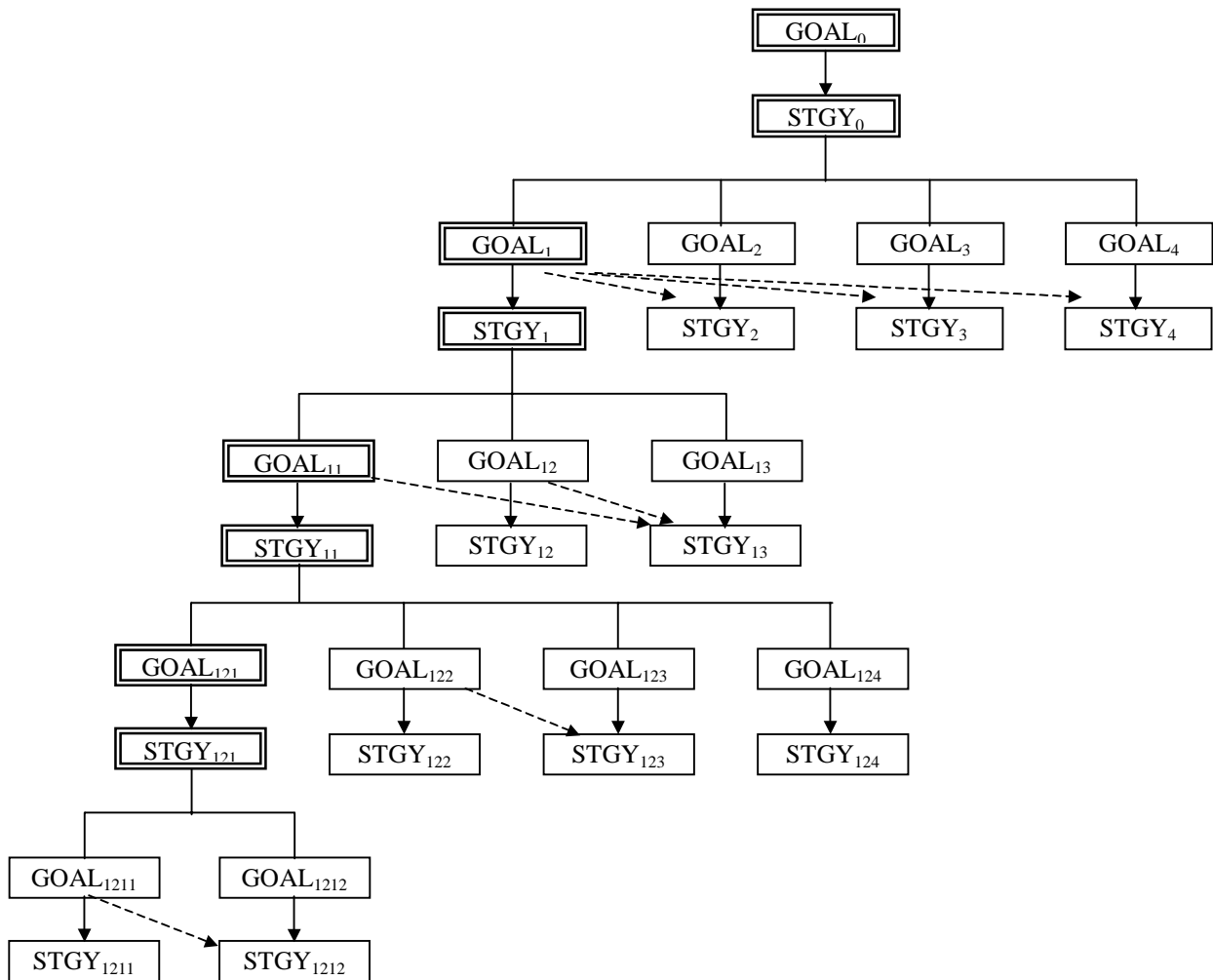


Figure 5.13. Decomposition Level 4: Banner Advertising

This decoupled strategic design matrix states that an order of strategies has to be followed to attract surfers on the web. As a first step, banner objective that will be communicated through banner advertising should be developed. Then the content of the banner has to be designed. The coupling in the design matrix shows this effect.

