An investigation into the application of agile manufacturing in an aerospace company

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Abstract

To compete effectively in the global marketplace of the twenty-first century, manufacturing companies are trying to maintain a high level of flexibility and responsiveness to achieve agility and to remain competitive. A limited number of research papers have discussed agility in manufacturing organizations. This paper presents a case study conducted on agile manufacturing in the GEC-Marconi Aerospace (GECMAe) company. GECMAe manufactures pumping systems, pneumatic systems, electro-mechanical actuators and sub-systems, and fuel handling and metering equipment for ground applications and for bulk fuel distribution. The study provides the reader with an insight into the company and its agility level. An agility audit questionnaire is used for assessing the agility level of the company. GECMAe’s agile manufacturing experience is reported, including a list of recommendations for improving its competitiveness. In addition, a framework has been formulated to highlight some important areas and to offer solution alternatives not only to the current problems but also to the ones that may be encountered in the future. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Manufacturing has undergone many evolutionary stages and paradigm shifts — in going from a craft industry to mass production; then to lean manufacturing, and finally, to agile manufacturing (Esmail and Saggu, 1996).

Businesses are re-structuring and re-engineering themselves in response to the challenges and demands of the twenty-first century. The businesses of the twenty-first century will have to overcome the challenges of demanding customers who will seek high-quality, low-cost products that are relevant to their specific and rapidly changing needs (Bunce and Gould, 1996). The companies competing primarily based on the price tag is today a thing of the past. Now is the time for the companies to compete in the global marketplace, and 'push the envelope’ in delivery–response, product quality, and overall excellence in customer service and customer satisfaction. Agility addresses new ways of running companies to meet these challenges.

Agile manufacturing can be defined as the ‘capability of surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets, driven by ‘customer-defined’ products and services” (Cho et al., 1996). Agile manufacturing is a new expression that is used to represent the ability of a producer of goods and services to survive and thrive in the face of continuous change. These changes can occur in markets, technologies, business relationships and all other facets of the business enterprise (DeVor et al., 1997). Agile manufacturing aims to meet the changing market requirements by suitable alliances based on core-competencies, by organizing to manage change and uncertainty, and by leveraging people and information.

Agility is about changing the patterns of traditional operation, and casting off those old ways of doing things that are no longer appropriate. In a constantly changing
competitive environment, there is a need to develop organizations and facilities that are significantly more flexible and responsive than the currently existing ones (Gould, 1997; JamesMoore, 1996).

Agile manufacturing is neither flexible manufacturing nor lean manufacturing, nor computer integrated manufacturing, nor the like. These techniques, themselves, are not really new; many have been available for several decades, and others have been developed gradually over the last 30 years by innovative companies, e.g. Toyota (Schonberger, 1982). What is new about these techniques is that, when they are implemented under agile manufacturing in a co-ordinated way, they bring about enormous improvements in products, flexibility, innovation and in responsiveness to the changing market needs. These improvements give companies such an edge in the marketplace that they are able to take a commanding competitive lead.

In short, agile manufacturing does not represent a series of techniques much as it represents a fundamental change in management philosophy (Maskell, 1994). It is not about small-scale improvements, but an entirely different way of doing business (Kidd, 1996) with a primary emphasis on flexibility and quick response to the changing markets and customer needs.

There are a number of research reports available in the literature that discuss the concept of agile manufacturing (Womack et al., 1990; Goldman et al., 1995; Booth, 1996; Bunce and Gould, 1996; JamesMoore, 1996; Preiss et al., 1996; Cho et al., 1996; Womack and Jones, 1996; Forsythe and Ashby, 1996). However, there is a need for a systemic approach to evaluate and study agility in real-world organizations. In view of the importance of this need, the present paper reports an attempt that has been made to study the level of agility in a real life setting.

2. Research methodology

The research methodology used in this project is a case study. Data for the case study have been collected using a standard questionnaire administered within the company studied, GEC-Marconi Aerospace Ltd. (GECMAe). The purpose is to perform an agility audit on the company using the questionnaire1 (Agility Audit Questionnaire) to identify the current level of performance within the company with respect to the following four key elements of agility (see Goldman et al., 1995):

- Enriching the customer.
- Co-operating to enhance competitiveness.
- Mastering change and uncertainty.
- Leveraging people and information.

