

The Impact of Technological Innovation Capabilities on the Competitiveness of a Mature Industry

Glykeria Karagouni, Dr. Ioannis Papadopoulos

Department of Wood & Furniture Design and Technology

Technological & Educational Institute of Larissa

karagg@teilar.gr, papad@teilar.gr

Abstract

The main objective of the present study is to understand the way in which Technological Innovation Capabilities of an industry at the level of its firms, affect the efficiency and the potential of small and micro firms that have to gain their competitive advantage through differentiation and innovation, rather than cost leadership. It attempts to draw on theoretical literature and empirical studies on Innovation Management and Technological Capabilities in an effort to explore the role of Technological Innovation Capabilities (TICs) in the Furniture Industrial sector. The paper examines the relevance of seven TICs to the performance of the firms, while explanations and conclusions are supported by further explanatory questions.

Empirical data was acquired through a recent study of 45 Greek and Cypriot small and very small (micro) firms. Regression analyses were employed to examine the correlation between TICs and innovation rate, sales growth, and product competitiveness among these firms. The survey findings verify the existence of correlation between TICs and the competitive performance and provide empirical evidence and insights of current TIC status in Greek and Cypriot Furniture firms. Marketing Capabilities prove to be the most powerful ones to safeguard the sales growth and product competitiveness. Strong Strategic Planning and Learning Capabilities enhance the innovation performance, while micro firms cultivate the Resources Allocation Capability to achieve product excellence. Especially the Learning Capability is regarded to be the most important and helpful one to dynamically expanding firms. However, the absence of R&D and Manufacturing Capabilities and the weak existence of Organizing Capabilities can be further investigated. The audit results, as well as the homogeneity of the sample, stress the need for the testing of new operating strategies that may contribute to more rapid technological change in mature industries.

Keywords: Technological Innovation Capability, Mature Industry, Furniture Firms

JEL Classification Codes: O32, L25

INTRODUCTION

Over the last few years an extraordinarily important socio-economic phenomenon has changed the world we live in. This phenomenon consists of an unstoppable internationalization of the economy and the globalization of the markets, forcing industries worldwide to face a new era of intense global competition. As competitive pressures increase, the need to continuously

adapt, develop and innovate has become a basic building block for organizational excellence. Most industry analysts agree that innovation is the key to successful competition (Tidd *et al.*; 2001, Brown; 1997, Davenport and Bibby; 1999). At the same time, researchers in the areas of sustainable competitive advantage have come to the conclusion that one of the critical things that give an organization a sustainable edge, is the development of Core Capabilities and -referring to innovation- Technological Innovation Capabilities. Studies have rarely incorporated the concept of Technological Innovation Capabilities (TICs) in understanding the links between technological capabilities and the long-term dynamism of a specific industrial sector. Most recent ones have advocated different technological innovation capabilities (TICs) and discussed their impact on a firm's competitive performance. Still, all research refers either to samples of firms belonging to various industrial sectors, mostly technology - intensive ones, or to organizations of developing countries. No research has been yet done for a specific sector, especially for a mature one. Mature, labour - intensive industries, such as the furniture industry, struggle to survive, in the new globalized markets, especially after the dynamic entrance of China. The findings can then be used by other industrial sectors too, or can motivate studies on capabilities' formation to lead such clusters to new competitive advantages.

Innovation can be defined as the application of new ideas to the products and processes of a firm's activities. Freeman *et al.*(1988) sees this as a process that includes the technical, design, manufacturing, management, and commercial activities involved in the marketing of a new or improved product or the first use of a new or improved manufacturing process or equipment. Innovation can be transformational, radical or incremental depending on the effect and nature of the change. Afuah (1998) suggests that innovations do not have to be breakthroughs or paradigm shifting. Roberts ((1988) in Chiesa *et al.*, 1996)) stated that the overall management of technological innovation includes the organization and direction of human and capital resources towards effectively: (1) creating new knowledge, (2) generating ideas aimed at new and enhanced products, manufacturing processes and services, (3) developing those ideas into working prototypes and (4) transferring them into manufacturing distribution and use. Thus, people process and product dimensions are included (Tidd *et al.*, 2001). Bessant and Francis (1998) suggest that effective innovation must involve all areas of an SME with the potential to affect every discipline and process.

The conclusion is that Innovation is concerned with the process of commercializing or extracting value from ideas. From this perspective, innovation would be expected to be closely linked to firm performance. Indeed there is widespread support for the assertion that firms must be innovative to survive and prosper in a competitive economy (Feeny & Rogers, 2001). Many studies have shown that technological innovation could bring positive impacts, enhancing the competitiveness of firms (Diericks and Cool, 1989; Guan & Ma, 2003).

Capabilities represent the ability of the firm to combine efficiently a number of resources to engage in productive activity and attain a certain objective (Amit and Schoemaker, 1993). A firms' capabilities are important in providing and sustaining its competitive advantage, and in the implementation of the entire strategy, (Guan & Ma, 2003). Capabilities can also be incorporated within models (CMM), as they have already been in the areas of software engineering, human resource and quality management (Blanas, 2003).

Technological Capabilities (TCs) are dynamic resources which encompass the skills, knowledge and routines involved in generating and managing technological change, whether they concern production activities, investment activities, or relation with other firms (Albu 1997). For example, prior to purchase and absorption of new technologies the firm should be able to make the right choice about the type of technology, about its sources and the price it is going to pay for it (Gulrajani M., 2006). According to Lall (1992), TCs can be described as knowledge and skills; technical, organizational and institutional aspects that allow productive enterprises to utilize equipment and information efficiently. The concept of technological capabilities can be used either as a micro concept, referring to the technological capabilities of a firm, or as a macro concept, referring to technological capabilities of a country. There are various ways to categorize firm-level TCs (Bell and Pavitt 1995; Lall 1992; Marcelle 2002; Ernst *et al.* 1998), who generally classify them in Production, Investment, Minor change, Strategic marketing, Linkage and Major change capabilities.

