A Conceptual Model for Machinery & Equipment Investment Decisions

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Abstract

Manufacturing has always been closely linked to technology, which, in recent years, is growing rapidly and directly affects the internal and external environment of all businesses, regardless of their size, economic results and the industry sector they belong to. Firms, in order to remain competitive, attempt to improve their infrastructure investing in new technology and acquiring new machinery and equipment.

This study proposes a new conceptual framework for examining the reasons that manufacturing firms decide to invest on the acquisition of new machinery and equipment in order to improve their infrastructure. It incorporates various factors related to the internal business environment (strategy, investment decisions etc.), the external business environment (customer relationship management, capital subsidies etc.) and the product (new product development, innovation, manufacturing flexibility etc.). The main goal is to understand how all these factors affect the investment decision making process.

Keywords: Firm performance, Machinery & Equipment acquisition, Capital subsidies, New product development, Investment decisions, Manufacturing flexibility

1. Introduction

Companies' need for survival forces them to find ways to preserve and augment the market share they hold. In recent years, a large number of approaches have been developed for improving firms' operation performance (Kannan and Tan, 2005). In particular, various theoretical studies have focused on a) improving the quality of the products produced, b) the level of flexibility that enterprises have in order to catch up the enormous competition of the growing market and, c) reducing their production costs.

Performance improvement is a key target for all businesses irrespectively of their size (large, medium or small), type (listed, not listed), or sector (private or public). This is why many researchers have studied various important dimensions of performance, like product quality, response time, relationship with clients or suppliers etc. (Tari, 2005; Kannan and Tan, 2005; Saraph et al., 1989). Companies are trying to remain competitive by improving their products, reducing production costs, and investing in new manufacturing technologies. However, investing in new technology is always a difficult decision, as it may be influenced by many factors that cannot be accurately defined and may affect firm performance.

This study proposes a new conceptual framework to Small and Medium (SME) manufacturing Enterprises (SME) operating in Greece. The main goal is to assist decision makers understand how various product, business and environment-related factors affect the investment decision making process and, consequently, firms'

performance.

2. Literature Review

Many researchers have attempted to examine the relationship between firm performance and various factors, which are mainly related to the internal and external business environment, as well as the products themselves. These factors are presented in Table 1.

The main purpose of this research is to link the decision to invest on machinery and equipment (M&E) with all these factors and with Firm Performance. An attempt will also be made to highlight the relationship between these factors as they appear in literature.

Insert Table 1 Here

2.1 Machinery & Equipment Investments (M&E)

The new growth theory suggests that innovation and investment in new technology involve high costs, which many companies cannot afford to spend. Abdi (2008) concluded that investments in M&E affect the level of the production process and remains the only source of growth. This is also supported by Pakko (2002) and Gort et al. (1999), who argue that the development of technology affects positively firms that invest in M&E.

Many researchers claim that there is a positive relationship between the development of an enterprise (firm performance) and the M&E investment rates (Barro, 1991; Levine & Renelt, 1992; Mankiw et al., 1992; Meliciani, 2000). However, the limitation of these studies is that the sample of the firms and industries cannot be captured in these cross-country studies and economists started developing models using time-series and panel data estimation approaches (Abdi, 2008). Such examples are the studies of Coe & Helpman (1995), Li (1998) and McGrattan (1998), whose results support the growth models. Finally, Young (1992) applied the same methodology using a sample of companies from Hong Kong and Singapore, but did not find a significant positive relationship between M&E investments and economic growth.

2.2 Just In Time Approach

The philosophy of Just in Time (JIT) theory is to eliminate the trashy products by simplifying the production line (Kannan and Tan, 2005). In other words, how quickly a firm can produce products that satsify customers' demands, without causing stocks in its plants. Therefore, JIT goals achievement is an internal business issue that affects performance and is determined by specific management decisions (Kannan and Tan, 2005).

It should be stressed, though, that the literature does not only consider the implementation of the JIT approach to manufacturing processes (Germain and Droge, 1997). For example, Lee and Ebrahimpour (1984) examined the relationship between the JIT approach and other production processes, as well as the collaboration between customers and suppliers that follow the JIT (Sakakibara et al., 1993). The benefits to business performance is in all cases purely economic (Callen et al., 2000; Fulleron and McWatters, 2001; Germain et al., 1996), while, in most cases, an increase in market share also occurs (Germain et al., 1996; Germain and Droge, 1998).

2.3 Total Quality Management Practices

Total Quality Management (TQM) is another internal business issue that affects performance. TQM allows firms to obtain a high degree of differentiation in their production line and to reduce their production costs (Tari, 2005). In spite of TQM's advantages (Sohal et al., 1991; Maani et al., 1994; James, 1996; Kanji, 1998; Lee, 1998; Quazi and Padibjo, 1998), many problems have been detected during its implementation (Joubert, 1998; Kanji, 1998; Quazi and Padibjo, 1998). Firms should develop many components of a product in order to achieve a successful production and better economic performance (Easton and Jarrell, 1998; Claver et al., 1999).

Saraph et al. (1989) were the first researchers internationally, who attempted to identify the critical factors of TQM that must be found in a firm in order for effective quality management to be achieved. The same authors also developed measures for many quality management factors that affect economic performance, manufacturing performance and technological performance. A similar study was conducted by Anderson et al. (1994), who developed seven TQM factors and tried to represent the "Deming management method". The relationships that were developed between these factors were later analyzed by Anderson et al. (1995).

