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The Manufacturing Industry – Coping with Challenges

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Abstract

The perception of many people who live in the developed economies of Europe and America are often heard saying that the days of manufacturing are numbered in these countries and that China is the new “factory of the world”. This paper demonstrates how far from reality such a broad sweeping statement is. Manufacturing in developed economies is still flourishing and there is still scope to maintain and sometimes to bring back manufacturing to these parts of the world. Indeed, the landscape has changed; the types of industries, technologies, capabilities and manufacturing methodologies have been totally transformed over the years and now display high levels of sophistication. What has not changed is that the majority of companies around the world are still Small & Medium (SME) sized firms. The need for co-operation and collaboration has never been more needed than it is now as at individual firm level most SMEs do not possess all the resources and capabilities necessary to compete internationally.
New challenges have also emerged. Indeed, the newly developing nations such as China, India and Korea have demonstrated a fast catch up capability. Competition is now global, greatly assisted by the revolutions undertaken in the communications and transportation sectors. Companies have also gone global through distributed organizations. The paper reviews current literature regarding trends and challenges in manufacturing and will illustrate how competition has shifted towards intangible assets, the capability to outsource, to innovate and to invest in advanced technologies not only to bring costs down but to enhance quality, cope with mass customization and develop the capability to produce high value added sophisticated products. Supply chains also form a new frontier to achieve competitive advantage and an area where competencies are being built.

Malta is no exception. Being part of the European Union, and facing ever rising costs and global competition, manufacturing has shifted from low level labour intensive industries to more sophisticated, high technology companies within the pharmaceutical, electronics and medical products sectors among others. The total number of people employed in manufacturing has indeed reduced due to increased productivity of the manufacturing processes being deployed.

The challenges to develop manufacturing capabilities and competencies remain as they have always been; central to competitive advantage. The change that has taken place is that many new manufacturing competencies had not traditionally been viewed as part of the manufacturing paradigm. The scope of the competency base has grown. Manufacturing companies have taken advantage of the globalization of industries by sourcing and producing where the highest competitive advantages can be reaped.

Keywords: Competitiveness, Manufacturing Competence, Manufacturing Priorities, Intangible Assets, Innovation, Outsourcing, Supply Chain

1.0 Introduction

In most developed economies, manufacturing is accounting for a lesser proportion of a country's Gross Domestic Product (GDP) than it did in the past when issues such as; competing with low cost (wage) countries, outsourcing and the rise of economies like China and India were not mainstream components of the manufacturing landscape.

All considered, manufacturing remains an essential part of a country's economy and has a significant multiplier effect in areas such as transportation, finance, telecommunications and retail. As manufacturing has outsourced many back office functions such as accounting and logistics, these are no longer counted as part of manufacturing and hence today also contribute to the multiplier effect. In America, manufacturing generates the most economic activity per dollar of production. The United Kingdom (UK) has a vision to see its manufacturing sector as a globally competitive force and leading the way in higher value components of the value chain and high technology manufacturing. Contrary to common perceptions it is a fact that the manufacturing sector output in the United States (US) is growing. In 2008 it generated 1.64 trillion (11.5% of GDP) United States Dollars (USD) worth of goods, an increase of 22% over the previous 10 year period. It was predicted that Manufacturing output will surpass the overall economy in 2011 by showing a 5.5% growth as compared to 3.2% for the economy and the 2012 predictions state that manufacturing will grow by 4.6% whilst the economy will grow at 3%. (The Manufacturing Institute 2009) (IndustryWeek.com, 2011)

The largest industries in the US contributing to this growth are the: Chemicals, food, computers and electronics and fabricated metals. Germany also claims success in its manufacturing sector and this is derived from a number of factors, such as: a strong focus and national commitment on advanced technologies to a balanced mix of small, medium, and large enterprises which operate across a wide span of industrial sectors, creating regional innovation networks. There is also a strong commitment to preserve and encourage key industries (and the accompanying jobs) at home, even if parts of the manufacturing processes are moved overseas. The German economy is very heavily

export-oriented, accounting for one-third of national output. Its major exports are: motor vehicles, electrical devices, chemical products, machinery, and telecommunications technology. Its exports in 2011 reached €1057.6 billion averaging around €90 billion a month, with February 2012 still showing strong figures of €93 billion. (Trading Economics-German Exports n.d). Firm size, human capital intensity, physical capital intensity and Research and Development (R&D) intensity are the critical characteristics necessary to develop exporting capacity. Of these characteristics, human capital is considered to be the most critical. Hence, human capital intensity plays a central role in the determination of international competitiveness and the growth of industries and economies (Wagner 2010). In the UK, manufacturing output decreased by 0.8 per cent in February 2012, compared with February 2011, (Second Estimate of GDP Q4 2011, 2012) however manufacturing still accounts for 13% of GDP. The UK, already a global leader in exporting high tech products sees itself becoming a world leader in manufacturing solutions for a low carbon economy and wants to create at least a million jobs in this sector by 2030. (The Manufacturing Institute 2009), (Thomas A. et al. 2012)
So contrary to common perceptions, manufacturing in developed economies is not in decline. What has happened, is that the actual activity going on in this sector does not fit into the traditional image anymore of what manufacturing is. Successful firms have developed in unfamiliar territories such as; in-flight refueling systems, silicon design, Bluetooth technology, fuel cells, plastic electronics, or in sectors at the frontier of new technologies, such as information and communication, biotechnology, fuels and nanotechnology. The factory of the future in Europe will be worker-friendly, sustainable and competitive, customer driven, on-demand, life cycle oriented, networked, integrated, intelligent and adaptive.

Indeed competition from China is also growing. China ranked as the world's largest manufacturer in 2010. Its lower labour costs and economic growth have allowed it to attract the main share of Foreign Direct Investment (FDI). China's total manufacturing production expanded by 107.9% in real terms over the period 2005-2010. This amounts to US$10.2 trillion, more than double that of second-placed US (Euromonitor.com, 2012).

Access to large and growing markets still remains the main driving force behind FDI. Cheap labour has never been the main reason and a large share of FDI from developed high wage countries is still mainly targeted to similar countries.

Even Hong Kong manufacturers having taken strategic decisions to relocate their plants to China, to take advantage of its lower labor and land costs. However, it is a known fact that this decision on its own will not lead them to long-term competitive strength. Manufacturers must also strengthen product innovation, invest in advanced technological competencies through technology innovation and technology/management know-how transfer (Tummala et al., 2000).