Innovation capability is a special asset of a firm. It is tacit and non-modifiable, and it is correlated closely with interior experiences and experimental acquirement (Guan & Ma, 2003). Adler and Shenbar (1990) defined innovation capabilities as: the capacity of (1) developing new products satisfying market needs; (2) applying appropriate process technologies to produce these new products; (3) developing and adopting new product and processing technologies to satisfy the future needs; and (4) responding to accidental technology activities and unexpected opportunities created by competitors. Christensen (1995) classified innovative assets into: (1) scientific research assets; (2) process innovative assets; (3) product innovative assets; and (4) aesthetic design assets and stressed the need of the combination of more than one of these assets for a company to be successfully innovative. Tyabji (2000) places emphasis on two other significant components of innovative capabilities; management's capacity for effective absorption of knowledge and labour processes conducive for innovation. Guan and Ma (2003), and Yam *et al.* (2004) classify the innovation capabilities into seven dimensions: (1) learning (2) R&D (3) manufacturing (4) marketing (5) organizational (6) resources exploiting and (7) strategic capability, all of them including a certain number of dimensions.

Technological Innovation Capabilities (TICs) are defined by Burgelman *et al.* (2004) as a comprehensive set of characteristics of an organization that facilitates and supports its technological innovation strategies. TICs are a kind of special assets or resources that include technology, product, process, knowledge, experience and organization (Guan and Ma, 2003). Peteraf (1993), claims that a firm's heterogeneous resource portfolios (e.g. technology, capital and human resources) play a vital role in observed variability in its financial returns. Adler and Shenbar (1990), regard four types of TICs, including (1) the capability of satisfying market requirements with new products; (2) the capability of manufacturing these products; (3) the capability of developing and introducing new products for future needs and (4) the capability, to respond to competitors and unforeseen circumstances.

An extensive literature review was carried out to identify the characteristics of competitive firms, as well as the critical factors for success. Cooper and Tushman and Moore (in Chiesa *et al.*, 1996) noted the importance of identifying customer needs and matching them with technological capabilities. Von Hippel (1988) proposed the direct links with customers and exploiting lead users as a source of innovative concepts. Chiesa *et al.* (1996) developed a model for auditing a firm's innovation capability by

identifying an extent list of indicators of the characteristics of good practice, and constructed a hierarchy of good process characteristics. Similar to Chiesa's approach, Guan and Ma (2003) and Yam *et al.* (2004) developed an innovation audit model that includes a capability audit and a performance audit. There are many other suggestions of key factors, such as Cooper (1980 and 1996), Rothwell (1992), Christensen (1995), Burgelman *et al.*, (2004), Feeny S. and Rogers M., (2001) etc.

METHODOLOGY

The purpose of the present study is to identify the way that TICs are related to success and failure in making and sustaining the firms of a specific mature industry competitive and is realized through measuring their impacts on firm performance.

Integrating the findings of relevant literature, activities, processes, or characteristics that are found to be associated with innovation success and failure are used to develop the questionnaire. The elements are then grouped, using the seven capability dimensions of Guan and Ma (2003) and Yam *et al.* (2005) and comprise the first part of the questionnaire. The second part consists of further explanatory questions.

Specifically, the questionnaire investigated the following aspects: Knowledge and skills, R&D aspects and approaches, drivers for change, the firm's ability to exploit its technological, human and financial resources operating under a well-established organizational structure, abilities of creating products that meet market needs, in accordance with design request, the understanding of consumers' current and future needs, customers' access approaches and competitors' knowledge, priorities, innovative activities, obstacles and enablers and the adaptation to the dynamic changes in a highly competitive environment.

The three indicators, which were used in Yam *et al.* (2004) study, are also used here to decide the impact on firm's performance: innovation performance (innovation rate), sales performance (sales growth) and product performance. Due to business confidentiality, and because of the reluctance of the majority of firms and particularly the small ones in Greece and Cyprus, to reveal any financial information, firms would not disclose their financial statements.

Both quantitative and qualitative data were collected through a combination of e-mailing and personal interviews to very small and small companies: The questionnaire was e-mailed to the firm, after a telephonic agreement, so that managers had enough time to reflect upon their actions and views that could reveal the actual TICs of the company. The interviewer would then arrange a personal interview in order to discuss the questions, clarify difficult points and finally complete the questionnaire. The questionnaire was pre-tested in five firms. Interviewees were first asked to provide their views on various aspects of innovation and competitiveness, including the easiness of making new moves and planning new strategies. This discussion was largely unstructured although a series of standard probes were used to guide the discussion. At the end of the interview session, respondents were then requested to fill in the structured questionnaire, in the presence of the researcher. The average length of the interviews was one hour. Respondents, one per firm, were senior executives such as general managers, directors, production managers or the entrepreneurs themselves. The data analysis techniques employed are descriptive statistics, reliability analysis,

correlation analysis and regression analysis. All computations were done using the SPSS package (Norusis,1997).

The qualitative responses are used to provide context for the statistical results obtained.

The survey concentrated 45 questionnaires, which is considered a representative sample of small / micro furniture firms in Greece and Cyprus (Papadopoulos, 2005). All firms belonged to the Furniture Sector and were chosen to have 50 employees at maximum. They are grouped into Conservative or Dynamically Expanding, according to the performance indicators and Active or Steady according to whether they have moved into new activities, during the 3 last years, or not.

MAJOR FINDINGS

The major findings of the study are presented in the following:

Profile of respondent firms

Both the Greek and Cypriot Furniture Industry are predominantly characterized by a population of micro and small, privately- owned firms (the majority employing less than 50 people), with a not irrelevant share of medium ones. The sector is a mature one, with many firms operating in a 'craft' production mode and very labour intensive. Products can be classified according to primary material (wood, upholstered, metal, other), use (case goods [dining room and bedroom furniture], occasional furniture [coffee and end tables]), as well as style, finish, quality, and price. The production is highly diversified (i.e. chairs, dormitories, armchairs, living rooms, kitchen furniture etc.). No cases of foreign ownership were come upon (Papadopoulos et al., 2005).

The firms involved in the survey are Greek or Cypriot. The 51% of them have less than 9 employees, and the rest 49% between 10 and 49. Out of a sample of forty-five firms in the survey, twenty -six (57.8 per cent) firms reported to have moved into at least one new activity in the last 3 years.

A 10% exports mostly in East European countries.

For a start, 100% of the firms sampled considered themselves innovative. A matter of discussion should be whether or not design remodeling (new colors, change in components, shape, etc.) or some other refinishing may be considered as new products. Process innovation is quite common, even if it consists mainly in purchasing new machines.

