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Technological Capabilities Assessment

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1. Introduction

The aim of this project is to provide the client (the SME Support Network – University of Huddersfield) with an assessment tool that can give a clear indication to the technological capabilities of the manufacturing companies that the client is dealing with in order to find ways to help and improve these company's technologies.

However, the original title for this project was 'Technology Audit', and as it turned out that the meanings and different definitions of 'Technology Audit' do not completely fit with the main requirement of the client, then, the title of the project has been changed to 'technological capabilities assessment'. This will be discussed thoroughly in the literature review.

As carrying out a full technological capabilities assessment is very complex that cannot be done in just few pages of checklists as every managerial concept has an impact one way or another at the company's technological capabilities. It becomes clear that the designed assessment tool should be focused to meet the specific needs of the client. In other words, the assessment tool should be custom-designed to fit the real needs of the client, as it would be ineffective in terms of energy and time for the client to have a checklist that included every point that has an effect on their technological capabilities.

For the above reason it was important to identify the real needs of the client before designing the technological capabilities assessment tool.

After a series of meeting with the client, and through using the 'what & why' technique, which will be discussed later in the methodology, the client needs have been crystallised to the following specific objectives:

- 1- To have a general awareness to the company's activities and their market.
- 2- To assess the company's attitude to the acquisition of new technologies.

- 3- To assess the company's perception toward their current technologies.
- 4- To assess the efficiency of the company's production processes.
- 5- To assess the level of the product competitiveness.
- 6- To assess the company's attitude toward technology improvement.

Each objective represents a group of questions, and the first group of questions are general round-up questions that give an idea about the participating company and the market they operate in.

The second group of questions helps to identify the management values, beliefs, and attitude toward acquiring new technologies.

The third group gives an indication to the level of utilisation and usefulness of current used technologies.

The fourth group would give an indication of the weakness areas in the production process. This would be regarded as a pre-step to stimulate thoughts about what and how technologies could be used to improve these areas.

The fifth group has the same aim as the previous one. This group of questions gives an indication of the weakness points in the product competitiveness, which would help to stimulate thoughts about what and how technologies could be used to improve these points.

The sixth group might seem similar to the second group but it is not. The second group deals with the management attitude towards technologies. This group gives an indication of the attitude and motivation of the employees to improve the current technologies.

As the purpose of the first group of questions is to get familiar with the company and its market, then there would be no strong or weak answers and thus there would be no score to these questions. But for the next groups, the aim is to evaluate the company's strengths

and weaknesses, thus it is possible to provide a score that would give an idea of the level of the company in each group.

After the score has been counted for each group (i.e. the second to the sixth group), then it is possible to present these scores in a visual diagram, as this would make it easier to visualise the company's current situation, and it would make it easier to compare the result of different companies.

It should be noted that there was an argument to make the visual diagram a spider-web type as it is the newest type, however after discussion, the decision was to use the vertical bar type as it is easier, simpler, and could give the opportunity to compare between companies (see the visual diagram in the appendix – page 50).

After the objectives of this project were agreed, efforts have been focused on the literature review and the managerial concepts needed to build the required assessment tool.

In building this assessment tool, the author faced a dilemma: First one needs to make the assessment tool as comprehensive as possible to give a clear and accurate evaluation, but on the other hand, it is necessary to make the assessment tool easy and simple to the participants. Egan (1993) had captured this idea when he described models, and the same phrase could also describes auditing and assessment tools:

“Two criteria characterize working models: 1) they must be complex enough to account for the reality they attempt to portray, and 2) they must be simple enough to use. A model that meets only the first criterion is likely to be of interest only to theoreticians and researchers. A model that meets only second criterion would tend to be simplistic rather than merely simple and would be useless as a working models.” (Egan, 1993, p23).

The above discussion could backup the idea that auditing and assessment tools are not and cannot be comprehensive (Walley, 1974), and the skill is to create an assessment tool that can give a fair assessment and can highlight areas that require further investigation.

Building up on the above discussion, the assessment tool has been designed through the following main guidelines:

- 1) The assessment tool should answer the requirements of the clients.
- 2) The assessment tool should be in alignment with the managerial concepts and theories.
- 3) The assessment tool should be 'complex enough and simple enough'.

The previous guidelines were the corner stones that identified the project methodology, which will be discussed in the next section.

2. The methodology

It has been found that the literature about the technology capabilities assessment tools is rare and not sufficient. So it seemed that the best way to enter to this project is to find a proper models that describe the main elements of the organisation then to find the effects of each of these elements toward technology.

This might be seen as the wrong entry point. However, De Bono (1971) implied that the entry point to a problem is not very essential for the progress and success in solving that problem, but the most essential is the entry itself and the way you move from that entry point forward. In other words, choosing the right entry point to the problem is helpful but not very essential as making the entry and the way you deal with the problem after you made that entry.

Making that investigation and then returning back to the client gave the client more light to their specific and real requirements.

At that point it came clear that there are different views that should all be taken into consideration:

- The requirements of the client.
- The managerial concepts and theories.
- The fact that the assessment tool should be complex enough to reflect reality and simple enough to be used.

In order to ‘design’ a tool that meets the previous views, the scientific method of solving problems has applied:

Raybould & Minter (1971, p.55) approach to problem solving is as the following:

- “Definition of the problem.
- Collection of relevant data.
- Analysis of data.
- Establishment of controlling factors.
- List of ideas (for others to assess).
- Short list of ideas for trial and research.
- Outline of a number of possible schemes.
- Number of fully evaluated schemes.
- Acceptance of schemes.
- Preparation for installation.
- Limited supervised installation.
- Maintained running scheme.”

Bocchino (1972, p.53) approach to problem solving is as the following:

- “Identify the problem.
- Gather data.
- List possible solutions.
- Test the solutions objectively.
- Select the best solution.
- Put your solution into action”.

The way that the problem-solving method has been applied to the project in hand was using the following steps:

- Identify the specific and real requirements of the client.

- Collect relevant data from the literature.
- List of possible ideas for you and the client to discuss and evaluate.
- Selecting the best ideas.
- Build the assessment tool by using the selected ideas.
- Test the assessment tool by taking proper feedback from external experts.
- Evaluate the assessment tool and get proper feedback form experts.
- Repeat the method if necessary.

Two points in the previous methods might need further elaboration: Identifying the specific requirement and Listing possible ideas.

1- Identifying the specific and real requirements of the client:

As was mentioned in the introduction, the client's requirements should be specified and crystallised in order to make the assessment tool 'complex enough & simple enough'. The way to make the requirement specific and crystallised is by defining and redefining the problem (which is in this context the client's requirements):

Proctor (1999, p82) had mentioned that "restating the problem might unlock a new viewpoints that can lead to many creative solutions". He provided the following two methods (among many other methods) that could help in redefining problems:

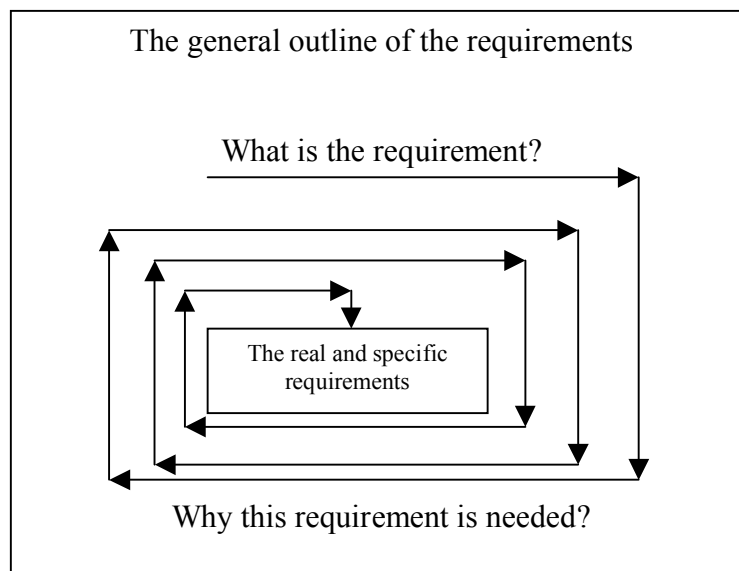
1- The goal orientation method (p.82):

- Make a general outline of the problem.
- Question the needs, obstacles and constrains.
- Redefine the original problem.