The questionnaire is administered to the key personnel within the new GECMAe Change Team as they know more about the problems of the company than anyone else does, and because it is their job to investigate and correct them. The aim is to produce a good set of results, and from these, determine an agility index (as a percentage) for where they think or perceive they are at the moment, and another index for where they should be with respect to becoming a more agile company. However, a question that arises is, Does the company need to become fully agile in order to remain competitive? This question is addressed at the end of the study, along with a discussion and a set of recommendations to GECMAe.

3. Case study: GEC-Marconi Instruments (UK)

In this section, the details of the case study conducted at GECMAe are presented. First, a background on the company is provided. Then, the aforementioned Agility Audit Questionnaire is used to audit agility by assigning an appropriate possible score to indicate a current and perceived agility index (expressed as a percentage).

3.1. Gec-Marconi Aerospace Ltd

GECMAe, formerly Marconi Aerospace, is a part of the multi-national group General Electric Company, PLC, of the United Kingdom (GEC/PLC-UK). (Marconi Aerospace was previously owned by the Plessey group before a take-over bid in 1989 by the multi-national company GEC.) At its Titchfield branch, on the south coast of England, occupying a 25-acre site with 351,000 ft² of factory and office space, GECMAe employs about 700 people, and has an annual turnover in excess of £80 million. It is an operating company within the GEC/PLC-UK group, and supplies its products to most of the major original equipment manufacturers (OEMs) active in the aerospace and defence sectors, and to all major airlines in the world. Competitors of GECMAe include Lockheed Martin, Pratt-Whitney, Douglas, Algonquin Parts Incorporated, Fortner Engineering and Manufacturing Inc., and Space Innovations Ltd.

The upper management structure of GECMAe is fairly straightforward. There are nine executives forming the board (at Titchfield), accountable to the Managing Director. In all, there are four levels of management. The GEC Head Office, based in London, oversees GECMAe and all the divisions.

GEC has a group annual turnover of over £9.4 billion (around US $15 billion) spread across many high-technology areas. It has the substantial resources to provide

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1 Available from authors upon request.
its operating companies — such as GECMAe — with the R and D, production and investment support facilities required to meet the growing needs of the international market place.

GECMAe is an international market leader in the design and production of a wide range of critical systems needed to maximise the performance, integrity and safety of the current and next generation aircraft and air/land systems. It has been active for over 50 years supplying systems for civil and military aircraft and for ground defence applications. Its R and D and production facilities in UK are mirrored by similar operations at GEC Aerospace Inc. in Whippany, New Jersey. The Company’s manufacturing bases in UK and USA are subject to continuous investment to achieve the highest levels of quality and cost-effectiveness. Product support is fully integrated into the GECMAe management structure. It is aimed at ensuring a complete total-life service to its customers across the world for systems supplied today that will continue to be in service well into the future.

All GECMAe products are offered to its worldwide client base with the necessary approvals from the appropriate statutory or regulatory bodies. The product range includes a wide and innovative variety of equipment for:

1. Pneumatic systems.
2. Electro-mechanical actuators and sub-systems.
3. Electrical and ground power systems.
4. Pumping systems.
5. Fuel handling and metering equipment for ground applications, including bulk fuel distribution.

The company is a specialist in the design, development and production of high-quality components and systems for applications in civil and defence markets, including products used in military fighting vehicles and weapon systems. It supplies to most of the world’s aircraft manufacturers, and also supports the equipment in the field of airlines and air forces worldwide. In addition, the company provides a comprehensive service ranging from consultancy to total project management, with a 24 hour Aircraft-On-Ground service and logistic support. The shares of different products of GECMAe are shown in Fig. 1.

The company has extensive site facilities for the design, development, manufacture, testing and support of its products, with specialist departments for key activities in (i) high technology; (ii) heat treatment; (iii) metal finishing; (iv) repair and overhaul; and (v) testing. Manufacturing comprises the following areas: (i) high-speed machining cell; (ii) prismatic cell; (iii) cylindrical cell; and (iv) grinding. Up-to-date high-speed machining centres provide unattended running with improved quality levels while reducing process times by up to 60%.

In the design and development of new products, the company pays careful attention to meet specification requirements, including post-design work in liaison with the customer, if necessary. Design teams covering fuel, electrical, mechanical and pneumatic systems, and intelligent power control systems are in existence. Supporting the project and design teams is a group of engineers providing stress, thermal and performance analyses.

3.2. Current manufacturing situation

GECMAe is committed to maintaining its lead as a major supplier of safety-critical systems to a global market, recognising that customers need high quality and cost-effective solutions and/or products with reliable lead times. A review of the product life cycles revealed that some of the GECMAe products are within the mature stage and on the order books for the next 10 years! GECMAe, however, does not rely on the safety and security of these orders and remain stagnant; new products are being developed, especially for the new Joint-Strike Fighter aeroplane project.