At a macro level, the manufacturing industry will always be influenced by externalities such as; energy prices, taxes, regulation, and raw material prices, so trade policies must support growth by reducing trade barriers, tax regimes must be competitive and regulatory costs kept low for the sustained future of manufacturing in developed economies.

2.0 Key Challenges

The global economic crisis of 2008 had its fair share of an impact on manufacturing employment, however, in advanced economies and specific sectors where advanced manufacturing competences such as lean manufacturing, and advanced human resource skills are present, the impact was not severe.
An export orientation is critical to sustain the manufacturing sector and advanced economies fare best when producing products with high value added in areas such as; aerospace, semiconductors, pharmaceuticals and scientific instruments. China in 2008 was exporting 28% more than the US; a sharp difference to the year 2000 where the US was exporting three times more than China. In March 2012 China exported 165.7 billion USD and the US exported 181.2 billion USD in February 2012. The nations are now quite at par with each other. (Trading Economics –China Exports n.d.), (Trading Economics – Unites States Exports, n.d.)

The key challenges faced by manufacturing that have been highlighted in studies in the UK are[1]:

• Global value chains: Their increasing prevalence and complexity
• Technology: The accelerated growth rate
• Intangibles: The need to invest and develop them
• People and skills: The need to invest in them
• Low carbon economy: The need for companies to move in this direction

BERR (2008), (The Manufacturing Institute, 2009)

The above and other challenges have been confirmed by a more recent study by (Thomas, Byard & Evans, 2012) where nine key challenges have been identified:

1. Using new manufacturing technologies to develop new products
2. Manufacturing high value added products & services by developing human competencies
3. Utilising business intelligence and knowledge management systems
4. Care for the environment, with minimum damage to it
5. Transforming enterprise capabilities and supply chains rapidly
6. Creating innovative products, services and processes
7. Closer collaboration with Universities for enhanced R & D.
8. Developing new manufacturing management paradigms
9. Developing and enhancing digital networks and systems.

These new manufacturing challenges need to be addressed by redefining how firms achieve excellence in their sectors. Manufacturing firms will need not only need to build competencies in areas like; quality, reduction of lead time with Just-in-Time (JIT) for small lot production, utilization of cellular processes, rather than product lines, continuous improvement and programs for the elimination of waste. (Leachman et al., 2005). New competencies in areas like; involvement of employees, collaboration,

[1] BERR Economics Paper No. 2: 'Five Dynamics of Change in Global Manufacturing' – Underpinning Economic Analysis www.berr.gov.uk/fi les/fi le47663.pdf as cited in……. BERR (2008)

environmental, knowledge(intangible), services, networking with suppliers and customers, innovation and supply chain management will need to be developed

3.0 Small and Medium Enterprises

Small and Medium Enterprises (SME's) still dominate the manufacturing landscape with micro sized firms making up the largest proportion of manufacturing firms. Small companies do have their fair share of problems too, with export orientation being a main difficulty. However, they are learning to face their challenges as a response to the ever increasing pressures by the globalization process. In the US from 2001 to 2008 the number of firms reporting that they export more than 25% of their output rose from 3.8% to 12.8%. (The Manufacturing Institute 2009) These firms are now benefiting from global market opportunities. Government programs and policies aimed at increasing macro level national competitiveness are being achieved through the creation of favourable framework conditions of both a financial and non-financial nature for SME development. (Karaev et al., 2007) (Holban 2011). Nevertheless, SMEs must transform themselves and strive to increase their individual competitiveness. Also, in order to make up for the structural limitation of size, hence limited resources, in their strive to improve competitiveness and flexibility and to possess the capacity to change to meet new market needs they must create synergy by entering into cooperative relations and partnerships between themselves and partner institutions. Only in this way will they acquire the ability to offer a holistic customer oriented supply of complex products and services. Few SMEs can claim to have enough resources to structure their value chains independently. In effect, and at best, individually they can only realize sub-sequences of process chains. The new competitive framework is seeing more firms forging structured relationships and partnerships rather than trying to compete on their own and in this way compensating for missing competencies (Perez et al., 2006) (Muller et al., 2006).

3.0 Competitiveness

The competitiveness of a firm is a complex array of interdependent factors relating to its quality, innovation, efficiency, effectiveness of internal processes, customer satisfaction, employee satisfaction and empowerment and how these functions find their way into the products being made. (Rybakovas, 2009) It translates into the way a firm combines its resources and capabilities to be able to create and deliver value to its customers (Holban et al., 2011).

Firms should work upon identifying their core competencies and developing them in order to achieve sustainable competitive advantage. Core competencies are critical capabilities, usually unique in their characteristics if competitiveness is to be sustainable. They are much more critical in low technology, more traditional manufacturing firms than they are in high technology firms. (Agha et al., 2012) To be more competitive, manufacturing managers must be driver to develop strategies that will increase their knowledge and understanding of core competencies. (Gilgeous & Parveen, 2001). Some of the major competency gaps identified in SMEs are related to quality, just-in-time manufacturing, problem solving, teamwork, and lean manufacturing (Stier 2006); all key skills required to increase competitiveness in SME manufacturing firms.

Manufacturing is still to be considered as a very important factor for national competitiveness (Pitelis & Antonakis, 2003). Thus sends a clear signal to (developed economies) policy makers that deindustrialization will lead to competitive problems and therefore it is in the national interest to create conditions, institutions and mechanisms in support of manufacturing competitiveness. One of the least understood benefits of manufacturing is its close relation to R& D, innovation in design, product development, quality control and process improvements so reducing manufacturing output in an economy will have ripple effects in these areas. The US has recognized this and is taking great strides to attract manufacturing back to US shores. President Obama said *"When new technologies are developed and new industries are formed, I want them made right*

here in America. That's what we're fighting for." – President Obama, August 16, 2010 (Kota S, 2011). Every country must realize that if it wants to achieve the aspirations of its citizens, and enjoy a healthy economy, then manufacturing must be developed to reach a competitive edge. (Kaushal A. et al., 2011)

The economic transformations that have taken place over the past decade in Asia, specifically in China and India, have changed the nature of competition in international markets of manufactured products. These countries can offer a nearly unlimited supply of low-cost labor for the global market and an ever increasing growing number of highly skilled scientists and engineers. They have other competitive advantages such as location and investment incentives for manufacturing companies. As a result, the rest of the world is challenged especially in sectors that are labour intensive and therefore profit margins have been hit hard. This is not only a concern for industrialised countries but also for other developing economies. The competitiveness of the export manufacturing industry (EMI) in Central America, Mexico, and the Dominican Republic has been significantly eroded by increasing competition from Asian countries in the past decade (Perez & Hernandez, 2010). To remain competitive the apparel EMI has shifted toward niches that require rapid responses to changes in fashion or season, making geographical proximity to the U.S. work to their advantage, and toward full-package production, thereby vertically integrating more links of the value chain.

