The Influence of Tactical Flexibilities on the Competitive Advantage of a Firm: An Empirical Study on Jordanian Industrial Companies

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Abstract

This study aims at investigating the influence of tactical flexibilities (mix flexibility, volume flexibility, and modification flexibility) on the competitive advantage of a firm. To address this objective, a cross-sectional survey employing a questionnaire method of data collection is adopted. The study targets operations managers, plant managers, and quality managers in Jordanian Manufacturing Companies listed in Amman Stock Exchange Market. A total of 153 usable responses are received representing a response rate of 69.5%. For the purpose of data analysis, the research utilizes multivariate data analysis using exploratory and confirmatory factor analysis. The results of structural equation modeling analysis indicate significant impact of tactical flexibilities on competitive advantage. The study includes managerial implications for managers and proposes several directions for future research such as examining the role of tactical flexibilities in planning the corporate and functional strategies of a firm.

Keywords: Mix flexibility, Volume flexibility, Modification flexibility, Competitive advantage, Exploratory factor analysis, Structural equation modeling

1. Introduction

In today's uncertain business environment characterized by rapid changes, advanced technology systems, complexity of customers' requirements, new forms of strategic alliance, customized products, increasing levels of product variety, appearance of new trends toward quality issues (e.g. six sigma approach) and extension of the globalization phenomenon across and outside borders; flexibility is emerging as a competitive priority required to respond effectively to changing circumstances resulting from internal and external environments. Companies are becoming more aware of their responsiveness to customer needs by offering high product variety with short lead-times. However, flexibility in general and tactical flexibilities (volume flexibility, mix flexibility, and modification flexibility) in particular would play a major role in planning and implementing the corporate and functional strategies of a firm. Tactical flexibilities should be considered whether a firm takes a reactive or proactive role since they provide a firm with good and quick reactions to changes in market needs whilst dealing reactively. On the other hand, if a firm deals proactively, tactical flexibilities result in fast and shorter response times to environmental changing conditions. More specifically, flexibility helps a firm to deal with internal and external environmental factors such as: shorter product life cycle, the market acceptance of the product, the ease of entry into the market, rapid technological change, entry of barriers, the availability of substitute products, and poor market acceptance. Flexibility according to Gupta and Somers (1996) has direct effects on an organization's growth (financial) performance and would play a mediating role between business strategy and the organizational performance of firms.

In summary, flexibility as a competitive priority should be considered when planning and implementing the strategic and operational objectives of a firm since meeting these objectives leads to maintaining and improving the competitive advantage of a firm.

2. Research Aim and Objectives

The aims of this research can be summarized as follows:

1. Examining the influence of tactical flexibilities (mix flexibility, volume flexibility, and modification flexibility) on the competitive advantage of a firm.

2. Providing a better understanding for the role of tactical flexibilities in developing the competitive advantage of a firm.

Considering the research objectives mentioned above, the central question of this study is-: To what extent do the tactical flexibilities (mix flexibility, volume flexibility, and modification flexibility) positively affect the development of competitive advantage of a firm in the Jordanian manufacturing companies?

3. Literature Review

The literature review is presented in the next sub-sections. Flexibility definition and classification is presented. Drivers of flexibility and competitive advantage are discussed.

3.1 Flexibility Definition and Classification

There is considerable ambiguity in the existing literature with regards to the definition of flexibility. In this context, Gupta and Somers (1996, p. 205) state that, " *There is little agreement on how to define flexibility, how to achieve flexibility, or what are the costs and benefits of more, or less, flexibility.* In the same vein, Shewchuk and Moodie (1998) argue that flexibility remains poorly understood in theory and poorly utilized in practice because the term flexibility that has been used based on different perspectives of what constitutes a manufacturing system and its environment. Moreover, researchers have had different ideas as to what information is required for defining and measuring flexibility because flexibility is a multidimensional construct (Sethi and Sethi, 1990) covering different uses and scopes.

Flexibility is defined by Upton (1994) as the ability to change or react with little penalty in time, effort, cost, or performance. Scholars (such as: Boyer et al., 1997, Kathuria, 1998, etc.) have adopted Upton's definition and extended it where all of them agreed at the fact that the term flexibility is used to describe features of manufacturing systems to respond effectively and efficiently to changing business environment. Zhang et al. (2003) define flexibility as "the ability of the organization to manage production resources and uncertainty to meet various customers' requests". It could be concluded that a flexible firm is the one that has the ability to do changes, reactively and proactively respond to changes, and cope with uncertainty with a little time, efforts, and money. In this sense, (Kathuria, 1998, p. 246) states that *"flexibility gives manufacturing plants the ability to introduce new designs or new products into production quickly, adjust capacity rapidly, customize products, handle changes in the product mix quickly, and handle variations in customer delivery schedule"*.

The classifications of flexibility found in the literature vary according to the approach which each particular author adopts. The variation may refer to its different functions and uses, since each dimension of flexibility may be used in dealing with certain types of uncertainty. All scholars and authors seem to agree that classifying flexibility in different types is important (Corrêa, 1992). An early classification of flexibility is proposed by Mandelbaum (1978) who classifies it into two dimensions: action flexibility and state flexibility. The former is the capacity for taking new action to meet new circumstances and the latter is the capacity to continue functioning effectively despite changes in the environment. Slack (1987) differentiates between range and response flexibility. Range refers to the maximum number of different outcomes a resource with the respective flexibility type can achieve, such as the total number of different products a given machine can produce. "Response" refers to the time and cost with which different values within a range can be achieved (e.g. setup time and cost for switching between two products (Reichhart and Holweg, 2007). Upton (1994) considers Slack's classification and adds a third dimension of flexibility: uniformity, which refers to the ability to maintain performance standards as a firm switches among products. Upton (1994) uses the term mobility which has the same mean of the term response used by Slack (1987) to refer to the ability to change from one product to another quickly. More dimensions of flexibility are reported in the work presented by Narasimhan and Das (2000). They divide flexibility into three levels, each having its dimensions as follows:

1. Operational flexibilities (Machine /shop level): This level consists of the following dimensions: machine flexibility, material flexibility, routing flexibility, and program flexibility.