GOAL<sub>112</sub>: Send e-mails to consumers

STRATEGY<sub>112</sub>: E-mail advertising

While trying to create destinations that people will come to, companies need to use the power and reach of the Internet to deliver tailored messages and information to current and potential customers. Goals and strategies of e-mail advertising are (Figure 5.14):

GOAL<sub>1121</sub>: Set focused mail groups by subscription

GOAL<sub>1122</sub>: Send e-mails related with the products and/or special payment offerings

STRATEGY<sub>1121</sub>: E-mail newsletters

STRATEGY<sub>1122</sub>: Direct e-mailing

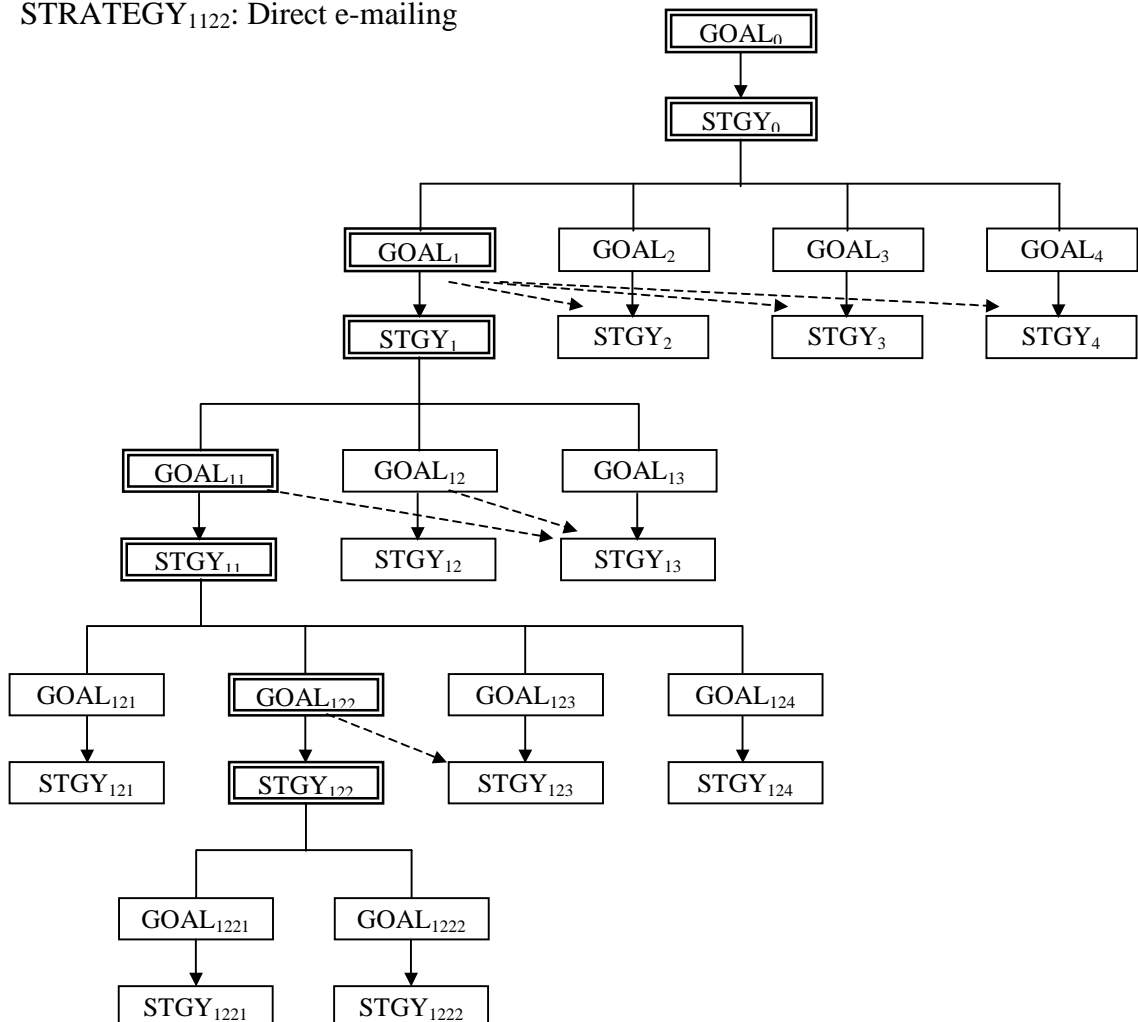


Figure 5.14. Decomposition Level 4: E-Mail Advertising

The strategic design matrix will be as follows:

$$\begin{Bmatrix} \text{GOAL}_{1121} \\ \text{GOAL}_{1122} \end{Bmatrix} = \begin{bmatrix} X & 0 \\ 0 & X \end{bmatrix} \begin{Bmatrix} \text{STGY}_{1121} \\ \text{STGY}_{1122} \end{Bmatrix}$$

The strategic design matrix is uncoupled, since e-mail newsletters and direct e-mailing activities can be organized independently.