In sectors where labour costs remain a predominant competitive factor, firms must find new ways of competing. One of the industries under most competitive pressure in the European Union (EU) would be the textile-clothing sector. It faces intense international competitive pressure from exports of newly industrialized countries with China dominating in this respect.
EU textile factories in Spain, Greece and Italy are placing new emphasis on quality, customer service, supply chain, efficient management systems, knowledge management and production cost efficiencies (Bilatis et al.,2006). Other key elements to success will be the introduction of advanced technology, adaptability and differentiation.

In Lithuania the share of the wearing apparel industry has rapidly decreased from 9.1 to 2.8 percent of total manufacturing output, with manufacture of textiles reduced almost thrice, hence confirming the intense competitive challenge that this industry faces (Sabonienė, 2011),

The productivity performance of this industry varies drastically in various countries. Despite the low cost advantage of newly developing economies like India, productivity improvement of the Indian textile industry has not improved and could nullify its labour cost advantage (Bheda et al., 2006). This highlights the all too critical prerogative for manufacturing companies to always seek ways to improve productivity as advantages gained though these measures could easily compensate for other structural disadvantages. In order for firms to engage in productivity improvements three critical success factors are necessary; the investment and deployment of technology, quality systems and the technical capability of the workforce; areas still highly lacking in the Indian scenario. Even in Iran, despite having access to raw material, and high demand for synthetic fiber, competitiveness is low due to lack of training, poor development of expertise, long lead time on spare parts, and a general lack of strategic direction within the industry (Shafaei 2009).

Competitiveness of Canadian and Australian manufacturing plant is being accounted for by the following emerging patterns of operation (Gordon et al., 2001):

- The restructuring of operations;
- The application of innovation within the infrastructure;
- The switch and upgrade towards advanced technologies;
- The forging of vertical integration-partnerships;
- The due attention given to time and flexibility;
- Ensuring that labor-management cooperation is present; and
- The development of a high performance culture.

Many of the above factors are in line with the key challenges identified in the previous section, thus illustrating that many manufacturers have realised their importance and are doing something about them.

Even FDI's in China report that they are enhancing internal cost control systems, improving productivity, implementing lean manufacturing, applying energy saving measures and switching to alternative, low-cost raw materials as measures for enhanced competitiveness. (Booz & Co. 2010).

Manufacturers must also be technology leaders. This leads to improved and new product and process development and maintains the sectors competitiveness. The industries where there will be investments in advanced technologies will play an important part in the functioning and development of a nation's economy.
In order to upgrade technologically, firms must display more-advanced technological capabilities which will be manifested in the way they develop new products or processes and the way they engage in knowledge intensive activities (Perez & Hernandez, 2010). When investments are not made, high tech manufacturing will not develop and competitiveness will diminish. This in the case of Lithuania, where the manufacturing industry is mainly composed of low-technology and medium-low-technology industries. Medium to high technology industries have been noted to be in decline due to lack of investment (Sabonienė, 2011).

Therefore it is clear that in order to maintain competitiveness in advanced manufacturing technologies, companies must invest heavily. Investment decisions made in UK manufacturing firms have primarily been made to improve competitive advantage and secondly to reduce costs (Burcher & Lee, 2000) so strategically these kinds of investments will also result in improved competitiveness as they have been formulated by the broader business strategy but affected through a manufacturing strategy. In other words, they have been market-driven in their investments, rather than technology-driven. Post investment appraisals showed that some of the most observed benefits were rather intangible such as; enhanced image and improved attitudes, apart from observing improvements in areas such as quality, cost, delivery lead time, delivery reliability, product features, flexibility, volume variability, innovativeness and service to customers.

The importance of quality in relation to manufacturing competitiveness cannot be more emphasized. Quality, from among criteria such as; know-how, flexibility, delivery, quality, customer focus and costs, which are all part of the hierarchy model of competitiveness priorities of manufacturing strategy emerges is the most important strategy to maintain a leading position (Si et al., 2009) (Takala et al., 2007). Know-how and customer focus also rank high in this heierarchy. This is in concordance with the fact that high tech companies use skilled technicians, who can improve the creative ability and manufacturing quality of the company. The costs, delivery and flexibility could be considered as secondary factors in the operational strategy. These lower important factors indicate that cost is not the key factor of the operational strategy and should therefore not be the central focus for enhanced competitiveness.

Manufacturing competitiveness is driven by many factors but as pointed out by (Deloitte & Touche,2010) one of the major components is having talented people that drive innovation. Therefore having and developing skilled employees specifically; engineers, researchers and scientists will be the top driver towards competitiveness. As always, the external and regulatory environment will play a major part in overall competitiveness. Manufacturers cannot do it all alone. They depend on Governments playing their part by developing national manufacturing policies and strategies that are collaborative, integrated, focused, and effective.

The international competitiveness of the French Manufacturing industry has long became less reliant on cost advantages or pricing and changed its emphasis towards areas like; innovation, the capability to absorb and transfer new technologies, quality, on-time delivery, services to support manufacturing, flexibility and adaptability to changing global economic conditions (Agenor P.R. 1997)

The Government of Japan has realized its role in improving manufacturing competitiveness and its policy direction is clear and well funded. It has closely linked its science and technology (S&T) strategic direction with its manufacturing competitiveness strateg.. These areas are well coordinated and organized (Corwin J., Puckett R. 2009).

In Thailand too, even back in 2000, the government started intervening to enhance manufacturing competitiveness by initiating a number of collaborative programmes with

international and bilateral agencies such as The World Bank, Japan Export & Trade Organisation (JETRO), and The Asian Development Bank. (Dhanani S, & Scholtès P., 2002).

