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Research paper

The critical link between products related factors and machinery investments

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Abstract

Purpose: The main goal is to understand the way the machinery investment decision making process is affected by specific organisational and, mainly, product related factors.

Design/methodology/approach: The proposed framework is empirically tested using a sample of 248 Greek manufacturing firms that have invested in new machinery and equipment during the past five years. Structural Equation Modelling (SEM) has been used for testing the appropriateness and validity of the proposed model.

Findings: The results indicate that new product development, new product innovation and manufacturing flexibility directly affect investment decision on machinery and equipment. Further, the positive influence of machinery and equipment investments on firm performance is also highlighted.

Originality/value: This study proposes a new conceptual framework for examining the reasons manufacturing firms decide to invest on the acquisition of new machinery and equipment. The machinery and equipment investment model that derives from the present study, presents a complex yet clear picture of important organisational definitions that can affect management's way of thinking and can also be used for the evaluation of future strategies.

Keywords: Machinery & Equipment Investments, Firm Performance, New Product Development, Manufacturing Flexibility, New Product Pricing Policy, New Product Innovation.

1. Introduction

For a firm to become competitive in the market and gradually increase its market share over time, it has to create and provide competitive products (Bergstein & Estelami, 2002). The basic aim of the study is to understand the way many factors affect the investment decision making process and to find out how machinery investments affect firm performance. The conceptual framework has never been studied before in the Greek industrial sector.

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In the present study, a thorough review of the literature is realised, while the description of the research conceptual framework, follows. Afterwards, the research methodology employed to achieve the research goals is described. Finally, the presentation of this study's outcomes and main conclusions are stated. Initially, a thorough review of the literature is performed, followed by the description of the conceptual framework. The next section briefly presents the research methodology issues that have been adopted in order to accomplish the research goals. Finally, a discussion of the research results follows and its main conclusions are highlighted.

The basic aim of the study is to understand the way many factors affect the investment decision making process and to find out how machinery investments affect firm performance. The conceptual framework has never been studied before in the Greek industrial sector which has at its core the influence of investments on the performance of firms.

In the present study, a thorough review of the literature is realized, while the description of the research conceptual framework follows. Afterwards, the research methodology employed to achieve the research goals is described. Finally, the presentation of this study's outcomes and main conclusions are stated.

Results demonstrate that at both strategic and operational levels, linkages exist between all factors, which are viewed by organizations as part of their operations strategy. The sample frame for this study consisted of Greek firms that belong to the manufacturing sector of Greek economy.

2. Theoretical framework and research hypotheses

In recent years, numerous approaches have been proposed to improve firm performance. Six in particular: manufacturing flexibility, new product development, research and development, new products innovation, product lifecycle decision systems and new products pricing policy have received considerable attention. The main purpose of the study is to find out how these factors affect firm performance through machinery investments.

2.1. Investments in machinery and equipment

Very few studies have been carried out in order to evaluate the effect of the investment in Machinery and Equipment (M&E) on a company's performance. Delong & Summers (1991) and Sala-i-Martin (1997) in their studies in the U.S.A., define some econometric indexes which can be applied for evaluation investments in machinery and equipment. Delong & Summers (1991) found that when firms increase their investments in M&E by 1% their long-term development could increase by 0.2-0.3%. Sala-i-Martin (1997) similarly suggest that when firms increase their investments in machinery and equipment by 1%, a growth increase of 0.2% is observed. Sargent & James (1997) have made an attempt to empirically evaluate the impact of the invested capital on firms' growth, by estimating at the same time the influence of their machinery and equipment on their growth. Based on the studies of Delong & Summers (1991) and Sala-i-Martin (1997), they conclude that knowledge and experience of a firm's management have a strong and direct effect on the investments in machinery and other equipment. Abdi (2008) suggests that investments in machinery and other equipment positively affect the

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levels of the production process. Gort et al. (1999) also claim that the development of technology positively affects the M&E investments.