GOAL<sub>113</sub>: Establish efficient communication among customers  
 STRATEGY<sub>113</sub>: Customer communities

There are some other methods for getting consumers to the website and keeping them there, such as establishing online conversations or setting e-mail groups. Encouraging the consumers to start discussion forums about their topics of interest, to share their experiences about the products or to make suggestions for product improvements are some of the ways of establishing customer communities and creating a reason to visit the website again.

Goals and strategies in this level (Figure 5.15) are:

GOAL<sub>1131</sub>: Establish communication among customers  
 GOAL<sub>1132</sub>: Enable and support the sharing of experiences among customers  
 STRATEGY<sub>1131</sub>: Discussion forums, e-mail groups etc.  
 STRATEGY<sub>1132</sub>: Interest groups

The strategic design matrix is:

$$\left\{ \begin{array}{l} \text{GOAL}_{1131} \\ \text{GOAL}_{1132} \end{array} \right\} = \begin{bmatrix} \text{X} & \text{X} \\ 0 & \text{X} \end{bmatrix} \left\{ \begin{array}{l} \text{STGY}_{1131} \\ \text{STGY}_{1132} \end{array} \right\}$$

In order to make the website visitors communicate with each other; groups of customers with similar interests have to be established. Depending on the organization and interrelations of these interest groups, discussion forums, e-mail groups and some other tools can be used to make the customers interact with each other.