3.2.1. Concurrent engineering and electronic data interchange (EDI) — world-wide

Currently, GECMAe uses process layout on the shop-floor. An integrated suite of CAE tools enables tasks, such as design analysis, CNC planning and measurement, and rapid prototyping, to be carried out concurrently from the same 3D model. Networking allows this information to be stored not only across the business but also with customers and partners worldwide. It is claimed (GEC marketing brochure) that the benefits in improved quality, reliability and time-to-manufacture are well proven.

3.2.2. Internal excellence by investment and external review

In addition to investing extensively in the skills of its people, GECMAe takes full advantage of the knowledge and experience available within the GEC group of companies. Project plans are regularly reviewed by external specialists, starting before bid submission and continuing
throughout the life of the product. It is also claimed (GEC marketing brochure) that the lifecycle management process helps to provide customers with defect-free products, on-time and within budget. Furthermore, as mentioned earlier, major investment in the latest high-speed machining centres provides unattended running and improved quality, while reducing processing times by up to 60% such that some of the more complex products can now be machined in ‘one hit’.

3.3. Results and analysis

The following data have been collected by interviewing members of the GECEMAe Change Team using the Agility Audit Questionnaire. Using a predetermined scale (see Tables 1–4), the scores have been calculated and summarised in each table as a percentage of the total maximum possible score, reflecting an actual and a suggested agility index. The results are given in Tables 1–4, where the areas that require improving with respect to agility are denoted by (improvement) arrows. Table 1 below gives the results for enriching the customer.

One of the most important factors for enriching the customers is to understand their needs with respect to importance objectives, and knowing the value of quality for their products and services.

The results for co-operating to enhance competitiveness are presented in Table 2. It can be seen from the results that this area also calls for improvement. An interesting question, which will be covered in the discussion later is, “does GECEMAe need to start shifting the centre of value it adds for its customers from products to information and services?”

Table 3 presents the results for mastering change and uncertainty. The most striking point concerning mastering change and uncertainty is that GECEMAe is actually putting new levels of organisational hierarchy! This goes against the idea of agility, in that adding levels of hierarchy increases the levels of communication, thereby slowing down the speed of organisational decision making, and rendering the organisation sluggish in adapting and responding to the non-linear characteristics of today’s global market.

On the other hand, it is encouraging to see that GEC-
Table 2  
Results for co-operating to enhance competitiveness (GECMAe) (maximum possible score=12; current performance for enhancing competitiveness=4/12=33% agility index; suggested performance for enhancing competitiveness=12/12=100% agility index)

<table>
<thead>
<tr>
<th>Co-operating to enhance competitiveness</th>
<th>Answer</th>
<th>Actual performance</th>
<th>Suggested performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you co-operating opportunistically across organisational lines?</td>
<td>‘Trying to’!</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Do you use cross-functional customer teams?</td>
<td>‘No’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Do the workers believe that you encourage sharing, co-operation, and team work (1), or are they focused on individual performance and rewards (0)?</td>
<td>‘Individual performance and rewards’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Is information readily available to those who need it through an enterprise-wide information system (1)? Or is information hard to find and not generally shared (0)?</td>
<td>‘Information hard to find and not generally shared, but its getting better, Investors In People’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Does your organisational structure facilitate concurrency throughout the enterprise (1)? Or are you organised into functional silos, which act independently with a minimum of communication and little co-ordination (0)?</td>
<td>‘No, organised into functional silos which act independently with a minimum of communication and little co-ordination’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Is the decision to partner a first alternative rather than a last resort?</td>
<td>‘No’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Do you both protect (1) and share (1) intellectual property?</td>
<td>‘Yes, we protect but not necessarily share’</td>
<td>1</td>
<td>Improve 2</td>
</tr>
<tr>
<td>Do you have a track record of trustworthiness (1), and will you be preferred as a partner (1)?</td>
<td>‘Yes’</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Are you using the virtual company model to achieve vertical integration (1)? Are products conceived by teaming with the customer and suppliers (1)? Or are products conceived by internal teams and kept secret until announcement dates (0)?</td>
<td>‘Products are conceived by internal teams and kept secret until announcement dates, Engineering is a mystery’</td>
<td>0</td>
<td>Improve 2</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 3  
Results for mastering change and uncertainty (GECMAe) (maximum possible score=9; current performance for mastering change and uncertainty=3/9=33% agility index; suggested performance for mastering change and uncertainty=(7.1/2)/9=83% agility index)