5.0 Manufacturing Strategy, Capabilities and Competencies

5.1 Manufacturing Strategy & Capabilities

Manufacturing enterprises are not exempt from needing a clear corporate strategy which should define organisational objectives, and methods on how to achieve such goals in order to compete effectively in local, regional and global markets. The achievement of the organisational objectives is realised through: the deployment of strategic decisions and the alignment of resources with the strategy (Pun, 2005).

Manufacturing strategy has its pillars deeply founded around the "structure" and "infrastructure" of the firms' operations. They are the "hard" and "soft" aspects of operations. The structure mainly focuses on the fixed investment parts like technology, process design, facilities; parts of the strategy that are difficult to change without additional large investment. (Hill, 2005) On the other hand infrastructure decisions are focused on organisational and human dimensions, sourcing and supply chain management practices, quality management and knowledge. (Skinner 1969, Hayes and Wheelwright 1984). Manufacturing strategy is also about making decisions such as lean manufacturing, mass customization or agile manufacturing (Henriksen and Rolstada, 2010).

If manufacturing strategic objectives are linked to and enhance factors valued by customers they will have a positive effect on business performance and competitiveness. When this linkage is missing then business performance is highly unlikely to improve. Senior managers must ensure that competitive advantage is achieved through manufacturing by developing a manufacturing strategy that leverages the firm's capabilities in order to fulfill market needs in co-ordination with the business strategy.

It has long been established that distinctive manufacturing competences are essential assets for manufacturing companies to obtain competitive advantage. With the advent of outsourcing and the global distribution of manufacturing processes, competences too have been dispersed across national boundaries with a major challenge now being the integration of the management of these competences. Global integration is mainly achieved through centralization, formalization, information and people (Kim & Park, 2000).

This is the reason why it is so important to ensure that manufacturing is not relegated to a tactical division within the firm devoid of any strategic significance. On the contrary the production function should be integrated into the strategic planning process of the overall business strategy. Production managers should actively participate in the strategic planning process; and ensure that the business strategy is properly communicated to production workers; that they allocate the appropriate level of technical and human resources to the production function; and establish training and incentive schemes aimed at achieving the manufacturing objectives and overall business objectives (Avella & Bustelo, 2010). Management will enhance their firm competitiveness by adopting a broad set of manufacturing practices which may be linked to their competitive priorities, realizing that people are essential components to organizational success and hence building and developing them, and ensuring that clear processes are built within the firm.

5.2 **Competitive priorities**

The deployment of a manufacturing strategy will help achieve business success when strategy in this area is consistent with the business and corporate strategies. Business competiveness will improve once manufacturing capabilities are coordinated with competitive priorities (derived from the business strategy and reflecting the market needs). The firm must determine what its manufacturing competitive priorities are, and where it stands on these aspects relative to its major competitors. A firm's competitive priorities act as the link between business strategy and the manufacturing objectives. (Si et al, 2009). Four widely accepted competitive priorities are cost, delivery, quality and flexibility. (Yang et al., 2011), also propose the inclusion of transformational leadership and technology level to the list. Competitive priorities might also be used as measures of

competitiveness (external) and competence (internal) (Singh et al., 2008). A study on competitive priorities of Thai manufacturing companies by (Phusavat & Kanchana, 2007) lists six key factors; quality, know-how, customer focus, delivery, cost, flexibility and with the first three being the most important to maintain competitiveness. These results are consistent with (Takala et al., 2007).

While alignment of the manufacturing function with strategic priorities is core to competitiveness, the continuous improvement of the manufacturing function plays a very important complimentary role in the quest of competitiveness in the long run. In order to sustain or improve manufacturing strength, the firm needs to understand what critical manufacturing practices determine superior manufacturing. Three key practices are identified and hypothesized as determinants of superior manufacturing. The practices are R&D commitment, time compression during production, and degree of outsourcing (Leachman et al., 2005). The introduction of outsourcing as a key capability has entered the literature more recently. Successful companies enjoying superior performance and enhanced competitiveness all tend to concur that a number of key manufacturing practices that are essential in any industry focused around the following:

- Total quality management;
- Continuous improvement;
- Employee involvement;
- Just-in-time;
- Benchmarking;
- Time based competition;
- Concurrent engineering;
- Mass customisation;
- Process re-engineering;
- Supply chain management; and
- Team work.

5.3 Production Competence

Production Competence is defined as "the fit between manufacturing competitive priorities and manufacturing capabilities" whose dimensions are closely linked to; cost competence, flexibility competence, quality competence, delivery competence, and environmental protection competence (Avella & Bustelo, 2010). The first four factors bear various similarities to (Singh et al, 2008) and (Phusavat & Kanchana, 2007), however the last dimension, Environmental competence, relates to a more recent trend in environmental awareness, which is also being translated into a manufacturing competence. The theory on competencies has evolved to include dynamic environments which reflect the firm's capability to develop new competences such as Marketing and R & D. Others insist that product innovation, human resources, and marketing are part of a manufacturing firms set of competencies (Li 2000). These new competences are possible due to the fact that the firm has an enhanced infrastructure and can engage in explorative organizational learning. Hence according to dynamic capability theory, some firms are better able than others at altering their resource base by adding, reconfiguring, and deleting resources or competences (Danneels, 2008) (Lewis 2003).

5.4 Firm Performance & Capabilities

The three main theories that govern and link firm performance (and hence competitiveness), to capabilities have been regularly cited in the literature. The Trade – off theory suggested by Skinner (1969,1974) has been advocated by (Porter 1980, 1985, Hayes and Wheelwright 1984, Hill 1995) and more recently by (Sarmiento et al, 2010). Its main tenet is that no manufacturing firm can perform equally well along all factors leading to manufacturing competitiveness such as quality, cost, delivery speed, flexibility, and time. Resources must also be aligned to the operational and business strategy.

The cumulative capability model was suggested by (Ferdows & de Meyer 1990). This model is still cited (Fynes et al. 2000 & Flynn and Flynn 2004).and suggests that if an organization develops a path along which it will focus its improvements it may overcome the trade-off limitations. This is also known as the sand cone model where a firm focuses

on quality, flexibility, speed (delivery), and cost efficiency, respectively. More recent literature (Avella et al., 2011) also suggest the introduction of environmental protection as a new and emerging capabilities which is closely linked with the traditional four dimensions and (Yang et al., 2011 suggest the introduction of Transformational Leadership and Technology level. Innovation and service, which could also be included in the key list of capabilities, are sometimes considered embedded within flexibility and quality. Over time more capabilities are being considered as essential tools for manufacturing firms to focus upon in order to address new challenges.

