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Six Sigma: The Panacea to Sustainability*

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Whilst there are a number of qualified methodologies, the researchers have opted to utilise the tools available through Six Sigma to prove that Six Sigma can be used to save resources and improve quality and process. Five industry sectors were identified as the ones to be surveyed using quantitative and qualitative methods and finally piloting the results on five different SMEs. Since this is a relative new methodology to the Cypriot entrepreneur and regrettably at the time of carrying out the study an international financial crisis caused a lot of financial problems to many respondents and as such could not see the immediate effects or benefits of Six Sigma and were reluctant to co-operate or participate. The Six Sigma methodology can be customized to industrial sectors and a tailored version of the methodology can be developed for a particular process or problem. The paper illustrates the problem areas identified from both the qualitative and quantitative research per industry. This is the first study carried out on Six Sigma in a small economy like Cyprus and tested on five industry sectors using both qualitative and quantitative methods.

Keywords: Six Sigma, Sigma, lean, DMAIC, ISO 9000, EFQM, TQM, SME, CAF, industry sectors, Cyprus

The global financial crisis started to show its effects in the middle of 2007 and into 2008. The world stock markets have fallen, large financial institutions have collapsed or have been bought out, and governments in even the wealthiest nations have had to come up with rescue packages to bail out their financial systems. Six Sigma is a methodology for minimising mistakes and maximising operational significance. Ultimately mistakes have a cost, a lost customer, the need to repeat in undertaking an activity, a part that has to be replaced, time or material wasted, efficiency lost, or productivity squandered. In fact, waste and mistakes cost many organisations as much as 20 to 30 percent of their revenue. In other words it has been defined as a measure of the quality of products and services, a philosophy and a process. Higher product quality is measured by higher "σ" ratings and Six Sigma uses a range of tools to achieve quality. It is disciplined, data-driven approach and methodology for eliminating defects in any process. Defects and lost customers have serious repercussions for a company particularly during economic crisis. The question however is how acceptable would such a methodology be in a small economy by SMEs?

Literature Review

During the 1990s, Total Quality Management (TQM) was the dominant theoretical and empirical paradigm for quality management and included many elements advocated by leading quality thinkers such as Deming (1986, 1994), Juran (1989) and Crosby (1979). Some argued that Six Sigma is the latest banner of TQM

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(McManus, 1999), others disagree claiming it is something new (Pande, Neuman, & Cavanagh, 2000). Schroeder, Linderman, Liedtke and Choo (2007) have carried out an extensive comparison of Six Sigma and TQM. They conclude their comparison by saying that "what is being done in Six Sigma is not entirely new with respect to prior quality tools or principles, but the deployment approach and emergent structure of Six Sigma are new". "The management practices and principle" offer a new structure for improvement. "The structural differences simultaneously promote both more control and exploration in improvement efforts". Anbari (2002) went a step further and stated:

"Six Sigma = TQM + Stronger customer focus + Additional data analysis tools + Financial results + Project management."

What Is Sigma?

Sigma is the Greek letter that is a statistical unit of measurement used to define the standard deviation of a population. It measures the variability or spread of the data.

In the world of Six Sigma companies (Ioannou, 2007), the term Sigma has to come to signify how well a business process, product, or service is meeting the requirements of the marketplace. Six Sigma has come to mean failing to meet customer requirement only 3.4 times out of a million opportunities.

What Is Six Sigma?

Six Sigma is a data-driven method focusing on the customer and the quality of the product or services provided (Islam, 2004). It is a "very basic and systematic approach based on statistical data, which provides companies with a way to reduce these uncertainties" (Lee & Choi, 2006). It is a business strategy that focuses on "improving customer requirements understanding, business systems, productivity and financial performance" (Kwak & Anbari, 2006). It is a "systematic, data-driven approach using the Define, Measure, Analysis, Improve, and Control (DMAIC) process" (Kwak & Anbari, 2006).

The definitions of Six Sigma vary from "it is a business strategy used to improve business profitability, to improve the effectiveness and efficiency of all operations to meet or exceed customer needs and expectations" (Kwak & Anbari, 2006) to being a disciplined method of rigorous data gathering and robust statistical analysis to identify sources of error and ways of eliminating them (Harry & Schroeder, 1999).