DeLong & Summers (1991) observed a strong positive relationship between firms' financial performance and investments in machinery and equipment. Sala-i-Martin (1997) supports the view of the aforementioned researchers since he has found that the effect of machinery and equipment investments on firms' financial performance is fourfold than the effect it would have if the firm operated with the existing machinery and equipment. Jalilian & Odedokun (2000) empirically proved not all types of investment schemes (in machinery and equipment) catalytically contribute the same in the growth of a firm (Pratono & Mahmood, 2014). The model is a synthesis of the results produced by many previous researches that have dealt with these specific issues Dzakiria (2016). Most studies which deal with firms' investment decisions on similar fields are carried out for separate, individual countries, in order for the investment and development initiatives to be the same throughout the sample of the study (Abdi, 2008). However, in Greece no similar study has been carried out recently focusing on the influence of M&E investments on firm performance. Meliciani (2000) supports that there is a positive relationship between a firm's performance and the investments in necessary equipment. Based on all the aforementioned, it is hypothesized:

Hypothesis 1: *Investments on machinery and equipment (M&EI) have a positive effect on firm performance (FPERF).*

2.2. Manufacturing flexibility

Upton (1997) defined flexibility as "the ability of a firm to respond or change according to the prevailing conditions with the lowest possible cost in time and the smallest effort in order to enhance performance". Flexibility has been widely recognized as a multidimensional principle that deals with the operation of a firm (Sethi & Sethi, 1990; Gerwin, 1993) and has proactive or reactive character. The reactive character of flexibility has to do with the uncertainty of the internal and external environment of the firm. The proactive character of flexibility allows the firm to redefine the uncertainty of the market or influence the expectations of its customers (Gerwin, 1993).

Gupta & Somers (1992) and Sethi & Sethi (1990) concluded that flexibility can be observed from different perspectives, the two most important which are volume flexibility and product- mix flexibility (Bengtsson & Olhager, 2002). Bengtsson (2001) used the definition of Sethi & Sethi (1990) and studied the importance of manufacturing flexibility in three levels: basic level, system level and aggregate level. The results show that manufacturing flexibility at system level can be a critical factor in the process of strategic change, which means that it can have an impact on the desirability of strategic change or on the more specific strategic fit.

During the years, several attempts have been made to measure the manufacturing flexibility (Gupta & Somers, 1992; Sethi & Sethi, 1990). A higher level of manufacturing flexibility demands, at the same time a higher level of technology, something that is accomplished through investments in new equipment (Llorens et al., 2005). As a result, the following hypotheses arise:

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Hypothesis 2a: *High manufacturing flexibility (MF) positively affects firm performance (FPERF).*

Hypothesis 2b: *High manufacturing flexibility (MF) positively affects machinery and equipment investments (M&EI).*

2.3. New products development (NPD) processes and research & development (R&D) approach

The market dynamics, along with the needs and demands of customers, exercise high pressure and push executive officers of the production department in a continuous development and promotion of the products within the smallest possible timeframe (Hui et al. 2013). According to Ayers et al. (1997), less than 10% of sixteen thousand (16,000) new products that are annually introduced in the market are as successful as they were expected to be. Thus, more firms employ new product development systems, allocating enormous amounts of their budgets on them.

The department of the firm that deals with the development of new products is the research and development department (R&D). This department combines the abilities and technologies that the firm disposes in the construction of new or improved products or processes for firms that pursue profit. According to Ayers et al. (1997), the benefits from this activity will be greater than the expenses, if the expenses needed for the R&D department to operate are taken into consideration.

New products development (NPD) is the process, by which a firm uses its experience and abilities to create a new product or improve an existing one (Cooper, 2003). The development of new products appears as a process for ensuring the success, survival and reform of firms, especially firms that are up-and-coming or operate in an extremely competitive environment. The firms that invest in the development of new products, are obliged to cut down on cycle time and development cost without sacrificing the innovativeness of the new product, as characterized by a faster–better–cheaper philosophy (Sabherwal & Jeyaraj, 2015).

Product development is an essential part of the research and development department (R&D) and it is considered as an activity that is expected to improve the competitive advantage of the firm and ensure its future success in terms of profitability and market share. The adoption of the product development process allows firms to decrease the uncertainty of the environment with new products (Cooper & Kleinschmidt, 1996).

Further, Rolfe et al. (2006) recognize a number of factors that influence the success of a company, with the development of new products positively affects the performance of a company. Unfortunately, there are not many studies in literature analysing the relationship between new product development processes and machinery and equipment investments. Cooper & Kleinschmidt (1996) support that new product development processes (R&D and NPD) affect firm performance but new technology in firms is not always necessary. Thus it is hypothesized:

Hypothesis 3a: Introduction and e*xtensive use of research and development (R&D) has a positive influence on firm performance (FPERF).*

Hypothesis 3b: E*stablishment and extensive use of research and development (R&D) has a positive impact on machinery and equipment investments (M&EI).*

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Hypothesis 4a: I*ntroduction and use of new product development processes (NPD) have a positive effect on firm performance (FPERF).*

Hypothesis 4b: I*ntroduction and use of new product development processes (NPD) have a positive impact on machinery and equipment investments (M&EI).*

2.4. New product innovation

Innovation is the process that starts with an idea, continues with the development of an invention and results in the introduction of a new product in the market (Thornhill, 2006). An innovation process is initiated from the personal or team efforts and reflects the company's ability to adapt to the concept of innovation (Lumpkin & Dess, 1996). According to Thornhill (2006), a firm that trades innovative products takes on great responsibilities and many risks, but it is, also, the first that finds solutions to the occurring problems.