<table>
<thead>
<tr>
<th>Mastering change and uncertainty</th>
<th>Answer</th>
<th>Actual performance</th>
<th>Suggested performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the speed of organisational decision making measured in hours (1), days (3/4), weeks (1/2), months (1/4) or years (0)?</td>
<td>‘Years’</td>
<td>0</td>
<td>Improve 1/2</td>
</tr>
<tr>
<td>Are you constantly reinventing and reengineering the organisation?</td>
<td>‘Yes’</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Are you taking levels out of the organisational hierarchy?</td>
<td>‘No, in some cases putting them in’!</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Are you organised by functional departments (0) or by customer opportunity teams (1)?</td>
<td>‘Organised by functional departments’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Is the organisation dynamic and effective at meeting changing goals and objectives?</td>
<td>‘No’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Is change and chaos recognised as opportunity?</td>
<td>‘Yes’</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Can the organisation decide on appropriate courses of action in the face of change, and does it implement those actions?</td>
<td>‘Yes’</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Is information held for power (0) or distributed to empower (1)?</td>
<td>‘Information is held for power’</td>
<td>0</td>
<td>Improve 1</td>
</tr>
<tr>
<td>Is the mix of available manufacturing processes constantly changing?</td>
<td>‘No’</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>3</td>
<td>7 1/2</td>
</tr>
</tbody>
</table>
MAe is really starting to concentrate — like many other firms — on leveraging people and information (and treating employees as valuable assets, as opposed to depreciable facilities), though much improvement is needed. Teamwork, instead of individual performance metrics, must be considered. This seems to be an issue of great conflict amongst GECMAe employees and tends to discourage teamwork and enthusiasm. The results for leveraging people and information are presented in Table 4.

3.4. Recommendations

As mentioned earlier, GECMAe has a process layout on the shop floor (see Section 3.2). It is observed that ‘late delivery’ is a crucial problem area that needs improving. A move towards a group (cellular) technology layout would improve these characteristics dramatically.

Taking the product life cycle into account, a shift towards cellular manufacturing would make sense for the majority of GECMAe products (particularly those that are already well established and in their maturity stage). Considering the maturity stage of the product life cycle, the strategic requirement at this stage is to reduce unit production costs to remain competitive. Cellular manufacturing will not only reduce the unit costs, but it will also reduce the throughput time, and hence, the Work-In-Process (WIP). Consequently, cellular manufacturing would go a long way towards improving the turn around/delivery times, as well. GECMAe can also dramatically improve its volume without sacrificing the variety by moving from process layout to cellular layout.

On the other hand, it should be noted that, group technology has a little less product flexibility than process layout, but this does not affect the products that are already well established. Process layout could still be kept, dedicated to the new products that require more flexibility, and hence, facilitate agility in the area of new-build production. GECMAe is implementing cells as a pilot scheme at the time of the study, away from the shopfloor, and experiencing the benefits of low WIP and low throughput times.

The company has won the Investors in People award, a national standard of excellence in UK, which recognises the importance of the contribution of training and development of people to the achievement of business goals and targets. Keeping to the theme of training...
people, a team of employees called, ‘GECMAe Change Team’ has run the ‘Plug Game’ (where one builds a plug through both a push and a pull system) in an effort to train the employees, and then to empower them, in the aspects of the Kanban system. The Kanban system is to be implemented to help reduce manufacturing costs. It is known that making a pull-system work in the manufacturing environment is not an easy task, and that buffers and WIP must be carefully managed. Therefore, training is essential.

Structured Kanbans can smooth out the flow of work (Slack et al., 1995). The Kanban system would work very well with cellular manufacturing as it is more suited to higher volume production. The answer given to the question, “If Kanban is so great, why isn’t it already being used?” is interesting and revealing:

Until recently, we were able to cope with the demands placed upon us as a supplier, and our fire-fighting skills are extremely good when we have had a problem. Also, our systems have been in place for many years and are well entrenched. This combined with natural resistance to change has meant that there has not been such a strong drive to look for a radical alternative method to manufacture our products, following the line, ‘if it ain’t broke don’t fix it!’ Demand is increasing faster than our ability to supply, thus we have to look for simpler, maybe radical ways of increasing our capacity which may need a cultural change in the workforce.