Benefits derived from the use of Six Sigma have ranged from: (1) financial outcomes resulted from cost reduction (Lee & Choi, 2006); (2) customer and employee satisfaction (Elliott, 2003); (3) business operations being more successful, with strategies being set faster and more effectively than competitors (Lee & Choi, 2006); (4) giving priority to preventive measures that remove the root cause of the defects rather than searching for defects after they occur (Rowlands, 2003); (5) standardization measurement process common (Xagoraris, 2003); (6) driving out waste and raising levels of quality (Cua, 2001); (7) no Six Sigma project will be approved unless the team determines the savings generated from it (Antony, Kumar, & Madu, 2005); (8) Six Sigma integrates human aspects and process (Antony et al., 2005), (9) Six Sigma methodology links the tools and techniques in a sequential manner (Antony et al., 2005) and (10) Six Sigma creates a powerful infrastructure for training of champions, master black belts, black, green and yellow belts (Adams, Gupta, & Wilson, 2003).

Motorola developed Six Sigma in 1987 in an effort to reduce defects (Barney, 2002). Companies which have used the Six Sigma methodology ranged from Ford, Honeywell and American Express (Hahn, Doganaksoy, &

Hoerl, 2000). Companies have estimated the financial benefit of implementing Six Sigma. An example of this is General Electric which estimated in 1999 that the impact on net income derived from the implementation of Six Sigma after allowing for the cost of implementation exceeded $2 billion (General Electric Company, 1999). Kwak and Anbari (2006) provided a list of the benefits/savings derived from the implementation of Six Sigma on 15 companies (See Table 1).

Table 1

Reported Benefits and Savings From the Implementation of Six Sigma

Company	Project Metric	Measures Benefit/Savings
Motorola (1992)	In-process defect levels	150 times reduction
Raytheon/aircraft integration systems	Depot maintenance inspection time	Reduced 88% as measured in days
GE/Railcar leasing business	Turnaround time at repair shops	62% reduction
Allied Signal (Honeywell)/laminates plant in South Carolina	Capacity cycle time inventory on-time delivery	Up 50% Down 50% Down 50% Increased to near 100%
Allied Signal (Honeywell)/bendix IQ brake pads	Concept-to-shipment cycle time	Reduced from 18 months to 8 months
Hughes Aircraft's Missiles Systems Group/wave soldering operations	Quality/productivity	Improved 1,000%/improved 500%
General Electric	Financial	$2 billion in 1999
Motorola (1999)	Financial	$15 billion over 11 years
Dow chemical/rail delivery project	Financial	Savings of $2.45 million in capital expenditures
DuPont/Yerkes plant in New York (2000)	Financial	Savings of more than $25 million
Telefonica de Espana (2001)	Financial	Savings and increases in revenue 30 million euro in the first 10 months
Texas Instruments	Financial	$ 600 million
Johnson and Johnson	Financial	$ 500 million
Honeywell	Financial	$1.2 billion
Bank of America (BOA)	Customer Relationships	10.4% increase in customer satisfaction and 24% decrease in customer problems
American Express	Quality/productivity	Improve external vendor processes, and eliminate non-received renewal credit cards
The radiology film library at the University of Texas MD Anderson Cancer Center	Quality/productivity	Improved service activities greatly
University of Texas MD Anderson Cancer Center outpatient CT exam lab	Quality/productivity	Patient preparation times were reduced from 45 min to less than 5 min in many cases and there was a 45% increase in examinations with no additional machines or shifts

Note. Source: Kwak and Anbari (2006).

Lean Six Sigma and Six Sigma are classified as process improvement programmes, which include "process re-engineering, theory constraints and total productive maintenance" (Shah, Chandrasekaran, & Linderman, 2008). This concept dates back to the beginning of the 20th century (Taylor, 1911) and the decisive work of Ohno (1978), Shingo (1981), Deming (1986) and Shah (2006). Thus it can be used in all the industries.

Lean Six Sigma and Six Sigma have been tested in manufacturing (Shah et al., 2008; Schroeder et al., 2007; Kumar, Antony, Singh, Tiwari, & Perry, 2006; Kwak & Anbari, 2006; Lee & Choi, 2006; Mahesh, Wong, Fuh, & Loh, 2006; Antony et al., 2005; Linderman, Schroeder, & Choo, 2005); Construction (Heon Han, Jin Chae, Soon

Im, & Dong Ryu, 2008; Kwak & Anbari, 2006; Pheng, Sui, & Sze Hui, 2004); Service industry (Chakrabarty & Tan, 2007; Oke, 2007; Schroeder et al., 2007; Antony et al., 2006); Automotive (Antony et al., 2005); Healthcare (Kwak & Anbari, 2006); Public Sector (Furterer & Elshennawy, 2005)

Whilst Six Sigma has been implemented in large and multinational organizations SMEs have experienced some resistance to implement it perhaps due to the costs involved. It appears however, and as stated by Antony et al. (2005), large organizations have left no choice on the SMEs to consider the introduction of Six Sigma strategy in order to provide high quality products and highly capable businesses processes. Harry and Crawford (2004) demonstrated the benefits of implementing white belts on SMES and creating value for customers with a savings of about $300,000 per year. Wilson (2004) identified the following advantages for small-businesses embarking on Six Sigma initiative: (1) stronger, more intimate relationships with customers, (2) fewer number of sites, (3) fewer layers in the management hierarchy, (4) faster and effective internal communication and (5) strong owner influence.