2- The Why method (p.85):

- “Specify the problem.
- Ask why one should do whatever the problem states.
- Redefine answers given as a new problem.
- Repeat the process until the redefinition are no longer appropriate”.

The method that has been adapted in identifying the real and specific requirement of the client was a modification of the previous methods. The method could be named as the What & Why cycle:



By using the what & why cycle and by checking the relevant literature, the client's requirements came clear and crystallised as it was stated in the introduction.

2- Listing possible ideas:

As mentioned previously, the literature in this subject is rare and not sufficient. So the way to list possible ideas will be through the following:

- To gain from the available literature, i.e. previous audits and assessment tools.
- To take ideas from similar assessment tools as innovation audits, operation audits, manufacturing questionnaires, etc.
- To check and apply the relevant managerial theories and concepts gained from the managerial books and articles.
- To break down the organisation to its elements and then to notice the elements that seem making a direct effect to technology and to the specific requirements of this project.

As there will be a lot of including and excluding in designing the ‘technological capabilities assessment tool’ in order to fulfil different demands (as making the tool ‘complex enough & simple enough’ and fulfilling the specific requirements of the client) then there might be a lot of selection that is based on the author’s common sense and experience. The way to test the usefulness of the final draft of the assessment tool would be by taking the feedback of several external experts and taking the feedback from the pilot implementation.

3. The project work plan

Building on what has been stated in the introduction and the methodology, the work plan for this project could be identified in the following chart:

No.	Task	Weeks												
		1	2	3	4	5	6	7	8	9	10	11	12	
1	To clarify the main aim of the client.	■												
2	To identify and crystallise the client's requirements.		■	■	■									
3	To generate and evaluate possible ideas that could meet the client's requirements.					■	■							
4.	To select the best ideas and to design the assessment tool accordingly.							■	■	■				
5	To evaluate the designed tool and to make the necessary modification.										■	■		
6	To write the project report (the dissertation).							■	■	■	■	■	■	■

The assessment tool has been designed as scheduled, and is included in the appendix.

4. The literature review

As it was mentioned in the introduction, the original intention of this project is to design a 'technology audit'.

However 'technology' does not have a unanimous definition, neither does the expression 'technology audit', and it was obvious that attention should be drawn to these definitions and a clear chose from them should be made before doing anything else.

Technology has so many definitions:

- 1) "The science of industrial art" Concise Oxford dictionary.
- 2) "Any tool or technique, any product or process, any physical equipment or method of doing or making, by which the human capability is extended" (Schon in Ryan, 1984, p19).
- 3) "The science of technique" i.e. "A scientific study of the relationships involved in the man/tool/machine/object interface (factors or production) concerned in carrying out particular task" (Green & Morphet in Ryan, 1984, p19).
- 4) Technology is the operational hardware that is a result and outcome of invention, innovation, research, or development (Ryan, 1984).

The definition agreed and adopted in this project is the definition of Schon (the second definition) as it provides a general but clear-cut identification to the meaning of technology.

Technology Audit has also different meaning for different people:

- 1) It is a method to "help to assess the current technology status of a region and specific companies in relation to products, process, and resources (human and material)" (Parsons, ?*).

* There is no clear date for this article.

- 2) “Technology audit involve some kind of review of the current technology base of the firm. They are used to identify gaps, strengths to build on and weaknesses which need addressing” (Wiley.co.uk).
- 3) It is a method to “uncover opportunities to generate more income from technology, equipment and expertise”(Kingham, ?).
- 4) Technology Audit is a “detailed examination of either your product or competitor product, designed to inform developers and product managers” (progstrat.com, 2001).
- 5) “To assess the current status of a company in relation to products, processes, and resources (human and material) in order to recommend how companies may be developed using technology to improve profitability” (Murphy, 1987).
- 6) “To assess the current technology status of a company in relation to resources, processes and products in order to find the best way to improve competitiveness and profitability (Nunez, 1991).

Looking at the above definitions and after discussion with client using the ‘what & why cycle’ (see the methodology chapter) to identify the main aim of the project, it came clear that technology audit (as has defined above) does not perfectly fulfil the main requirement of the client:

The client does not want to audit the current technologies of the participant companies, as technologies are countless and in continuous change, and to audit the main technologies in the participant companies would require a long checklist.

The best way to audit the current technologies of the participant companies would be through direct observation rather than a long checklist.

However, the client wants to have a checklist that can provide good indication to the technological capabilities of the participant companies and to highlight areas in the participant’s current technologies that require direct investigation, and the aim of this

checklist is to help the client to generate suggestions that would improve the technological capabilities of the participant companies.

The client aim does not completely fit with any of the above definitions of ‘technology audit’, and another title should be chosen for this project.

This should not affect the project itself, as the Chinese proverb says: ‘it is not important the colour of the cat, the importance is that the cat should hunt the mouse’. Similarly, it is not important the title of the project, the importance is that the project should fulfil client’s requirements.

The new title of the project has been derived from the identified aim of the client and has been chosen to be ‘Technological Capabilities Assessment’.

After this clarification came the next step, which is to break down the client aim into project objectives.

Using the probing tools that have been discussed in the methodology, the client’s aim were crystallised to the following objectives:

- 1- To have a general awareness to the company’s activities and their market (i.e. general round-up).
- 2- To assess the company’s attitude to acquire new technologies.
- 3- To assess the company’s perception toward their current technologies.
- 4- To assess the efficiency of the company’s production processes.
- 5- To assess the level of the product competitiveness.
- 6- To assess the company’s attitude toward technology improvement.

After these objectives have been identified, the effort pointed toward checking the previous assessments for technological capabilities and other similar assessment tools (as innovation audits, manufacturing audits, product developments audits, etc.).

After reviewing the literature and after through discussion with the client, the required assessment tool has been designed and the next chapter will discuss the academic background to its elements (the designed tool is included in the appendix).

However, it would be appropriate, before discussing the elements of the designed assessment tool, to give a general review about the other assessment tools that provided the entry points and ideas and helped designing the required technological assessment tool.

The main aims for this review is to reinforce the idea mentioned in the introduction that assessment tools are not and cannot be comprehensive, and to give an idea about how these tools helped the author to design the required assessment tool.

- Manufacturing Questionnaire (Northumbria et al, 1998):

This questionnaire has a broad view. It has 63 check-points that cover the strategy and culture of the company, the operation characteristics (i.e. production cycle times, layout, and operation system), the company's attitude toward quality and innovation, the company's financial position, product and market development process, and the company's position in the market.