TICs and sales performance

It is shown in Table 1 and Figure 1, that the Dynamically Expanding firms (sales rate higher than 20%) have significantly higher scores in TIC components (the difference of their mean scores is significant at the 0.05 level) than Conservative firms, in all seven dimensions, regarding their effect in sales performance. This result is considered rather normal. The biggest difference is found in their Learning Capabilities.

Regression analysis is used to explore the effects of individual TICs on firms' sales growth, and the standard regression coefficients of variables are given in Table 2. It shows that Learning Capability determines the sales growth of very small firms (i.e. Mode 1; standard regression coefficient = 2.337 at significant level $P < 0.05$). The overall finding on the impact of

this TIC is also significant (i.e. Mode 3; standard regression coefficient = 0.317 at significant level $P < 0.05$), indicating that the sales growth depends mainly on the Learning Capability of firms that develop it. Marketing Capability is the critical one for small firms (i.e. Mode 2; standard regression coefficient = 0.934 at significant level $P < 0.05$). This is in accordance with literature that associates sale performance with marketing excellence. It is interesting to mention that critical elements of it are the maintenance of the corporate image, the personal relationship with customers and the close after sales relations. Instead, micro companies (<10) rely heavily on Learning Capability for their sales growth, rather than on Marketing Capability.

Learning Capability is also the strongest ability that helps Active firms to move into new activities (standard regression coefficient = 0.913 at significant level $P < 0.05$), in order to achieve a better sales performance. Technology management and the knowledge obtained by fairs, customers and suppliers were marked as the most important facilitators in such activities. So, Greek and Cypriot furniture firms pay great attention in cultivating and sustaining the ability to identify, assimilate, and exploit knowledge from the environment, an ability which seems to pay back in terms of sales growth and of generating new ideas and putting them into action.

It is not surprising that fairs appear to be a significant source of information, since they offer the opportunity to gather ideas about new products and, for small firms, are gateways for establishing links with potential new buyers. International fairs increased considerably their importance for both small and medium firms, which confirms the increasing degree of internalization of the sector. Internet also starts to become an important source of knowledge (22%).

On the other hand, Learning Capability is also significant for Steady firms (standard regression coefficient = 0.894 at significant level $P < 0.05$). In this case, the result indicates the difficulty of obtaining knowledge as the first and most important obstacle in not innovating in the furniture sector with a 26%, (the shortage of skilled personnel is ranked second (22%) and the difficult access to financial resources third (18%)).

The wish to have a better access to knowledge, especially on new products development and innovative processes, has affirmed the 90.24% of the sampled firms, in order to build and sustain their competitive advantage in the new globalized economy. The above findings affirm that Learning Capability affects the innovation efforts and economic growth in the firms studied.

TICs and innovation performance

There is only an 18% of innovative firms in the sample, considering the fact that - according to the European Innovation Trend Chart, - a firm is innovative when its innovation rate is greater than 20%.

It is very interesting to see that R&D and Manufacturing Capability play no role at all in supporting the innovativeness of the firms, or distinguish the two categories. The explanation can be twofold: the sample consists of small and very small companies of a mature industry and can be considered as a representative one of many other similar industry clusters not only in Greece or Cyprus, but in Europe or worldwide. Such firms cannot actually excel in R&D, so they have to develop other TICs in order to become innovative. On the other hand, the industry is a labour intensive one and manufacturing ability

has not yet be given the importance it deserves. Firms fail to identify areas of improvement or to match the process capabilities with market requirements. Moreover, often, SMEs experience problems in this area, which are caused by lack of capital expenditure on technology and insufficient expertise to use the technology to its maximum effectiveness (Alstrup, 2000).

Contrary, there is a significant difference in the means of Resources Allocation, Marketing, Organizing and Strategic Planning Capability (Table 3, Figure 2). In one sense, the results are consistent with the literature. According to Berry (1996), if SMEs need to be successful and even survive in the long term, they must be more market-driven rather than technology-driven. The literature also suggests that, innovation cannot be viewed as the sole brief of a research and development or technical department (Tidd *et al.* 2001) and that in implementing and developing the process of innovation, there is no definitive path that can be embarked upon (Bessant and Caffyn, 1997). Porter and Stern (1999) also stress that innovation involves much more than just science and technology.

Regression analysis stresses the fact that innovative organizations tend to be those that develop the most suitable fit between structure, operating contingencies and flexibility (Tidd *et al.* 2001). The results (see Table 4), show that the Strategic Planning Capability significantly affects the innovation rate of the firms; small or very small ones, (i.e. Mode 1; standard regression coefficient = 0.602 at significant level $P < 0.05$ and Mode 2; standard regression coefficient = 0.684 at significant level $P < 0.05$). The overall finding of the Strategic Planning Capability is also significant (i.e. Mode 3; standard regression coefficient = 0.462 at significant level $P < 0.05$). In order to achieve competitive advantage, the sampled firms prove that planning, flexibility, contingencies handling and target setting -as well as the rest elements of the Strategic Planning Capability are important factors in strengthening their innovative efforts.

A weak element of this capability concerns firms' attitude towards co-operative agreements on innovation projects, either formal or informal, with other firms (horizontal co-operation), subcontractors, input providers (vertical linkages) or research centers. According to literature, due to limited financial and human resources, SMEs must rely on external R&D and must develop co-operation and partnership in technology and innovation with other SMEs, public institutions, and large corporations (Dodgson and Rothwell, 1991; Riedle, 1989).

There is evidence of a growing trend of co-operation between producers (6 companies (16.2%) with 6 projects each, in the three last years). Such co-operation is however scarce in quantitative terms. Only a small percentage of firms develop innovation jointly with other partners on a regular basis (16.2%), while a 40.5% have never had any co-operation on innovation projects. Both questionnaire results and interviews suggest that firms still resist co-operation with their local competitors. This dimension of Strategic Planning Capability is ranked between "unknown" to "not satisfactory" by the 54.5% of the firms tested. Our conclusions reaffirm previous studies results, for instance Meyer-Stamer (1998) and Morrison (2003) for Santa Catarina's and Sao Bento furniture industry in Brazil, respectively.