Lean production, evolved from the Toyota Production System (TPS) and its purpose was to improve firm performance through elimination of waste. Lean production can be defined as a "philosophy, as a set of principles and as bundles of practices" (Shah, Chandrasekaran, & Linderman, 2008). Womack et al. (1996) defined lean production in terms of production philosophy that eliminates waste from a product's value-stream and shortens the time between order placement and product delivery.

Six Sigma ranges from "a business philosophy for improvement to a collection of statistical tools and metrics" (Shah et al., 2008). Schroeder et al. (2007) identified six concepts which relate to Six Sigma: (1) top management leadership, (2) customer requirements, (3) focus on financial and non-financial results, (4) structured method of process improvement, (5) strategic process selection and (6) full-time specialist. Six Sigma concentrates on performance target of operating within 3.4 defects per million opportunities.

The Difference Between Lean and Six Sigma

"Lean practices and techniques focus on streamlining processes, whereas Six Sigma practices and techniques help identify and eliminate root causes of problems" (Evans & Lindsay, 2005). Thus lean places emphasis on process flow while Six Sigma concentrates on process defects (George, 2003). Lean is a bottom up approach whereas Six Sigma plays a "more active role by selecting improvement projects based on financial and strategic goals" (Shah et al., 2008).

Obstacles and challenges of the Six Sigma methodology have varied from simply repackaging traditional principles and techniques (Catherwood, 2002) to not being the panacea to answer to all business issues (Kwak & Anbari, 2006). Of course the cost to implement such a process whilst they are less than the savings in harsh economic times it is difficult to convince that it is worth spending a few hundred thousand to save a million.

Whilst Six Sigma appears to be winning ground in developed economies and academic literature is steadily increasing on the topic non existent research appears on its use in small economies. The researchers decided to select and test the use of Six Sigma in Cyprus for the following reasons.

Firstly, Cyprus based on the World Bank Report (2007) is one of 45 small economies. Secondly it has a large percentage of SMEs (99.9% of its businesses are SMEs)[1]. Cypriot Micro enterprises within SMEs (those employing less than 10 persons) are 94.1%, whilst Medium size enterprises (those employing between 10-49

[1] Source: www.mof.gov.cy/mof/cystat/statistics.nsf

people) account for 5% and only 0.8% are Large SMEs (those employing 50-249)[2]. Thirdly according to the Minister of Finance on July 9, 2009, Cyprus is one of two countries in the EU 27 with a positive economic growth in the first half of 2009 (Minister of Finance on July 9, 2009).

Having therefore identified the country the research was to be carried out, the authors decided to concentrate on SMEs and on the main industries the country's economy relied upon which are: Hospitality and tourism, construction, banking and finance, healthcare and automotive and transport.

Methodology

Given the size of the country and of the companies as well as the economic crisis being faced at the time of the research it was decided that the research questions are as follows:

(1) In what process areas can Six Sigma be implemented in a small economy?

(2) Is there a difference in the processes identified depending on the industry?

(3) Can real financial benefits be derived from the implementation of Six Sigma in SMEs?

To enable the researchers to carry out the present study, an academic and a Six Sigma Black Belt were involved throughout the research, funding was provided by the Research Promotion Foundation of Cyprus. Having conducted an extensive literature review a generic questionnaire was developed. The researchers decided to use the Common Assessment Framework (CAF) (2006) as a basis to identify the problematic process areas. The reason CAF and not another model was used was because this particular framework is widely used by many quality officers in Cyprus. Having therefore adapted the CAF model on the needs and characteristics of a small economy the questionnaire was pilot tested on five quality managers within each of the industries. Once the questionnaire was approved by the team, it was mailed to 1000 Cypriot companies selected from the Cyprus Chamber of Commerce database. The questionnaires were mailed to the quality officer within each organization. As the database included all the members of the Cyprus Chamber of Commerce, there was no way of knowing which one of them was SMEs or not. Therefore, respondents were asked to state the number of employees and turnover or to only reply if they fulfilled the SME criteria. Over one hundred respondents replied that due to the economic crisis and that there were concerns of survivorship or staff redundancies, they were not interested in participating in this research. Additionally, many questionnaires were returned back to us because the companies had closed down.