2. Tactical flexibilities (Plant level): This level consists of the following dimensions: *mix flexibility, volume flexibility, and modification flexibility*. *These dimensions of flexibility are viewed as independent variables that are critical to achieving the competitive advantage of a firm in the present study.*

3. Strategic flexibilities (Firm level): This level consists of two dimensions: new product flexibility and market flexibility.

Recently, Reichhart and Holweg (2007) classify flexibility based on the supply chain approach into two categories namely, external flexibility which includes (product, mix, volume and delivery flexibility), and internal flexibility which includes (machine flexibility, material handling flexibility, operations flexibility, routing flexibility, expansion flexibility, and program flexibility).

3.2 Drivers of Flexibility

Scholars (i.e. Mandelbaum, 1978, Gerwin, 1987, Sethi and Sethi, 1990, Upton, 1994, D'Souza and Williams, 2000, Narasimhan and Das, 2000, Jack and Powers, 2006, Salvador et al., 2007, Tachizawa and Thomsen, 2007, and Wahab et al. 2008) have certainly emphasized that flexibility is a competitive priority that enables organizations to cope with uncertainty. Flexibility is also a top priority issue in manufacturing strategy (Nilsson and Nordahl, 1995). This means that flexibility is viewed as a main source for competitive advantage like other priorities such as quality, cost, and delivery. It is believed that change is the main driver for flexibility which places an emphasis on role of flexibility in managing and accommodating uncertainty. Thus, flexibility should be considered at each functional strategy level and at the corporate strategy level for the whole company. In this context, Slack (1987) argues that flexibility should be considered at four levels:

1. The production resources themselves;
2. The tasks, which the production function needs to manage;
3. The overall performance of the production function; and
4. The competitive performance of the whole company.

This means that the aforementioned levels require a firm to be flexible by meeting its customer demands and coping with changes in uncertain business environment which is characterized by increasingly sophisticated consumers that demand customized products and short lead times (Stevenson and Spring, 2007). However, a close examination of past studies reveals that four general areas (strategy, environmental factors, organizational attributes, and technology) comprise the dominant forces influencing manufacturing flexibility (Vokura and O'Leary-Kelly, 2000). It could be concluded that different situations of uncertainty and various environmental factors should be managed based on specific types of flexibility in order to improve the performance of a given firm. In this context, Slack (1988) indicates that different competitive strategies will require different forms of manufacturing flexibility in order to improve the firm's competitive performance. Similarly, Gerwin (1993) suggests that a firm's level of performances is contingent on its ability to match the appropriate type of flexibility with the corresponding type of environmental uncertainty faced by the firm. Moreover, Olhager (1993) emphasizes the need for flexibility in the short and long run. In the short run, flexibility gives the ability to adapt to changing conditions using the existing set and amount of resources. In the long run, flexibility gives the ability to introduce new products, new resources and production methods, and to integrate these into the existing production system. Similarly, and in more details, Slack (1987) argues that the variety of products and uncertain demand are two factors emphasizing the need to be flexible. Zhang and Sharifi (2000) conducted an empirical work to determine the factors that require a firm to be agile in a turbulent environment. They listed a number of factors related to internal and external environment include: *marketplace factors, competition factors*, *customer requirement*, technology *factors***,** s*upplier's factors, and internal complexity*.

In general, the aforementioned above factors can be considered as main drivers of flexibility as a whole concept and construct. Other scholars such as (Jack and Raturi, 2002, Oke, 2003, Tachizawa and Thomsen, 2007) have theoretically and empirically studied the drivers of specific type of flexibility. Jack and Raturi (2002) distinguish between internal and external sources of volume flexibility. Examples on internal sources of volume flexibility comprise: product and process technologies, batching, production planning and control systems, capacity, and setup-time/cost. External sources of volume flexibility comprise: vendor/supplier network, supplier relationships, network of plants, off-shore plants, and strategic alliances in the distribution network. Other major drivers of volume flexibility are demand uncertainty, short product life-cycle, short product shelf life, supply chain complexity and action of competitors (Oke, 2003). Recently, the results emerged from the work done by Tachizawa and Thomsen (2007) show that firms need supply flexibility for a number of important reasons including manufacturing schedule fluctuations, JIT purchasing, manufacturer slack capacity, demand volatility, demand seasonality and forecast accuracy), and that companies increase this type of flexibility by implementing two main strategies: "improved supplier responsiveness" and "flexible sourcing.

3.3 Competitive Advantage

Competitive advantage is defined as the "capability of an organization to create a defensible position over its competitors" (Li et al., 2006, p. 111). It comprises capabilities that allow an organization to differentiate itself from its competitors and it is an outcome of critical management decisions (Tracey et al., 1999, Li et al, 2006). The empirical research clearly identifies a number of manufacturing capabilities that help organizations develop and maintain their competitive advantage. Wheelwright (1984) suggests four strategic capabilities that can be considered as competitive priorities. These capabilities are: low cost, quality, quick delivery, and flexibility. Rondeau et al. (2000) referring to Koufteros (1995) define the following manufacturing-related competitive capabilities:

1. *Competitive Pricing:* firm is capable of competing based on low prices.
2. *Premium Pricing:* firm can command superior prices.
3. *Value to Customer Quality:* manufacturing enterprise is capable of offering product quality and performance that would fulfill customer's needs.
4. *Dependable Delivery:* manufacturing enterprise is capable of meeting delivery requirements.
5. *Product Innovation:* manufacturing enterprise is capable of introducing new products and features in the market place.

Helms (1996) considers that quality and productivity can be used as strategic weapons for achieving competitive advantage. He argues that organizations must be aware of what increases quality or supports production as strategic weapons; otherwise, they will lose market share. In this sense, D' Souza and Williams, 2000 argue that cost and quality will continue to remain the competitive advantage dimensions of a firm. Time to market is an important dimension of competitive advantage according to Holweg (2005). In summary, it seems that there is a consensus in the empirical literature on the identification of price/cost, quality, delivery, and flexibility as important capabilities required for achieving competing advantage (Li, 2002). Based on the above argument, the dimensions of the competitive advantage constructs used in this study are price/cost, quality, delivery dependability, product innovation, and time to market. These dimensions are identified and defined by the empirical work originally done by Li et al. (2006) and used in the empirical work done by Thatte (2007). See Table 2.