The third model, the Rigid-flexibility model was first suggested by Collins and Schmenner (1993). Instead of focusing on a predetermined path to avoid trade-offs a firm needs to develop "discipline" and "simplicity" in all its processes and procedures

The latter two models tend to overlap on a number of aspects and both suggest that firms should focus on quality programs, supplier involvement, just-in-time (JIT) production, workforce commitment and involvement.

There is no doubt that in order to remain in business and develop competitive capabilities, companies must develop a solid set of manufacturing capabilities, which must be aligned with their manufacturing strategy and at a higher level to their corporate competitive strategy. Companies must be prepared to invest in developing and building these capabilities. The whole corporate infrastructure must be designed to enhance innovation and growth. People cannot be left out of this equation. In this era of human capital, employees' activities must be aligned to corporate strategy. (Booz & Co. 2010).

6.0 Innovation

The US accounts for 40% of investment in all research and development (R&D) in the industrial world. In 2011, this was close to 400 Billion USD. The US spends almost twice as much as the EU. The capability to bring new products to market is a major contributor to competitiveness in a complex global business environment. Emerging nations are also are working hard to significantly boost their innovation capability with China and South

Korea's share of patent registrations rising rapidly. China has increased R&D investment by 10% annually over the last 10 years. It invested close to $150 billion in 2011, passing Japan's $140 billion. (thebreakthrough.org 2011) Innovation however does not only stem from the amount of investment in R&D. Other contributing factors, and here, the US has a significant advantage, are: the scientific output from academic institutions and capital investment and growth in the scientific and engineering workforce. German manufacturers have strategic advantages in R & D. Their close links with universities, poses the cornerstone of this success. The country is also a leader in new technologies, in areas such as renewable energy. (Fingletom 2010)

The EU is slowly advancing towards its 3 % R&D target - but there is a widening gap between the EU and its world competitors notably due to weaker business R&D investment (European Commission 2011). The European Commission's vision for manufacturing in 2020 is that European industry needs to *"increasingly concentrate its capabilities on high-added value products and technologies offering a broadened service range that fulfils worldwide customer requirements"*
With most manufacturing firm classified as SME's and operating in niche markets, it is important to understand what challenges they face when compared to large international firms in the innovation process, which is becoming one of the most important competitive weapons for advanced economies. Increased internationalization has allowed a number of SMEs to participate in the global markets where innovation is a pre-requisite for survival. The innovation process stretches beyond the technical capability, it is also a managerial and people dimension. Innovation can be viewed as a two phased approach with an entrepreneurial approach required for product innovation but a managed innovation phase required for cost efficiencies by process improvement methods. (Humphreys et al., 2005) state that the innovation process is dependant on leadership, culture, empowerment, technology, management, learning and structure. (Terziovski, 2010) found that the development of an innovation strategy and formal structures within an SME manufacturing firm are positive and significant predictors of performance. SMEs deal with unique size limitations and lack adequate resources to dedicate to the innovation process. A study on Australian SMEs carried out by (Sawang S., Matthews J., 2010),

highlights the importance for SMEs to form collaborative networks to overcome their small size limitations. He found that firms that use collaboration strategies with external networks like suppliers or business partners reported higher new product introduction capabilities. This finding also supports the notion that innovative firms manage their innovation through managing knowledge and information flows as sources of innovation and market knowledge, which together may be components of broader dynamic capabilities of the firm. Other studies revealed a positive correlation between innovation and collaboration with customers, competitors, consultant or universities (Kaufmann & Tödtling, 2001; Souitaris, 2002)

A study by (Kontic, 2011) on Serbian manufacturing SMEs revealed that the main obstacles to innovation are cost and knowledge factors. A lack of internal funds also appears to be a critical factor in hampering an innovation process and this is closely followed by the lack of financing from outside sources. The lack of qualified personnel is also a major barrier to innovation in the group of knowledge factors. Low labor skill level is the main constraint to innovation activities. As innovation is closely linked to production capabilities (Andersen,2006) hints that just as many production capabilities have been outsourced to low cost emerging economies, innovation will follow and this will impact on firm and nation competitiveness.

Firms willing to innovate could face a number of impediments, many of which are external to the firm. (Shiang & Nagaraj, 2011) in their study on Malaysian manufacturing firms propose nine major impediments that can serve as blockers to firms going down the path to innovation. These are:

(1) COST - Innovation costs are too high
(2) RISK -Excessive perceived economic risks
(3) FINANCE - Lack of appropriate sources of finance
(4) CUSTOMER RESPONSE - Lack of customer responsiveness to new products
(5) INFOMANTION (MRKT) - Lack of information on market
(6) INFORMATION (TECH) - Lack of information on technology
(7) SKILL - Lack of skilled personnel
(8) REGULATION - Insufficient flexibility of regulations and standards
(9) ORGANISATION (RIGID) - Organizational rigidities within company

As can be seen above not only must a firm overcome its own internal weaknesses to become an innovator but is also dependent of the right external environmental factors.

Innovation is related to the acquisition of new knowledge, through investments in research and the capability to apply this knowledge to develop new products and services that satisfy know or yet unknown needs and wants in the marketplace. Investments in R & D are essential tools within a firm's competitive strategy. (Mobillo, Sanz & Gaite 2006). Where innovation capability is missing, countries will loose industries as they will stagnate and push themselves out of the competitive race. For companies and industries to remain competitive in today's global market investing in innovation capability is a must. This can only be realized when companies have:

- Access to capital
- Tools and resources such as skilled workers, quality programs, flexible manufacturing, cost reduction and timing capabilities.
- External networks and collaborative capabilities
- Friendly government regulations and tax regimes.

Innovative manufacturing firms face multiple challenges such as: ever changing customer demands, cost of labour, changing manufacturing techniques, changing regulations and fierce competition on cost, time and quality.
At European Union level, much is being done to enhance Research & Innovation (R & I) across the EU. However, despite the EU's R&I competitiveness remaining strong, there is no denying that the world's centre of gravity for research and technological activity is shifting towards Asia, which seems well on track to becoming the centre for science and technology by 2020. (EU Commission 2011)

7.0 Intangible Assets

Intellectual capital, also know as intangible assets are now recognized as important assets across a broad business spectrum and manufacturing is no different. Intangibles are a solid foundation on which market performance and profitability can be linked to and are strongly guarded by leading corporations (Lin & Tang 2008).