The useful responses (ignoring incomplete questionnaires, as well as, respondents that did not qualify under the European Commission's SME definition) were 50. Following the low response rate, it was decided to have a follow up action to the quantitative study and carry out a qualitative study as well. In the qualitative study we invited CEOs/MDs and Quality Managers of leading organizations and Government Regulators who have an influence on the market of SMEs from the five industry sectors running five different focus group meetings. This gave us an opportunity, to obtain tangible information from these individuals by operating outside the box (See Tables 2 and 3).

[2] Source: www.mof.gov.cy

Table 2

Demographics of Quantitative Research

	N	%
Position of the respondent		
• Board member	6	9
• Managing director	17	35
• Accountant	7	15
• Manager	20	41
Type of organization		
• Automotive and transport	5	10
• Banking and insurance	6	12
• Construction	10	20
• Healthcare	9	18
• Hospitality	20	40
Legal status of the organization		
• Private company	41	84
• Public and listed on the stock exchange	9	16
Number of employees		
• <10	7	14
• 10-49	19	38
• 50-249	24	48
• 250+		
Management systems already implemented (multiple response question)	24	40
• ISO 9001 quality management systems	6	10
• ISO 1400 environmental management systems	9	15
• ISO 2200 food safety management systems Six Sigma	1	2
• EFQM European foundation for quality management	2	3
• ISO 18000 health and safety systems	6	10
• Other	12	20

Table 3

Areas of Primary Concern

B1 Leadership	1(%)	2(%)	3(%)
1. We provide direction for the organization in developing its mission, vision and value, by:			
• Formulating and developing the mission (what our goals are) and the vision (where we want to go) of the organization by involving relevant stakeholders and employees.	75	15	10
• Translating the mission and vision into strategic (long-and medium-term) and operational (real and short-term) objectives and actions.	78	10	12
• Creating conditions for effective communication of its mission and vision by ensuring a wider communication of their values, strategic and operational objectives in the organization and to other stakeholders.	76	12	12
• Periodically reviewing the mission, vision and values to reflect changes in the organization's external environment.	64	19	17
2. We develop and implement a system for the management of our organization's, performance and change, by:			
• Developing processes and organizational structures in accordance with strategy, planning, needs and expectations of stakeholders, using available technologies.	75	10	15
• Defining appropriate management forms (levels, functions, responsibilities and competencies) and ensuring a system exists for managing such processes.	76	7	17
• Giving direction on output and outcome targets balancing the needs and expectations of different stakeholders.	49	29	22
• Communicating initiatives and reasons for changes to employees and relevant stakeholders.	73	15	12
3. We motivate and support people in the organization and act as role model, by:			
• Leading by example, thus acting in accordance with established objectives and values.	80	10	10
• Demonstrating personal willingness of leaders/managers to accept change through constructive feedback.	83	10	7

(to be continued)