4. Research Methodology

The research methodology is presented in the next sub-sections through discussing the research model and hypotheses, population and sample, and data collection methods.

4.1 Research Model and Hypotheses

The research model seen in Figure 1 is designed to predict the causal hypothesized relationships between tactical flexibilities and competitive advantage of a firm. The model is considered after extensive review of the literature on manufacturing flexibility. The model is drawn using structural equation modeling through the EQS 6.1 software. More specifically, the model is designed after consideration of the results that emerged from the factor analysis technique. Based on these results, the constructs of tactical flexibilities are defined as follows:

1. Volume flexibility construct is loaded on one factor which is labeled as VF
2. Mix flexibility is loaded on three factors which are named and labeled as follows:

- Mix flexibility based on range dimension (MIX_R).
- Mix flexibility based on mobility dimension (MIX-M).
- Mix flexibility based on uniformity dimension (MIX_U).

3. Modification flexibility construct is loaded on three factors which are named and labeled as follows:

- Modification flexibility based on range dimension (MOD_R).
- Modification flexibility based on mobility dimension (MOD_M).
- Modification flexibility based on uniformity dimension (MOD_U).

The research hypotheses can be formulated as follows:

H1: Volume flexibility has a positive impact on the competitive advantage of a firm

H2: Mix flexibility has a positive impact on the competitive advantage of a firm

H3: Modification flexibility has a positive impact on the competitive advantage of a firm

4.2 Population and Sample

This study targets the entire population of the manufacturing companies listed in Amman stock exchange market as public shareholding companies. This population consists of 93 industrial companies according to the report of Amman Stock Exchange for the year 2009. The data of interest in this study represents the responses that are collected from executives with titles of operations manager, plant manager, and quality Manager. A total of 220 questionnaires are distributed to the targeted executives. Of the 220 questionnaires distributed, 153 usable questionnaires are received from 66 operations managers, 35 plant managers, and 52 quality managers. The usable and returned questionnaires represent a response rate of 69.5 percent where the responding firms cover a wide range of manufacturing activities including electronics, engineering products, electric, chemical, textiles, leathers, and clothing, glass and ceramic, engineering and constructions, mining and extraction, food and beverages, paper and cartoon, and pharmaceutical and medical products.

4.3 Data Collection Methods and Measurement of the Research Constructs

Data collection consists of a questionnaire designed to test the model and a delivery and collection questionnaire method is used in distributing and collecting the questionnaires to ensure a high response rate and to take the advantages of personal contact since this method enhances respondent participation (Saunders et al., 2000). The questionnaire format is highly structured where all of its questions are fixed-response alternative questions that require the respondents to indicate the degree of agreement or disagreement with each statement included in the questionnaire by using five point Likert scales with end points “strongly disagree” (1) and “strongly agree” (5). For instance, respondents are asked to indicate the role of tactical flexibilities in developing the competitive advantage of a firm and they are also asked to determine the extent that they agree or disagree with each statement determined for measuring their firm’s competitive advantage. All the measurement scales used in this research are developed and adapted based on previous empirical research. Minor amendments are done based on the constructive feedback received during the pilot study stage. Table 1 shows the research constructs with supported literature for their measurements. The items determined for measuring the independent variables (volume flexibility, mix flexibility, and modification flexibility are shown in Tables 3, 4, and 5 respectively. These tables represent the results of factor analysis. Competitive advantage is measured using five dimensions including price, quality, delivery dependability, product innovation, and time to market. These dimensions are adapted from Li et al., 2006 and cited in Thatte (2007). The items determined for measuring these dimensions are presented in Table 2.

5. Data Analysis and Discussion

This section presents statistical data analysis techniques, results that emerged from data analysis, and discussion of the results. It starts with presenting and discussing the results factor analysis, reliability and validity. Results of data analysis including factor analysis, confirmatory factor analysis, and hypothesis testing are thoroughly discussed. Finally, a discussion of the research results is also presented.

5.1 Exploratory Factor Analysis (EFA)

Exploratory factor analysis (EFA) is utilized to operationally redefine the various dimensions of tactical flexibility included in the research model. However, these dimensions are identified and measured depending on supported literature related to each variable included in the research model. EFA is the technique that defines the possible relationships in the most general form, and then allows for multivariate techniques to estimate the relationships (Hair et al, 1998, Field, 2000). Two main objectives of EFA are determined: data summarization and data reduction (Hair et al., 1998). The following subsections show that the factor analysis for the independent variables (types of manufacturing flexibility) is carried out and all factors loadings are inspected carefully and considering the sample size, a significant loading of 0.5 is used as cut-off point (Hair et al.1998).

5.1.1 Volume Flexibility Construct

The factor analysis shows a one-factor solution of product flexibility construct. The factor analysis shows clear discriminant validity since all items are loaded on one factor. Loading for the factor ranges from 0.78 to 0.95. This factor explains 87% of the total variance. Items representing the volume flexibility construct are displayed in Table 3.

5.1.2 Mix Flexibility Construct

The initial factor analysis indicates the existence of dimensions (three-factor solution) of mix flexibility construct. As shown in Table 4, the three dimensions of mix flexibility are characterized as mix flexibility based on range dimension (MIX_R), mix flexibility based on mobility dimension (MIX_M), and mix flexibility based on uniformity dimension (MIX_U). The literature on manufacturing flexibility (e.g. Slack, 1987, Upton, 1994) supports the idea that each type of manufacturing flexibility has three distinct attributes: range/variety, mobility/responsiveness, and uniformity. The final factor analysis shows sound discriminant validity. Loadings for the three factors range from 0.53 to 0.93. These three factors explain 82% of the total variance and all of which have eigenvalues greater than one. Items representing the mix flexibility construct are displayed in Table 4.