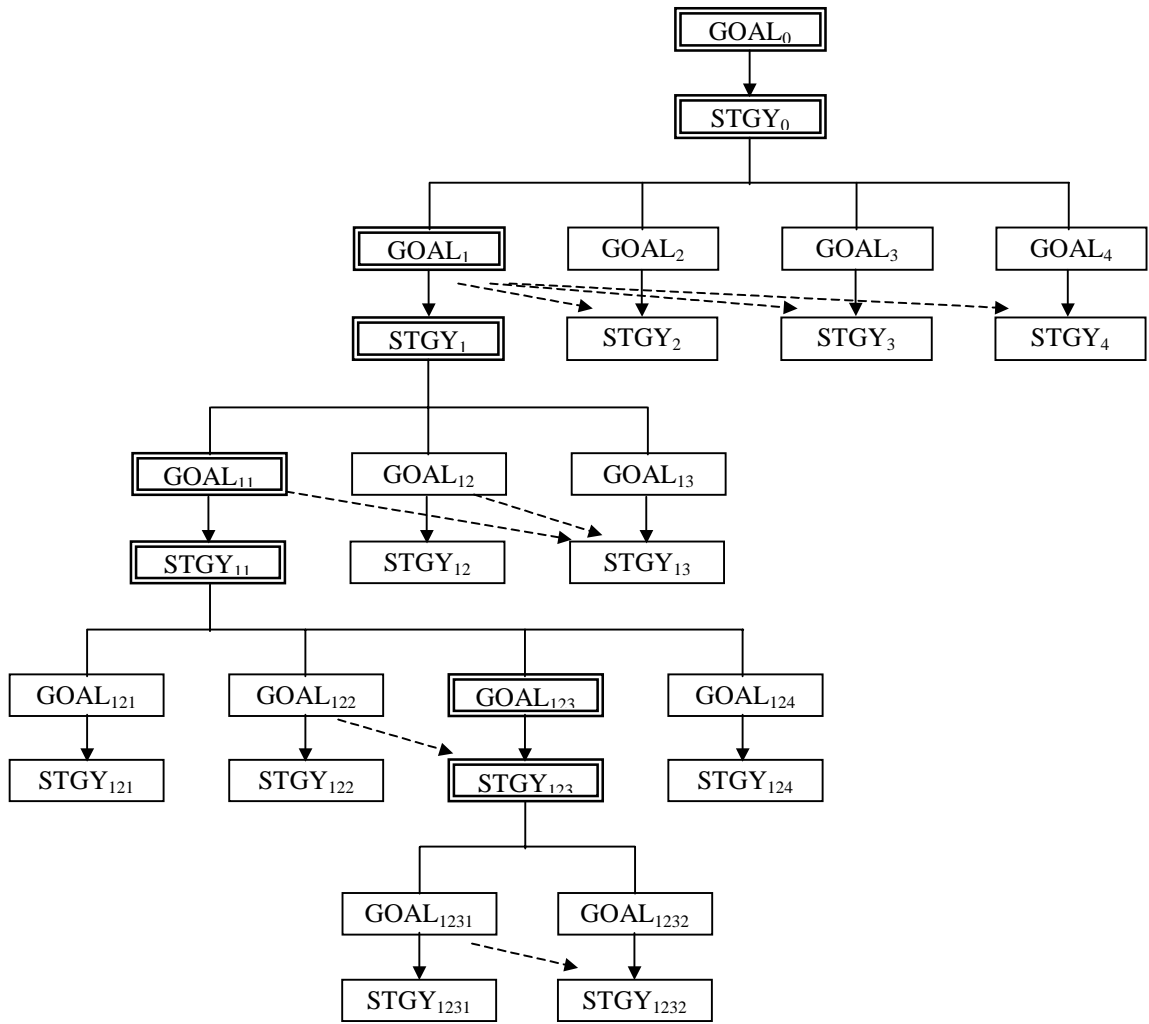


Figure 5.15. Decomposition Level 4: Customer Communities



Table 5.1. List of Goals

GOAL<sub>0</sub>: Organize enterprise B2C e-commerce applications

GOAL<sub>1</sub>: Get customers to the website

GOAL<sub>11</sub>: Perform effective advertising

GOAL<sub>111</sub>: Attract surfers on the web

GOAL<sub>1111</sub>: Communicate a simple and focused message

GOAL<sub>1112</sub>: Give the surfer reason to click

GOAL<sub>112</sub>: Send e-mails to consumers

GOAL<sub>1121</sub>: Set focused mail groups by subscription

GOAL<sub>1122</sub>: Send e-mails related with the products and payment offerings

GOAL<sub>113</sub>: Establish efficient communication among customers

GOAL<sub>1131</sub>: Establish communication among customers

GOAL<sub>1132</sub>: Support the sharing of experiences among customers

GOAL<sub>114</sub>: Take traditional consumers to the e-store

GOAL<sub>12</sub>: Offer competitive prices and payment terms

GOAL<sub>121</sub>: Offer various payment terms to the customer i.e. delivery choices

GOAL<sub>122</sub>: Offer special prices and/or payment terms to the re-visitors

GOAL<sub>123</sub>: Offer special discounts and/or marketing programs

GOAL<sub>13</sub>: Create an image and brand identity

GOAL<sub>2</sub>: Provide the customers with easy and secure online shopping

GOAL<sub>21</sub>: Have a logically organized and convenient website

GOAL<sub>211</sub>: Arrange the products according to customer interests or product types

GOAL<sub>212</sub>: Provide quick loading web pages

GOAL<sub>213</sub>: Provide quick and accurate search results

GOAL<sub>214</sub>: Provide the knowledge to solve any problem

GOAL<sub>22</sub>: Provide customized sales constancy to the consumers

GOAL<sub>221</sub>: Make product/service recommendations for every individual customer

GOAL<sub>222</sub>: Provide expert opinions about specific products

GOAL<sub>23</sub>: Set up a secure payment system

GOAL<sub>231</sub>: Get optimum personal information from the customer

GOAL<sub>232</sub>: Provide a secure payment process

GOAL<sub>24</sub>: Set up an enjoyable website

GOAL<sub>241</sub>: Give an equivalent feel for the use of the products

GOAL<sub>242</sub>: Make the customers contribute to the website

GOAL<sub>3</sub>: Deliver the purchased products

GOAL<sub>31</sub>: Deliver digital goods and services

GOAL<sub>32</sub>: Deliver material goods

GOAL<sub>4</sub>: Provide after sales service

GOAL<sub>41</sub>: Provide customer support at all stages of the relationship

GOAL<sub>42</sub>: Provide quick response to the customers

Table 5.2. List of Strategies

STGY<sub>0</sub>: Enterprise e-commerce strategy

STGY<sub>1</sub>: Marketing strategy

STGY<sub>11</sub>: Advertising strategy

STGY<sub>111</sub>: Banner advertising

STGY<sub>1111</sub>: Banner content

STGY<sub>1112</sub>: Banner objective and attractiveness

STGY<sub>112</sub>: E-mail advertising

STGY<sub>1121</sub>: E-mail newsletters

STGY<sub>1122</sub>: Direct e-mailing

STGY<sub>113</sub>: Customer communities

STGY<sub>1131</sub>: Discussion forums, e-mail groups etc.