• Promoting a culture of innovation and improvement by encouraging and supporting employees to make suggestions and be proactive in their daily work.	81	7	12
• Respecting and addressing employees' individual needs and personal circumstances.	93	2	5
4. We manage the relations with politicians and other stakeholders in order to ensure shared responsibility, by:			
• Developing and maintaining partnerships and networks with important stakeholders (Non-Government Organizations (NGOs), interest groups, industry and other public authorities).	56	22	22
• Seeking public awareness, reputation and recognition of the organization and its services.	73	17	10
• Developing a concept of marketing (product and service targeted) and its communication in relation to stakeholders.	68	22	10
B2 Strategy and planning	1(%)	2(%)	3(%)
1. We gather information relating to the present and future needs of stakeholders, by:			
• Identifying all relevant stakeholders.	71	17	12
• Systematically gathering and analyzing information about stakeholders, their needs and expectations.	54	34	12
• Systematically analyzing internal strengths and weaknesses (e.g. using methodologies such as, Total Quality Management (TQM), Common Assessment Framework (CAF). European Foundation of Quality Management (EFQM) and strengths, weaknesses, opportunities and threats (SWOT) analysis).	39	27	34
2. We develop review and update strategy and planning, taking into account the needs of stakeholders and available resources, by:			
• Developing and applying methods to monitor measure and/or evaluate the performance of the organization at all levels ensuring the monitoring of the strategy's implementation.	70	15	15
• Systematically reviewing risks and opportunities (e.g., SWOT analysis) and identifying critical success factors by regularly assessing these factors in the organization's environment (including political changes).	58	17	25
• Balancing tasks and resources, long and short term pressures and stakeholder requirements.	51	29	20
• Assessing the need to reorganize and improve strategies and methods of planning.	61	22	17
3. We implement strategy and planning in the whole organization, by:			
• Translating strategic and operational objectives of the organization into relevant plans and tasks for departmental units and individuals within the organization.	53	32	15
4. We plan, implement and review modernization and innovation, by:			
• Integrating tools and measures (e.g., input→ process→ output measurement or the use of TQM principles).	48	22	30
• Ensuring the availability of the necessary resources to implement the planned changes.	70	13	17
B3 People	1(%)	2(%)	3(%)
1. We plan, manage and improve human resources transparently with regard to strategy and planning, by:			
• Regularly analyzing current and future human resource needs, taking into account the needs and expectations of stakeholders.	73	12	15
• Ensuring HR capability (recruitment, allocation, and development) is available to achieve and balance tasks and responsibilities.	73	10	17
• Ensuring good environmental working conditions throughout the organization including taking care of health and safety requirements.	98	0	2
• Ensuring that conditions are conducive towards achieving a reasonable work-life balance for employees.	90	5	5
2. We identify, develop and use competencies of employees, aligning individual and organizational goals, by:			
• Identifying current competencies at the individual and organizational level in terms of knowledge, skills and attitudes.	86	12	2
• Developing and agreeing on personal training and development plans for all employees with a special emphasis on managerial, leadership, and abilities to deal with diverse customers and partners.	75	15	10
• Planning of training activities and developing communication techniques in the areas of risk and conflict of interest management.	63	15	22
3. We involve employees in open dialogue and empowerment, by:			
• Promoting a culture of open communication and dialogue and encouraging team work.	80	12	8
• Involving employees and their representatives in the development of plans, strategies, goals the design of processes and in the identification and implementation of improvement activities.	61	22	17
• Regularly conducting staff surveys including publishing results/summaries/interpretations.	35	27	38

(to be continued)

B4 Partnerships and resources	1(%)	2(%)	3(%)
1. We develop and implement key partnership relations, by:			
• Identifying potential strategic partners (e.g., purchaser-provider, co-production) and establishing an appropriate partnership agreement taking into account the nature of the relationship.	69	22	9
2. We develop and implement partnerships with customers, by:			
• Ensuring transparency of the organization as well as its decisions and development.	51	15	34
• Being open to ideas, suggestions and complaints by customers, and developing as well as using appropriate mechanisms to collect them (e.g., by means of surveys, consultation groups, questionnaires, complaints boxes, opinion polls, etc.).	76	12	12
3. We manage finances, by:			
• Ensuring the cost efficient management of financial resources.	90	5	5
• Introducing innovative systems for budgetary and cost planning (e.g., multi-annual budgets, programmes of project budgets).	63	15	22
• Ensuring investment decisions and financial controls are based on cost/benefit-analysis.	78	15	7
4. We manage information and knowledge, by:			
• Developing systems for managing, storing and assessing information and knowledge within the organization in accordance with strategic and operational objectives.	83	12	5
• Developing internal channels to cascade such information throughout the organization to ensure that all employees have access to the information and knowledge relevant to their tasks and objectives.	63	27	10
5. We manage technology, by:			
• Implementing an integrated policy of technology management in accordance with the strategic and operational objectives of the organization.	76	12	12
6. We manage amenities, by:			
• Ensuring a safe, cost efficient and ergonomically suitable use of office facilities based on strategic and operational objectives; accessibility by public transport; needs of the employees; local culture and physical constraints (e.g., open plan offices vs. individual offices, mobile offices) and technical equipment (e.g., number of computers, photocopiers and internet access by service type).	81	7	12
• Ensuring an efficient, cost effective and sustainable use of transport and energy resources.	66	15	19
• Ensuring an efficient, cost effective, planned and sustainable maintenance of buildings, offices and equipment.	87	8	5
B5 Processes	1(%)	2(%)	3(%)
1. We identify, design, manage and improve processes on an ongoing basis, by:			
• Identifying, describing and documenting key processes on an ongoing basis.	76	17	7
• Identifying process owners and assigning responsibilities to them.	78	12	10
• Allocating resources to processes based on the relative importance of their contribution to the strategic aims of the organization.	68	27	5
• Improving processes on the basis of their measured efficiency, effectiveness and results (outputs), in conjunction with relevant stakeholders.	68	20	12
• Analyzing and evaluating key processes, risks and critical success factors taking the objectives of the organization and its changing environment into consideration.	71	17	12
• Identifying, designing and implementing process changes leading to one-stop-principle services.	48	40	12
• Measuring and reviewing the effectiveness of process changes and carrying out benchmarking to drive improvement.	63	27	10
2. We develop and deliver customer-oriented services and products, by:			
• Involving customers and other stakeholders in the development of quality standards for services, products and information for customers.	61	17	22
• Developing clear guidelines and regulations using plain language.	75	15	10
• Developing sound response query handling and complaint management systems and procedures.	66	19	15
3. We innovate processes involving customers, by:			
• Providing the resources necessary for process innovations.	49	24	27