- Self-assessment guide to successful product development (DTI, 1995):

This checklist is a self-assessment guide produced by the Department of Trade and Industry. This checklist has 26 check-points that are distributed in the following categories:

- 1- Product development strategy: This includes the business strategy, the knowledge of products and markets, the attitude toward new technologies, customer orientation, and quality culture.
 - 2- Structured product development process: This part question whether the product development process has been defined, well planned and organised, well implemented, measured and properly evaluated.
 - 3- Teamwork: This part questions the selection, organisation, and operation of teams in the company.
 - 4- Tools and techniques: This part question “the availability and application of appropriate tools and techniques, eg. CAD, SPC, FMEA, at all stages of the product design process to maximise the performance of the development team.
 - 5- Working in parallel: This part questions whether the development process of a project is working in the same time.
 - 6- Project and programme management: This part questions the efficiency of the management system.
- Self-assessment guide to innovation (DTI, 1994):

This checklist is also produced by the Department of Trade and Industry. This checklist has 26 check-points that are distributed in the following categories:

- 1- Product innovation: This part questions the ability to understanding customer needs and the ability to generate innovative product concepts and

product enhancements.

- 2- Product development: This part questions the efficiency of the product development process.
- 3- Process innovation: This part questions the effectiveness of the innovation process, i.e. “the process of ensuring continuing innovation in production processes, their effective implementation and continuous improvement”.
- 4- Technology acquisition: This part questions the company’s capability to monitor, acquire and exploit technologies.
- 5- Market focus: This part questions the company’s ability to monitor changes in the market and monitor changes in its competitive position.
- 6- Leadership: This part questions the company’s ability of setting goals and priorities for innovation.
- 7- Resourcing innovation: This part questions the company’s ability to ensure that “there are sufficient and appropriate high quality human resources and that the innovation process is properly funded.
- 8- System and tools: This part questions “how systems, tools, and formal methodologies are used to support the innovation processes”.
- 9- Innovation performance: This part “examines the goals that the company sets, how it measures them and the results, in terms of innovation performance and customer satisfaction”.

- Best factory award audit (Cranfield, 1999):

This audit has been developed by Cranfield School of Management. This audit does not have check-points, but questions that participants have to answer precisely. This audit has 238 questions that are distributed in the following categories:

- 1- The plant profile: This is a general round-up of the company.
- 2- Nature of manufacturing operation.
- 3- Cost structure.
- 4- Inventory profile.
- 5- Employee profile.
- 6- Management information.
- 7- Market positioning.
- 8- Product innovation.

The previous tools have many things in common and many things that are unique, and this is due to the fact that every one of these tools has been tailor-made to specific requirements. However, there are some main managerial concepts that all of the previous tools are threaded around them. These concepts could be identified as the following:

- 1- The Strategy of the company.
- 2- The culture of the company.
- 3- The operation system.
- 4- Level of innovation.
- 5- The company's financial position.
- 6- The company's position in the market.

By asking questions about how these concepts affect the level of technologies in companies, and answering these questions has enabled the author to make the first draft

of the required technological assessment tool, which later on has been refined and modified to fit with the client requirements.

5. The assessment tool – notes and discussion

As it was mentioned before, the tool has to meet six requirements:

- 1- To provide a general awareness to the company's activities and its market (i.e. general round-up).
- 2- To assess the company's attitude to acquire new technologies.
- 3- To assess the company's perception toward their current technologies.
- 4- To assess the efficiency of the company's production processes.
- 5- To assess the level of the product competitiveness.
- 6- To assess the company's attitude toward technology improvement.

The full assessment tool can be found in the appendix.

To meet the above requirements, the assessment tool has been designed with six categories with the same headings of the above requirements:

5.1 General Round Up:

The purpose of this category is to give an idea about the company and its market. So, in this group of questions, there is no strong or weak answers and there is no scale.

The general points that have been chosen for this category are the following:

- 5.1.1 The company name.
- 5.1.2 The company address.
- 5.1.3 The activity of the company, i.e. what they do.

5.1.4 Type of the business, i.e. are they sole trader, partnership, private limited company, or public limited company. This question has been adopted from Montage (Internet Ref.).

5.1.5 The business start-up.

5.1.6 Number of employees.

In this point, the European Commission definition – 1996 - of small and medium enterprise has been taken into account (unece.org – nternet Ref.):

The small size enterprise in the European definition is the enterprise that has fewer than 50 employees and has either an annual turnover not exceeding ECU 7m (i.e. £4.5m, 25-Sep-02) or an annual balance-sheet total not exceeding ECU 5m (i.e. £3m, 25-Sep-02).

The medium size enterprise in the European definition is the enterprise that has fewer than 250 employees and has either an annual turnover not exceeding ECU 40m (i.e. £25m, 25-Sep-02) or an annual balance-sheet total not exceeding ECU 27m (i.e. £17m, 25-Sep-02).

Also the European Commission has differentiated between small enterprise (i.e. 9 to 50 employees) and micro-enterprise (i.e. 1 to 9 employees).

5.1.7 Annual turnover.

The same as the previous point, the annual turnover scale had considered the European Commission definition of the small and medium enterprise.

Regarding the balance-sheet total, it has been recommended that it should not be included in the assessment tool as it would be confusing as there are

different format for balance sheet in UK.

5.1.8 The percentage of the part-time employees to the overall employees.

5.1.9 The main paying system, i.e. salary-base, hourly-base, or paid-by-piece.

This would give an idea to the human resource strategies in the company. If the main paying system in the company is 'paying-by-piece' then it would be difficult for the company to launch a training program as the time for this program (in the mind of the employees) would be better to be spent in making money.

5.1.10 The percentage of tasks that require high level of training.

5.1.11 The level of sophistication of the product. If the product is sophisticated that would imply high level of technology usage more than if the product was simple.

5.1.12 The level of complexity of the production processes. If the production processes are complex then that would imply high level of technology usage more than if the processes were simple.

5.1.13 Identification to the current management challenges that are occupying the management agenda. This would give an idea about the major problems and difficulties that the company are facing at the moment and want to solve it.

These difficulties could be categorised as the following:

1. Culture difficulties, as low of moral, lack of teamwork, lack of communication skills, etc.
2. Products deficiency and lack of product quality.
3. Over-expensiveness in the production processes.

4. Inefficiency of information processing.
5. Long lead time.
6. Lack of coordination between different functions.

Identifying the major problem within the company would highlight the technology that they might be interested in.

5.1.14 The major competitive edge in the market.

The competitive edge is the edge that would attract customers if the price, quality, and delivery schedule were all nearly equal within all competitors. The competitive edge might be cheaper price, more quality, more speed in term of delivery, the image of the company, and the company's after-sales-services.

Having an idea about the main competitive edge would give an idea about the market where the company is currently operating. A market where the price is the main competitive edge is different than a market where the company's image is the main competitive edge in it.

5.1.15 The company's manufacturing type.

Russell and Taylor (1998, p.43) had identified three type of manufacturing companies:

“The kinds of products and services offered by a company drive operation strategy. Products and services can be classified as make-to-order, make-to-stock, assemble-to-order:

Make-to-order products and services are designed, produced, and delivered to customer specifications in response to customer orders.

Make-to-stock products and services are designed and produced for standard customers in anticipation of demand.

Assemble-to-order products and services are produced in standard modules to which options are added according to customer specifications”.

However, the assemble-to-order could be viewed as a special case of make-to-stock as there should a level of stock for a semi finished products.