Firms that are involved in the introduction of innovative products have to implement a "preventive strategy", therefore have an alternative plan in the case a new product fails, and under no circumstance have a risk aversion strategy. The complete avoidance of risk, on the other hand, is a policy that needs to be followed only by firms that decide to avoid the creation and development of innovative products (Cooper, 1999).

According to Bergstein & Estelami (2002), the development of innovative products is the most critical factor for a firm to maintain its existing market share in a competitive market. According to Prajogo & Sohal (2006), innovation management of new products can be measured with two factors: product innovation and production process innovation. Summarising the above, the following hypotheses derive:

Hypothesis 5a: *New products innovation (NPI) has a positive effect on firm performance (FPERF).*

Hypothesis 5b: *New products innovation (NPI) has a positive impact on machinery and equipment investments (M&EI).*

2.5. New products pricing policy

After the completion of the necessary process for the product to reach its final form, the firm has to implement a pricing strategy for its efficient promotion in the market (Cooper & Kleinschmidt, 1996). There must be an understanding of the customers' needs and the realization of these needs into solutions that will be important for a firm (Zirger & Maidique, 1990).

Bergstein & Estelami (2002) mention that the greatest challenge firms face when launching a new product in today's competitive market is the definition of its selling price. The acceptance of the new product selling price from the buying public depends on the other features (characteristics) of this product, compared to the other competitive products already being in the market. However, Bergstein & Estelami (2002) concluded that the biggest challenge firms that develop and promote new products encounter is the determination of the selling price. They also consider that the pricing policy a firm finally adopts is indissolubly linked with firm's success and therefore, directly affects

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its financial results. As a result, they claim that pricing policy can even define the future investment decisions of the company. Summarizing the above, the following hypotheses arise:

Hypothesis 6a: *Implementation of an appropriate new product pricing policy (NPPP) positively affects firm performance (FPERF).*

Hypothesis 6b: *Implementation of an appropriate new product pricing policy (NPPP) has a positive impact on machinery and equipment investment (M&EI).*

2.6. Product life-cycle decision systems

The appropriate decision making process in every phase of the product's life-cycle is important for the healthy and viable development of a firm. Hu & Bidanda (2009) focus on the decision making process during the life-cycle of a product, after it has been launched in the competitive market. Curran et al. (2007) focus on the product development phase before the product's entry into the market, as well as the methodology that is used during the decision making which is limited to a vast extent by the fundamental models.

Finally, Hu & Bidanda (2009) have developed a model that involves the products' life-cycle. This model is based on the product life-cycle; it has been developed at a strategic level with the goal to maximize the long-term total profit of the firm (Sundin et al., 2009). A lot of firms change their manufacturing philosophy and do not focus on the technical characteristics and life-cycle of the products. Based on the above, the following hypotheses arise which will be studied as well:

Hypothesis 7a: *"Product life-cycle decision systems" (PLDS) positively affect "firm performance" (FPERF).*

Hypothesis 7b: "*Product life-cycle decision systems" (PLDS) have a positive impact on "machinery and equipment investments" (M&EI).*

The composition of the seven research hypotheses that have been presented above leads to the formation of the Conceptual Framework (Figure 1) of the present study, which focuses on the relationships among the research factors.