(to be continued)

• Actively identifying, analyzing and overcoming obstacles to innovation.	61	27	12
4. Our products and services are produced, delivered and serviced, by:			
• Communicating, marketing and selling products and services to existing and potential customers.	83	10	7
5. Our customer relationships are managed and enhanced, by:			
• Handling feedback received from day-to-day contacts, including complaints.	83	12	5
• Following up on sales, servicing and other contacts in order to determine levels of satisfaction with products, services and other customer sales and servicing processes.	83	12	5
• Using regular surveys, other forms of structured data gathering and data gathered during day-to-day customer contact in order to determine and enhance customer relationship satisfaction levels.	54	22	24
B6 Customer-oriented results	1(%)	2(%)	3(%)
1. Customer satisfaction measurements are carried out on:			
• Products and services (e.g., quality, reliability, compliance with standards, processing time, value of advice given to customers).	73	12	15
2. Customer-oriented indicators are measured through:			
• Employee training in relation to the effective handling of customer relationships (e.g. professionalism and friendly communication with, and treatment of customers).	66	17	17
B7 People results	1(%)	2(%)	3(%)
1.People's satisfaction and motivation is measured by:			
• The level of employees' involvement in the organization and its mission.	63	20	17
2. Indicators are utilized to:			
• Measure satisfaction level of employees (e.g., levels of absenteeism or sickness, rates of staff turnover, number of complaints).	54	24	22
• Measure level of performance by employees (e.g., measures of productivity, results of evaluations).	63	15	22
B8 Society results	1(%)	2(%)	3(%)
1. We measure our stakeholders' perceptions by:			
• General public's awareness of the impact of how the organization's performance affects the quality of our customers' lives.	52	27	21
2. We identify society's perceptions on how our organization's			
• Programmes protect customers and employees from exposure to possible health risks and accidents.	68	15	17
B9 Key performance results	1(%)	2(%)	3(%)
1. External results: Outputs and outcomes of goals are measured in terms of:			
• The extent to which the goals are achieved in terms of output (delivery of products or services).	86	12	2
• Cost efficiency (outputs achieved at the lowest possible cost).	81	7	12
• Cost effectiveness (outputs achieved at the lowest possible cost).	72	13	15
2. Internal results ,are measured in terms of:			
• The degree of involvement of all stakeholders in the organizations.	49	22	29
• Process performance.	76	14	10

Notes. 1=Agree; 2=Do not know; 3=Disagree.

Utilizing the information gathered from the qualitative and quantitative study, the major problem areas identified per industry sector are listed in Table 4. For instance as indicated in Table 3 above, leadership issues appear to be of less importance to the Banking and Automotive and Transport Industries. It was found in the focus groups that there are some issues in the leadership field that need to be addressed unlike the other three industries. Putting therefore the findings of both studies the research team has identified the problem areas needing to be addressed per industry.