The firms' research network is still very limited, since few and very recent organizations have been setting up to assist firms in technological matters. This weakness can be explained either referring to the sector characteristics or to scarce firms' innovation capabilities. Besides, research in furniture is very close to the development stage, therefore pre-competitive research

activities are limited. In conclusion, although co-operation is not widely observable, an institutional environment favorable to co-operation has been set up. Firms are reluctant to establish direct links, either vertical or horizontal, but they demonstrate a growing propensity to co-operate through public institutions.

For Active firms, the Learning Capability is the only one affecting the innovation rate (standard regression coefficient = 0.931 at significant level $P < 0.05$). That means that Knowledge Identification, Assimilation and Exploitation plays a vital role in helping small and micro firms successfully start an innovative activity. That is quite normal if we assume that this category has not the resources and potential for proper knowledge management. Steady companies follow the trend of the total of firms (irrespective of personnel number), with the Strategic Planning Capability the only significant one.

TICs and product performance

Survey results indicate that firms with stronger TICs have higher product competitiveness, and vice versa, (see Table 5 and Figure 3). The differences in all the scores between the two groups are statistically significant, at significant level $P < 0.05$. Dynamically Expanding Firms are considered the ones with an overall product performance 6 or 7 (satisfactory to very satisfactory).

It is believed that most TICs could be associated with product competitiveness (Guan 2003). However, in our study, the standard regression coefficients of individual TIC dimensions prove that the Resources Allocation Capability and Marketing Capability are the only two significant predictors of product competitiveness in very small firms (<10 employees), while Marketing Capability stands alone for small ones (10 - 50 employees), (see Table 6). Marketing Capability is also the only one significant to product competitiveness for Active companies, while it is worth mentioning that besides Marketing Capability, Organizing Capability is significant for Steady firms to product performance. Having practically no possibility for R& D activities, both because of size of firms and nature of industry, these firms have to rely on their human, capital and technology resources and an excellence in marketing, if they want to be among the main players in product competitiveness.

Resources Allocation Capability seems to play an influential role also for the totality of firms (standard regression coefficient = 0.291 at significant level $P < 0.05$). Human, capital and relational capabilities are increasingly identified in literature as strategic assets to access knowledge, and in turn to build up Technological Innovation Capabilities. Human resources represent a key asset for successful management of innovation. Nevertheless, although the personnel is cautiously selected, the importance to human resource is not satisfactory (29.3 % considers it as very rare and 24.4% as not satisfactory). Capital resources are not satisfactory (Mean = 3.818, Std. Dev. = 1.398). A 36.4% of the sampled firms have never had -or wish to have - any co-operational innovative activities, while the same percentage finds it difficult to devote a steady capital for innovation. A 28% feel that funding for innovation is vital for their survival, but still they are reluctant to sharing costs with other firms. Technology resources are satisfactory enough (Mean = 5.046, Std.Dev. = 1.18). Active firms consider the Knowledge exploitation through technology transfer, cooperation with institutions or Universities and benchmarking as one of the most important facilitators for innovative activities. 60% of all firms have benchmarked at least once and

43.9% have participated in at least one research program. The lack of Know-how is considered the second obstacle for Steady firms.

On the other hand, special attention is given to the development of the Marketing Capability, some characteristics of which are marked as "absolutely satisfactory" (i.e. the customer - company relationship, ranked as totally satisfactory by a 46.5% and with a Mean =5.98 and a Std Dev = 0.916). Marketing Capability significantly affects the product performance of the firms; small ones with a standard regression coefficient = 0.669 at significant level $P < 0.05$ or very small ones (standard regression coefficient = 0.995 at significant level $P < 0.05$). The overall finding of the Marketing Capability is also significant (i.e. Mode 3; standard regression coefficient = 0.494 at significant level $P < 0.05$). Furthermore, having the adjusted R^2 98.5% in Mode 1, 98.9% in mode 2 explains the impact of Marketing Capability on product competitiveness, irrespective of firm size.

Marketing Capability proves to be the strongest and most influential one in product performance and the *sine que non*-of TICs, that decides company competitiveness in general. It gains the highest scores and gets involved in firm's all activities. Company image takes a 7 in a seven - point Likert scale by 43.2% of firms, which is expected by companies selling furniture. Marketing efficiency is ranked satisfactory (Mean =5.31, Std Dev = 0.772). Present and future customer needs are considered the most important parameters in forming a firm's strategy (Mean =6.53 and a Std Dev = 0.751). Marketing incapability is noted to be the first obstacle in not moving into new activities (Mean =5.05 and a Std Dev = 1.929). Thereupon, it proves to be of crucial importance for firms to develop marketing and export-oriented skills especially in the era of global competition.

It is statistically evident that there exists a relationship between TICs and company performance. It is worth mentioning that each performance indicator is predetermined mainly by one TIC, no matter the company size. The sales growth is affected by the Learning Capability (with the only exception of Marketing Capability for the 10-to-50-person firms), the innovation rate by the Strategic Planning Capability and the product performance by the Marketing Capability. There are without doubt the most influential factors of a firm's performance and the TICs with the greatest impact on the competitiveness of the mature furniture industry in Greece and Cyprus. In the area of product performance, Resources Allocation Capability is also important, while Organizing Capability is significant only for Steady firms. R&D and Manufacturing Capabilities do not appear at all, but that is quite normal, as we have explained above and this fact points out the weaknesses of the target group. Since firms appear to be innovative or product - competitive in a small scale, the situation could be described as rather unhealthy. That means that firms should try to cultivate all seven categories of TICs, reconsider their practices, identify the gaps and closely relate their TICs to the formulation of technology strategy and harmonization of innovation activities. The results, as well as the homogeneity of the sample, stress the need for the testing of new operating strategies that may contribute to more rapid technological change in mature industries such as: diversity, consolidation, agility, adaptability, ability to respond quickly to changes and co-operation. Firms should consider a more balanced focus on their TICs' harmonizing enhancement. On the other hand, the existence and cultivation of Learning, Marketing and Strategic Planning Capability stress the importance of TICs in the process of innovation and technological change, even in mature industries keen to survive in the new globalized business landscape. Greek and Cypriot Furniture SMEs have so long paid mostly attention to TICs related to customer value innovation, neglecting the R&D

and Manufacturing part. Still, in implementing and developing the process of innovation there is no definitive path that can be embarked upon (Bessant and Caffyn, 1997). In order to gain a sustainable competitive advantage, firms that have worked on TICs should combine customer value innovation (Kim and Mauborgne, 1999) with technology and process innovation, which now seems to be underestimated. This combination can help companies gain an increased chance of enjoying sustainable growth and profit in the new era of intense global competition (Humphreys P. et al., 2005).