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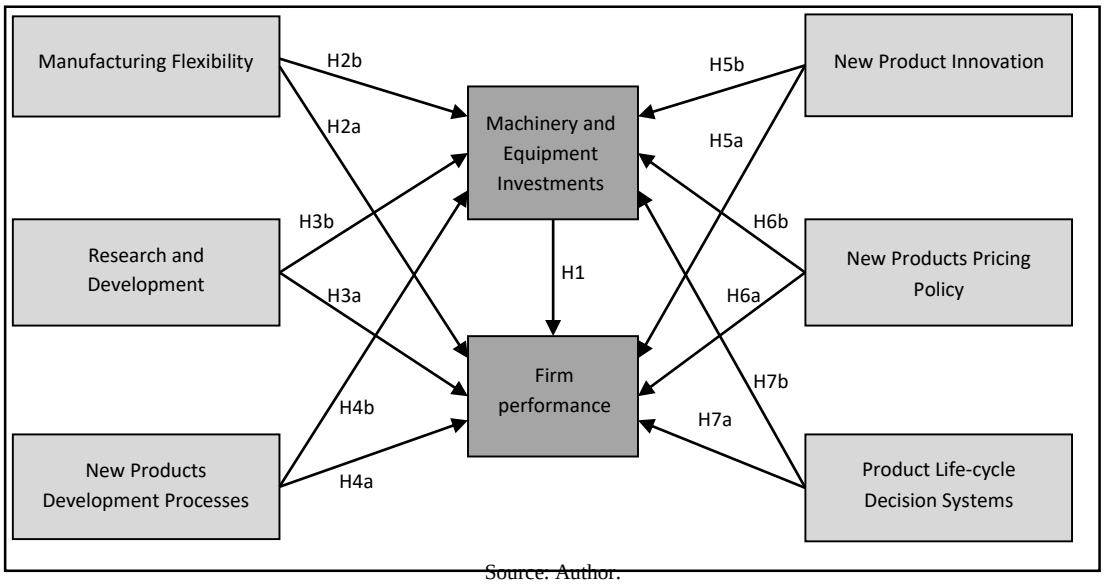
Figure 1: The conceptual framework of the study



Source: Author.

3. Research Methodology

The theoretical model developed to test the alignment hypothesis was analyzed using multivariate statistical analysis, via SEM, using SPSS Amos 19. Such techniques can be used to conduct tests of complex theory on empirical data (Brannick, 1995). The data were analyzed following a two-step approach (Anderson & Gerbing, 1998); in the first step, confirmatory factor analysis (CFA) is performed to assess the adequacy of the measurement model, while in the second step the structural model is tested using SEM.

3.1. Population and sample of the research

Greek industries, according to the statistical data of ICAP, entitled "Greek Economic Guide 2007", is characterized as most sectors of Greek economy, by the small-to-medium size of firms. Only 2% of the firms' employ more than 500 people. The sample of this study consisted of Greek firms that belong to the manufacturing sector of the Greek economy, and employ at least 20 employees. The sample data consists of 248 firms that have made investments during the past five years.

3.2. Measurement of research factors

A structured questionnaire was designed and utilized for the data collection. All constructs were measured using multiple items and all items (totalling 115) were measured using a seven-point Likert-type scale ranging from one (very low) to seven (very high). The questionnaire is divided into nine sections. The first section refers to the general characteristics of the firm (industry, size, sales, market share and number of employees).

The other eight sections contain questions concerning all the relevant model factors (machinery & equipment investments, manufacturing flexibility, research and development, new product development, new product innovation, new product pricing policy, product life-cycle decision systems and firm performance. Table 1 presents all

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constructs, their factors and the number of items used to measure each construct along with the related literature.

Content validity was established through adopting a questionnaire pre-testing process (Zikmund, 2003). Pre-test participants (five managers and expert reviewers) were asked to comment on any difficulty or lack of clarity in the scale items and instructions. Some modifications were made (wording) in order to ensure that the original text was clearly interpreted in the target language, i.e. Greek. Then, the translated questionnaire was validated using the "back-translation" method, a process of translating back into the original language to ensure correspondence with the original version (Zikmund, 2003). Wording of questions was again slightly modified before the final format was established, based on remarks and suggestions offered by the pre-testing participants.

The measurement of each factor (concept) of the present study has been made with the use of multiple defining variables (questions). These defining variables were selected from international literature. For measuring all the defining variables the use of regular scales was employed.