Table 4

Problem Areas Validation

1. Construction
B2 Strategy and planning
• Developing and applying methods to monitor measure and/or evaluate the performance of the organization at all levels ensuring the monitoring of the strategy's implementation.
B5 Processes
• Subcontractor management (no standards). • Risk management. • Developing sound response query handling and complaint management systems and procedures. • Using regular surveys, other forms of structured data gathering and data gathered during day-to-day customer contact in order to determine and enhance customer relationship satisfaction levels.
B9 Key performance results
• Extent to which the goals are achieved in terms of output (delivery of products or services). • Cost efficiency (outputs achieved at the lowest possible cost). • Process performance.
2. Hospitality
B2 Strategy and planning
• Systematically gathering and analyzing information about stakeholders, their needs and expectations.
B5 Processes
• Risk management. • Demand capacity management. • Measurement of operational cost.
B6 Customer-oriented results
• Customer satisfaction measurement.
3. Automobile/transport
B1 Leadership
• Promoting a culture of innovation and improvement by encouraging and supporting employees to make suggestions and be proactive in their daily work.
B2 Strategy and planning
• Systematically gathering and analyzing information about stakeholders, their needs and expectations. Ensuring the availability of the necessary resources to implement the planned changes.
B3 People
• Identifying current competencies at the individual and organizational level in terms of knowledge, skills and attitudes. • Promoting a culture of open communication and dialogue and encouraging team work. • Involving employees and their representatives in the development of plans, strategies, goals the design of processes and in the identification and implementation of improvement activities.
B4 Partnerships and resources
• Partnership management. • Supplier management. • Information technology management.
B5 Processes
• Identifying, describing and documenting key processes on an ongoing basis. • Allocating resources to processes based on the relative importance of their contribution to the strategic aims of the organization. • Improving processes on the basis of their measured efficiency, effectiveness and results (outputs), in conjunction with relevant stakeholders.
B6 Customer-oriented results
• Customer service management.

(to be continued)

B7 People results
• Measure satisfaction level of employees (e.g., levels of absenteeism or sickness, rates of staff turnover, number of complaints).
B9 Key performance results
• The degree of involvement of all stakeholders in the organization. • Process performance.
4. Healthcare
B2 Strategy and planning
• Systematically analyzing internal strengths and weaknesses (e.g., using methodologies such as, Total Quality Management (TQM), Common Assessment Framework (CAF). European Foundation of Quality Management (EFQM) and Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis). • Balancing tasks and resources, long and short term pressures and stakeholder requirements.
B4 Partnerships and resources
• Technology management.
B5 Processes
• Identifying, describing and documenting key processes on an ongoing basis. • Measuring and reviewing the effectiveness of process changes and carrying out benchmarking to drive improvement. • Providing the resources necessary for process innovations. • Using regular surveys, other forms of structured data gathering and data gathered during day-to-day customer contact in order to determine and enhance customer relationship satisfaction levels. • Risk management. • Risk assessment. • Financial management. • Inventory management. • Waste management. • Subscription.
B6 Customer-oriented results
• Customer measurement.
5. Banking/finance/insurance
B1 Leadership
• Creating conditions for effective communication of its mission and vision by ensuring a wider communication of their values, strategic and operational objectives in the organization and to other stakeholders. • Communicating initiatives and reasons for changes to employees and relevant stakeholders. • Promoting a culture of innovation and improvement by encouraging and supporting employees to make suggestions and be proactive in their daily work.
B2 Strategy and planning
• Systematically reviewing risks and opportunities (e.g. SWOT analysis) and identifying critical success factors by regularly assessing these factors in the organization's environment (including political changes). • Strategy execution monitoring. • Strategic identification of critical projects for implementation. • Project improvement implementation.
B3 People
• Regularly analyzing current and future human resource needs, taking into account the needs and expectations of stakeholders. • Identifying current competencies at the individual and organizational level in terms of knowledge, skills and attitudes. • Planning of training activities and developing communication techniques in the areas of risk and conflict of interest management. • Involving employees and their representatives in the development of plans, strategies, goals the design of processes and in the identification and implementation of improvement activities. • Human resources. • Performance measurement. • Identification of training needs. • Training.

(to be continued)

B4 Partnerships and resources
• Ensuring a safe, cost efficient and ergonomically suitable use of office facilities based on strategic and operational objectives; accessibility by public transport; needs of the employees; local culture and physical constraints (e.g., open plan offices vs. individual offices, mobile offices) and technical equipment (e.g., number of computers, photocopiers and internet access by service type).
B5 Processes
• Developing clear guidelines and regulations using plain language. • Providing the resources necessary for process innovations. • Handling feedback received from day-to-day contacts, including complaints. • Following up on sales, servicing and other contacts in order to determine levels of satisfaction with products, services and other customer sales and servicing processes. • New product development management.
B6 Customer-oriented results
• The extend of employee training in relation to the effective handling of customer relationships (e.g., professionalism and friendly communication with, and treatment of customers).
B7 People results
• The level of employees' involvement in the organization and its mission. • Measure level of performance by employees (e.g., measures of productivity, results of evaluations).
B8 Society results
• General public's awareness of the impact of how the organization's performance affects the quality of our customers' lives.

Discussion on Findings and Piloting

Responding to the two research questions posed earlier, for example,

(1) In what process areas can Six Sigma be implemented in a small economy?