CONCLUSIONS

Several research studies have pointed out to the need for innovation as a key source of competitive advantage for organizations. In today's competitive environment, the challenges for all businesses (including SMEs) is not only to innovate in existing markets, to survive and remain profitable, but also to innovate in new markets, in order to stay in front of competitors. In this study, we examined how SMEs of the mature Furniture Industry are combating this challenge, using their Technological Innovation Capabilities and how successful they are in doing it. We proved the existence of a correlation between TICs and the competitive performance. As this is a single industry sector study, generalizations are limited. Some conclusions can be drawn for managers of SMEs and entrepreneurs, particularly in this cluster.

Marketing Capabilities prove to be the most powerful for all firm categories and the ones that safeguard the sales growth and product competitiveness. On the other hand, strong Strategic Planning and Learning Capabilities are the ones that enhance the innovation performance, while micro firms cultivate the Resources Allocation Capability to achieve product excellence. Especially the Learning Capability is regarded to be the most important and helpful one to dynamically expanding firms. However, the absence of R&D and Manufacturing Capabilities and the weak existence of Organizing Capabilities can be further investigated. The last ones appear only in Steady Firms but assure their importance on companies' competitiveness.

Adapting the concept of core (a capability set of R&D, manufacturing and marketing), and supplementary innovation assets (a capability set of learning, organizational, resource and strategic), as defined by Guan and Ma (2003), it is implied by the study that micro and small furniture firms can support and harmonize the innovation process quite successfully. The research results in this paper imply that the supplementary innovation assets are the dominant ones in determining the performance of companies of that size. Therefore, small firms of a mature industry should assimilate and enhance the supplementary innovation assets which they already possess, and work harder on the specific factors of core assets in order to achieve excellence in performance and be competitive in a global sense. Firms with favorable interior supplementary innovation environments can respond faster and more effectively to external changes, and can adjust to technology strategies more easily.

Referring to the differences in size between micro and small companies, no grate differences were found to distinguish the TICs, which predetermine the performance of the two categories. This finding leads to the conclusion that size does not play an important role and TICs can be cultivated and affect the companies of the particular sizes in a similar way.

An important limitation is the fact that data are obtained mostly from the entrepreneurs themselves, or directors and production managers and the firm

itself is often not the best judge on its own performance. The methodology would be strengthened if the data collected from the key informants could be cross-validated by information from other sources, which has not been possible here. Despite these limitations, the findings and suggestions are useful, given the absence of guidelines for monitoring innovation capability in mature industries.

In order to maintain their sustainable development and enhance their whole innovation capability, Furniture firms should reconsider their practices, identify the gaps and closely relate their TICs to their strategies and the future planning of innovation activities. The audit results, as well as the homogeneity of the sample, stress the need for the testing of new operating strategies that may contribute to more rapid technological change in mature industries. Firms should consider a more balanced focus on their TICs' development.

FUTURE RESEARCH DIRECTIONS

This study aimed only to explore the impact of TICs on the competitiveness of the weakest part of a mature industry, that is the small and micro firms. For this reason, Greek and Cypriot furniture industries were used, in order to have a more holistic view of a sector, exceeding local and national borders. There was no distinction or comparisons made between Greek and Cypriot companies, since we were interested only in collective results, in order to see an international aspect of the subject. However, it would be very interesting -and we intend - to investigate which TICs and how affect the furniture firms of each country, comparing the relevant data and commenting on the TIC status in Greek and Cypriot Furniture firms.

Furthermore, future research could deal with benchmarking TICs (and the way they are applied) of leading furniture SMEs worldwide, and formulate the technology strategy and harmonisation of technical innovation activities in Greek and Cypriot firms. Another possible direction could be the enlargement of the sample, with data of companies from other countries, either for collective or for comparative results and insights.

REFERENCES

- Abernathy, W., and J. Utterback, 1978, "Patterns of industrial innovation", *Technology Review*, 80(7), 41-7.
- Adler, P.S., and A. Shenbar, 1990, "Adapting your technological base: the organizational challenge". *Sloan Management Review*, 25, 25-37.
- Afuah, A. Innovation Management: Strategies, Implementation and Profits, 1998, *Oxford University Press*, New York, NY.
- Albu, M., 1997, 'Technological Learning and Innovation in Industrial Clusters in the South', SPRU Electronic Working Paper No. 7, University of Sussex, Brighton.
- Alstrup, L., 2000, "Coaching continuous improvement in small enterprises", *Integrated Manufacturing Systems*, 11(3), 165-170.
- Amit R, and P.J. Schoemaker, 1997, "The competitive dynamics of capabilities: developing strategic assets for multiple futures." in G. Day, D. Reibstein (eds), *Wharton on Dynamic Competitive Strategy*, Wiley: New York, 368-394.
- Amit R, Schoemaker P.J., 1993, "Strategic assets and organizational rent", *Strategic Management Journal*, 14(1), 33-46.
- Archibugi, D. and J. Michie, 1995, "Technology and Innovation: An Introduction", *Cambridge Journal of Economics*, 19(1), 1-4.