Table 1: Questionnaire factors, latent and measurement variables

Factors	Latent variable	Measurement variable	References
Machinery and Equipment Investments (M&EI)	External factors (M&EI1)	• Commercial demands • Logistic problems • Environmental regulation • Equipment investments effect positive at natural causes like poor weather conditions	Abdi (2008), Muchiri & Pintelon (2008)
	Internal business related factors (M&EI2)	• Equipment investments effect positive at internal logistic problems • Equipment investments effect positive at organizational problems • Equipment investments effect positive at capital projects within the plant	
	Internal operation-related factors (M&EI3)	• Production losses encountered in the cause of running the plant • Production losses encountered in the cause of running the machinery	
Manufacturing flexibility (MF)	Manufacturing flexibility (MF1)	• Process flexibility • Product flexibility • Routing flexibility • Volume flexibility • Expansion flexibility	Llorens et al. (2005), Sethi & Sethi (1990)
	Environment (MF2)	• Dynamics frequency • Dynamics intensity • Complexity variables • Complexity relations	
	Financial resources (MF3)	• Uncommitted resources • Short payback • Access resources	
New Product innovation (NPI)	Product innovation (NPI1)	• Innovation level in new products • Usage in new technology • Growth rate of new products • Input of new products in market • Number of first-to-market products	Prajogo & Sohal (2006)
	Process innovation (NPI2)	• Technological level of firm • Adoption in new technology • Technology modernization	

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		• Change of machinery and technology	
Research and development (R&D)	Leadership (R&D1)	• Management leadership • Operational management • Business management • Social responsibility • Management ethics	Sohn et al. (2007), Page (1993)
	Strategic planning (R&D2)	• R&D strategy • R&D objective • R&D discussion • Measurable outcome • R&D plan	
	Customer & market focus (R&D3)	• Target customer • Market analysis • Customer maintenance • Satisfaction analysis • Customer relationship management	
	Information & analysis (R&D4)	• R&D outcome ownership • R&D team management • R&D outcome management • Management information system • R&D outcome analysis	
	Human resources focus (R&D5)	• R&D organization • R&D culture of division • Employee administration • R&D environment • Employee education	
	Process management (R&D6)	• Technological commercialization • R&D support • R&D needs • Effective fund execution	
New product development (NPD)	Technology strategy (NPD1)	• Articulate the company's strategic intent • Map the company's R&D portfolio	Schilling & Hill (1998), Rolfe et al. (2006)
	Organizational context (NPD2)	• Use strategic alliances to gain rapid access to enabling technologies • Choose and monitor alliance partners • Include strategic implications of technology development in the project selection and screening process • Use a parallel development process • Use executive champions	
	Teams (NPD3)	• Include a diverse range of functions in project teams • Involve customers and suppliers in the development process • Match team structure to project type • Match team leader attributes to type of team • Establish mission, charter, and contract book for project team	
	Tools (NPD4)	• Search for tools to improve the efficacy of new product development • Use appropriate tools to improve the efficacy of new product development	
New product pricing policy (NPPP)		• Price of the new product • Design and technological changes • New product's expected life	Prahinski & Kocabasoglu (2006)

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		• Expected length of product model life • Product recalls • Demand for the used product • Availability of used products • Age of the used product • Quality of the used product • Cost to recondition the used product • Operating and maintenance cost of the used product • Material salvage value	
Product life-cycle decision systems (PLDS)		• Decisions should be made with a far-sighted approach • The market is more competitive, the company decreases its investment • The market demand is lower, the company decreases its investment • When a product is at its introduction phase, high investment support is recommended • The company may want to invest the most as well • When a product is at its decline phase, the company should consider providing low or no investment support • The company should consider making a significant investment	Sundin et al. (2009), Hu & Bidanda (2009)
Firm performance (FPERF)	Financial performance (FPERF1)	• Sales growth • Return on assets • Return on sales • Performance success	Llorens et al. (2005), Sethi & Sethi (1990), Sohn et al. (2007)
	Market performance (FPERF2.1)	• Market share • Return on assets • Overall product quality • Overall competitive position • Overall customer service levels	
	Technological performance (FPERF2.2)	• Improvement of technological ability • Technological progress • Conquest of a technological gap • Localization of a technology	
	Business performance (FPERF3)	• Improvement of marketing • New product development • Localization of a product • Improvement of a company's popularity • Sales and export increase	
	Management performance (FPERF4)	• Improvement of employment • Wage increase • Improvement of R&D environment • Improvement of manufacturing environment • Improvement of MIS	
	Manufacturing performance (FPERF5)	• Product quality • Improvement of a productivity • Improvement of manufacturing cost • Improvement of process control • Standardization	

Source: Author.

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3.3. Data collection method

The survey was conducted from June to October 2013. In total 768 questionnaires were sent to 768 different manufacturing firms all over Greece (personally, electronically and by post), while 248 of them were returned completed. Subsequently, the response rate was about 32% and is considered satisfactory, especially when compared to the average of 20% mentioned by Young (1992) for similar studies.