STGY<sub>1132</sub>: Interest groups

STGY<sub>114</sub>: Traditional media and direct mailing

STGY<sub>12</sub>: Pricing strategy

STGY<sub>121</sub>: Payment options

STGY<sub>122</sub>: Customized pricing

STGY<sub>123</sub>: Promotions

STGY<sub>13</sub>: Market positioning and branding

STGY<sub>2</sub>: Website development strategy

STGY<sub>21</sub>: E-store design

STGY<sub>211</sub>: Market and product segmentation

STGY<sub>212</sub>: Web page content size

STGY<sub>213</sub>: Search functions

STGY<sub>214</sub>: Instructions and help facilities

STGY<sub>22</sub>: Customization

STGY<sub>221</sub>: Tracking customers' interests and purchase behaviors

STGY<sub>222</sub>: Expert insights

STGY<sub>23</sub>: Online payment system

STGY<sub>231</sub>: Customer identification

STGY<sub>232</sub>: Payment process

STGY<sub>24</sub>: Creative website design

STGY<sub>241</sub>: Creative design

STGY<sub>242</sub>: Interactive tools

STGY<sub>3</sub>: Product delivery system

STGY<sub>31</sub>: Delivery over the Internet

STGY<sub>32</sub>: Physical product distribution network

STRATEGY<sub>4</sub>: Customer support

STGY<sub>41</sub>: Integrated service

STGY<sub>42</sub>: Contact management

## **6. Conclusions**

This paper presents axiomatic design application in the field of strategy formulation. After introducing the fundamentals of axiomatic design, strategy axioms for business applications are provided and explained.

Based on the principles of axiomatic design, which provides a structured methodology assuring that all vital aspects of a design are addressed in an orderly and simple manner, an infrastructure for the development of e-commerce strategies is created. This is a new approach to strategy development and formulation in electronic commerce, with the decomposition of goals and strategies. This model can be used in the following cases:

- Strategy formulation of a new internet-only business,
- Organizing e-commerce applications of a company that aims to launch an e-store and conduct electronic retailing, in order to combine existing retail stores and traditional marketing tools with Internet presence,
- Analyzing the design of an existing e-commerce strategy for identifying goals without corresponding strategies or strategies that have no corresponding goals. By creating hierarchies in the design domains using the existing goals and strategies, it can be determined whether the decomposition of the goals is sufficient, or if new sub-goals have to be introduced.

The structured design and decomposition method assures that the decisions made in the design are made in proper sequence. It assures that “What to do” is answered before “How to do it”; and that “How to do it” is answered before “What resources are needed”. This concept prevents the designer from designing all kinds of processes or systems without having a clear understanding of its need.

The decomposition of the electronic commerce strategies has provided an insight into the application of axiomatic design to both organizational design and strategy formulation.

## **Appendix:** **Coupling Reduction Strategies During E-Commerce Strategy Design Process**

This appendix explains the coupling reduction strategies that were implemented during the e-commerce strategy design. During the design process, the designer can evaluate the interrelations of goals with their corresponding strategies as well as the strategies of the other goals at that level.

According to the independence axiom of axiomatic design, coupled design matrices cause inefficiencies in the system. In order to set up the total strategy, the designer should re-evaluate the couplings that occur during the design process and try to decouple the design through developing appropriate strategies to satisfy the goals. Couplings among different levels should also be reduced to improve the strategy and to have a better design.

Axiomatic Design Software, Inc. [30] has developed “Acclaro” software that accelerates the design development process by using axiomatic design. Acclaro software for axiomatic design allows designers to evaluate every decision at each level and to specify the relationships between FRs (goals) and DPs (strategies) to any level of detail. It also does matrix manipulations, checks for design problems such as coupling, and communicates information to the designer.