- Bell, M. and K. Pavitt, 1995, 'The Development of Technological Capabilities', in I. u. Haque, *Trade, Technology and International Competitiveness*. Washington D.C.: Economic Development Institute of The World Bank.
- Berger M. and J.R. Diez, 2006, " Technological Capabilities and Innovation in Southeast Asia: Results from Innovation Surveys in Singapore, Penang and Bangkok", *Science, Technology & Society*, 11(1)
- Berry, M., 1996, "Technical entrepreneurship, strategic awareness, and corporate transformation in small high-tech firms", *Technovation*, 16(9), 187- 198.
- Bessant, J. and Caffyn, S., 1997, "High - involvement innovation through continuous improvement", *International Journal of Technology Management*, 14(1) 14-22.
- Bessant, J. and Francis, D. (1998), "Implementing the new product development process", *Technovation*, 17(4), 187-197.
- Blanas, G., *Total Quality Networking: TQM - HRM and IS Networks*, 2003, Patakis Publications, Athens.
- Brown, J.S., 1997, "Seeing Differently, Insights on Innovation", Harvard Business School Press, Boston, MA.
- Burgelman, R., M.A. Maidique, S.C. Wheelwright, 2004, "Strategic Management of Technology and Innovation". McGraw-Hill, New York
- Chiesa, V., P. Coughlan, and C.A. Voss, 1996, "Development of a technical innovation audit", *Journal of Product Innovation Management*, 13(2), 105-136.
- Christensen, J.F., 1995, "Asset profiles for technological innovation", *Research Policy*, 24, 727-745.
- Cooper, R.G., 1980, "Factors in new product success.", *European Journal of Marketing* 15(5-6), 277-292.
- Cooper, R.G., 1996, "Overhauling the new product process.", *Industrial Marketing Management* 25, 465-482.
- Davenport, S. and D. Bibby, 1999, "Rethinking a national innovation system: the small country as SME", *Technology Analysis & Strategic Management*, 32(3), 241-55.
- Dierickx, I., Cool, K., 1989, "Asset stock accumulation and sustainability of competitive advantage." *Management Science* 35, 1504-1511.
- Dodgson, M. and Rothwell, R., 1991, "Technology strategies in small firms", *Journal of General Management*, 17(1), 45-55.
- Dutta, S, O. Narasimhan, and S. Rajiv, 2005, " Research Notes And Commentaries Conceptualizing And Measuring Capabilities: Methodology And Empirical Application", *Strategic Management Journal*, 26, 277-285
- Ernst, D., L. Mytelka and T. Ganiatsos (1998), 'Learning, Technological Capability Building and Sustainable Export Growth', in D. Ernst, L. Mytelka and T. Ganiatsos, eds, *Technological Capabilities and Export Success in Asia*. London: Routledge.
- European Trend Chart on Innovation, 2005, "Annual Innovation Policy Trends and Appraisal Report Greece 2004-2005", (www.cordis.lu/trendchart)
- Feeny S. and M. Rogers, 2001, " Innovation and Performance: Benchmarking Australian Firms", Working Paper No. 7/01, Melbourne Institute
- Freeman, C. and P. Carloza, 1988, "The Structural Crisis of Adjustment", in G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete, (eds.), 'Technical Change and Economic Theory', Pinter Publishers, London.
- Grant RM., 1991, "The resource-based theory of competitive advantage", *California Management Review*, 33, 114-135.
- Guan, J., N. Ma, 2003, "Innovative capability and export performance of Chinese firms.", *Technovation*, 23(9), 737-747.
- Gulrajani M., 2006, "Technological Capabilities in Industrial Clusters: A Case Study of Textile Cluster in Northern India", *Science, Technology & Society* 11(1),

- Humphrey P., R. McAdam and J. Leckey, 2005, "Longitudinal evaluation of innovation implementation in SMEs", *European Journal of Innovation Management*, 8(3), 283-304
- Kim, W.C. and Mauborgne, R.,1999, "Strategy, value innovation, and the knowledge economy", *Sloan Management Review*, 40(39), Spring, 41-54.
- Lall, S., 1992, "Technological Capabilities and Industrialization," *World Development*, 20(2), 165-86.
- Lawless, M.J., R.J. Fisher, 1990, "Sources of durable competitive advantage in new products", *Journal of Product Innovation Management* 7(1),35-43.
- Marcelle, G.M.,2002, "Reconsidering Conventional Wisdom on Technology Transfer.", International Conference on Science, Technology and Innovation-Emerging International Policy Issues, Harvard University, Cambridge MA.
- McGrath RG, I. MacMillan, S. Venkataraman, 1995, "Defining and developing a competence: a strategic process paradigm", *Strategic Management Journal* 16(4), 251-275.
- Meyer-Stamer J., 1998, "Path dependence in regional development: persistence and change in three industrial clusters in Santa Catarina, Brazil", *World Development*, 26(8), 1495-1511.
- Morrison A., 2003, "Local Systems of Innovation in Developing Countries: Evidence from a Brazilian Furniture Cluster", Università del Piemonte Orientale , Novara
- Norusis, M., 1997, "SPSS Professional Statistics 7.5",Chicago, SPSS Inc.
- Papadopoulos I., 2005, "Historical Study on the structure and development of Furniture Sector", *Geotechnical Scientific Issues*, 18
- Papadopoulos I., G. Ntalos and K. Soutsas, 2005, "A Research Study On The Competitiveness And Response To The Changes Of The External Environment Of Thessalian Furniture Firms, As Elements Of Dynamic Marketing", *Geotechnical Scientific Issues*, 18
- Peteraf, M., 1993, "The cornerstones of competitive advantage:a resource-based view.", *Strategic Management Journal* 14 (3),179-191.
- Porter, M.E. and Stern, S., 1999, "The New Challenge to America's Prosperity: Findings from the Innovation Index", Council on Competitiveness, Washington, DC.
- Riedle, K.,1989, "Demand for R&D activities and trade-off between in-house and external research: a viewpoint from industry with reference to large companies and small and medium sized enterprises", *Technovation*, 9, 213-25.
- Roberts, Edward B., 1988, "Managing invention and innovation.", *Research and Technology Management* 31(1), 1-27.
- Rothwell, R., 1992, "Successful industrial innovation: critical factors for the 1990's.", *R&D Management* 223, 221-239.
- Soderquist K., J. Motwani, and J.J. Chanaron, 1997, " Managing innovation in French small and medium sized enterprises: an empirical study", *Benchmarking for Quality Management & Technology*, 4(4), 259-272
- Tidd, J., J. Bessant, and K. Pavitt,K., 2001, "Managing Innovation: Integrating Technological, Market and Organizational Change", Wiley, Bognor Regis.
- Tyabji, N, *Industrialization and Innovation: The Indian Experience*, 2000, Sage Publications, New Delhi.
- von Hippel, E., *The Sources of Innovation*, 1988, Oxford University Press, New York
- Yam R. C.M., J.C. Guan, K.F. Pun, E.P.Y. Tang, 2004, " An audit of technological innovation capabilities in Chinese firms: some empirical findings in Beijing, China", *Research Policy*, 33 1123-1140