Tari and Sabater (2004) claim that the critical factors of TQM are the elements that may lead to satisfactory performance, as has also been proved by earlier studies (Badri et al., 1995; Powell, 1995; Ahire et al., 1996; Adam et al., 1997; Hendricks and Singhal, 1997; Grandzol and Gershon, 1998; Quazi et al., 1998; Das et al., 2000). However, although the results show that there are strong connections between the TQM factors and firms' performance, it cannot be absolutely proven that TQM always leads to increased performance, but that such relationship almost always exists (Powell, 1995) and, also, that the company image may influence part of its

performance. In some cases, the impact of TQM practices on a firm's performance is weaker and not always significant (Sousa and Voss, 2002).

Various studies attempted to develop a model with critical TQM factors by representing an integrated approach to TQM implementation (Sila & Ebrahimpour, 2005). Adam (1994) has attempted to identify techniques for quality and productivity improvement that have the greatest impact on firm's performance, as far as the quality of the manufacturing process is considered, as well as its financial performance. He also found that the improvement of products' quality leads to better performance and, a strong relationship between manufacturing and financial performance. Adam's et al. (1997) study was an expansion of an earlier research (Adam, 1994), where the relationship between TQM factors and financial performance across three regions, Asia/South Pacific, Europe, and North America was examined.

2.4 Supply Chain Management in manufacturing firms

Supply chain management (SCM) refers to the management of logistics or the supply base, although this implies the need to integrate transportation, logistics and purchasing functions with manufacturing processes (Kannan & Tan, 2005). When the competencies increase, firms are under greater pressure to effectively leverage supplier and customer relationships. Kannan and Tan (2005) show that doing so is a significant driver for a firm's success.

Manufacturing firms may respond to demand uncertainty more effectively, improve their flows within the supply chain, manage inventory more effectively, and improve their service levels, by pulling materials through the supply chain in response to demand patterns rather than pushing them to forecasts (Tavis, 1993; Scott and Westbrook, 1991; Tan et al., 1998). This is the same with the concept of integrated logistics systems (Lambert et al., 1998; Bowersox and Closs, 1996; Coyle et al., 1996).

Supply focus can be seen as the simplification of the supply base, and the integration of suppliers into manufacturing activities. Supply chain management forces a firm to focus on core competencies, allows to improve its resources and remain more flexible to its needs, and also to improve its suppliers' capabilities, technologies, and efficiencies (Kannan & Tan, 2005).

2.5 Environmental Management

The surrounding in which a firm operates is the environment of a firm, including air, water, land, natural resources, humans and their interrelation (Tam et al., 2006). The environmental performance of manufacturing firms is defined as the company's achievements in managing any interaction between firm's activities and the environment, and plays an important role in environmental protection (Polster et al., 1996; Rikhardsson, 1999; Morledge and Jackson, 2001). An Environmental Management System (EMS) can help a company to achieve a high level of environmental performance (Tse, 2001). In implementing an EMS, Environmental Performance Assessment (EPA) forms a basic criterion for measuring continual improvement and thus needs to be implemented by manufacturing firms (Kuhre, 1998; Tam et al., 2001).

Environmental Management System (EMS), of the ISO 14000 series, is promoted as a vehicle for business organizations to develop environmentally friendly practices (Tam et al., 2004). Governments and firms start to consider the important of environmental management and begin to invest money in machinery & equipment, new technology in order to prevent pollution (Huang and Shih, 2010). Taiwan's environmental problems, for example, that require urgent solutions, such as the water pollution and heavy metal pollution, have increased social awareness of environmental issues in general and many corporations are now attempting to demonstrate that they are taking their responsibility to reduce the impact of business operations on the natural environment very seriously. The number of firms that obtain ISO 14000 certification is rapidly increasing in the field of machinery and equipment (ISO, 1999). Environmental Performance Assessment (EPA) is introduced to assist EMS in improving the implementation process by providing information about achievement in environmental policy, objectives, targets, actions and responsibilities and measuring, analysing, assessing, reporting and communicating on organizational environmental performance (Kuhre, 1998; Ren, 2000). It also helps an organization to determine its performance in meeting environmental criteria, which helps to reduce environmental impacts, aids in the reporting of environmental performance, identifies ways to prevent pollution, and helps to improve the business's overall performance. EPA can also provide a critical help to the improvement of environmental performance by identifying the gap between company performance and a given standard (Matteo and Federica, 1999).

2.6 Investment Decisions and Capital Subsidies

Strategic decision making on investing in new manufacturing technology is always difficult. Investments in new

technologies are usually costly, are affected by numerous factors (e.g. reduction of cost production, product differentiation, market demands) (Sohn et al., 2007b), and the potential task benefits are often hard to be predicted (Tan et al., 2006). Decisions are based on managers' intuition and experience and they are, usually, supported by multicriteria decision support tools. However, these approaches do not retain and reuse knowledge, so managers are not always able to make the right use of their knowledge and experiences. Thus, it is difficult for managers to take such a decision (Deng, 1994) and, sometimes, they don't act based upon their knowledge and experience.

According to Bernard and Leroy (2004), investment decisions are based on financial incentives, they are associated with firms' growth, or the payback of the M&E investment. The investment decision is purely a strategic decision, as it contains financial, human and organic resources of the company and is the only way for managers to keep the company alive for a long time. The implementation of investments is critical for a company for its future success and survival, and depends on the correct predictions and correct decisions made by firms' managers (Ojala and Hallikas, 2006).

Capital subsidies have a very long tradition in European, North American and Japanese industrial policy (Tzelepis and Skuras, 2006). Subsides are usually focused on specific sectors and not the whole economy. Some grants are usually associated with selective fiscal incentives of accelerated depreciation and tax reduction. During the 1980s and 1990s, industrial subsidies constituted 5 % of the productivity in the European Union countries with a decreasing trend.