Manufacturing companies are making a move towards becoming more “product - service providers” rather than simply product manufacturers and in doing so are incorporating knowledge based competencies manifested in their move towards developing service related capabilities.

Companies are thus moving towards a “servitization” model of operation. This suggests that companies need to move away from just selling products and to move towards the development and selling of integrated products and associated services which add value. This hybrid offering offers manufacturers new opportunities. (Ulaga & Reinartz 2001). The implication here is that manufacturing is moving towards becoming a node in the complex network of suppliers, customers, engineering and other services, where the customer is more involved in the design of products. In the new economy, asset portfolios have become much more diversified than in traditional organizations and the emphasis has shifted to intangible assets such as leadership, intellectual property, relationships, networks, knowledge, brands, the knowledge of flexible and high-quality production processes, employee talent, customer loyalty, reliable suppliers, efficient distribution networks and systems (Hernandez & Noruzi 2010) . These assets must be located where they will be most strategically effective and serve as sources of added value. (Walters & Buckman 2001) Human Capital, (the ability, knowledge and talent of the individual employees) is generally considered one of the most important intangible assets that an organization must build as it is the source of creativity in today’s knowledge economy. There is further good reason for the importance of human capital, as success now requires personnel who have what it takes to blend their mastery of technology with rapid but sound decision making. This asset is demonstrated by employee know-how, technical expertise, problem-solving capability, attitude and entrepreneurial spirit. Investments in intellectual assets are key strategic elements to maintain a business’ growth, profitability and competitiveness and clearly tallies with one of manufacturing’s main challenges, that of developing its human competencies. (St.Pierre, Audet, 2011)

Whilst technology has created new processes and enhanced efficiency; skilled workers are in demand in large numbers, and less-skilled job seekers land fewer employment opportunities in areas such as assembly, logistics, maintenance, and production support. Many growing manufacturing organizations are demonstrating a greater need for workers

with teamwork, decision making, technology, communication, and customer service skills then ever before. (Handler et al., 2009)

Relationship assets are also a critical dimension of the intangible asset portfolio of modern organisations. This can take the form of alliance agreements, contracts, distribution agreements, customer loyalty and brand image.

The third major component of intangible assets can be classified as structural assets. These take the form of patents, copyright, trade names, brands, designs, trade secrets, organization culture, distribution networks, processes and virtual networks. (Marr 2005)

Competitiveness for modern manufacturers will be a function of the interdependence and interrelation of traditional assets together with the added set of intangible assets. These intangibles are resources that are not available on the market and which would take time and money to develop internally but making them difficult to imitate (Perez et al.,2006). It will be the prerogative of the leaders of organizations to strategically combine these sets of assets in ways that will generate added-value and uniqueness to derive market place competitive advantage.

Manufacturers must therefore take a fresh look at their stock of resources that they are leveraging to create value. The new dynamics of value creating require the intelligent combination of both traditional (tangible) and the more intangible resources. The knowledge and capability of management to understand the need to build this vast spectrum of resources will translate into new manufacturing competencies being developed to be leveraged for enhanced competitive advantage.

8.0 Global Supply Chains

Competitiveness of supply chains is gaining tremendous importance when considering the global challenges faced by manufacturers due to the global location of production of intermediate products, such as parts and components. In essence manufacturing has become globally fragmented and therefore the supplier – customer relationship has taken on a new dimension. Supply Chains are the new frontier of competitive advantage. It is not just anymore about the products sold, but also about the way in which companies

manage their flows in their supply chains. Companies need to understand their product and demand characteristics as these will influence supply chain priorities in areas such as flexibility and responsiveness, in managerial decision making. Companies must have access to highly integrated supply networks and logistics capabilities to compete in today's global economy. Efficient logistics support will reduce transportation cost and lead time (Zhang & Huang 2009). The capability to deploy efficient supply chain management practices is being considered as a core operational competence, where the definition of operational competencies has been extended to include the ability of a firm to control costs, quality, flexibility, deliveries and service (Halley and Beaulieu, 2009).

The integration of the main actors in supply chains, namely; suppliers, manufacturers, distributors, retailers and customers has become a necessary activity. The rapid growth of information technology has made the concept of global optimization of supply chains a reality with more transparency of information flows reducing bullwhip effects and reduced pipeline inventories (Verma A. and Seth N., 2011). A customer orientation approach together with enhanced cooperation, coordination, collaboration agility, supply chain flow cycles, supply chain synergy, flexibility, intra and inter-organizational information flows are essential to create satisfaction to customers and are must-haves for supply chain competitiveness (Verma and Seth, 2010).

Supply chain solutions must be designed with the aid of highly skilled employees engaged in knowledge-intensive and complex activities. Modern supply chains are not to be confused with the traditional concept of "box moving". They have now developed to a point where they are designed to offer customer solutions. A study in Ireland showed that small indigenous companies still need to develop supply chain management skills. They are now engaged within the network of the external supply chains of larger multinational companies and therefore Supply Chain Management (SCM) integration has still a lot of potential, in particular for Irish-owned SMEs if they want to enhance their competitiveness (Huber & Sweeney 2007)

A study by (Nair 2005) has also shown that techniques such as manufacturing postponement and centralized distribution have positive effects on firm performance. These policies reduce costs and offer the possibility to deliver products in the most cost-

effective manner. Companies can reduce their investment in inventory and improve responsiveness. To be effective however, these techniques depend on a well designed and functioning supply chain structure and therefore only applicable to firms that have mastered their supply chain effectiveness

Advances in technology, offering companies platforms for collaboration and virtualization solutions, enable them to extend their reach to global locations, as well as being the catalyst to build partnerships within supply chains. Partners can then play a more integral role in the way they assist in areas such as product and service development as well as marketing. Through the network, businesses can respond more rapidly to opportunities as they build on their collaboration capabilities, establish and maintain strong relationships, and accelerate decision making, complex project execution, and facilitate innovation. (Cisco 2009)