Another interesting observation from the case study is that, even with late deliveries, high prices, and slow response to changes in the market, customers will still come to GECMAe. This suggests that the key factors of importance to the customer consist of other attributes, such as reliability and durability (as one is dealing with aeroplanes and related products). Perhaps the customers are dealing with GECMAe because of the prestige of the company. Improvements must be made in order to maintain this competitive advantage. Otherwise, with competition becoming increasingly intense, if the company rests on its laurels, it will be marginalised. However, this is not to say that GECMAe must become a fully agile company. Quite the opposite! It is evident that the company is successful, and has survived through one of the hardest hitting recessions of the 1990s. GECMAe may not be a fully — or even a highly — agile manufacturing company, and it may not (or does not) need to be, owing to the very nature of the industry (as mentioned earlier in Section 3.2, many products are on the order books for years). That is, the market for GECMAe is by no means as turbulent as, e.g. the mobile phone industry where there is a definite requirement to be agile and to remain so. This is owing to the fact that, on average, the product life cycle for a mobile phone is around 12 months while it has an average development time of 18 months, which means that the company is always six months behind. This is not at all the case at GECMAe.

GECMAe is good at implementing the right technologies for the right purpose. Some of the enablers of agile manufacturing, such as rapid prototyping and EDI are used, but to prosper, the company does not need to be a highly agile organisation at the moment. For GECMAe, the first priority is to become a lean organisation. Without the prerequisite of leanness, the jump to agility is not only not required, but also difficult to accomplish.

Obviously, the concept of agile manufacturing is not really new to GECMAe. The company has always taken the necessary steps to stay competitive. Aspects of agility can, and have been, implemented but the road to success in the case of GECMAe can be described as a balance between lean production characteristics for the established, mature products, and agile attributes for the next generation of products. This is not to say that agility is only applicable to the new products, and that leanness should be purely applied to older products; attributes and enablers of each concept can be used across the product range. However, the focus of agility should be on new products, using knowledge-based systems to store data that can aid future designs, and the focus of leanness should be on older products to reduce unit costs, WIP, and throughput times. For this company, the road to agility hits a breakpoint between being fully lean and fully agile, consistent with the break point between old and new products.

The data collected from the questionnaire have led to the conclusion that cost is a key parameter for both production (the company) and, more importantly, the customer. As cost is the primary issue, one should be in the mode of ‘thinking lean’. To reduce costs, along with cellular manufacturing, adoption of other valuable concepts and technologies, such as the following, should also be considered:

- Business process re-engineering (BPR).
- JIT/Kanban (to reduce costs associated with lead times).
- Concurrent engineering (DFM, CAD/CAM).
- Modularization/standardisation of products.
- Rapid prototyping (to reduce development costs).
- Quality function deployment (QFD) (to reduce overall costs by getting it right first time with the customer).

Bearing in mind the statement (Slack, 1991) that “The high-tech solution can seem attractive, especially to the company’s process engineers, but why commit to the expense and risks of technology-based solutions if a cheaper and more adaptable alternative is available”.

The summary of suggestions made for improving the agility level of the company is as follows:
4. A generic framework for agile manufacturing

Agility is the way forward, but companies must decipher the right level of agility necessary for their particular markets and business goals. A generic framework, which can be applied virtually to any manufacturing company, is shown in Fig. 2. The key steps to improving business performance are centred around four major areas: strategy, technologies, organisation, and people, suggesting the need for an enterprise to develop vision and strategy, develop technology solutions, change organizational culture, and integrate and invest in people.

The model above is intended to provide a general overview of some of the things that every company can look at to improve its overall effectiveness, and hence, its competitive advantage. The framework shows the following possible links between the key components — strategy, technology, organisation, and people — of a manufacturing company:

- Business process re-engineering (BPR).
- Information technology (IT) and electronic commerce (EC).
- Quality function deployment (QFD).
- Training and education, incentive schemes.

4.1. Business process re-engineering

Business process re-engineering (BPR) is perhaps one of the most powerful concepts which can be used to determine the non-value adding activities of processes and technologies. BPR is a link between the technology of the organisation and its overall strategy. Part of a GECAe’s strategy should be to reduce the number of non-value adding activities, which may be achieved by incorporating new technologies. One example may be the implementation of a CAD/CAM system to reduce the number of hand-offs between production and engineering, not to mention the reduction in non-value adding activities such as the re-work that results from ‘fire-fighting’ when a design has not been communicated properly from engineering to production.