The most notable example of subsidies in the European Union was England, where there were designated areas (British Regional Selective Assistance) where subsidies were given to employment from 1963 (Armstrong, 2001). Other important subsidized firms were operating in Germany and France (Ford and Suyker, 1990), Ireland (Hart et al., 1993, 2000), the Netherlands (Van Tongeren, 1998), Sweden (Bergstrom, 2000), Greece (Tzelepis and Skuras, 2004) and in many other countries. Capital subsidies have also been widely used also in Japan (Beason and Weinstein, 1996), Korea (Lee, 1996) and other important economies of the world. All the above mentioned findings have emphasized on productivity growth, profitability, and liquidity effects, which target a specific area of business performance (Tzelepis and Skuras, 2006).

2.7 Customer Relationship Management & Buyer/Supplier Selection

The ultimate goal of a company is to make its customers happy, since managers recognize that they are the ones who keep the business running. However, even today, there are many companies that do not consider Customer Relationship Management (CRM) as an important factor, and often ignore their customers, as well as their real needs. "Customers are always right", "do whatever it takes to deliver your promise" and whatever similar is the key phrases for a successful implementation of CRM (Nguyen et al. 2007).

CRM has become a necessary tool for businesses, because it distinguishes an organization from its competitors by giving the knowledge and the ability to identify and find solutions to customers' problems. This is a way that can shorten the distance between customers and the firm itself, contributing to organizational success through superior service, improved customer loyalty, better information gathering, and organizational learning. A CRM system is strongly linked to other decision support systems, such as recourse planning systems, information systems, supply chain management systems, and product life-cycle management systems. CRM systems can also help organizations to maximize their abilities by interacting with their customers. This leads to improved quality and can also enhance the rapid response to customers' needs (Anderson, 2006).

Furthermore, supplier management represents an investment that may reduce transaction costs and yield a more cooperative relationship (Carr & Pearson, 1999). Healthy relationships with the suppliers provide the benefits of lower costs, better communication, coordination and quality. A firm needs to develop a strategic function to manage successful a buyer–supplier relationship.

2.8 Research & Development (R&D) and New Product Development Process (NPD)

R&D is a product related internal issue, which can be used to determine firm's performance (Sohn et al, 2007a), and which can also be linked to leadership (Barnowe, 1975), strategic planning (Roberts and Bellotti, 2002), customer and market focus, information and analysis, and human resource focus (Hurmelinna et al., 2002).

New product development (NPD) is defined as the process where an organization can use its resources, production line and capabilities in order to create a new product or to improve an existing one (Cooper, 2003). Enormous pressure is exercised on the project teams that are involved in the development of new products, in order to increase products' cycle time and reduce cost. This should be achieved without sacrificing product innovation and products basic characteristics, and completed in a faster, better and cheaper way (McDonough et

al., 1999; Paté-Cornell and Dillon, 1998).

In manufacturing firms, the number of products successfully introduced to the market is very important, because they show the development of a firm, and has a long term positive impact on financial performance. What strategy should a company follow, in order to keep its products competitive in market? A firm should emphasize on the development of new products, adopt appropriate pricing policy, introduce innovation to all its new products etc. All these product related strategies that a firm should follow are analysed in the following paragraphs.

The development of new products is strongly linked to the available technology. The literature highlights the need for Research and Development (R&D) by linking the business management with firms' strategy, processes, structure and culture (Dussauge et al., 1992; Christiansen, 2000). Iansiti (1998) argues that technology adds value only by innovating. Similarly, other researchers examine the importance of integrating technology in marketing to achieve a successful development of new products (Ayers et al., 1997; Beltramini, 1996). Such an integrated solution will enable a business to learn where to innovate, always based on market requirements.

Cooper and Kleinschmidt (1995) conclude that new products programs (R&D & NPD) affect firm performance but do not always require a total new technology to the firms. The level of technology depends on the characteristics and the quality of the new product, which have to be defined before development work begins. Sohn et al. (2007a) compared several performance indexes, and the firms' technological performance turned out to be the highest, while the management performance is still relatively low. Technological performance is the level of technology used in a manufacturing firm, while management performance is the level of the decisions that managers take.

2.9 New Product Strategy (Innovation, Pricing Policy, & Lifecycle Decision Support Systems)

When a firm is about to launch a new product in the market, it needs to know what exactly expects from this product. No matter if the new product is just an update of an existing one, or is an all new product. Managers should also take into consideration the price of the new product, in order to be competitive, and, of course, the approximate time period the characteristics of the specific product will be requested in the market. Thus, innovation, pricing policy and product lifecycle decision are the three dimensions of the new product strategy that should be carefully examined.

Innovation is the process that begins with an idea, continues with the development of the product/service, and ends with its introduction in the market (Thornhill, 2006). Innovative activities reflect firm's orientation (Lumpkin and Dess, 1996; Naman and Slevin, 1993). An entrepreneurial firm is one that combines product with market innovation, takes responsibility in risky ventures, and is first to come up with proactive innovations, beating competitors to the punch (Miller, 1983).

Pricing decisions are the most difficult part of the management dilemma. When the prices fall in market, firms try to reduce production cost, especially when the NPD programs depend on the advantages of the characteristics of the new products. Falling prices reduce firms' revenues and margins, but if this happen faster than it was expected, it may be destructive (Calantone & Beredetto, 2007). Managers should be serious minded about cost-volume-profit considerations when making the price decision (Kotler, 2003, Guiltinan, 1999). Skimming or penetration pricing decision does not always lead to better performance. Literature has focused on the interactions at the time of the launch stage of the product (Guiltinan, 1999; Ottum, 1996; Hultink et al., 1997; Hultink and Robben, 1999). Shankar and Bolton (2004) tried to understand which of the following factors were most important in pricing: customer, market, chain, store, category, brand and competitor in determining how managers make pricing decisions under different conditions.