5.1.3 Modification Flexibility Construct

The initial factor analysis indicate the existence of dimensions (three-factor solution) of modification flexibility construct. As shown in Table 5, the three dimensions of modification flexibility are characterized as modification flexibility based on range dimension (MOD_R), modification flexibility based on mobility dimension (MOD_M), and modification flexibility based on uniformity dimension (MOD_U). The final factor analysis shows sound discriminant validity. Loadings for the three factors range from 0.53 to 0.87. These three factors explain 81% of the total variance and all of which have eigenvalues greater than one. Items representing the modification flexibility construct are displayed in Table 5.

5.2 Reliability and Validity

Prior to running EQS, all constructs are tested for validity through factor analysis. Principal components analysis with Varimax rotation is used. One construct (volume flexibility) loaded on one factor and two constructs (mix flexibility and modification flexibility) loaded on three factors. Items loading on all factors for each construct are higher than the cut-off point of 0.50 as recommended by Hair et al., (1998). A reliability test is carried out using Cronbach's alpha, which measures the internal consistency of a construct. The results can be seen in Table 6. To ensure the validity of the survey is met, the survey instrument is pre-tested with executives and academic experts who are asked to review the questionnaire for readability, ambiguity, completeness, and to evaluate whether individual items appeared to be appropriate measures of their respective constructs (Dillman, 1978). This process leads to several minor changes, which are made prior to generate the final version of questionnaire, though the items are drawn from previous studies having validated survey instruments. In addition, as indicated in Tables 1 and 2 the constructs of this research are conceptually defined based on reviewing the literature and previous empirical studies. This procedure ensures that the factors' scales are considered to have face validity (Hair et al., 1998). Construct validity is considered to ensure that each item measures only the particular construct it is designed to measure. It is determined through principal components factor analysis and item-to-scale correlation analysis. Tables 3, 4, and 5 contain the results of factor analysis and indicate the items that represent the expected construct. Construct validity related to the direct effect of tactical flexibilities on competitive advantage is partially validated by previous studies that found a positive impact of tactical flexibility on organizational performance and competitive advantage. Examples on these studies include: Gupta and Somers, 1996; Vickery et al., 1997, and Zhang et al, 2003. Convergent validity is also considered to ensure that items expected to be related based on theory, are, in fact, related. It is assessed by examining: the factors having eigenvalues greater than 1.0; the percent of variance explained; and the factor loadings for each item on a construct. Considering the results of factor analysis presented in section 5.1, all these criteria indicate that the convergent validity is met.

5.3 Confirmatory Factor Analysis (CFA)

Structural equation modeling (SEM) is utilized to test the hypothesized relationships based on the output of factor analysis. SEM is a multivariate technique combining aspects of multiple regression (examining dependence relationships) and factor analysis (representing unmeasured concepts-factors-with multiple variables) to estimate a series of interrelated dependence relationships simultaneously (Hair et al, 1998, p. 583). According to Badri et al. (2000, p. 162), SEM allows the researcher to propose and subsequently test theoretical propositions about interrelationships among variables in a multivariate setting. SEM consists of two models: a measurement model and a structural model (Hoyle, 1995). According to Hair et al. (1998), the measurement model specifies the indicators for each construct, and assesses the reliability of each construct for estimating the causal relationships, while, structural model is a set of one or more dependence relationships linking the hypothesized model's constructs. Confirmatory factor analysis (CFA) is utilized in the measurement model to establish the loading of each measured variable on the latent variable and to establish the reliability and validity of the construct). SEM shares three assumptions with other multivariate methods: independent observations, random sampling of respondents, and the linearity of all relationships (Hair et al., 1998, p. 601). Kurtosis and skewnes values are used in this study to examine and check the normality of each variable included in the research. According to Hair et al. (2003, p. 244) when skewness values are larger than +1 or smaller than –1 this indicates a substantially skewed distribution. Looking at the statistics presented in Table 6 shows that the skewness and kurtosis values for all variables fall within the acceptable range which means that the data is normally distributed. This study utilizes EQS 6.1 as the software to be used for data analysis. EQS is highly recommended for a number of reasons as EQS provides several goodness-of-fit indexes that address statistical and practical fit. EQS also enables users to do robust statistics with most selected estimation methods (Byrne, 1994).

Measures of Tolerance and Variance Inflation Factor (VIF) are used to check the Multicollinearity among the independent variables. Tolerance is the amount of variance in an independent variable that is not explained by the other independent variables. VIF measures how much the variance of the regression coefficient is inflated by multicollinearity (Hair et. al, 2003, p. 305). To indicate no problem with muticollinearity, tolerance value should not be less than 0.10 while VIF value should not be more than 10. The values of tolerance and VIF summarized in Table 6 indicate no problem with multicollinearity.

5.4 Hypothesis Testing and Discussion

The hypotheses of this research are formulated to investigate and examine the effect of volume, mix, and modification flexibility on the competitive advantage of a firm. To ensure that the hypothesized models are fit, the three types of goodness-of-fit measures recommended by Hair et al. (1998) are used in this study. These measures include: *Absolute fit measures* (AFM) including Chi-square X^2 accompanied by the model's degrees of freedom and its probability, goodness of fit index (GFI), and the root mean square error of approximation (RMSEA). These measures assess the overall model fit (both structural and measurement model collectively); *Incremental fit measures* (IFM) including indices such as Tucker-Lewis index (TLI), comparative fit index (CFI), and the incremental fit index (IFI); and *Parsimonious fit measures* (PFM) including indices such as normed fit index X^2/df (the adjusted Chi-square by the degrees of freedom) (Hair et al., 1998). Table 7 lists various measures of model fit used in this research and their recommended values as suggested in the literature.

5.4.1 Testing Hypotheses 1-3 and Analysis of the Structural Model

As shown in Table 9 and considering the recommended values of goodness-of-fit measures seen in Table 7, goodness-of-fit measures well exceed the recommended cut-off values for the three hypotheses. **Testing hypothesis** 1 shows that the structural model is estimated with one latent variable (CA: competitive advantage) and one path (see Figure 2). The review of the hypothesized model revealed that (beta=0.39), *t* –value (3.57) of the completely standardized coefficient of (**Volume flexibility → CA: competitive advantage)** regression path is significant. The coefficient of determination R^2 of the regression path (Volume flexibility → CA: competitive advantage)) is 0.15. This means that 15% of the total variance in (**CA: competitive advantage)** is accounted for by the volume flexibility.