That would lead to two main types of companies regarding manufacturing type: make-to-order or make-to-stock.

5.1.16 The company’s production type.

Russell and Taylor (1998, p.44), had identified four main types of production processing:

Project processing type: “A project is a one-at-a-time production of a product to customer orders”.

Batch production type: “Batch production processes many different jobs through the production system at the same time in groups or batches. Products are made to customer order, volume (in term of customer order size) is low, and demand fluctuates”.

Mass production type: “Mass production produces large volumes of a standard product for a mass market. Product demand is stable,

and product volume is high”.

Continuous production type: “Continuous production is used for very high-volume commodity products that are very standardised”.

5.1.17 Market & technology trends:

In dealing with the market there is four main strategies the company could adopt (Kotler, 1994):

- 1- Market Penetration: “Here the management looks for ways to increase the market share of its current products in their current markets”.
- 2- Market development: This is identifying new markets (i.e. new group of customers).
- 3- Product development: This is to improve the existing products or developing new products for the same market that the company is operating.
- 4- Diversification: This is entering new market with a new kind of products.

In the other hand, Goodman and Lawless (1994, p.55) had introduced seven main types of technology actions that company could choose from:

- 1- Investing in productivity in order to make the product cheaper or more valuable.
- 2- Investing in capacity in order to increase the volume of the output products.
- 3- Investing in flexibility in order to increase the company's ability to produce new products.
- 4- Invest in R&D for new general products.
- 5- Invest in R&D for new niche products.
- 6- Invest in R&D for hierarchical design.
- 7- Negotiate hierarchical governance.

Taking both of the above models, then the company would have the following types of strategies to choice for their business:

- 1- To invest in productivity to reduce the cost of production.
- 2- To invest in productivity to improve the quality of the product.
- 3- To invest in productivity to reduce the costs of making different products. (i.e. investing in flexibility).
- 4- To invest in capacity to increase the market share of the company.
- 5- To invest in 'research & development' to design new products.
- 6- To enter a new market.

This point would give an idea about how the management see their future in the market. Also this point would give an idea about the technologies that the company might need in the future.

5.2 The company's attitude to the acquisition of new technologies:

Many academics connect the characteristic of entrepreneurship with the passion towards new technologies:

“There is a popular and romantic perception of talented entrepreneurs, often operating in high technology sectors, developing innovative new products and processes that will transform their industry's, and even their country's prospects. Thus, they are perceived as the dynamos of technological development, social progress and economic growth” (Beaver & Prince, 2002).

“The traditional mainstream view of the entrepreneur is as a ‘risk-taker’ bringing different factors of production together. The Austrian school takes more dynamic perspective with entrepreneurship crucial for economical development and as a catalyst for change. In particular the Schumpeterian entrepreneur is an innovator who introduces new products and technologies.” (Henderson & Robertson, 1999).

“Here the function of the entrepreneur is to reform or revolutionize the pattern of production by exploiting and invention, or more generally, an untried technological possibilities for producing a new commodity or producing an old one in a new way, by opening up new source of supply of materials or a new outlet for products, by reorganising an industry and so on” (Schumpeter in Hamilton & Harper, 1994).

So it could be argued that the elements of entrepreneurship could be regarded as the same elements that underpin the attitude toward new technologies.

The elements of entrepreneurship can be listed as the following:

- Proactive patterns (Miller & Friesen, 1982, Barringer & Bluedorn, 1999).

- Financial risk-taking (Miller & Friesen, 1982, Barringer & Bludorn, 1999).
- Innovation (Miller & Friesen, 1982, Barringer & Bludorn, 1999).
- Obsession for winning (or competitive aggressive (Lumpkin & Dess, 1996)).
- Market scanning (or Scanning intensity Barringer & Bludorn, 1999)).

Also there are other elements that seemed to have a direct effect on the attitude toward new technologies:

- Financial pressures.
- Level of rivalry in the market.
- Market attractiveness.

These elements will be now discussed in detail:

5.2.1 Proactive Patterns:

Proactiveness has been seen as a major dimension for entrepreneurship (Miller & Friesen, 1982, Lumpkin & Dess, 1996). Proactiveness refers to a firm “that was the quickest to innovate and first to introduce new products or services” (Lumpkin & Dess, 1996).

However, this idea has been first introduced in different form and in much clearer way by Miles & Snow (1978). They introduced a typology for organisations in term of their “pattern of behaviour”^{*} that dominate their

^{*} This has been called later on as the company’s strategic pattern (Kald et al, 2000).

planning and decision making. The main typology is as the following:

1. Prospector:

These are risk taker companies, first-to-try, and first-to-the-market. They have a burning desire to try something new and to achieve something unique.

2. Analyser:

These organisations have considerable amount of risk taking but they are also cautious. These companies are the second-to-the-market, and whenever there is something new they would first search for previous companies that have tried it.

3. Defender:

These organisation are very happy with what they have got and they don't want to change it unless their are considerable evidences that a change should take place.

As there is a clear similarity between this typology and the meaning of proactiveness, the name of this checkpoint has been labelled as proactive patterns to refer to this typology.

5.2.2 Risk Taking:

There are also many aspects for risk taking, as personal risks, social risk, psychological risk, and many others (Lumpkin & Dess, 1996). The risk taking that is relevant to entrepreneurship (and the attitude toward technologies) is the risk to commit a large amount of money into the

unknown. The idea behind this element is whether the management are willing to commit a considerable amount of money in high risky projects, and this is completely different than the previous element (proactiveness), which reflects the passion to try new things.

5.2.3 Innovation:

There are many aspects and ways to clarify innovation, however, the main issue in innovation that is relevant to the attitude to acquire new technologies would be whether the management have “a strong emphasis on research and development and technological leadership” (Barringer & Bludorn, 1999, p.440).

5.2.4 The obsession for winning:

This has been named by Lumpkin & Dess (1996) as the “Competitive aggressive”, however, the expression “The obsession for winning” might give a clearer implication to the content of it.

The obsession of winning is the burning desire to be number one. It is the drive to scrutinise your competitors and try hard to exceed them.

The difference between this dimension and proactiveness is that proactive people are driven by the challenge of trying to create something new, so even if they are in a market with no competitors they still will innovate.

However if this situation happened to the ‘obsessive for winning’ people, they will probably lose interest of innovation in this market.

5.2.5 Market Scanning:

Barringer & Bluedorn (1999) have stressed the importance of market scanning (in their terminology: Scanning Intensity) to the entrepreneurship orientation:

”Recall that entrepreneurial firms are innovative, risk taking, and proactive; and a central theme of the innovation literature is that information gathering and analysis is critical to the development and maintenance of successful innovation strategies” (Barringer & Bluedorn, 1999, p423).

This connection between market scanning and entrepreneurship can also clarify the same connection between market scanning and the attitude toward technology; having clear and up-to-date knowledge about the market would influence the attitude toward technology as it will influence the attitude toward innovation.

5.2.6 The market attractiveness:

This reflects the market life cycle in the eyes of the company, so if the company think that the market is still in the booming phase then they would think seriously for development, while if the company think that the market is in a mature and stable phase then they might hesitate to think about developments. If the company think that the market is in a decline stage then it is expected that the company won't look for new developments.

5.2.7 The level of rivalry in the market:

If the level of rivalry is high, then each player in the market would trace their competitors and would improve their technologies to meet or exceed

the advantage of their competitors, thus, the level of rivalry would effect the attitude toward new technologies.