The third dimension of the new product strategy is product lifecycle time. Ali et al. (1995) defined product lifecycle time to be the elapsed time from the beginning of an idea to the launch of a product. They believe that this time does not affect the decision making after the products are released into the market. Day (1981) focused on the factors that determine the progress of the product through the stages of the lifecycle and the role of the product lifecycle concept in the competitive strategy. Product lifecycle theory has been a key principle in the literature of innovation and has been recognized as a tool for strategic decision making (Windrum and Birchenhall, 1998). Taking 'right' decisions at each stage of a product's lifecycle is important to a firm's development (Hu & Bidanda, 2009). Most of the literature on decision making in product lifecycle management focuses on the NPD stage, before the product enters the market. There have also been methodologies that embody design and manufacturing modelling at the phase of concept design (Curran et al., 2007).

Summarizing the new product strategy, Cooper (1979) captures 18 dimensions which separate the successes

from the failures in a new product situation. The most important dimension to the new product success is "product uniqueness and superiority". Unique products are innovative with unique features for customers' needs. This demands a high level of technology, and the only way to success the new product strategy is to invest money in new manufacturing equipment.

2.10 Flexibility of Manufacturing Systems

Manufacturing companies face instability, in terms of the markets' customization requirements (Llorens et al, 2005). A company needs to possess some degrees of flexibility, because of the volatility problems that manufacturing firm's face, in order to stay competitive and profitable.

The development of flexible capabilities rests on the mandate of the top management, allows firms to manage environmental uncertainty, and tends to improve firm performance (Evans, 1991). Many organizations believe that it is impossible to address these forces without some structural adjustments that can provide greater flexibility (Young-Ybarra and Wierseman, 1999). Llorens et al. (2005) believe that manufacturing flexibility can influence strategic fit. Chang et al. (2003) proposed a theoretical relationship between strategy and manufacturing flexibility.

Bengtsson (2001) studied the value of manufacturing flexibility at the basic level, at the system level and at the aggregate level. Sethi and Sethi (1990) framework includes machine flexibility, material handling system flexibility and operation flexibility. Flexibility, at the system level, concerns flexibility of the whole manufacturing system and will be dependent on the flexibility types at the basic level. Sethi and Sethi (1990) define five flexibility types at the system level and these are process, product, routing, volume and expansion flexibility. Finally, flexibility, at the aggregated level, concerns flexibility at the plant level. Sethi and Sethi (1990) identify and define three types of flexibility at the aggregate level and these are program, production and market flexibility.

3. Conceptual Framework

The main goal of this paper is to examine (i) how all factors presented in Table 1 and discussed in Section 2, affect Firm Performance and the M&E investment decisions, and (ii) how strong is the relationship between M&E investments and Firm Performance.

3.1 The impact of M&E Investments on Firm Performance

Firm performance can be measured as financial performance, technological performance, business performance, management performance and manufacturing performance (Sohn et al., 2007a; Llorens et al., 2005; Sethi and Sethi, 1990). According to Abdi (2008), M&E Investments can be measured by: (i) external factors (commercial demands, logistic problems, environmental regulation and natural causes), (ii) internal business related factors (internal logistic problems, organizational problems and capital projects within the plan that forces production to be stopped), and (iii) internal operation related factors (when production losses encountered in the cause of running the plant or the existing machinery).

In literature, there is a lack of studies that attempt to examine the relationship between M&E Investments and Firm Performance. Delong and Summers (1991) assert that investment in M&E has a positive influence on productivity growth and that the private return from investments is below the social return (Bergstrom, 2000). If their conclusions are correct, one implication would be that subsidized investments, may have contributed to increased economic growth.

Delong & Summers (1991) and Sala-i-Martin (1997) provide some economic results in their studies of U.S. companies. Delong & Summers (1991) have found that increasing investment in M&E by 1% can increase the long-term development of the company at 0.2-0.3%. Sala-i-Martin (1997) confirms these results, suggesting that increasing investment in M&E by 1%, leads to an increase of growth by 0.2%, while increasing investment in M&E less than 1%, increases firms' growth by just 0.06%.

Most of the existing literature focuses on the impact of human capital on firm performance. Few studies have attempted to assess the impact of investment in machinery and equipment (M&E) on performance (Tzelepis and Skouras, 2006). The examination of this link is a main goal for the research.

Hypothesis 1: Investments on M&E positively affect Firm's Performance.

This hypothesis is the core of the specific model and it's very important to find out the relationship between these factors.

3.2 Relationships between JIT, TQM practices and Firm Performance

Flynn et al. (1995) demonstrated that JIT and TQM practices are mutually supportive, and that their synergy contributes positively to manufacturing performance. They also found that common infrastructure factors positively influence performance. Nakamura et al. (1997) found that both JIT and TQM are necessary to improve manufacturing performance, though TQM has a stronger and more consistent impact on performance. The main research questions that emerge from the above discussion are the following:

Hypothesis 2: The adoption of JIT approach positively affects firm performance.

Hypothesis 3: The implementation of TQM practices positively affects firm performance.

In this research model, we'll try to find out how JIT and TQM approaches affect firm performance. Kannan & Tan (2005) found a positive effect. This research tries to find out what happens in the Greek business environment.