As seen in Figure 3, **testing hypothesis 2** shows that the structural model is estimated with two latent variables (Mix and CA), and one path. The review of the hypothesized model revealed that (beta=0.31, *t*-value =2.05) of the completely standardized coefficient of **Mix → CA** regression path is significant. The coefficient of determination R^2 of the (regression path: Mix → CA) = 0.10. This means that 10% of the total variance in the (CA: competitive advantage) is accounted for by the mix flexibility.

As seen in Figure 4, **testing hypothesis 3** shows that the structural model is estimated with two latent variables (Modification and CA), and one path. The review of the hypothesized model revealed that (beta=0.41, *t*-value =2.47) of the completely standardized coefficient of **Modification → CA** regression path is significant. The coefficient of determination R^2 of the (regression path: Modification→ CA) = 0.17. This means that 17% of the total variance in the (CA: competitive advantage) is accounted for by the modification flexibility.

Based on the above argument, **H1, H2, and H3**, are fully accepted at 0.05 significance level. The results are summarized in Table 8.

5.4.2 Discussion of Hypothesis Testing

In summary, the results of hypothesis testing presented in Table 8 imply that tactical flexibilities have a positive impact on the competitive advantage of a firm. These results are consistent with the literature on flexibility and competitive advantage in which manufacturing companies need flexibility to maintain and develop their competitive advantage through balancing capacity with different volumes of demand, particularly, when dealing with uncertain business environment. For instance, Jack and Raturi (2002) identify a number of internal sources of volume flexibility (i.e. product and process technologies, batching, capacity, setup-time/cost, workforce/labor flexibility, facility and equipment, and range of products) and external sources of volume flexibility (i.e. vendor/supplier network, supplier relationships, network of plants, and strategic alliances in the distribution network). These sources explain how significantly the volume flexibility positively affects competitive advantage which can be achieved by meeting customers' expectations and needs. However, achieving competitive advantage urge manufacturing companies to implement varying strategies for creating volume flexible responses; these include using overtime and temporary workers, cross training workers, developing complementary product portfolios, creating and maintaining slack resources, creating a network of facilities, improving forecasting and planning systems with information technology as well as leveraging the firm's ability to negotiate on volume with suppliers and customers (Jack and Raturi, 2002, p. 520). Similarly, Kara et al. (2002) support the idea that volume flexibility has positive impacts on organizational performance and competitive advantage in which they state that "*volume flexibility permits the factory to adjust production upward or downward within wide limits*", and this directly impacts customers' perceptions by preventing out-of-stock conditions for products that are suddenly in high demand. Thatte (2007) in line with Upton, 1997 and Martin and Grbac, 2003) argue that the improvement of flexibility and speed of response has become increasingly important as a method to achieve competitive advantage. The results of this study are also supported by Zhang et al. (2003) who have found a positive impact of mix flexibility on customer satisfaction by providing the kinds of products that customers request in a timely manner. Therefore, it could be concluded that mix flexibility can help firms achieve and maintain their competitive advantage by adopting the following strategies: product differentiation, process improvements, replacement products, new uses for product, process efficiencies; product innovation, product replacement, market segmentation, new channels of distribution, and selection of the target markets. All these strategies are basically related to operations and marketing and they contribute to development of competitive advantage of a firm.

Modification flexibility also plays a major role in gaining the competitive advantage, particularly, when a firm places an emphasis on customization strategy because modification flexibility gives a firm the ability to make functional changes in the product (Kara et al., 2002). These changes may arise at the beginning of the life cycle for a standardized product or throughout the life cycle for a product that can be customized (Gerwin, 1987). In this context, Narasimhan and Das (1999) argue that modification flexibility should be utilized when coping with changes result from short product life cycle. Thus, this conclusion leads us to consider the role that modification flexibility plays in contribution to the competitive advantage, particularly, when a product move from one stage to another across the product life cycle. Similarly, Hill (1994) suggests utilizing the product life cycle in conjunction with product volume data to guide manufacturing strategy development. Hill emphasizes linking product volumes and order-winning criteria such as quality, cost, and innovation to the different stages of the product life cycle. Based on the above argument, it could be concluded that each of volume, mix, and modification flexibility are needed for improving the competitive advantage of a firm and competing on price, quality, and differentiation. This notion is supported by Tachizawa and Gimenez (2010) who consider supply flexibility to be the ability of the purchasing function to respond in a timely and cost effective manner to the changing requirements of purchased components in terms of volume, mix and delivery date. These components address the relationship between flexibility dimensions and competitive advantage (Cousens, et al., 2009).

6. Managerial Implications

The findings of this research have the following practical implications for managers:

- Managers are encouraged to use the tactical flexibilities for maintaining and developing the competitive advantage of a firm.
- Managers need to analyze the effect of tactical flexibilities on achieving competitive advantage, for example, there is a need for determining the effect of volume flexibility on profitability, market share, financial stability, and quality, where all of them contribute to improved competitive advantage.
- Competitive advantage can be achieved and carried out based on different dimensions of tactical flexibilities. For example, volume flexibility can be used for managing demand fluctuations and scheduling in response to changes associated with demand behavior across the stages of product life cycle. Mix flexibility help organizations deal with market segmentations by satisfying the variation of customers' needs. Modification flexibility is useful for implementing customization strategy since it is required for dealing with customers' needs and wants to satisfy all levels of customer expectations.
- Tactical flexibilities can be used for managing demand and capacity in the short and long run since they can be used in matching the fluctuations of demand with available capacity.