### **A1. Coupling Reduction at Level 2**

In decomposition level 1, we have the following goals and strategies:

GOAL<sub>1</sub>: Get customers to the website

GOAL<sub>2</sub>: Provide the customers with easy and secure online shopping

GOAL<sub>3</sub>: Deliver the purchased products

GOAL<sub>4</sub>: Provide after sales service

STRATEGY<sub>1</sub>: Marketing strategy

STRATEGY<sub>2</sub>: Website development strategy

STRATEGY<sub>3</sub>: Product delivery system

STRATEGY<sub>4</sub>: Customer support

During the initial decomposition of marketing strategy, the following goals and strategies had been determined:

GOAL<sub>11</sub>: Perform effective advertising

GOAL<sub>12</sub>: Offer competitive prices and payment terms

GOAL<sub>13</sub>: Establish efficient communication among customers

GOAL<sub>14</sub>: Create an image and brand identity

STRATEGY<sub>11</sub>: Advertising strategy

STRATEGY<sub>12</sub>: Pricing strategy

STRATEGY<sub>13</sub>: Customer communities

STRATEGY<sub>14</sub>: Market positioning and branding

The strategic design matrix for this level is:

$$\left\{ \begin{array}{l} \text{GOAL}_{11} \\ \text{GOAL}_{12} \\ \text{GOAL}_{13} \\ \text{GOAL}_{14} \end{array} \right\} = \begin{pmatrix} \text{X} & 0 & \text{X} & \text{X} \\ 0 & \text{X} & 0 & \text{X} \\ \text{X} & 0 & \text{X} & 0 \\ 0 & 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{11} \\ \text{STGY}_{12} \\ \text{STGY}_{13} \\ \text{STGY}_{14} \end{array} \right\}$$

This is a coupled system. According to the independence axiom, goals #2 and #3 cannot be adjusted without affecting the performance of each other. Interrelations of all the goals and strategies should be analyzed again and the current design has to be changed.

After the assessment of marketing and advertising levels, an “improvement” in design has been made in order to reduce the coupling. The new goals and their corresponding strategies can be stated as:

- GOAL<sub>11</sub>: Perform effective advertising
- GOAL<sub>12</sub>: Offer competitive prices and payment terms
- GOAL<sub>13</sub>: Create an image and brand identity

- STRATEGY<sub>11</sub>: Advertising strategy
- STRATEGY<sub>12</sub>: Pricing strategy
- STRATEGY<sub>13</sub>: Market positioning and branding

The strategic design matrix for this level is:

$$\left\{ \begin{array}{l} \text{GOAL}_{11} \\ \text{GOAL}_{12} \\ \text{GOAL}_{13} \end{array} \right\} = \begin{pmatrix} \text{X} & 0 & \text{X} \\ 0 & \text{X} & \text{X} \\ 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{11} \\ \text{STGY}_{12} \\ \text{STGY}_{13} \end{array} \right\}$$

And decomposition of the advertising strategy is realized as follows:

- GOAL<sub>121</sub>: Attract surfers on the web
- GOAL<sub>122</sub>: Send e-mails to consumers
- GOAL<sub>123</sub>: Establish efficient communication among customers
- GOAL<sub>124</sub>: Take traditional consumers to the e-store

- STRATEGY<sub>121</sub>: Banner advertising
- STRATEGY<sub>122</sub>: E-mail advertising
- STRATEGY<sub>123</sub>: Customer communities
- STRATEGY<sub>124</sub>: Traditional media and direct mailing

And the strategic design matrix is:

$$\left\{ \begin{array}{l} \text{GOAL}_{121} \\ \text{GOAL}_{122} \\ \text{GOAL}_{123} \\ \text{GOAL}_{124} \end{array} \right\} = \begin{pmatrix} \text{X} & 0 & 0 & 0 \\ 0 & \text{X} & \text{X} & 0 \\ 0 & 0 & \text{X} & 0 \\ 0 & 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{121} \\ \text{STGY}_{122} \\ \text{STGY}_{123} \\ \text{STGY}_{124} \end{array} \right\}$$

After the improvement, we obtain decoupled strategic design matrices at both levels. Therefore the independence of related goals can be guaranteed if the strategies are developed in a proper sequence.

## A2. Coupling Reduction between Levels 1 and 2

According to the principles of axiomatic design, designers have to evaluate every decision at each level and specify the relationships between goals (FRs) and strategies (DPs). During this design process, the relationships between the goals and strategies of different levels should also be evaluated, because there may be some couplings that affect the structure of the total system design. Since design matrix of the total system gives a big matrix (including all the goals, strategies to show all the interrelations among each other), it may be difficult to realize that kind of couplings. “Acclaro” software developed by Axiomatic Design Software, Inc. [30] provides the designer with the information about the entire system.