4.2. Information technology and electronic commerce

The ability to communicate is paramount to customers, suppliers, employees, and machines; i.e. it is essential both inside and outside the company limits. Information technology (IT) and electronic commerce (EC) can facilitate better communication links between the technology of the firm and the rest of the organisation. However, often it is not easy to deploy/implement IT and EC; this can take a long time. For instance, in the case of GECAe, it may take up to two years to install Windows®98 on all computers as there are a lot of software compatibility checks that need to be carried out!

4.3. Quality function deployment (QFD)

QFD may be used to improve the link/communication between people and the organisation. (‘People’, in this context, is more aptly applicable to those found outside the company, like the ‘customers’, than to the employees.) QFD can be used to communicate the customer requirements into real manufacturing data for the organisation. Consequently, through QFD, the company becomes more customer-driven; and hence, more adaptive to the ever-changing, unpredictable, and turbulent
market. What is really nice or appealing about QFD is that, it can be applied to any company without too much effort, and the benefits are numerous.

The concept of becoming more customer-driven highlights a need for a company to:

- develop vision and strategy;
- change culture;
- integrate and improve enterprise;
- develop technology solutions.

These are summarised within a generic model (see Fig. 2), using the GECMAe business process re-engineering software called Quality Management Activity Software (QMAP).

4.4. Training, education, and incentive schemes

Training, education and incentive schemes — all of which aim at making workers become more agile in the business sense — will improve people by empowering them and by keeping them motivated, which ties well with the overall business strategy.

Incentive schemes at GECMAe are in the form of a ‘suggestions scheme’, where employees are financially awarded for good ideas that may save the company money, or improve the working atmosphere. On the whole, a workforce that is more enthusiastic, empowered, and educated will lead to better business.

5. Conclusions

In this paper, an attempt has been made to give a real-world account of agile manufacturing, the latest manufacturing concept, in the context of a case study from the real world of business. Its enablers were identified, and a conceptual framework was offered to illustrate them along with the four key areas of organizational agility. The case study conducted at GECMAe, an aerospace company, was used to add a real industrial perspective; thus, it provided a basis for assessing and discussing the implementation of agile manufacturing. It also highlighted some important problems arising (at the time of the study) within GECMAe, especially with regard to the applicability of agile manufacturing.

Agile manufacturing techniques that rapidly generate new models would be more applicable to the next generation of GECMAe products. It was also noted that, for GECMAe, there is a breakpoint between being a fully agile and a fully lean company. A recommendation has been made to apply a ‘lean mindset’ to the long-established products that are within the maturity stage of the product life cycle in order to reduce unit costs, while new products could lend themselves to a more agile approach.

There are many firms, which have to be agile because the life cycle of their products is short. The example of mobile phones was given to note the fact that companies can be six months behind in developing new models, while the customers in this market are very demanding.

For the established products at GECMAe, the lifecycles can be quite long, with numerous designs on the order books for the next 10 years; hence full-agility is not required. This is not to say that agile manufacturing is totally inapplicable. Quite the opposite; various enablers of agile manufacturing (e.g. Electronic Commerce, Supply Chain Management, Enterprise Resource Planning Systems, Integrated Product/Production/Business Information Systems, and Concurrent Engineering) are quite useful to employ in a company like GECMAe.
Over the years, GECMAe has been quite successful in implementing the right technologies and concepts at the right time. This is confirmed by the very survival of the Company through one of the hardest-hitting recessions. There are, however, many changes that are currently taking place at GECMAe, as well. The ‘Change Team’ has been set-up to investigate the current manufacturing problems. Much work has been carried out to improve the training and education of employees, and the pilot introduction of Kanbans and cellular manufacturing have been most successful. Changes are being made in light of the overall business perspective and market — not necessarily to become more agile, but simply because it makes sense to change!

GECMAe has the right philosophy, in that, there is no point in buying the latest technology if re-engineering or efficiency improvements can achieve the same desired end result. BPR is a powerful concept that has proven to produce some impressive increases in productivity. At GECMAe, not many employees have heard of BPR; yet, unaware of it and inadvertently, they use many BPR ideas, improving business processes and reducing the number of hand-offs in the spirit of best practice more than anything else.

At GECMAe, a software called QMAP (Quality Management Activity Processing) is used to produce tree diagrams of the activities and processes carried out within departments. The diagrams are then discussed, finalised and put up on the walls within departments where people are encouraged and empowered to write on them with reference to possible improvements, or identification of loopholes within the processes.

We have made a number of recommendations to GECMAe with the objective of improving its overall business competitiveness. Not all of them, however, need to be incorporated, or be implemented at the same time. Some of the recommendations have been reviewed at GECMAe, bearing in mind the future opportunities and threats to the business.

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