7. Limitations and Directions for Future Research

Several limitations in this study should be noted. Measures of flexibility are subjective and situational, i.e. lack generality. The study has not taken into consideration the effect of the moderating and intervening variables (*such as company size, business unit, organizational structure, industry type, etc.*) on the relationships between tactical flexibilities and competitive advantage. These limitations should be viewed as opportunities for future research. This study has made a significant contribution, as it is one of the first attempts at empirically testing the impact of tactical flexibilities on competitive advantage. The following directions are suggested for further research:

- Conducting empirical studies about the need for flexibility at strategic, operational, and tactical levels in a firm.
- Conducting empirical studies about the role of flexibility dimensions in gaining the competitive advantage and improving a firm's performance
- Examining the role of tactical flexibilities in planning the corporate and functional strategies of a firm.
- Investigating the role of the intervening and moderating variables (i.e. company size, organizational level, industry type, etc) on the relationship between tactical flexibilities and competitive advantage.

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Table 1. Supported literature for measuring the research constructs

Construct	**Source of construct measurements**	**Supported literature for construct measurements**
Volume flexibility (independent)	Zhang et al. (2003)	Sethi and sethi, 1990, Das, 2001, Kara et al., 2002, Chang et al., 2003, Salvador, et al., 2007.
Mix flexibility (independent)	Koste (1999)	Sethi and Sethi, 1990, Zhang et al., 2003, Koste et al., 2004, Salvador, et al., 2007, Gong and Hu, 2008.
Modification flexibility (independent)	Koste (1999)	Sethi and Sethi, 1990, Gupta and Somers, 1996, Kara et al., 2002, Koste et al., 2004, Salvador, et al., 2007.
Competitive advantage (dependent)	Thatte (2007)	Rondeau, et al, 2000, Li et al., 2005, Li et al. (2006)

Table 2. Definitions and measurement items of competitive advantage dimensions. Source: Thatte (2007), p. 44 and p. 117

Dimension	Definition	Measurement items
Price	The ability of an organization to compete against major competitors based on low cost / price" (Li et al.,2006, p. 120)	We offer competitive prices
		We are able to offer prices as low or lower than our competitors
Quality	The ability of an organization to offer product quality and performance that creates higher value for customers" (Koufteros, 1995)	We are able to compete based on quality
		We offer products that are highly reliable
		We offer products that are very durable
		We offer high quality products to our customers
Delivery dependability	The ability of an organization to provide on time the type and volume of product required by customer(s)" (Li et al., 2006, p. 120)	We deliver customer orders on time
		We provide dependable delivery
Product innovation	The ability of an organization to introduce new products and features in the market place" (Koufteros, 1995)	We provide customized products
		We alter our product offerings to meet client needs
		We cater to customer needs for "new" features
Time to market	The ability of an organization to introduce new products faster than major competitors" (Li et al., 2006, p. 120)	We are first in the market in introducing new products
		We have time-to-market lower than industry average
		We have fast product development

Table 3. Factor analysis results of volume flexibility construct

Item	Volume flexibility
1. The manufacturing system can operate efficiently at different levels of output	.78
2. The manufacturing system can operate profitability at different production volumes	.83
3. The manufacturing system can run economically various batch sizes	.86
4. The manufacturing system can change the quantities for our products quickly	.92
5. The manufacturing system can vary total output from one period to the next	.93
6. The manufacturing system can change the production volume of a manufacturing process easily	.95

Principal Component Extraction and Varimax Rotation with Kaiser Normalisation

Table 4. Factor analysis results of mix flexibility construct

Mix flexibility			
Item	**Factor 1 MIX_R**	**Factor 2 MIX_M**	**Factor 3 MIX_U**
Producing different product types without major changeover	.53		
Building different products in the same plants at the same time	.74		
We can produce, simultaneously or periodically, multiple products in an operating cycle	.85		
We can vary product combinations from one period to the next	.87		
The manufacturing system can quickly changeover to a different product mix		.81	
The cost of changing between different products in the product mix is low in our company		.86	
The time required to change to a different product mix is short		.93	
Productivity levels are not affected by changes in product mix			.67
Product quality is not affected by changes in product mix			.81
The performance of the system is not affected by changes in product mix			.88

Principal Component Extraction and Varimax Rotation with Kaiser Normalisation

Table 5. Factor analysis results of modification flexibility construct

	Factor 1 MOD_R	**Factor 2 MOD_M**	**Factor 3 MOD_U**
A large number of products are modified to the customer's specifications	.56		
The features of existing products are often modified	.73		
Engineering change orders are often used to modify products	.75		
Modified products are very different from each other	.79		
Modified products are very different from existing products	.85		
Modified products can be made quickly		.53	
The average cost of introducing modified products into full-scale production is low		.58	
The time to produce modified products is small		.68	
Product modifications are easy to make		.84	
Productivity levels are not affected when a modified product is introduced into the manufacturing system			.79
Manufacturing system performance is not affected by the production of modified products			.84
The quality of existing products is not affected when a modified product is introduced into the manufacturing system			.87

Principal Component Extraction and Varimax Rotation with Kaiser Normalisation

Table 6. Selected statistics of the research constructs

Construct	Skewness	Kurtosis	Tolerance	VIF	α – value
Volume flexibility (VF)	.672-	.221	.636	1.572	.84
Mix flexibility based on range dimension (MIX_R)	.518-	.326	.602	1.661	.78
mix flexibility based on mobility dimension (MIX_M)	.668-	.397	.605	1.652	.88
Mix flexibility based on uniformity dimension (MIX_U)	.493-	.308-	.650	1.538	.81
Modification flexibility based on range dimension (MOD_R)	.580-	.126-	.793	1.261	.84
Modification flexibility based on mobility dimension (MOD_M),	.523	.071	.682	1.465	.86
Modification flexibility based on uniformity dimension (MOD_U).	.672	.760	.770	1.299	.79
Competitive advantage	.206	.100			.82

Table 7. Recommended values of goodness-of-fit measures. Source: Adapted from Chau (1997), p. 318

Goodness-of –fit measures	Recommended values
Chi-square	P ≥ 0.05
Normed Chi-Square	≤ 3.0
Goodness-of-Fit Index (GFI)	≥ 0.90
Comparative Fit Index (CFI)	≥ 0.90
Tucker –Lewis Index (TLI)	≥ 0.90
Root Mean Square Error of Approximation (RMSEA)	≤ 0.10