APPENDIX

Figure 1: Results on Sales Performance

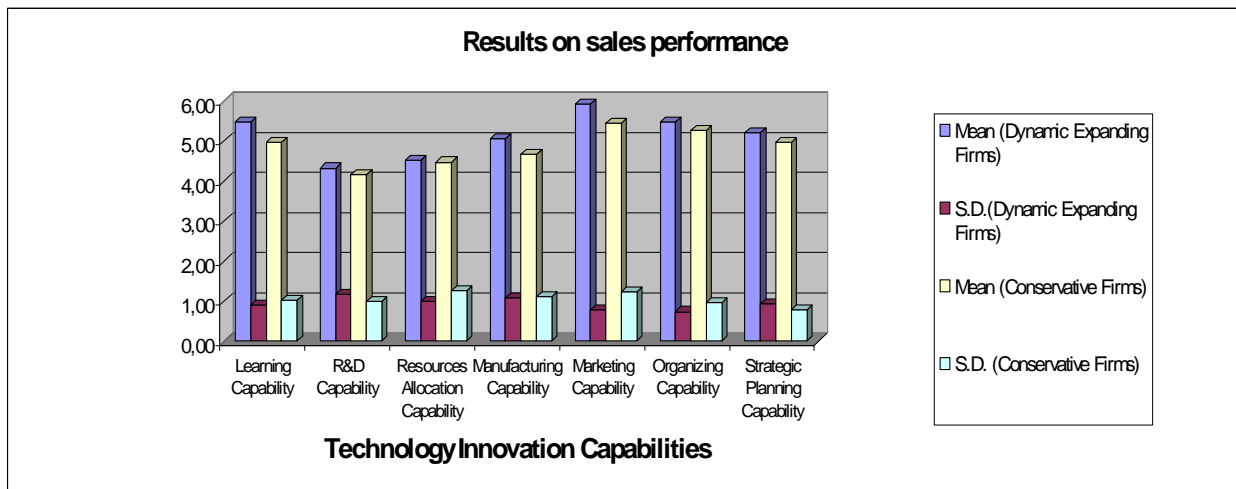


Figure 2: Results on Innovation Performance

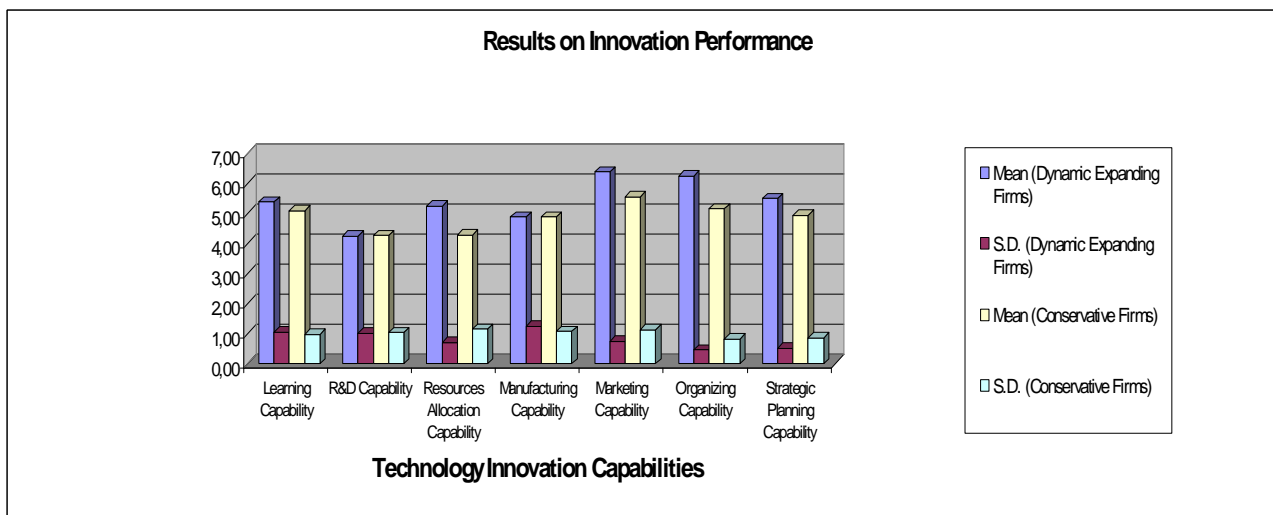


Figure 3: Results on Product Performance

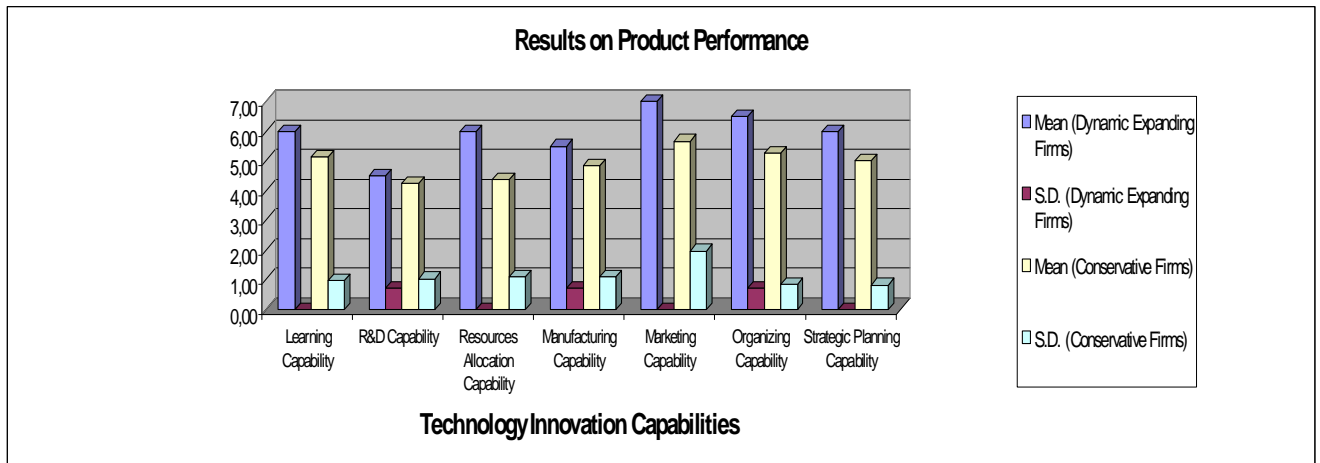


Table 1: Results on Sales Performance

Results on sales performance					
Technology Innovation Capabilities	Dynamic. Expanding Firms (N= 15)		Conservative Firms (N= 25)		t-Test
	Mean	S.D.	Mean	S.D.	
Learning Capability	5,47	0.915	4.96	1.020	-1.579
R&D Capability	4.33	1.175	4.16	0.987	-0.501
Resources Allocation Capability	4.53	0.990	4.48	1.262	-0.140
Manufacturing Capability	5.07	1.100	4.68	1.108	-1.072
Marketing Capability	5.93	0.799	5.44	1.227	-1.387
Organizing Capability	5.47	0.743	5.28	0.980	-0.635
Strategic Planning Capability	5.20	0.941	4.96	0.790	-0.866