3.4. Questionnaire validity testing

Before carrying out the survey, questionnaire's content validity test was performed. This involved discussions with academics who deal/associate with business people and higher executive managers. Moreover, a pilot testing of the questionnaire was also conducted with the help of the aforementioned people and a small number of business executives. This process has allowed the questions to be expressed in a way that is understood and thus, avoid inappropriate phrasing that could lead to misconceptions and general confusion. Further, in order to verify the construct validity of the research factors, a test concerning the one-dimensional structure of the elements that compose each research factor was carried out, as well as a reliability analysis of every research factor separately.

To perform the test, Exploratory Factor Analysis was employed using the method of Principle Components Analysis. Furthermore, for evaluating the reliability of the research factors the Cronbach Alpha index was used. The results of these analyses that were carried out (Table 2) allow us to claim that the defining variables are solid, reliable constructs, capable of contributing to measuring the factor they belong to. In order to evaluate the adjustment quality of the defining variables to the proposed factor models, Confirmatory Factor Analysis was also employed. Initially, the complete model was tested and then the structural model. All the analyses that have been carried out have produced satisfactory results.

New product pricing policy (NPPP) has been removed from the exploratory factor analysis, so it can be used to analyse the structural model. This is because the statistical indicators of variables (Bartlett's Test of Sphericity and Cronbach alpha) show values lower than the acceptable limits. Products' life-cycle decision systems (PLDS) are removed from the structural model due to its low value on goodness of fit index, although it shows very satisfactory statistical indicators in the factor analysis. Cronbach's alpha (a) is employed to test instrument reliability. According to Nunnally (1978) any value above 0.7 indicates reliability. The results show that all factors range between 0.612 and 0.923, which surpasses the criteria of reliability (Table 2).

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Table 2: Confirmatory Factor Analysis

Factors	Sub-factors	Loadings	KMO	TVE	Bartlett's Test Sig.	Cronbach alpha
Machinery and Equipment Investments	M&EI1	.752	.608	65.874	.000	.613
	M&EI2	.821				
	M&EI3	.932				
Manufacturing Flexibility	MF1	.863	.630	64.113	.000	.695
	MF2	.704				
	MF3	.826				
Research and development	R&D1	.854	.891	76.484	.000	.923
	R&D2	.888				
	R&D3	.903				
	R&D4	.873				
	R&D5	.854				
New product development	NPD1		.616	62.772	.000	.701
	NPD2	.840				
	NPD3	.858				
	NPD4	.664				
New product innovation	NPI1	.849	.500	72.070	.000	.612
	NPI2	.849				
Firm performance	FPERF1	.704	.705	52.525	.000	.649
	FPERF2.1	.820				
	FPERF2.2	.803				
	FPERF3	.841				
	FPERF4	.849				
	FPERF5	.850				

Source: Author.

Table 3: Confirmatory Factor Analysis

Factors	X2/df	RMR	GFI	CFI	CR	VE
Machinery and equipment investments (M&EI)	.000	.000	1.000	1.000	0.93	0.87
Manufacturing flexibility (MF)	.000	.000	1.000	1.000	0.84	0.64
Research and development (R&D)	2.314	.006	.982	.993	0.94	0.76
New products development (NPD)	.000	.000	1.000	1.000	0.83	0.63
New products innovation (NPI)	.000	.000	1.000	1.000	0.84	0.72
Products life-cycle decision systems (PLDS)	2.723	.023	.978	.968	0.84	0.51
Firm performance (FPERF)	.984	.003	.990	1.000	0.92	0.66

Source: Author.