There is no doubt that SCM has become the new dimension for competitive strategy. Information technology and communication have direct influences on the success of using SCM competitively and effectively. The forging of relationships with partners in the "Supplier-Customer" chain has seen organizations achieve benefits in the form of reduced costs, serviceability and enhanced profitability (Verma & Seth 2011). Competitiveness through SCM cannot be achieved through the sole efforts of a single organization. The different players within the chain have to be competitive enough themselves, so that the combined synergistic competitiveness can be achieved, hence the reasons why cooperation and coordination are central in achieving this (Verma & Seth 2010). In its very nature SCM remains an area that poses many challenges; conflicting objectives of the players, design, collaboration, information sharing and inventory. The winners will be those organizations that manage to create added value for their customers through techniques like collaborative planning, forecasting, and replenishment. (World Scientific Publishing_____)

9.0 Outsourcing

9.1 Outsourcing Advantages & Challenges

With pressures to cut costs, manufacturing companies in developed economies are attracted by the lower cost structures in labour, overheads and infrastructure in Asia and Eastern Europe. To make things easier, trade liberalization, lower transport and telecommunication costs have further encouraged the move. Also, the entry of many eastern European nations into the EU and the entry of China into the World Trade Organisation (WTO) and their subsequent growing markets are also critical reasons to relocate.

However, when manufacturing companies take decisions to outsource they could be making mistakes without even realizing it. When manufacturing is only viewed as a cost center, there is going to be little concern about the impact that outsourcing or off shoring will have on the capacity to innovate. The main problem lies in the fact that few executives consider manufacturing to be part of a company's innovation system at all. Two things need to be considered in this regard: (1) the ability of R&D and manufacturing to operate independently of each other, or their modularity; and (2) the maturity of the manufacturing technology *(*Pisano & Shih, 2012). When these issues are part of the decision making process then outsourcing could provide tremendous competitive advantages.

The increased modularity of manufacturing and development resources has created new practices for activity coordination and co-alignment, which generate global activity coordination and configuration through an outsourcing strategy. The strongest responses for increasing outsourcing emerged from manufacturers of semiconductor equipment, consumer products, auto parts and telecom equipment (Weber 2002). Outsourcing is no easy task. It requires expertise on a number of fronts; mainly: Developing a clear strategy and business case; and managing the transfer with professional project management; assuring highest product expertise through know-how transfer and managing local cultural differences. Another difficulty in outsourcing is the fact that many companies

still utilise enterprise and planning systems that were built and implemented for a very different supply chain model. Where today, an issue like visibility of quality, quantity, and timeliness of what is being produced is critical, their systems make this very hard to achieve. Today companies want to enjoy this real time confidence because ultimately they are the ones who will be facing customers if promises are not kept. It is not sufficient anymore to rely on penalties for contract manufacturers if they fail to deliver.(Supply Chain Digest 2008)

Lean manufacturing and supply chain expertise are standard practices when doing business in developed countries, but these techniques could be new to many low-cost countries. It is also necessary to run processes efficiently even in such low cost countries, so practices such as lean processes, pull planning, kanbans, and Six Sigma quality should be implemented once the new production facility is operational. These techniques should be supported with training and development for the local team. (Gross, Laurence, Toth & Vasak 2006) Manufacturers found that a more collaborative approach to outsourcing arrangements, and hence the dependence on a "relationship" intangible asset, will improve their planning accuracy and capability to respond quickly to changing markets. By outsourcing manufacturing and some of their "upstream" supply chain activities, Original Equipment manufacturers (OEMs) could free themselves to focus on their core competencies, tighten planning processes, and be more responsive to customer demand. Many manufacturers want to focus on what they are good at, such as product design, product development, and sales and marketing. Differences in today's outsourcing arrangements as compared to more traditional ones are: The level of shared strategic risk. Partners now must work together to achieve strategic outcomes. Another is performance measurement, which is no longer just dependent on cost savings, but also by revenue, earnings per share and market share. Finally, today's outsourcing arrangements are highly dependent upon tight linkages between partners. The strength of this relationship creates a "logical enterprise"; one in which all trading partners in the supply chain are virtually synchronized thus becoming a critical success factor (Delattre, Hess and Chieh 2003).

9.2 Contract manufacturing

The contract manufacturing (CM) industry has evolved in the last decade. It is now providing services for almost every aspect of the manufacturing supply chain. Today, the ultimate goal of a CM vendor is to become a critical partner of a branded system vendor. CM offers a number of benefits to OEMs, and has become an integral partner in the product development cycle. As CM's develop their manufacturing competencies, they add expertise in areas such as front-end design, full system assembly, repair and warranty service, logistics, improved efficiency, cost reductions, enhanced quality, flexibility, advanced production technology, additional capacity, faster time to market and responsiveness. CM has now become a complete solution. For outsourcing to be effective, manufacturers must be willing to give up aspects of control over their production and in return benefit from a chance to reduce their financial risks and get time-sensitive products to market faster. As product lifecycles get shorter building proprietary assembly lines becomes less practical (Weber 2002). CM's have their challenges too as they face rising costs in areas like labor, materials management, engineering and hardware. CM's too, have started to realize that in order to reap more value they must also develop their own brands and learning from collaborative relationships is allowing this to happen. Many CM's obtain advanced techniques of product design from their customers who have lead product techniques and available market information. Not only do CM's leverage their capabilities but are now learning new ones. Therefore, many CM's build their product design and development competence by learning and imitating their customers (Liu et al, 2008). When this happens, the relationship with their clients could take on a competitive nature. A concentrated client structure is the main constraint for CM's that decide to launch their own brand products (Liu et al., (2011). CM's have their fair share of constraints too, they face the added challenge of not having full control over the design process with many decisions already made by their customers (Kumar & Wellbrock 2003)

Outsourcing still remains very debatable with some manufacturers still convinced that internal production is also crucial to their survival. They question whether contract

manufacturing is a hindrance or a competitive advantage. Without factories of their own, they cannot differentiate their products and end up losing competitive power in the long term.

9.3 Subsidiaries

When multinational organizations use the subsidiary model instead of CM, connections with customers, suppliers, research institutes and other agents can be important network resources for the development of subsidiary competences. The corporate network remains a prime source of knowledge and competence for most subsidiaries who receive the up-to-date technology, as well as other knowledge, from the corporate headquarters. They actively exchange this knowledge and tacit skills with the peer subsidiaries and other units in the corporate network. (Filippov & Duysters, 2011) identified nine corporate functions that could be undertaken in subsidiaries. These are: (1) basic and fundamental research, (2) product development, (3) manufacturing of goods, (4) assembly, (5) marketing, (6) sales and after sales, (7) distribution, (8) logistics and (9) purchasing and procurement. In a study carried out among foreign-owned electronics manufacturing companies in the Czech Republic, Hungary and Poland the five main sources of competence building were found to be (1) The corporate Headquarters (2) Other subsidiaries in the network (3) Supplier, customer or competitor on the local network (4) A customer, supplier or competitor abroad (5) A University or Research centre in the host country.