3.3 Linking Supply Chain Management with Firm Performance

Literature provides a strong link between SCM practices and firm performance. The logistics literature suggests that operational performance is positively affected by inter-firm coordination (Stank and Lackey, 1997; Stank et al., 1999; Fawcett and Clinton, 1996), functional integration (Stank and Lackey, 1997), customer focused logistics strategy (Stank and Lackey, 1997; Stank et al., 1999; Fawcett and Clinton, 1996), and management of logistics (Fawcett and Clinton, 1996). Furthermore, firm's operational performance is positively influenced by supplier development (Scannel et al., 2000), supplier partnerships (Scannel et al., 2000; Groves and Valsamakis, 1998), supplier involvement (Vonderembse and Tracey, 1999), and strategic sourcing (Narasimhan and Jayaram, 1998).

In addition, supplier partnerships (Tan et al., 1998b), supplier development (Curkovic et al, 2000) and supply chain flexibility (Vickery et al., 1999), all positively impact the buying firm's business performance (Kannan and Tan, 2005).

Hypothesis 4: The implementation of SCM practices has a positive impact on firm performance.

This hypothesis is also based on Kannan & Tan (2005) research, as hypotheses 2 & 3. So the question remains if supply chain integration, supply chain coordination and supply chain development have a positive effect on firm performance.

3.4 The impact of Environmental Management on M&E Investments and Firm Performance

Firms have the choice to reduce negative effects of their activities on the natural environment by using new technology. Pollution-prevention technologies, known as clean technologies, minimize the creation of pollution and wastes in the production process. Manufacturing companies have to differ by their major competitors by investing in new production technologies and equipment (Christmann, 2000). Continuously updating existing or implementing new technologies and equipment can be expected to lead to the creation of capabilities for process innovation and implementation.

Several authors have used large samples of firms to analyze the effects of environmental strategies (Christmann, 2000). Most of these studies analyze the relationship between various measures of environmental performance with measures of the firm's financial performance (Hart & Ahuja, 1996; Klassen & McLaughlin, 1996; Russo & Fouts, 1997). Some studies show no relationship between environmental and financial performance, some show a positive relationship, and some show a middle relationship. Only a few studies look at the effects of environmental practices on measures of firm performance. Nehrt (1996) has found that one "best practice" of environmental management contributes to growth in profits, while the investment in pollution prevention has negative effect on firm performance. Thus, studies show inconclusive results regarding the effects of environmental performance and environmental practices on firm performance and competitiveness.

Hypothesis 5a: The adoption of environmental management positively affects firm performance.

Hypothesis 5b: The adoption of environmental management positively affects investments in M&E.

This hypothesis has two parts. The first one tries to find out the relationship between the environmental performance and firm performance, and the second one between environmental performance and M&E investments.

3.5 The Relationship of Investment Decisions with Firm Performance and M&E Investments

Sohn et al. (2007b) tried to link strategic investment decisions with financial performances. They used a set of latent variables that positively affect financial performance (knowledge and experience of managers, operation

ability of managers, level of technology, marketability, profitability and financial performance index) (KOTEC, 2005; Sohn et al., 2005).

Sohn et al. (2007b) also developed a financial performance index by considering the relationship among various factors. The results showed that the operation ability of the manager (and his investment decisions) has the highest direct effect on financial performance, while the level of machinery & equipment technology has the highest indirect effect on financial performance. They also conclude that much investment commitment is needed on the companies in order to strengthen the technology competitiveness. Thus, effective management is necessary to be applied for investing in new technology and equipment, and for improving financial performance.

Hypothesis 6a: Appropriate investment decisions positively affect firm performance.

Hypothesis 6b: Appropriate investment decisions positively affect M&E investments.

Based on literature, the 6th hypothesis tries to find out the effect of the strategic investment decisionson firm performance and on M&E investments, which can be measured by the knowledge & experience of manager and the operation ability of managers.

3.6 Linking Capital Subsidies with Firm Performance and M&E Investments

Investment subsidies are seen by many politicians all around the EU as an efficient instrument to increase firms' growth. Since it is unclear how they influence firms' productivity growth, Bergstrom (2000) examined differences in productivity performance between Swedish non-subsidized firms and firms which have been granted capital subsidies. By comparing the firms and controlling for different firms that might affect factor productivity growth, he has tried to isolate the effects of subsidization. His study shows that subsidization is positively correlated with firm growth and that the productivity of the subsidized firms seems to increase from the first year after investments. However, the gap between subsidized and not subsidized firms in growth and productivity is not too big after the first year.

Van Tongeren (1998) examined the investment subsidies in The Netherlands and found that investment subsidies were inadequate to change investment decisions. Tzelepis and Skuras (2006) argue that financial performance measures, such as ROI, ROA, etc., indicate short-run financial and organizational effects and that firm may use capital subsidies to pursue long-term corporate strategies. Investments in plants and machinery carried out using capital subsidies, may not account for immediate profits but may be directed to efficiency and leadership targets or gaining a better position in the market even at the expense of short-run profits.

Hypothesis 7a: Capital subsidies positively affect firm performance.

Hypothesis 7b: Capital subsidies positively affect M&E investments.

Based on literature, capital subsidies seem to have positive effect on firm performance and machinery & equipment investments. The point of the specific research is to find out what happens in the Greek manufacturing environment.

3.7 The Relationship between Customer Relationship Management & Byer/Supplier Selection with Firm Performance

Roh et al. (2005) expect CRM processes to enhance organization's performance. Their study concludes to a positive correlation between CRM investment and a firm's internal efficiency. The positive relationship between CRM and financial performance is indirect through customer satisfaction.

Hypothesis 8: Focusing on CRM has a positive impact on firm's performance.