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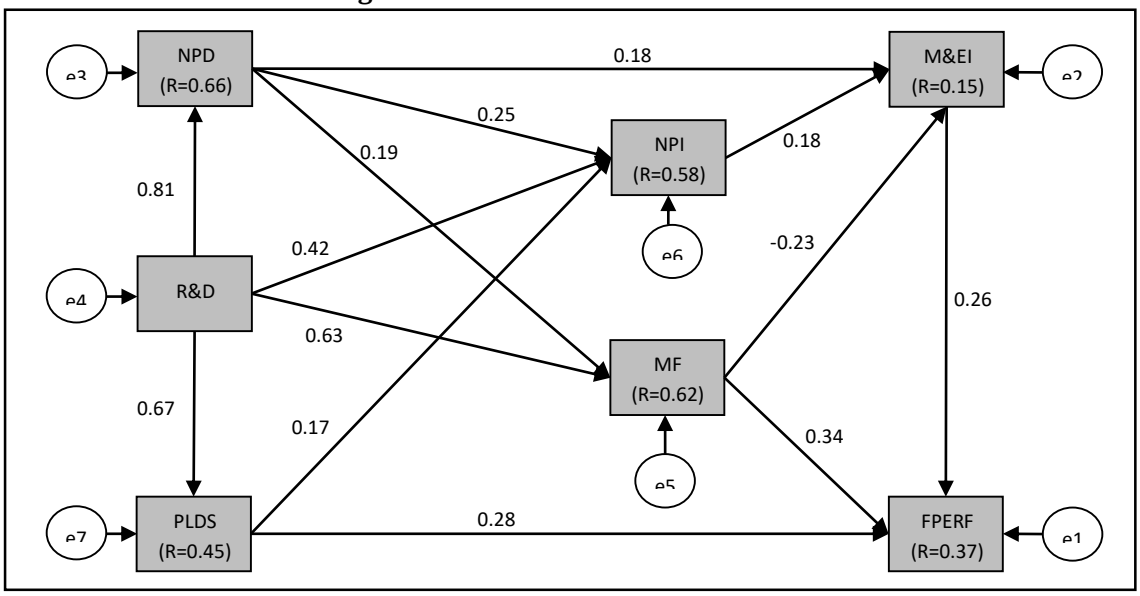
4. Data analysis - Results

Following the primary and secondary factor analyses, one factor (new products pricing policy) was removed from the initially proposed model, since it did not fulfil the evaluation criteria. The remaining factors were used to fest the proposed model and the subsequent hypotheses, performing SEM (structured equation modelling) analysis. The final results of this analysis are presented in figure 2 as well as in table 4. The predictive power of the model is moderate (R=0.15 for M&EI and R=0.37 for FPERF).

Figure 2: Research structural modem



Source: Author.

Table 4: Overall fit of the CFA model

CMIN/DF	CFI	GFI	TLI	RMSEA
2.441	0.988	0.978	0.969	0.077

Source: Author.

As can be noticed (table 5) from the original15 hypotheses only six are accepted. More specifically, it is suggested that MF (H2b), M&EI (H1) and PLDS (H7b) affect FPERF (R=0.36), while MF (H2a), NPD (H4a) and NPI (H5a) affect M&EI (R=0.15). The factor that seems to play the most significant role is MF since it affects both M&EI (r=-0.23) and FPERF (r=0.34).

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Table 5: Hypotheses testing results

Hypotheses	Examined relationships	Regression coefficient	Commenting
1	M&EI → FPERF	0.26***	Accepted
2a	MF → M&EI	-0.23**	Accepted
2b	MF → FPERF	0.34***	Accepted
3a	R&D → M&EI	-	Rejected
3b	R&D → FPERF	-	Rejected
4a	NPD → M&EI	0.18**	Accepted
4b	NPD → FPERF	-	Rejected
5a	NPI → M&EI	0.18**	Accepted
5b	NPI → FPERF	-	Rejected
6a	NPPP → M&EI	-	Rejected
6b	NPPP → FPERF	-	Rejected
7a	PLDS → M&EI	-	Rejected
7b	PLDS → FPERF	0.28***	Accepted
***p<0.001 level, **p<0.05 level			

Source: Author

Further, the modification index indicated several new relationships (Figure 2). The key role of R&D is emerged. It can be noticed that it strongly affects all NPD (r=0.81), PLDS (r=0.67), MF (r=0.63) and NPI (r=0.42). Further, NPD is related to NPI (r=0.25) and MF (r=0.19), while PLDS affects NPI (r=0.17). This actually implies that R&D indirectly affects both M&EI and FPERF through MF and NPI. Companies do not focus so much on price, but on quality and innovative product features, in order to stay competitive in the market. Similar results conclude many researches in international literature (Llorens et al., 2005; Sundin et al., 2009; Cooper, 2003; Carbonell-Foulquie et al., 2004).

5. Results

In the presented model of this research, approaches influencing the performance of manufacturing firms, either positively or negatively, through machinery and equipment investments, were mentioned. This influence depends on how grave every firm considers each factor of the proposed model to be. This mixture of factors could possibly change depending on the gravity that is given to each factor and the type of the factor, as well. A lot of the suggestions for future research occur due to the recognition of the limitations of the present study. A different approach in measuring the factors could lead to different results.