5.2.8 Financial Pressures:

If the company has a high financial pressures, then they are probably won't have the interest or ability to invest in new technologies. In the other hand, if the company has a plenty of financial resources, then it would be expected that they would look for new ideas and projects and would be relaxed to invest in some type of risky projects.

5.3 The company's perceptions about their current technologies:

This dimension is related to the company's perceptions about the current technologies that the company are applying at the moment. The elements of this heading are the following:

- 5.3.1 The fitness between the company's needs and the technologies they are using (i.e. do the technologies that the company are using fit with the company's needs?).

Having technologies that are completely insufficient to the company's need would make a negative perception. The same negative perception would come if the company brought technologies that are completely over their needs.

Having an awareness to the company's perception of this element would trigger and stimulate thoughts to find ways to amend and improve. So, if the current technologies are over the company's needs then thoughts could be directed to find the areas that these technologies could be used thus generating extra profits. If, in the other hand, the current technologies are below the needs of the company, then thoughts could be directed to find the most cost-effective ways to obtain the needed technologies. If it turned out that this is a false perception (i.e. the technologies the company have are fit with the company's needs but the employees had a wrong perception) then it is an opportunity to improve the employees awareness and boost their motivation.

- 5.3.2 Level of technology utilisation in the company.

Having the right technology that has not been utilised properly would make a negative perception to the technologies in hand.

If the technologies are not fully utilised then thoughts could be directed to find ways to amend this situation.

5.3.3 Level of employees' training to handle the technologies in hand (i.e. the technologies that the company have at the moment).

Training in this context does not include development training but only training to use the technologies in hand in the best possible way. Each technology would have its own complexity and secrets, and for employees to master using these technologies they should acquire a certain skill and move-up to a certain level in their learning-curve. If the employees had acquired these skills and reached a good level in the learning curve smoothly by appropriate training then they would have a positive perception more than employees that they had to acquire these skills and move-up in the learning-curve by only their own initiatives using their judgment and trial and error methods.

If it turned out that there is a lack of employee training, then it could be possible to assess the current skill of the employees in dealing with the technologies in hand, and then, thoughts could be directed to find the most effective ways to increase the learning-curve of the employees.

5.3.4 Level of the company's technologies compared to their main competitors.

If the main competitors have technologies more sophisticated than the company, then this would make a negative perception to the current technologies that the company acquire. In the other hand, if the company's technologies were more sophisticated than their competitors then the company would have a positive perception toward their current technologies.

There is no contradiction between this element and the first one (level of

fitness), as their might be two perceptions: one feeling of pride as what the company have is better than their competitors, and another thought that there is an over fit between their technologies and their needs.

5.4 The level of the product competitiveness:

This measurement could be valuable as it could turn the attention toward hidden technological weaknesses in the company that could be amended as it will be explained at the end of this section.

Porter (1980) had introduced two main strategies Cost leadership and Differentiation*:

Cost leadership: “Here the business works hard to achieve the lowest production and distribution costs so that it can price lower than its competitors and win a larger market share” (Kotler, 2000, p.80).

Differentiation: “ Here the business concentrates on achieving superior performance in an important customer benefit area valued by a large part of the market” (Kotler, 2000, p.80).

Kotler (2000, p228) had listed five main types of differentiation:

1) Product Differentiation:

- Form: “The size, shape, or physical structure”.
- Features: “The characteristics that supplement the product’s basic function”.
- Performance: This refers to “the level at which the product’s primary characteristics operate”.
- Conformance: This refers to “the degree to which all the produced units are identical and meet the promised specification”.
- Durability: “The measure of the products expected operation life under natural or stressful conditions”.

* Actually, Porter (1980) had introduced three generic strategies: Cost leadership, Differentiation, and Focus strategies. However, as Kald et al (2000) explained, the focus strategy is not an “explicit strategy by it self” but it is rather a choice of the previous other strategies (i.e. cost leadership or differentiation) in a niche market. So Porter main strategies would be either cost leadership or differentiation.

- Reliability: “The probability that a product will not malfunction or fail within a specified time period”.
- Reparability: “The measure of the ease of fixing a product when it malfunctions or fails”.
- Style: “Style describes the product’s look and feel to the buyer”.
- Design: This refers to “the totality of features that affect how a product looks and functions in terms of customer requirements. To the customer, a well-designed product is one that is pleasant to look at and easy to open, use, repair, and dispose of”.

2) Service Differentiation:

- Ordering ease.
- Delivery: “Speed, accuracy, care attending, etc.”.
- Installation: “This refers to the work done to make a product operational in its planned location”.
- Customer training.
- Customer Consulting.
- Maintenance and repair: This describes the services program for helping customers keep purchased products in good working order”.
- Miscellaneous services.

3) Personnel Differentiation:

Competence, Courtesy, Credibility, Reliability, Responsiveness, Communication.

4) Channel Differentiation:

Coverage, Expertise, Performance.

5) Image Differentiation:

Symbols, Media, Atmosphere, Events.

Although the level of competitiveness is highly depending on the company's effectiveness of strategic planning and the company's culture and mind set, however, competitiveness also depends on the company's technological level compared to its main competitors.

As it is obvious that the level of technology can affect the cost of the product thus affect the price of the product, also the level of technologies can affect the level of differentiation of the product.

Looking back at Kotler lists of differentiation it is possible to recognise the following dimensions that technology has a very high effects on its level of competitiveness:

5.4.1 The value of quality in the product:

This is the value that the customer recognises in the product. This would refer to the following elements:

Design (physical structure, features, and styles are included in this elements to ease the assessment tool), Performance (conformance is included in this element), Durability, Reliability, and Reparability.

The concerns here whether the company's products are better, similar or lower in their over-all-quality compared to similar competitive products.

5.4.2 Speed of delivery.

The concern here whether the company's schedule delivery is faster, similar, or longer than their main competitors.

5.4.3 Credibility of delivery:

This refers to the company's commitment to their delivery schedule as agreed with their customers.

The concern in this point whether the company's credibility to deliver on time is high, medium, or low.

5.4.4 Professionalism of installation.

This refers to the company's capability to install the products to the customers as agreed.

5.4.5 After-sales-service in terms of maintenance-and-repair.

The concern here is whether the company's capability and credibility for after-sales-maintenance-and-repair is higher, similar, or lower than their main competitors.

5.4.6 Product packaging image.

The concern here is whether the company's product packaging is making a better, similar, or lower impression compared to similar competitive products.

It is fair to say that it is possible that the weaknesses areas in the level of product competitiveness is not caused by a lack of technology but to the quality of the company's strategic planning and culture. It is also fair to say that it is possible that a company would not be able to be a master in all the differentiation types mentioned previously.

But, it is very safe to postulate that we might be wrong. In life there is only one truth and many possibilities about it, and the best way to find the truth among all the apparent and hidden possibilities is to challenge our assumptions and to give our creative mind a chance to contribute.

So, whatever the reason behind the weaknesses of the company's position in the previous competitiveness points, it is worth to give the creative mind a chance to find a cost effective way (in terms of equipment, methods, or tools) that could either turn the company's weaknesses to strength or at least to improve the company's position in their weak competitive areas.

5.5 The efficiency of the production processes:

Production processes in this context are the activities that transfer input materials into output products.

If there are too many defects in products, then the production processes are not efficient. If the processes are interrupted too much due to 'too much faults' then these processes are not efficient.