Dwyer et al. (1987) describe a continuum of different types of buyer–supplier relationships. They believe that firms engage in cooperative buyer–supplier relationships (BSR) because they expect to benefit from these relationships. Only as long as the firms perceive a benefit from the relationship do they continue in the cooperative buyer–supplier relationship (Carr & Pearson, 1999). Noordewier et al. (1990) state that purchasing performance is an important determinant of a firm's competitiveness. Their empirical research shows that long-term cooperative agreements have a positive impact on purchasing's performance, in terms of acquisition cost, when the level of uncertainty is relatively high. However, long-term cooperative agreements have no effect on performance when the uncertainty is too low.

Establishing long-term relationships with the key suppliers can lead to improved financial performance (Han, 1993). Therefore, it is hypothesized that the buyer–supplier relationship has a positive impact on firm's financial performance.

Hypothesis 9: Emphasizing on BSR positively impact firm's performance.

Customers and suppliers selection are some of the most important factors for the firms' survival. This research will try to measure how customer information quality, customer satisfaction, buyer-supplier engagement, supplier selection and the success of supplier relationship have a positive effect on firms' performance, especially in the Greek manufacturing firms.

3.8 The Relationship between the NPD and R&D processes with Firm Performance

The NPD process belongs to the product related factors and they should be used correctly and orthologically by managers, since this process directly affect the overall firm performance. Rolfe et al. (2006) have identified a number of NPD process related factors that affect the success of a firm. Their survey is based on Schilling and Hill's (1998) research, where it was shown that the development of new products positively affects business performance. Unfortunately, there is not enough literature on the relationship between the NPD processes and investments in machinery. Cooper and Kleinschmidt (1995) support that new products programs (R&D & NPD) affect firm performance but do not always require a total new technology. The challenge for the current research is to find out how the new products programs affect firm performance and M&E investments. The following relations will be studied in order to estimate the importance, uniqueness and effectiveness of every approach on the overall firm performance.

Hypothesis 10a: The introduction and use of internal NPD processes has a positive effect on firm performance.

Hypothesis 10b: The introduction and use of internal NPD processes has a positive effect on M&E investments.

Hypothesis 11a: The introduction of internal R&D theory positively affects firm performance.

Hypothesis 11b: The introduction of internal R&D theory positively affects M&E investments.

The research tries to find out the linkage between NPD & R&D processes on firm performance and M&E investments. According to the literature new or improved products have a positive influence on these factors (performance & investments), but the question is to find out what happens on Greek companies.

3.9 The Relationship between New Product Strategy (Innovation, Pricing Policy, Lifecycle Decision), Firm Performance & M&E Investments

The introduction of a new product into the marketplace involves substantial risk and management planning. Information and tools are required to efficiently test-market the product price, segment-based price, and competitive price benchmark (Rolfe et al., 2006). The traditional approach to pricing such products has been on a cost-plus basis with subsequent adjustments as sales develop.

According to Bergstein and Estelami (2002), new products have become critical in maintaining revenue levels and market share in increasingly competitive markets. The dynamics of the market and consumer changeability are providing competitive pressure, forcing product managers to aggressively pursue, develop, and launch new products in record times. The race to reduce products' introduction time is apparent in the significantly shortened product development time of innovative organizations. According to Prajogo & Sohal (2006), innovation management in new products affects firm performance and can be measured with two sub factors: product innovation and process innovation. An additional goal of this study is to find out if innovation management affects M&E investments too.

Hypothesis 12a: Innovation (in new products) has a positive effect on firm performance.

Hypothesis 12b: Innovation (in new products) has a positive effect on M&E investments.

Bergstein and Estelami (2002) argue that the biggest challenge facing product developers launching such new products is the determination of the price. The acceptability of the product price largely depends on the incremental utility provided by the unique attributes of the product over any comparable existing products.

Cooper (1979) refers to "product innovativeness" as an important descriptor of new products. But because of the global nature of the term "innovativeness", he suggests in five dimensions that describe the nature of the product/project. These dimensions include the relative price of product. Cooper (1979) concludes that the pricing strategy of a new product is strongly linked to the success of a manufacturing firm.

Hypothesis 13a: New Products Pricing Policy positively affects firm performance.

Hypothesis 13b: New Product Pricing Policy positively affects M&E investments.

Manufacturing companies around the world are striving to increase their revenues and profitability by controlling a larger share of the market (Sundin et al., 2009). This can be achieved by improving the ability to

offer a higher degree of integrated product services instead of focusing on products (Lindahl and Olundh, 2001; Tischner et al., 2002). Thus, many manufacturing companies are changing their production philosophies from a traditional focus on the manufacturing of the physical product towards a focus on the life-cycle of the physical product. As a result, more focus is now put on the use and end-of-life phases, including maintenance and remanufacturing (Sundin et al., 2005). The examination of the links is another goal for the research.

Hypothesis 14a: Product Lifecycle Decisions positively affect firm performance.

Hypothesis 14b: Product Lifecycle Decisions positively affect M&E investments.

When a firm decides to introduce new products on market, should follow many strategic decisions about the new products' innovation, pricing policy and lifecycle decisions. These factors are very important, and affect positively the investment decisions. The goal of this research is to find out, if they affect firm performance and M&E investments in the Greek business environment.

3.10 The impact of Manufacturing Flexibility on Firm Performance & M&E Investments

There have been numerous attempts to define and measure manufacturing flexibility; for an overview, see e.g., Aranda (2003), Gupta and Somers (1992), Sethi and Sethi (1990) and Ramasesh and Jayakumar (1991). It is well established that flexibility can be viewed in many perspectives; the two most widely cited being volume flexibility and product-mix flexibility (Bengtsson and Olhager, 2002). Manufacturing flexibility can be linked to the development of organizational competences that enable the handling of strategic options (Llorens et al, 2005).