During the development of an enterprise e-commerce strategy the probable couplings between different levels have also been investigated. In order to reduce them, all the related goals and strategies are re-evaluated and a better design solution is found. The following case demonstrates the reduction of a coupling between levels 1 and 2.

In the initial design, decomposition level 1 was consist of the following goals and strategies:

GOAL<sub>1</sub>: Get customers to the website

GOAL<sub>2</sub>: Provide the customers with easy and secure online shopping

GOAL<sub>3</sub>: Deliver the purchased products

STRATEGY<sub>1</sub>: Marketing strategy

STRATEGY<sub>2</sub>: Website development strategy

STRATEGY<sub>3</sub>: Product delivery system

And the strategic design matrix was:

$$\left\{ \begin{array}{l} \text{GOAL}_1 \\ \text{GOAL}_2 \\ \text{GOAL}_3 \end{array} \right\} = \begin{pmatrix} \text{X} & \text{X} & \text{X} \\ 0 & \text{X} & 0 \\ 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_1 \\ \text{STGY}_2 \\ \text{STGY}_3 \end{array} \right\}$$

At the lower level of the system, goals, corresponding strategies and strategic design matrix of marketing strategy were:

GOAL<sub>11</sub>: Perform effective advertising  
 GOAL<sub>12</sub>: Offer competitive prices and payment terms  
 GOAL<sub>13</sub>: Provide after sales service  
 GOAL<sub>14</sub>: Create an image and brand identity

STRATEGY<sub>11</sub>: Advertising strategy  
 STRATEGY<sub>12</sub>: Pricing strategy  
 STRATEGY<sub>13</sub>: Customer support  
 STRATEGY<sub>14</sub>: Market positioning and branding

The strategic design matrix for this level is:

$$\left\{ \begin{array}{l} \text{GOAL}_{11} \\ \text{GOAL}_{12} \\ \text{GOAL}_{13} \\ \text{GOAL}_{14} \end{array} \right\} = \begin{pmatrix} \text{X} & 0 & 0 & \text{X} \\ 0 & \text{X} & 0 & \text{X} \\ 0 & 0 & \text{X} & \text{X} \\ 0 & 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_{11} \\ \text{STGY}_{12} \\ \text{STGY}_{13} \\ \text{STGY}_{14} \end{array} \right\}$$

Design matrices in levels 1 and 2 are not coupled. However STGY<sub>13</sub> (customer support) is directly related to GOAL<sub>1</sub> (get customers to the website) and it causes couplings between level 1 and level 2. Therefore the total system will probably have several couplings, which may cause organizational and managerial problems.

After the improvement, we have the following goals and strategies in the strategic level (decomposition level 1):

GOAL<sub>1</sub>: Get customers to the website  
 GOAL<sub>2</sub>: Provide the customers with easy and secure online shopping  
 GOAL<sub>3</sub>: Deliver the purchased products  
 GOAL<sub>4</sub>: Provide after sales service

STRATEGY<sub>1</sub>: Marketing strategy  
 STRATEGY<sub>2</sub>: Website development strategy  
 STRATEGY<sub>3</sub>: Product delivery system  
 STRATEGY<sub>4</sub>: Customer support

These goals and strategies yield the strategic design matrix for this level as:

$$\left\{ \begin{array}{l} \text{GOAL}_1 \\ \text{GOAL}_2 \\ \text{GOAL}_3 \\ \text{GOAL}_4 \end{array} \right\} = \begin{pmatrix} \text{X} & \text{X} & \text{X} & \text{X} \\ 0 & \text{X} & 0 & 0 \\ 0 & 0 & \text{X} & 0 \\ 0 & 0 & 0 & \text{X} \end{pmatrix} \left\{ \begin{array}{l} \text{STGY}_1 \\ \text{STGY}_2 \\ \text{STGY}_3 \\ \text{STGY}_4 \end{array} \right\}$$

This improved design of the enterprise e-commerce system will perform better than the initial one according to the principles of axiomatic design, since the couplings in the system are reduced. Efficiency of the e-commerce strategy is assured by achieving the independence of the goals and strategies, and the current design enables to follow an optimization of the implementation process.

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