If the activities itself are slow then these processes are not efficient.

There are many elements that can highlight the level of efficiency of the production processes, however, to make this tool 'complex enough & simple enough' the following elements have been chosen as it is thought that they can give a proper indication to the level of efficiency to the production processes:

- 5.5.1 The production cycle time: This is the average time that requires to transform input materials to output products. This point has been adopted and modified from Northumbria et al (1998).

If the production cycle time is slower than the company's main competitors then this might indicate an area of weakness in the production processes, thus thought could be directed to find the reasons and remedies.

- 5.5.2 The value-adding-processes time compared to the overall production time.

In any production processes, there are queues, paper work requirements, inspections, etc. and there are the main processes that do the product. The main processes that do the products is called the value-adding-processes, and the concern of this point is to compare the value-adding-processes time to the overall production time.

If the value-adding-processes time is very short compared to the overall production time, then this would indicate a lot of wasted time that might be unnecessary. This point has been adopted and modified from Northumbria et al (1998).

- 5.5.3 New product introduction time: This is the time that is needed to organise and adjust the production processes to produce a new product.

If the new product introduction time is slow then that would give a sign of inflexible processes which is a major weakness. This point has been adopted from Northumbria et al (1998).

- 5.5.4 Time needed to change main equipment.

In shifting from a process to another process, then the equipment in the first process might need to be changed to another piece of equipment that is more suitable for the other process. The time needed to change the equipment would give an idea to the type and complexity of the company's production processes. On the other hand, if the time needed to change the process is long, then there might be an opportunity of improvement by involving the creative problem solving techniques to try and find a way to reduce this time.

This question has been adopted from Northumbria et al (1998).

- 5.5.5 The percentage of defects of the output products.

Usually the way to measure defects is by using statistical process control (SPC). In this method, the probability of the output product to be within the required specification is described using the standard deviation (σ).

In this method if the production processes has a process control below 2

sigma then the probability of proper output product is less than 65% (approx.), which means that the probability of defective products is more than 35%.

If the process control is between 2 and 4 sigma then the probability of acceptable output products is between 65% to 95% (approx.), which mean that the probability of defective products is between 5% to 35%.

If the process control is between 4 and 6 sigma, then the probability of acceptable products is between 95% and 99.74%, which mean that the probability of defective products is between 0.26% to 5%.

In order to make things easier in the proposed assessment tool, the scale for the defective products will be as the following:

- * Less than 1%.
- * 1% to 5%.
- * 5% to 35%.
- * More than 35%.

5.5.6 The quality level of the company's maintenance preventive management.

If the preventive maintenance management is poor then this could explain some of the problems in the production processes.

5.5.7 The effectiveness of the lay-out of equipment.

Laying out the equipment in the right place could save a lot of time and energy, while laying them out in the wrong place might be the reason for bottleneck and queues within the production processes:

“Layouts have far-reaching implications for the quality, productivity, and competitiveness of a firm. Layout decisions significantly affect how efficiently workers can do their jobs, how fast goods can be produced, how difficult it is to automate a system, and how responsive the system can be to changes in products or service design, product mix, and demand volume” (Russell & Taylor,1998, p.272).

However, it would be difficult to assess whether the current layout is the best one through simple auditing. So, instead of entering a complex area of assessing whether the equipment is in the right place or not, another way of taking the needed indication is to ask whether the equipment has been laid-out after a professional considerations, under the assumption that a professional consideration should produced professional recommendations.

5.5.8 The condition of equipment and tools in terms of tidiness and cleanness.

If the condition of equipment and tools are disruptive and disorganised then this is a sign of a major inefficiency, as this situation would cost a lot of unnecessary time and effort in doing the required activities. This point has been adopted from Northumbria et al (1998).

5.6 The company's attitude toward technology improvement:

Technology improvement is part of the whole philosophy of continuous improvement which began with the vision of Edward Deming and was continued by the philosophy of the Japanese.

Edward Deming introduced his idea about continuous improvement through what has been called the PDCA cycle, which consists of: Planning, Doing, Checking , and Acting (Russell & Taylor, 1995, p83):

Plan: Identifying the problem and planning how to solve them.

Do: Implementing the plan and measuring the results.

Check: Evaluating the plan and its results.

Act: The learning outcome.

The Japanese took Deming ideas and concepts seriously and moulded it with their own culture and philosophy to produce what has been called 'Kaizen':

Kaizen: "Japanese term that means continuous improvement, taken from words 'Kai' means change, and 'Zen' means good" (The quality dictionary and glossary, Internet Ref.).

Kaizen: continual improvement, a philosophy which encourages workers constantly to look for better ways of doing the job. This may involve, for instance, re-arranging the workplace so that tools and parts are more readily accessible; it may equally involve ways of doing the job more quickly or with fewer workers, and therefore contribute to the intensification of work" (The dictionary of critical sociology, Internet Ref.).

Although Kaizen consists of a whole kind of philosophy that includes: people orientation, process orientation, employee involvement, quality standards, etc., it also depending on the utilisation of a series of effective tools including the following:

- “Training in basic problem finding and solving process.
- Training in basic CI [continuous improvement] tools and techniques.
- Setting up relevant vehicles (e.g. quality circles) to enact CI.
- Development of an Idea Management System to receive and respond to ideas.
- Development of an appropriate reward and recognition system” (Bessant & Francis, 1999, p1107).

It is clear that to embed the philosophy of Kaizen in a company requires a cultural paradigm shift in that company. However, for the sake of this assessment tool, many of the previous Kaizen tools could be applied to make useful improvements to the company’s current technologies without dramatic change in the company’s culture:

- 5.6.1 Providing training programs for the workforce to develop their skills in problem-solving and team-work.
- 5.6.2 Creating ‘idea management system’ to gather, receive, evaluate, and respond to new ideas from the workforce, customers, suppliers and others.
- 5.6.3 Creating ‘idea-reward-and-recognition-system’ to encourage and motivate the workforce to think and forward their ideas.
- 5.6.4 To monitor and make sure that the management attitude does not reflect at all any sign of blaming or cynicism toward ideas that are collected from the workforce and to try and fight the culture of blaming in the work environment.

The previous tools are cost effective tools and easy to implement and it would be argued that it is a common sense to expect that the reward for applying these tools would be an improvement of the company's methods and current technologies.

6. The Conclusion:

The main points that were essential in creating this assessment tool are the following:

- To specify clearly the client's requirements.
- To gather relevant examples and information.
- To generate possible ideas and proposals.
- To go back and forth with the client until a particular proposal is approved.
- To create the assessment tool to be in alignment with the managerial theories and concepts.
- To create the assessment tool to be complex enough to reflect the reality and simple enough to be easily used.

The author gained much pleasure in doing this project as it gave him the opportunity to go deeper into the techniques of problem solving and lateral thinking.

Also this project widened his perspective about continuous improvement, entrepreneurship, and the effect of technology awareness both on the company's performance and their strategic management.

The best issue in this project is that it gave the skill and ability to design and create assessment tools, which would be a valuable skill for monitoring and control.

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The Appendix

Technological capabilities assessment

The Introduction

Dear Sir/Madam:

The following checklist is a technology assessment that assesses the company's attitude to acquire new technologies, the company's perception toward their current technologies, the efficiency of the current production processes, the level of the product competitiveness, and the company's attitude toward technology improvement.

The aim of this assessment is to highlight areas of weaknesses as a pre-step to stimulate thoughts for possible technologies that can improve the company's position in the market.