It is expected that firms in which CEOs perceive the environment to be more uncertain, hostile and complex would be characterized by higher degrees of fit on a manufacturing flexibility (internal and external) level, which, in turn, should positively influence firm performance. Our arguments can be summarized in the following hypotheses:

Hypothesis 15a: Manufacturing flexibility positively affects firm performance.

Hypothesis 15b: Manufacturing flexibility positively affects M&E investments.

The last hypothesis is about the manufacturing flexibility. According to the literature flexibility has positive effect, but how does flexibility affect firm performance and M&E investments in Greek companies?All these hypotheses create the conceptual model formachinery & equipment investment decisions.

3.11 Research Model

Taking into account all these approaches (group of factors), a new research model has been developed. This model is a synthesis of all the factors mentioned above and presents their interactions. These relationships will be empirically tested using data from Greek manufacturing firms collected using a structured questionnaire sent to Chief Executive Officers (CEO) or quality managers.

Through this survey, an effort is made to study the way these factors affect decisions for M&E investment and firm performance. The research model incorporates many of the findings and views of other researchers who have developed similar subjects in other fields. Their views are various and diverse and, for this reason, the proposed research model includes many factors that affect the M&E investment decisions and lead to increased firm performance, as shown in Figure 1.

All factors that combine the research model are shown in Table 2 with the sub-factors and the supporting literature.

Insert Table 2 Here

Insert Figure 1 Here

4. Concluding Remarks

4.1 Conclusion

Despite the fact that during the last two decades there have been many efforts internationally, it is still true that quite enough issues concerning firm performance and M&E investment decisions remain unexamined and there is lack of theoretical and practical support. The expected goal of this research is to bridge the gap between existing literature and the management practices used by manufacturing firms by evaluating their needs for successful management of Machinery &Equipment Investment decisions.

Part of the value of this framework lies in the operationalization of factors and the examination of the possible relationships between them, which have not received the appropriate attention in literature, where there is no

complete model yet describing and analyzing the relationships between all these factors. The proposed framework is considered to be an original and complete model that intends to contribute to literature by exploring the linkages among: JIT, TQM, NPD, R&D, CRM, BSR, SCM, Innovation, New Product Pricing, Product Lifecycle Decisions, Environmental Management, Manufacturing flexibility, Management Decisions, and Capital Subsidies with Machinery &Equipment Investments and Firm Performance.

4.2 Instrumentation

Through a brief literature review, the construction of a new explicit conceptual framework has been formed. In this framework, a group of factors and sub factors have been added for the determination of the M&E investment decisions and, moreover, their impact on the final subjective and objective firm performance. This study will hopefully help in the evaluation and estimation of several firm performance related aspects.

This tool may also help the managers and the owners of the Greek manufacturing companies, who want to invest in new machinery and equipment. The specific conceptual model will provide them helpful information about the internal, the external and the products' related factors that affect firm performance and the investment decisions.

4.3 Research Limitations

The first potential limitation of this research has to do with the type of the paper that is a literature review, which imports a new conceptual framework, establishing the relations between many factors, has been developed, allowing the determinants of adoption of many implications to be discussed and to relate them to the peculiarities of the Greek manufacturing industry. The second limitation is about the measurements of the factors, that are based on specific literature sources.

4.4 Recommendations for Future Research

The research model suggested here will be validated using real life data. Authors have already constructed a structured questionnaire which has been refined in several pre-test stages and interviews with academics and practitioners (businessmen and managers) experts from many manufacturing companies. The data collection process is expected to be completed by the end of August 2011.

Finally, future studies could be designed to examine firms' inter-organizational relationships of different factors of strategic and manufacturing orientation, and performance, using more advanced information intensity measurements and modeling techniques. Moreover, the direction of causality for the new relationships of the model should be further examined.

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Table 1. Categorization of Factors that affect Firm Performance & M&E Investments

Categorization of Factors	**Factors**
Internal Business Environment	Just In Time Total Quality Management Supply Chain Management Environmental Management Investment Decisions
External Business Environment	Capital Subsidies Customer Relationship Management Buyer – Supplier Relationship
Products Related	New Product Development Research & Development New Product Innovation New Product Pricing Policy Product lifecycle decision support systems Manufacturing Flexibility

Table 2. Factors, sub-factors & supporting literature

Categorization of Factors	**Factors**	**Sub-factors**	**Supporting Literature**
Internal Business Environment	Just In Time	material flow commitment to JIT supply management	Kannan and Tan (2005), Hair et al. (1992), Bagozzi and Yi, (1988)
	Supply Chain Management	supply chain integration supply chain coordination supply chain development	Kannan and Tan (2005), Prahinski and Kocabasoglu (2006), Hair et al. (1992)
	Total Quality Management	leadership strategic planning customer focus information and analysis human resource management process management supplier management product design strategic commitment to quality supplier capability	Sila & Emprahimpour (2005), Kannan and Tan (2005), Saraph et al. (1989), Anderson et al. (1995), Flynn et al. (1995), Ahire et al. (1996), Adam et al. (1997), Dow et al. (1999), Wilson and Collier (2000), Kaynak (2003)
	Environmental Management	management and training air and noise auditing waste and water cost saving on resources energy regulation	Tam et al. (2006), Rikhardsson (1999), Kuhre (1998), Jasch (2000), Chen et al. (2000), Bennett et al. (1999)
	Investment Decisions	knowledge & experience of manager operation ability of managers	Sohn et al. (2007b), Ojala and Hallikas (2006), Tan et al. (2006), Forlani (2002),
External Business Environment	Capital Subsidies	use of subsidies type of subsidies	Tzelepis and Skuras (2006)
	Customer Relationship Management	process fit customer information quality system support efficiency customer satisfaction profitability	Kannan & Tan (2006), Roh et al. (2005)
	Buyer – Supplier Relationship	buyer-supplier engagement supplier selection success of supplier relationship	Narasimhan and Nair (2005), Kannan & Tan (2006)