*P<0.05

Table 2: Regression Analysis of TICs and Sales Performance

Results on sales performance					
Regression Variables	Mode 1 (N= 23)	Mode 2 (N=22)	ACTIVE	STEADY	Mode 3 (N=45)
Learning Capability	2.337	NO	0.913	0.894	0.317
R&D Capability	NO	NO	NO	NO	NO
Resources Allocation Capability	NO	NO	NO	NO	NO
Manufacturing Capability	NO	NO	NO	NO	NO
Marketing Capability	NO	0.934	NO	NO	NO
Organizing Capability	NO	NO	NO	NO	NO
Strategic Planning Capab.	NO	NO	NO	NO	NO
F	37.718	115.414	115.658	49.790	4.123
R	0.899	0.934	0.913	0.885	0.317
R2	0.807	0.872	0.834	0.781	0.100
Adjusted R2	0.786	0.864	0.827	0.765	0.076
Standard Error	1.703	1.823	1.598	2.395	2.054

NOTES : Mode 1:<10 employees, Mode 2 :10 -50 employees, Mode 3 = all firms, No = not significant, *P<0.05,

Table 3: Results on Innovation Performance

Results on innovation performance					
Technology Innovation Capabilities	Dynamic. Expanding Firms (N= 12)		Conservative Firms (N= 33)		t-Test
	Mean	S.D.	Mean	S.D.	
Learning Capability	5.38	1.061	5.09	0.980	-0.725
R&D Capability	4.25	1.035	4.27	1.039	-0.005
Resources Allocation Capability	5.25	0.707	4.30	1.159	-2.201
Manufacturing Capability	4.88	1.246	4.88	1.083	-0.009
Marketing Capability	6.38	0.744	5.55	1.148	-1.937
Organizing Capability	6.25	0.463	5.15	0.834	-3.573
Strategic Planning Capability	5.50	0.535	4.94	0.864	-1.746

*P<0.05

Table 4: Regression Analysis of TICs and Innovation Performance

Results on innovation performance					
<i>Regression Variables</i>	Mode 1 (N= 23)	Mode 2 (N=22)	ACTIVE	STEADY	Mode 3 (N=45)
<i>Learning Capability</i>	NO	NO	0.931	NO	NO
<i>R&D Capability</i>	NO	NO	NO	NO	NO
<i>Resources Allocation Cap.</i>	NO	NO	NO	NO	NO
<i>Manufacturing Capability</i>	NO	NO	NO	NO	NO
<i>Marketing Capability</i>	NO	NO	NO	NO	NO
<i>Organizing Capability</i>	NO	NO	NO	NO	NO
<i>Strategic Planning Capab.</i>	0.602	0.684	NO	1.942	0.462
<i>F</i>	88.537	119.588	56.240	39.751	10.290
<i>R</i>	0.907	0.932	0.931	0.927	0.462
<i>R2</i>	0.823	0.869	0.867	0.859	0.213
<i>Adjusted R2</i>	0.814	0.862	0.861	0.838	0.192
<i>Standard Error</i>	1.462	1.393	1.497	1.239	1.512

NOTES : Mode 1: <10 employees, Mode 2 :10 -50 employees, Mode 3 = all firms,
No = not significant, *P<0.05,

Table 5 : Results on Product Performance

Results on product performance					
<i>Technology Innovation Capabilities</i>	<i>Dynamic. Expanding Firms (N= 3)</i>		<i>Conservative Firms (N= 42)</i>		<i>t-Test</i>
	<i>Mean</i>	<i>S.D.</i>	<i>Mean</i>	<i>S.D.</i>	
<i>Learning Capability</i>	6.00	0.000	5.14	0.977	-1.227
<i>R&D Capability</i>	4.50	0.707	4.25	1.037	-0.319
<i>Resources Allocation Capability</i>	6.00	0.000	4.38	1.103	-2.052
<i>Manufacturing Capability</i>	5.50	0.707	4.83	1.102	-0.841
<i>Marketing Capability</i>	7.00	0.000	5.67	1.970	-1.700
<i>Organizing Capability</i>	6.50	0.707	5.26	0.857	-2.004
<i>Strategic Planning Capability</i>	6.00	0.000	5.00	0.826	-1.692

*P<0.05

Table 6: Regression Analysis of TICs and Sales Performance

Results on product performance					
Regression Variables	Mode 1 (N= 23)	Mode 2 (N=22)	ACTIVE	STEADY	Mode 3 (N=45)
<i>Learning Capability</i>	NO	NO	NO	NO	NO
<i>R&D Capability</i>	NO	NO	NO	NO	NO
<i>Resources Allocation Capability</i>	0.328	NO	NO	NO	0.291
<i>Manufacturing Capability</i>	NO	NO	NO	NO	NO
<i>Marketing Capability</i>	0.669	0.995	0.992	0.660	0.494
<i>Organizing Capability</i>	NO	NO	NO	0.342	NO
<i>Strategic Planning Capability</i>	NO	NO	NO	NO	NO
<i>F</i>	845.695	1704.327	1610.588	2025.330	28.576
<i>R</i>	0.993	0.995	0.992	0.998	0.688
<i>R2</i>	0.986	0.990	0.985	0.996	0.474
<i>Adjusted R2</i>	0.985	0.989	0.984	0.995	0.448
<i>Standard Error</i>	0.618	0.577	0.688	0.341	0.601

NOTES : Mode 1:<10 employees, Mode 2 : 10 -50 employees, Mode 3 = all firms,
No = not significant, *P<0.05,