Most of the questions in this assessment have multiple tick boxes. Please tick **one box only** for each question unless otherwise mentioned.

The result of this assessment will remain confidential.

Note: Please take into consideration that technologies in this assessment is regarded as "any tool or technique, any product or process, any physical equipment or method of doing or making, by which the human capability is extended".

Yours Sincerely,

Technology Capabilities Assessment

1. General Round-Up:

1.1- Company Name:.....

1.2- Company Address:

.....

.....

.....

Tel:

Fax:

Email:

1.3- Business activity:

.....

.....

1.4- Type of business:

- a. Sole Trader.
- b. Partnership.
- c. Private limited Company.
- d. Public Limited Company.

1.5- Business start-up:

- a. Less than one year.
- b. 1-5 years ago.
- c. More than 5 years.

1.6- Number of employees (full and part time):

- a. 1 to 9.
- b. 10 to 49.
- c. 50 to 249.
- d. 250 employees plus.

1.7- Annual turnover:

- a. Less than £4.5m.
- b. £4.5m to £25m.
- c. £25m plus.

1.8- What is the percentage of the part-time employees to the overall employment?

- a. Less than 25%.
- b. 25% to 50%.
- c. 50% to 75%.
- d. More than 75%.

1.9- What is the percentage of tasks that require high level of training?

- a. Less than 25%.
- b. 25% to 50%.
- c. 50% to 75%.
- d. More than 75%.

1.10- What is the main paying system for employees?

- a- Salary-base.
- b- Hourly-base.
- c- Paid by piece.
- d- Other system. Please specify:

1.11- The products that the company is providing are perceived by customers to be:

- a. Sophisticated.
- b. Normal.
- c. Simple.

1.12- The company's production processes are:

- a. Complex.
- b. Normal.
- c. Simple.

1.13- With reference to the following challenges that the management might be considering, which challenges do you think would be an urgent matter, an important matter, or 'Not a big problem matter' [for this question, please tick one box only for each statement]:

Urgent matter	Important matter	Normal matter	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	a. To improve the company's culture, as values, behaviours, norms, etc.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	b. To improve the quality of products.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	c. To improve the efficacy of the production processes.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	d. To improve the delivery due date.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	e. To improve the level of coordination between different function in the company.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	f. To improve the information processing.

1.14- Which two factors from the following have more impact on the market?
[For this question, please tick two boxes only]

First Importance	Second in Importance	
<input type="checkbox"/>	<input type="checkbox"/>	a. Price.
<input type="checkbox"/>	<input type="checkbox"/>	b. Quality.
<input type="checkbox"/>	<input type="checkbox"/>	c. Delivery schedule.
<input type="checkbox"/>	<input type="checkbox"/>	d. Company's image.
<input type="checkbox"/>	<input type="checkbox"/>	e. After sales services.

1.15- What is the company's manufacturing type:

- a. Manufacture-to-order. i.e. No customer orders, No production.
- b. Manufacture-to-stoke. i.e. The company maintain a certain stock level.
- c. Other type. Please specify:

1.16- What is the main processing type:

- a. Project-processing type. This type of process is used for fully customised products.
- b. Batch type. This type is used to produce products that are standard with some kind of customisation.
- c. Mass-production type. This type is used to produce fully standardised products.
- d. Continuous-production type. As the name implies, this type is used to make 24 hours continuous production.

1.17- Looking to the future, what do you think is the best strategy for the company to attract more customers and to make more profits [*for this question, please tick two boxes only*]:

The first The second
Priority Priority

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | a. To invest in productivity to reduce the cost of production. |
| <input type="checkbox"/> | <input type="checkbox"/> | b. To invest in productivity to improve product quality. |
| <input type="checkbox"/> | <input type="checkbox"/> | c. To invest in productivity to increase flexibility in order to do different jobs. |
| <input type="checkbox"/> | <input type="checkbox"/> | d. To invest in productivity in order to increase capacity thus increasing the market share of the company. |
| <input type="checkbox"/> | <input type="checkbox"/> | e. To invest in 'research and development' to produce new products. |
| <input type="checkbox"/> | <input type="checkbox"/> | f. To enter new market. |

2. The company's attitude to the acquisition of new technologies:

2.1- Looking to the future, what do you think the trend would be for the company's current market?

- 3- [] The market will continue to boom in the near future.
- 2- [] The market will reach a mature and stable level in the near future.
- 1- [] The market will decline and come down in the near future.

2.2- What is the level of rivalry within competitors in market?

- 3- [] High. There is aggressive competition in the market.
- 2- [] Normal.
- 1- [] Low. The competitors friendly.

2.3- Which statement might best describe the company at the moment:

- 3- [] The company is looking for new ideas.
- 2- [] The company has invested a considerable amount of money in current and future projects that it makes it under pressure. However, the management still able to act if new attractive ideas are introduced.
- 1- [] The company has invested a considerable amount of money in current and old projects that they are at the moment un-interested to consider new ideas even though it were attractive.

2.4- Which statement from the following might describe the company's attitude toward financial risks:

- 3- [] The management had demonstrated in the past that they are willing to commit for projects that have high financial risks if the rate of return is proportionally high.
- 2- [] The management had demonstrated in the past that they are willing to commit to risky projects, but in the same time, they also made clear concerns for cautious.
- 1- [] The management had clearly demonstrated in the past that they prefer to commit a considerable amount of money in low/medium risky projects with normal/low rate of return rather than high risky projects with high rate of return.

2.5- Which statement from the following might describe the company's attitude toward the market:

- 3- [] The company is keen to look for new things, to try new approaches, to provide new products or services. They could be described as the First-To-The-Market.
- 2- [] The company is willing to try new approaches and ideas. However, they are little cautious and would prefer first to have practical evidence that these new ideas have high probability for success. The company could be described as the Second-In-The-Market.
- 1- [] The company is happy with what they have and prefer not to change it or add to it unless it is important. The company are applying the proverb: If it is not broken, don't fix it.

2.6- Which statement from the following might describe the management's attitude toward winning:

- 3- [] The management seriously think that it is the best for all to try as hard as possible to over exceed their competitors.
- 2- [] The management are keen to be in a same level with their competitors, but they are not interested to over exceed them, neither they are interested to apply an aggressive competition against them.
- 1- [] The management are not really provoked by their competitors winning on them as long as they have a stable share in the market.

2.7- Which statement from the following might describe the company's emphasis toward research and development:

- 3- [] The company has a strong emphasis toward research and development.
- 2- [] The company has a medium emphasis toward research and development.
- 1- [] The company has a weak emphasis toward research and development.

2.8- Which statement from the following might describe the company's sensitivity towards the market, i.e. their efforts to gather data about the market and their attention to its meanings:

- 3- [] The company has a strong sensitivity toward the market.
- 2- [] The company has a medium sensitivity toward the market, i.e. the company has a an effort to gather data about the market, but either their efforts are not very serious or their attentions to the data's meaning are not very sharp.
- 1- [] The company does not have an accepted effort for gathering and analysing the market data.

A. Total score for the 'attitude toward new technology:

3. The company's perceptions about their current technologies:

3.1- Which statement from the following might describe the employees' perception about the technologies they are using?

- 3- Most employees think that the technologies they have are fit well with their needs.
- 2- Most employees think that the many features in the technology they have are over their needs and they might be better off with a lower type of technology.
- 1- Most of the employees think that the technologies they have are below their requirements and they also think that the company had made the wrong choice in acquiring these technologies.