Table 2. Factors, sub-factors & supporting literature (Continued)

Categorization of Factors	**Factors**	**Sub-factors**	**Supporting Literature**
Product Related	New Product Development	technology strategy organizational context teams tools	Schilling and Hill (1998), Rolfe et al. (2006), Dvir et al. (1998), Song and Montoya-Weiss (2001), Gobeli et al. (1998)
	Research & Development	leadership strategic planning information & analysis human resources focus process management	Sohn et al. (2007a), Page (1993)
	New Product Innovation	product innovation process innovation	Prajogo and Sohal (2006), Avlonitis et al. (1994), Deshpande et al. (1993), Subramanian and Nilakanta (1996)
	New Product Pricing Policy	pricing strategy	Prahinski and Kocabasoglu (2006), Purohit (1992), Rogers and Tibben-Lembke (2001), Souza et al. (2003), Zhao et al. (2002)
	Product lifecycle decision systems	product lifecycle decision support systems	Sundin et al. (2009), Hu & Bidanda (2009), Solomon et al. (2000)
	Manufacturing Flexibility	manufacturing flexibility environment financial resources	Llorens et al. (2005), Sethi and Sethi (1990)

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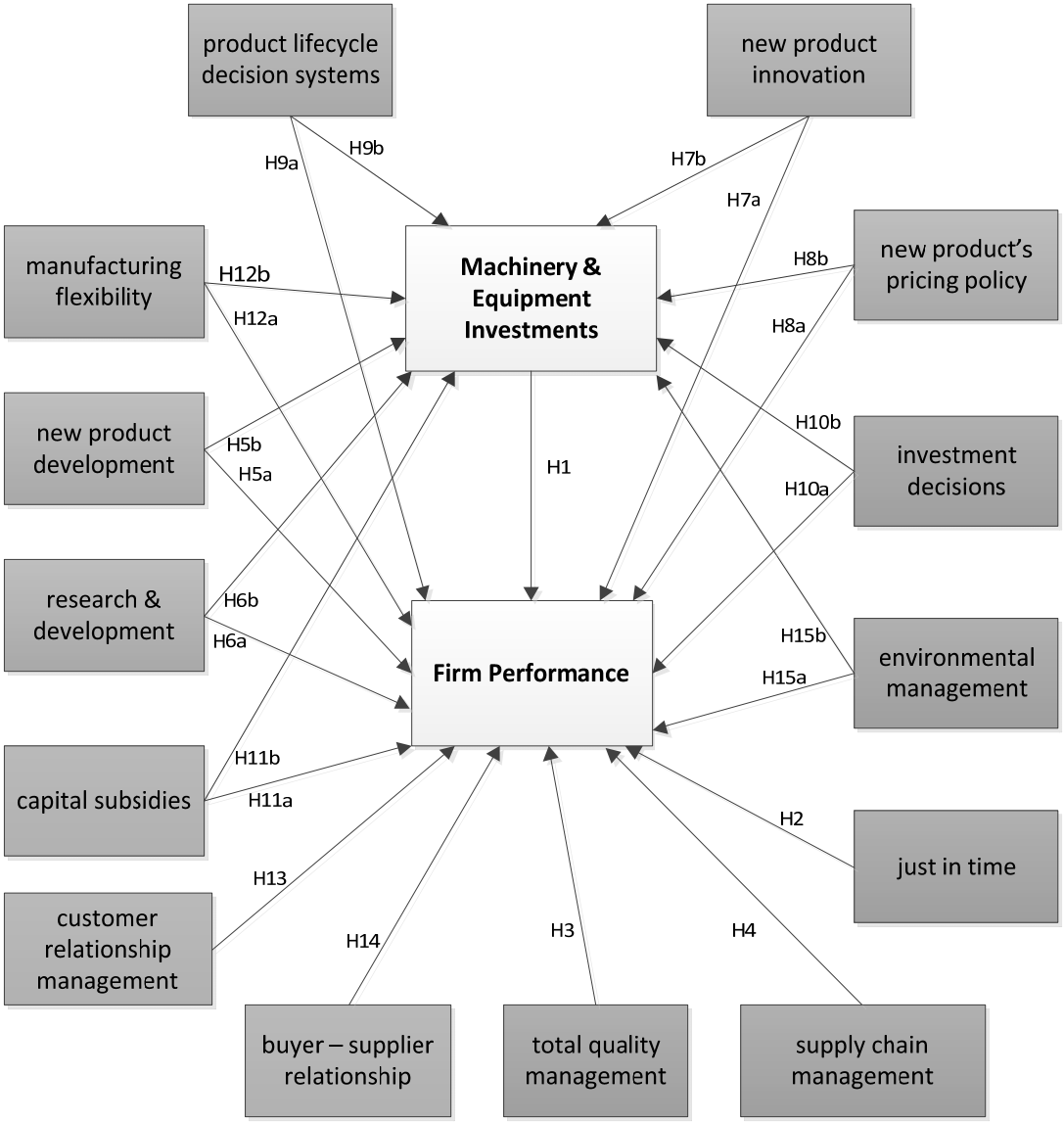

Figure 1. Research model