The core factor of this research "machinery and equipment investments" attempts to examine the processes that intermediate between firm strategy, investment decisions and firm performance. From the conceptual model proposed here derives that there are some important relationships among the examined factors, suggesting thus that each one of them can significantly affect (directly or indirectly) both M&EI and FPERF. The mix of these factors is very likely to change not only as far as the employees given to each one of them, but the factors as well. This happens because firms are "living" organisations operating within a dynamic environment that is continuously evolving while the changes occur at a high speed. This is why they have to be flexible so as to maintain a competitive advantage and survive literature (Llorens et al., 2005; Sundin et al., 2009; Cooper, 2003; Carbonell-Foulquie et al., 2004).

The results of the evaluation of the structural model support six and reject seven research hypotheses (Figure 2). Furthermore, the modification index indicated several important relationships between the factors of the structural model that have nothing to do with "machinery and equipment investment" (M&EI) and "firm performance" (FPERF), but with the factors in between them. Initially, the positive influence of machinery and equipment investments on firm performance has to be acknowledged. Although it can be considered as an expected result, its importance is great, as the adverse conditions that exist in the business environment of Greece, where the firms of the sample belong, must be taken under consideration (Bengtsson & Olhager, 2002).

The automation of production lines and the achievement of the higher possible manufacturing flexibility are imperative for firms in order to be able to produce event five the requested quantities of the products, based on demand. From the present study derives that manufacturing flexibility (MF) has a strong positive effect on firm performance (FPERF). On the contrary it has a negative effect on machinery and equipment investments (M&EI). This negative influence can be attributed to the fact that if the firm has already high level of MF it doesn't probably need more investments on M&E (Bergstein & Estelami, 2002).

The increasing demands of the market geometrically increase the requested product requirements. The new products have to incorporate the elements that will make them stand out against the competitive ones. At this phase it is the responsibility of the Research & Development (R&D) department to propose solution to specific market questions. According to Carbonell-Foulquie et al. (2004), R&D affects at a great degree new products in terms of their development stages and the innovation they incorporate (NPD & NPI). The same appears to be valid in the case of the Greek firms included in this survey, since the analysis has shown that there is an intense influence of R&D on NPD and NPI processes (0.81 and 0.42 respectively). Moreover, it has a strong positive effect on the product life-cycle (PLDS) and manufacturing flexibility (MT) (0.67 and 0.63 respectively). Thus, it appears that businesspeople and management executives have comprehended the importance of differentiating their products, in an era where the financial crisis has obviously left its marks. Therefore, the R&D department designs the products, so as to cover all the customers' categories, according to their demands.

The machinery and equipment investment model that derives from the present study, presents a complex yet clear picture of important organisational definitions that can affect the management executives' way of thinking in Greek firms in the field of new product development. The proposed model can be used for the evaluation of future strategies. However, theory is often different from application. Usually, when firms attempt to apply the proposed theories, they realise that theory and application can be widely different than expected. In terms of "reality", the practices that are related to the manufacturing process cannot be fulfilled from one day to the other, or from any other company (Hu & Bidanda, 2009; (Waweru, 2016; Wraikat et al. 2017)

It is essential to mention that this survey has been carried out with a sample of 248 firms which have realized investments during 2006-2013 period. Even though they represent an important percentage of the Greek firms that operate in the manufacturing field, the bigger the available sample, the more it reflects Greek reality.

Another limitation of this research could also be the fact that the survey gathers results and conclusions that clearly reflect the view of the Greek business people and management executives, without the participation of employees or other external associates of the firms. At this point it has to be mentioned that due to the harsh

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financial developments in Greece, most firms are at a descending course, regarding turnover and employed workforce. Therefore, the moment in time the research took place, consists a limitation on its own. If the same research occurred some years earlier, where the economy was growing and booming, then the results would have been different and possibly more optimistic. Moreover, the study has been conducted based on a certain model that contains specific factors. The use of different factor could have produced different results.

5.1. Limitations and future research

After observing the results of the research, it is useful to mention that the research was conducted with a sample of 248 firms which have implemented investments in the last five years. Even if they represent a significant percentage of the Greek firms that operate in the manufacturing field, the bigger the available sample would be, the better it would reflect the Greek reality.

In addition, due to the questions having subjective elements, some of the respondents could have overestimated a question by grading it 5 in Likert scale which could be "worth" 4, or underestimated it by grading it 2 when it could be "worth" 3. In order to extract the most objective responses possible, a lot of clarifying adjustments were made to the questionnaire.

Finally, a future research could benefit from the incorporation of other important factors in the research framework that has been developed in the present study. Factors, like business strategy and other internal and external factors influencing the firm can be added, since they affect and are significantly affected by investment firm movements.

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