For subsidiaries to turn into successful vehicles in the parent-subsidiary relationship it is important to define and understand what subsidiaries can offer to corporations rather than what corporations need from them. Local input is critically important for corporate strategy. The localization process must be properly planned if subsidiaries are to succeed in foreign markets. (Salgado 2011)

Outsourcing is a challenge to get right and is a process that requires expertise with issues facing both sides of the relationship. Management need to strategically work out what technologies they will employ to build the relationship, quality must be clearly defined,

pricing issues must leave both partners profitable. Outsourcing partners must display capabilities to be agile in their operations as they will face lead-time constraints. Aspects of control and transparency need to be clear and the sourcing of creativity and innovation should be encouraged. Technology transfer will also remain a critical challenge (Dibon 2009)

10. Supplementary note on Malta

Overall, the small size of the Maltese islands being separated into multiple islands and the distance between the islands generates time lags, higher costs for production and market access. So, Malta starts off with a geographic disadvantage in comparison to its European counterparts. Malta's manufacturing sector has long been in a state of transition but is definitely not going away as it is still a necessary pillar for the economy. The change started twenty years ago and is still on the path of moving away from a labour intensive to a value-added one with the vision of becoming a centre of manufacturing excellence in the Mediterranean. This change was and still is necessary as all protective levies were removed when Malta joined the EU and in the face of global competition Malta needs to compete with Eastern European countries and emerging economies too (Country Watch 2010), (NSRF-2006). The results of the transformation may be seen by the decrease in the textile sub sector and on the other hand the number of new firms operating high value added manufacturing such as pharmaceuticals, precision engineering, medical devices and electronics (Jones 2008). In 2011 there were 2.890 manufacturing and distribution companies, which employed 15% of the gainfully occupied and the sector contributed 14% of the island's GDP. Malta's manufacturing enterprise base, is no different from its mainland neighbours and predominantly consists of locally-owned SMEs operating alongside a small number of relatively large foreign owned export-oriented subsidiaries of multinational companies. (Operational Programme I, 2007) To battle the world financial and economic crisis of 2008, the government of Malta assisted industry with support packages and in this way workers were not laid off. Companies are now expanding in the pharmaceutical, cosmetic packaging and advanced plastic toys sectors and new FDI is still coming Malta's way (Central Bank of Malta 2011). There

were 12 new applications in 2009, mainly in the medical devices, printing, electronics, machinery and pharmaceutical sectors. Malta's valuable assets are its top-quality manpower, high productivity, dependability, low risk, relatively low wage when compared to Europe's industrialized counties and the ability to innovate and assimilate new skills. There is of course a supporting infrastructure with excellent telecommunications, state of the art – Information Technology (IT), logistics management, the banking sector, professional businesses and an English speaking people. Positive sentiments and results had been registered in the Manufacturing sector for 2011 with a net positive balance in all sectors. Exports are expected to be stronger in 2012 too. (Eurochambers Malta 2011) The government of Malta has established a vision 2015 which places high value added and advanced manufacturing as one of the key priorities (Country profiler – Malta -2011).

Malta is still highly predominantly based on the production function with a limited focus on research and development activities. A National Research Strategy for the Malta Manufacturing sector has been drafted (Beat Consulting 2011) with a brave mission statement: *"To transform the Maltese Manufacturing Industry into a centre of excellence for research, development and testing facilities by investing in resources and competencies that position it at the forefront in selected high technology manufacturing niche markets whilst retaining flexibility to continuously adapt its focus to emerging technologies and applications"*.

The development of an R&D base within the Manufacturing Sector requires the creation of a favourable climate within the country that encourages not only local industry to channel some of its funds into such activities but also foreign direct investors who could potentially relocate their research functions in Malta due to a defined set of location specific advantages (Fauser 2011). On the 27th March 2012, the Prime Minister announced that one of the top FDI companies operating in the medical devices sub sector will be using Malta as its global R&D centre and will be absorbing a large number of engineers to work there.

As can be seen, Human Resources constitute the backbone and the key resource that is an essential ingredient for the successful proliferation of R & D activities in the Manufacturing Industry in Malta.

11. Conclusion

This paper has reviewed current literature and has addressed the main challenges and key issues facing manufacturing firms. It has covered the areas of; Competitiveness, Manufacturing Strategy, Competitive Priorities, Production Competence, Innovation, Intangible Assets, Supply Chain Management and Outsourcing as the major tenets of manufacturing. Issues related to technology were embedded within the arguments and discussions related to these factors.

There is no doubt that manufacturing still has a very relevant place and role to play in developed economies and it would be wrong to conclude that all manufacturing should be relocated to cheap labour countries. Cost plays only a small part of what makes manufacturing competitive on a global scale. Today's new competitive challenges revolve around research & development, the capability to innovate, the integration of supply chains, human capital, collaborative networks, services and environmental competencies together with the more traditional areas of quality, cost, delivery and flexibility.

With the world at manufacturers' fingertips, there are endless possibilities on where to locate operations and this has led to a very fragmented landscape, emphasizing the need to have well designed value adding supply chains. Communication technology has reduced the barriers making all this possible.

The need for manufacturing to develop a sound manufacturing strategy that is linked to the overall business strategy has not changed. This strategy still needs to be deployed through the set of manufacturing competencies that a firm would have invested in and developed as it strives to improve performance and competitiveness. What has been illustrated in this paper is the broader approach by which to define manufacturing competencies. More intangibles, with a special emphasis on human capital, have been included and other non-traditional manufacturing components are now being viewed as forming an important role within manufacturing. Also, the importance for manufacturing to offer services embedded around the products they make is also a recent development for competitive advantage.

There is therefore no doubt that modern manufacturing practices require a revised skill set to cope with the challenges and opportunities being faced in a globally competitive environment.

Governments also have an important role to play as they are responsible for developing the appropriate quality of the infrastructure, regulation, taxation, and energy cost policies which all play a critical role for manufacturing to develop and address competitive challenges.

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