Table 8. Summary of the research hypotheses (H1-H3) and their results

Hypothesis	Description	Beta	t-value	Comment
H1	Volume flexibility has a positive impact on the competitive advantage of a firm	0.39	3.57	Accepted
H2	Mix flexibility has a positive impact on the competitive advantage of a firm	0.31	2.05	Accepted
H3	Modification flexibility has a positive impact on the competitive advantage of a firm	0.41	2.47	Accepted

Table 9. Goodness of fit for the structural equation model of the hypothesized relationships between tactical flexibilities and competitive advantage

Hypothesized model Number	Absolute fit measures (AFM)			Incremental fit measures(IFM)		Parsimonious fit measures PEM
	X^2 (Degrees of freedom)	GFI	RMSEA	TLI	CFI	X^2/df
Hypothesized Model (1) **(Volume flexibility → CA**	10.15 (8) P= 0.25	.96	0.06	0.97	0.99	1.268
Hypothesized Model (2) **Mix flexibility → CA**	17.70 (17) *P*=0.14	0.91	0.08	0.90	0.92	1.040
Hypothesized Model (3) **Modification flexibility → CA**	23.4 (17) *P*= 0.13	0.93	0.07	0.93	0.96	1.376

X^2, Chi-square; GFI, Goodness-of-fit index; RMSEA, Root-mean-square error of approximation; TLI, Tucker-Lewis fit index; CFI, Comparative fit index; X^2/df, Normed Chi-square. (*N=153*).

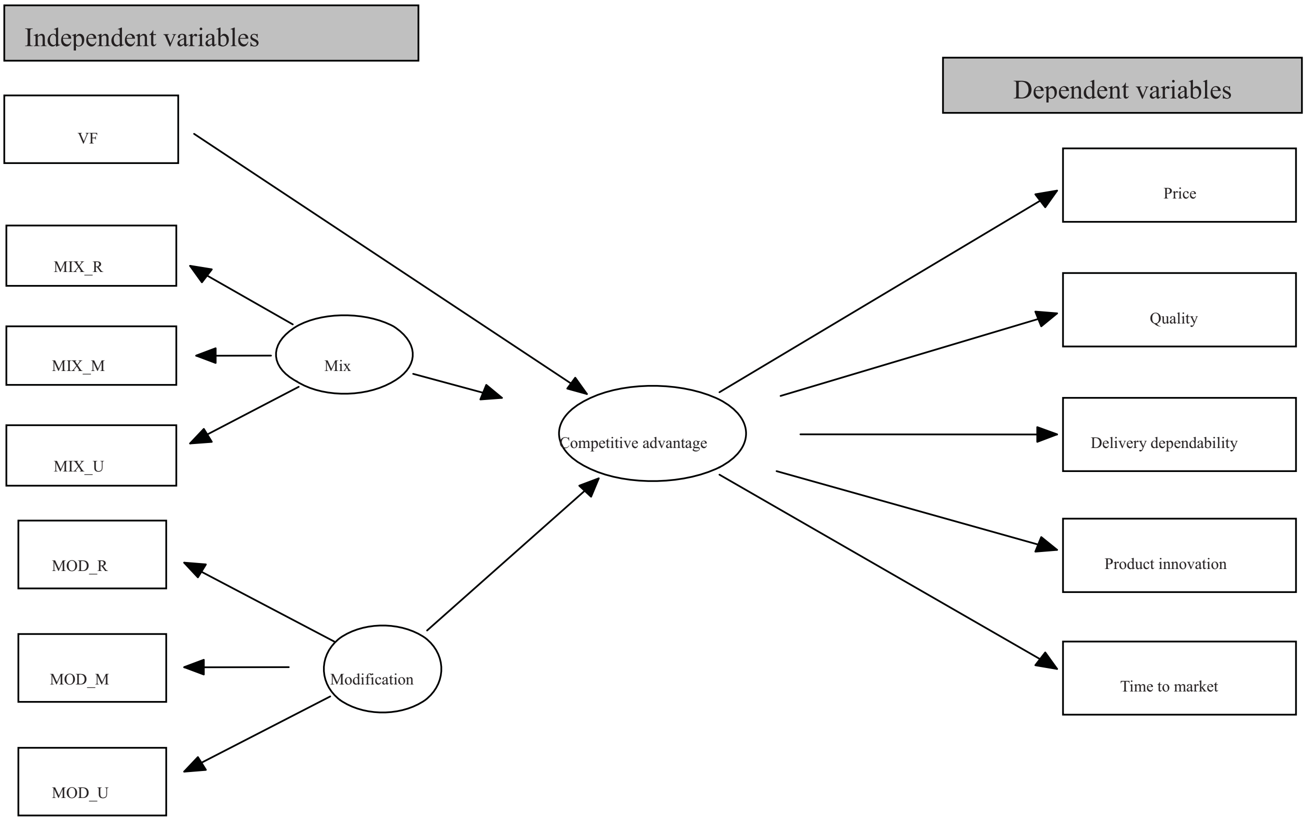

Figure 1. The research model

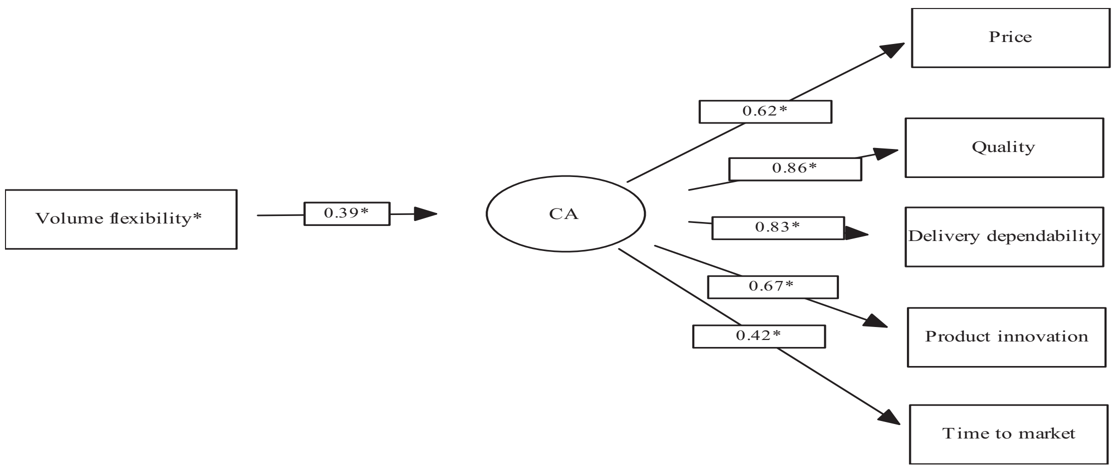

Figure 2. Hypothesized model of the relationship between volume flexibility (independent variable) and CA: competitive advantage (dependent variable) (H1)