(2) Is there a difference in the processes identified depending on the industry?

The participants of the focus groups and respondents of the questionnaire have been hesitant to agree that Six Sigma can be used during economic crisis period and more importantly the benefits to be derived if used in a small economy, like Cyprus. There was however, an interest for some to take up the free of charge six month pilot period offered since it will not have a financial burden on them.

More specifically, regarding the two research questions the findings from both the qualitative and quantitative study do illustrate that problem areas identified by industry vary.

Hospitality and Tourism

As a holiday resort, Cyprus depends heavily on tourism and other related services. However in the last two to three years due to exogenous factors this industry has been affected adverstly. These exogenous factors are: cheap near by destinations, the international economic crisis, the swine flu and finally due to its geographical location it is frequently found to be close to political unrests. Six sigma can help to sooth out some of these issues now that the problem areas have been identified. In most cases, the areas which are often highlighted are poor service delivery, high costs, customer dissatisfaction, staff training etc. From the present study only the following issues (see Table 4) were identified by the organisations: (1) strategy and planning, (2) processes and (3) customer-oriented results.

The company selected to pilot the Six Sigma was a conference and tour operator.

Banking and Insurance

Over the past couple of years, this sector is pressured to reduce costs, improve their operational cycle, reduce risks, and be competitive. This industry has been heavily affected from the local conditions due to international

interest roles, the downturn of the construction industry, the effects that tourism had on the island and the spending habbits of people on luxury items such as cars, etc.. The present research identified the following issues (Table 4) which need to be addresed by Six Sigma in the banking and insurance industry: (1) leadership, (2) strategy and planning, (3) people, (4) partnerships and resources, (5) processes, (6) customer-oriented results, (7) people results and (8) society results.

The company selected and having qualified as an SME was a bank.

Construction and Real Estate

Very little research has been conducted on setting definite quantitative goals for performance improvement while considering the defect rate involved in construction operations or external influences which affect their project performance or operational integrity. Whilst the construction industry in Cyprus has been booming, during the international economic crisis the same industry has been affected the most after the hospitality and tourism sector. Only three problem areas have been identified needing the attention of Six Sigma. These are (1) strategy and planning, (2) processes and (3) key performance results.

A construction company was selected.

Automotive and Transport

For years, Six Sigma was viewed simply as a process improvement tool (like TQM) to help companies improve their processes and operations, reduce product defects and a methodology applicable to the manufacturing industry. In small economies for this particular industry we can generalise by saying that it does not including the manufacturing of automobiles but only the retail and maintance component.The automotive industry has been affected very much because of the global crisis and local SMEs were not imune to those effects. Even so, the number of respondents were suprisingly better than anticipated and the following problem areas (Table 4) were identified: (1) leadership, (2) strategy and planning, (3) people, (4) partnerships and resources, (5) processes, (6) customer-oriented results, (7) people results and (8) key performance results.

A transport company was selected.

Healthcare

Despite the fact that generally Six Sigma principles and the healthcare sector are very well matched because of the healthcare nature of zero tolerance for mistakes and potential for reducing medical errors, the present research has shown that these organizations would like to use Six Sigma to address the following areas of concern (Table 3): (1) strategy and planning, (2) partnerships and resources, (3) processes.

Conclusion

Despite the limitations of the study (i.e., that only 50 companies participated in the study), the fact that results were rechecked with the aid of qualitative research it is argued that this exploratory study will provide room for further research in the field in small economies. In implementing Six Sigma in SMEs, its penetration into the workforce and the task of gaining commitment by management and employees would depend on whether the organization had prior experience with quality management systems, namely ISO 9000, Balanced Scorecard, Total Quality Management (TQM), European Foundation for Quality Management (EFQM) or other quality initiatives. In addition, it must be emphasized that the commitment of the top management is essential to progress and goal to attain Six Sigma projects.

As illustrated above Six Sigma is no longer a theoretical or big country panacea. It can be the solution in improving quality, minimizing defects and costs of SMES in small or emerging economies.

In conclusion it can be said that whilst Six Sigma can be implemented by SMEs in a small economy there will be lack of commitment to do so during harsh economic crisis since immediate benefits cannot be achieved. Six Sigma is a long term investment that needs to be made. Regarding the second research question whilst it was found that each industry has its own problem areas, strategy and planning is a problem area identified for all five sectors. In fact, in small economies, where most businesses are not only SMEs but family businesses, it is hard to have the vision and appropriate people to form strategic plans. Further research is suggested in this field.

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