3.2- Referring to the company's needs and requirements, the level of technologies utilisation is:

- 3- High. The main technologies in the company are efficiently utilised according to the management agenda.
- 2- Medium. The main technologies that the company have are not highly utilised.
- 1- Low. The main technologies have a low level of utilisation.

3.3- Do the employees receive sufficient and adequate training to use the available technologies in hand?

- 3- Yes. The employees receive sufficient and adequate training.
- 2- Somewhat. The employees receive some training.
- 1- None. The employees are left alone in their attempt to create their learning curve.

3.4- What is the level of the company's current technologies compared to main competitors?

- 3- Higher than the technologies that the main competitors have.
- 2- Similar to main competitors.
- 1- Lower than the main competitors.

B. Total score for the 'perception about the current technology:

4. The level of products competitiveness:

This would help to highlight the possible competitive weaknesses of the company, thus would trigger thoughts about what and how technology could help to improve that area of weaknesses.

4.1- What are the prices of the company's products compared to its main competitive products?

- 3- Cheaper than the main competitive products.
- 2- The same as the competitive products.
- 1- Higher than the main competitive products.
- 0- I am not sure.

4.2- What is the company's delivery schedule compared to main competitors?

- 3- Shorter than main competitors.
- 2- Similar to main competitors.
- 1- Longer than main competitors.
- 0- I am not sure.

4.3- Do the company deliver their products on the scheduled time as agreed?

- 3- Yes. Most of the company's products are delivered on time.
- 2- Somewhat.
- 1- The company has a problem in delivering on time.

4.4- What is the level of the company's product performance compared to its main competitive products?

- 3- The company's products performance is better than its competitive products.
- 2- Similar to its competitive products.
- 1- Lower than its competitive products.
- 0- I am not sure.

4.5- What is the expected operation life for company's product compared to its main competitive products?

- 3- The operation life for the company's products are higher than its main competitive products.
- 2- Similar to its competitive products.
- 1- Lower than its competitive products.
- 0- I am not sure.

4.6- What is the probability of the company's products **not** to fail in its specified time period compared to its main competitive products?

- 3- The probability not failing of the company's products is higher than the probability of its competitive products.
- 2- Similar to its competitive products.
- 1- Lower than its competitive products.
- 0- I am not sure.

4.7- What is the level of easiness of repairing the company's products faults, if occurred, compared to its main competitive products?

- 3- The company's products are more easy to repair than its competitive products.
- 2- Similar to its competitive products.
- 1- The company's products are harder to repair than its competitive products.
- 0- I am not sure.

4.8- What the perception of customers regarding the design quality of the company's products compared to its main competitive products?

Design in this context refers to the products look, features and characteristics.

- 3- Most of customers think that the quality design of the company's products is better than its competitive products.
- 2- Similar to its competitive products.
- 1- Most of customers think that the quality design of the company's products is lower than its competitive products.
- 0- I am not sure.

4.9- What is the level of the company's 'after-sales-service' in term of maintenance-and-repair compared to main competitors?

- 3- Better than main competitors.
- 2- Similar to main competitors.
- 1- Less than main competitors.
- 0- I am not sure.

4.10- What is the level of the product 's image (as packaging) compared to its main competitive products?

- 3- Better than main competitive products.
- 2- Similar to main competitive products.
- 1- Lower than main competitive products.
- 0- I am not sure.

C. Total score for the 'level of competitiveness':
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5. The efficiency of the production processes:

5.1- What is the level of the production cycle time compared to the main competitors?

The production cycle time is the average time that requires to transform the input materials to output products.

- 3- The production cycle time is less than the main competitors' production cycle time.
- 2- Similar to main competitors.
- 1- Greater than main competitors.
- 0- I am not sure.

5.2- What is the 'value-adding-processes' time referred to the overall production time?

Value-adding processes are the main processes in the production cycle that add value, so waiting time, rework time, and other wasted time is not included in the value-adding time.

The overall production time is the average time that requires to transform input materials to output products.

- 3- More than 25% of the overall production time.
- 2- 10-25%.
- 1- Less than 10%.

5.3- What is the level of the new product introduction time that is needed from introducing new ideas until production, compared to main competitors?

- 3- Shorter than main competitors.
- 2- Similar to main competitors.
- 1- Greater than main competitors.
- 0- I am not sure.

5.4- What is the time needed to change the main equipments?

The company would have to change equipments when shifting from a process to another process. The time of change should include the time for setting, adjustments and cleaning activities.

- a. Few minutes.
- b. Few Hours.
- c. Days or weeks.

5.5- What is the percentage of products defects at the output of the production process?

- 3- Less than 1%.
- 2- 1-5%.
- 1- 5-35%.
- 0- More than 35%.

5.6- What is the company's level in maintenance preventive management?

- 3- Effective.
- 2- Accepted.
- 1- Poor.

5.7- Have the equipments been laid-out after thorough considerations to space, time and efforts?

- 3- Yes. There was a through study to find the best lay-out of equipment.
- 2- There was a consideration thoughts but not in a formal way.
- 1- No. The equipments have been laid-out at the 'first-seen-convenient'.

5.8- Evaluate the current condition of equipments and tools.

- 3- organised and clean.
- 2- Accepted.
- 1- Disruptive.

D. Total score for the 'efficiency of processes':

6. The company's attitude toward technology improvement:

6.1- Does the company provide an effective development programs for their employees especially to develop their problem solving and teamwork skills?

- 3- Yes, and the results are encouraging.
- 2- Yes, but the programs are not very effective.
- 1- Sometimes.
- 0- No.

6.2- Does the company have a clear 'idea management system' to gather, receive, evaluate, and respond to new ideas from their employees and others (as suppliers and customers)?

- 3- Yes. The company has a clear idea management system, and employees think that the management are very serious about it.
- 2- Yes. The company has a system for ideas, but the employees think that the management are not serious about it.
- 1- No. The company does not have a clear system for ideas.

6.3- Does the company has a clear 'idea reward and recognition system' to encourage employees to forward their ideas?

- 3- Yes. The company has a clear 'idea reward system' and employees think it is appropriate and encouraging.
- 2- Yes. But the employees think that the system is not appropriate.
- 1- No. The company does not have a clear 'idea reward system'.

6.4- What is the level of the blaming and/or cynicism culture in the company?

- 3- The blaming and/or cynicism culture in the company is negligible.
- 2- The blaming and/or cynicism culture is medium.
- 1- The blaming and/or cynicism culture is high and obvious.

6.5- Has the company managed to motivate their employees to think and produce new ideas?

- 3- Yes. The employees are very motivated.
- 2- Somewhat. It seems that the employees are motivated, but no efforts from them have been noticed.
- 1- No. The employees are not motivated to think and produce new ideas.

Result Sheet

- A. Percentage level for ‘The company’s attitude to acquire new technologies’:
 Score x 100/24 = [] x 100/24 = [%].
- B. Percentage level for ‘The company’s perceptions about the current technologies’:
 Score x 100/12 = [] x 100/12 = [%].
- C. Percentage level for ‘The level of competitiveness’:
 Score x 100/30 = [] x 100/18 = [%].
- D. Percentage level for ‘The efficiency of the production processes’:
 Score x 100/24 = [] x 100/24 = [%].
- E. Percentage level for ‘The attitude toward technology improvement’:
 Score x 100/15 = [] x 100/15 = [%].