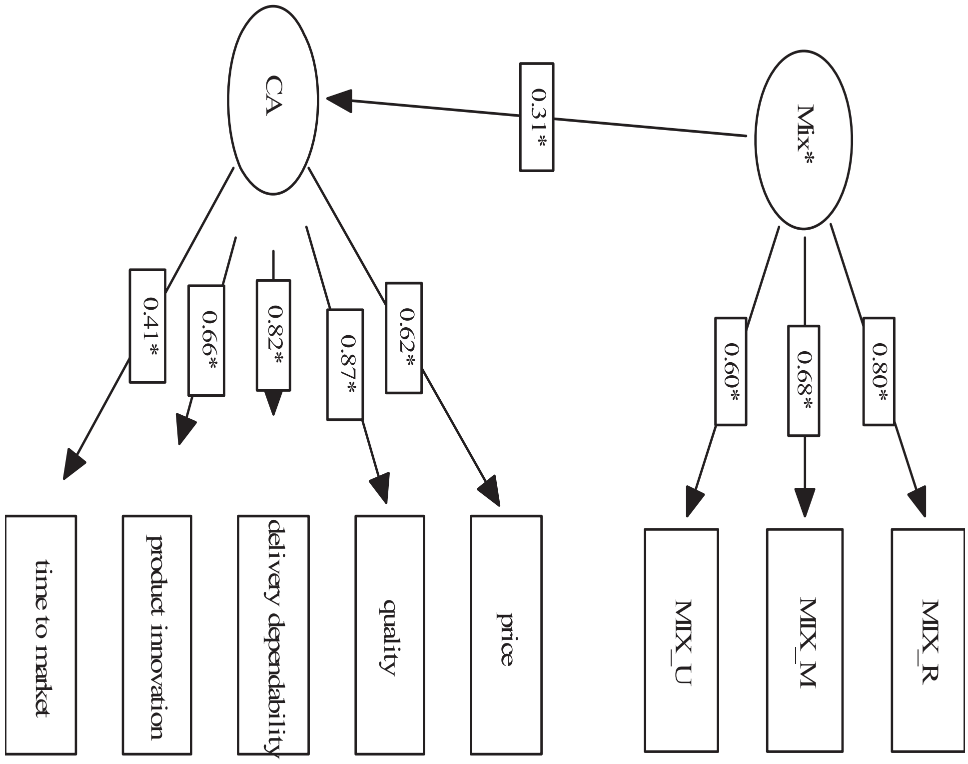

Figure 3. Hypothesized model of the relationship between mix flexibility (independent variable) and CA: competitive advantage (dependent variable) (H2)

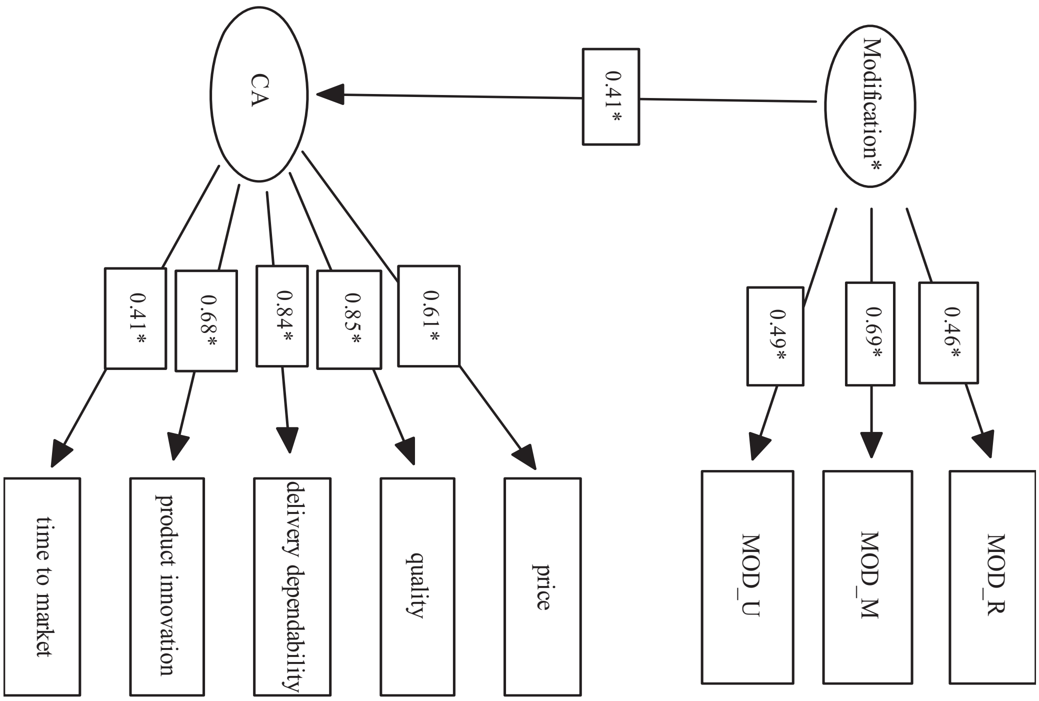

Figure 4. Hypothesized model of the relationship between modification flexibility and CA: competitive advantage (dependent variable) (H3)