E-BUSINESS SKILL AND TRAINING NEEDS FOR NEW MANUFACTURING

ABSTRACT

During February – April 2004, the Swinburne University of Technology TAFE Division’s Centre for Collaborative Business Innovation (CCBI) and Centre for New Manufacturing (CNM) combined to research current and emerging skill and training needs for e-business across the new manufacturing sector. This research was funded via a grant from the Victorian Office of Training and Tertiary Education, and it focused on small to medium-size enterprises (SMEs).

Using structured in-depth interviews with senior personnel within SMEs engaged in different niches within new manufacturing, the current status of e-business uptake by the new manufacturing sector was clarified. Training needs and preferences in relation to e-business skill formation were also identified.

While the uptake of certain aspects of e-business was found to be strong in all new manufacturing SMEs, most firms were not exploiting the full potential that e-business offers at all stages of the computer aided design/manufacturing/engineering product development process. Few firms fully understand e-business, and few integrate e-business practices effectively into all stages and facets of their operations. Invariably, the result is delay in getting new product to market.

The main barriers to further e-business expansion and integration were found to be cost constraints, a lack of skilled staff, and the unavailability of appropriate training options. A distinct lack of knowledge about existing e-business networks, support and training options was evident. Nevertheless, a clear preference emerged for e-business training that is short, self-paced, and relevant to each firm’s needs at all stages of its product development and distribution cycle.
INTRODUCTION

In its 2002 - 5 Strategic Plan, the Victorian Office of Training and Tertiary Education (OTTE) identified a need for the VET network to respond actively to the Government's strategic priorities, and to the needs of individuals, enterprises and communities. OTTE is committed to evidence-based policy formation, and this commitment led to it commissioning the Swinburne University of Technology TAFE Division's Centre for Collaborative Business Innovation (CCBI) to research e-business skill and training needs for the new manufacturing industry. The specific research objectives were to:

- Identify current and emerging e-skills needs within the Victorian new manufacturing sector
- identify relevant industry sub-sectors and stakeholders, to determine the characteristics of their existing and planned e-business models
- review current methods of skill formation for e-business in the new manufacturing industry to identify:
  - the suitability of existing training package products and delivery models
  - the need to customise existing products, and develop new approaches to training delivery
  - required program developments, at the leading edge of new manufacturing, to address emerging needs.

In consultation with Swinburne’s Centre for New Manufacturing and other industry networks, the specific research focus area chosen for the research was the component manufacturing sector of the automotive industry. The automotive sector occupies a critical position within the broader manufacturing sector, and thus within the Victorian economy. Moreover, the component producing sector is the largest employer utilising advanced technology for new manufacturing processes, and it includes many producers that manufacture and design for other industries.
METHODS

Following a review of the literature to determine trends and predictions for the industry, interview pro formae were developed to assist in gathering data from relevant businesses. The firms concerned were identified in consultation with the Centre for New Manufacturing, Automotive Training Victoria, the Industry Liaison Agent for Automotive Components Producers, the Engineering Skills Training Board and industry associations.

Along with further desktop research, the interviews were conducted during March – May 2004, with principals of the first and second tier of the automotive component sector, and third tier suppliers including toolmakers, machine tool manufacturers and independent design houses. Representatives of the three Victorian automotive manufacturers, Ford, Holden and Toyota, were also interviewed. The data gathered were then analysed to identify key skill and training needs.

In order to provide a level of consistency in the data obtained through the interviews, some key definitions were adopted. In particular, ‘e-business’ was taken to be “… the online distribution of information, collaboration between companies in various parts of a product life cycle and external and internal manufacturing and logistics operations support.” Similarly ‘new manufacturing’ with ‘advanced technologies’ is “…the integration of mechanical engineering with electronics and computer aided engineering in the design, prototyping and manufacture of products and processes.” This methodology incorporates the advanced technologies of computer-aided design (CAD), computer-aided engineering (CAE) and computer-aided manufacturing (CAM), and operates within a manufacturing environment driven by the lean manufacturing philosophy.

Finally, existing e-business and manufacturing training programs were mapped against the identified training needs, and gaps in the available training provision were clarified. This enabled the formulation of recommendations on integrated e-business and new manufacturing curriculum development and customisation for the sector.
Industry background

The automotive manufacturing industry in Victoria consists of the vehicle manufactures, Ford, Holden and Toyota, and of suppliers categorised by tiers. Tier 1 companies supply pre-assembled components, Tier 2 companies supply individual components, pressed metal fittings and tooling capabilities and Tier 3 companies supply a range of smaller components, tooling or design services to Tier 1 and 2 firms.

There is a fourth category that has emerged as the result of the warranty shift in manufacturing and design down the supply chain. The fourth category, Tier 0.5, consists of ‘full service’ suppliers – large, multi-site companies that can supply vehicle producers with sub-assembled components in large volumes. Advanced technologies that allow for virtual prototyping and testing, and rapid manufacturing have led to the outsourcing by vehicle producers of responsibility for product development (ATA, Report on the Review of the Automotive Manufacturing Training Package, Phase 1, Final Report, June 2003).

The Victorian industry is dominated by the foreign owned vehicle manufacturers, with key component manufacturers comprising a mix of foreign owned Tier 1 suppliers, and mostly Australian owned Tier 2 and Tier 3 suppliers. This has resulted in pressure for global integration of suppliers. In particular, the Tier 1 suppliers at the frontline need to operate to the standards of the multinational vehicle manufacturers that have adopted integrated lean manufacturing systems.

Lean manufacturing is manufacturing without waste. Lean Manufacturing improves material handling, inventory, quality, scheduling, personnel and customer satisfaction management. A set of techniques to identify and eliminate waste has evolved, which include Cellular Manufacturing, Pull Scheduling (Kanban), Six Sigma/Total Quality Management, Rapid Setup and Team Development.

Lean Program Management incorporates the e-business integration of lean manufacturing techniques throughout all operations, from strategic, daily, manufacturing, human resources and customer service operations, within the
organisation. It builds on Electronic Resource Planning (ERP) to enhance supply chain logistics in managing all aspects of internal and external customer and supplier relationships.

Given the inextricable links of suppliers to the lean vehicle manufacturers, many have also adopted the processes. However, though the majority of Tier 1 suppliers will follow Advanced Product Quality Planning (APQP) it is a complex and labour intensive. Very few follow the Automotive Industry Action Group’s (AIAG) standards.

A lean APQP system is one that meets demands with very little human inventory - including customer and supplier resources. For APQP to be successful, it needs to managing knowledge across complex supply chains. This can be achieved by applying the concepts of lean manufacturing and working towards a design chain business system. The system allows for collaborative e-business communications across the business and manufacturing operations within each organisation and throughout the supply chain, from the vehicle manufactures through to Tier 3 suppliers.
RESULTS

Automotive component manufacturers’ profile

In total, twelve businesses were interviewed. The businesses were selected to provide a representation of metropolitan and regional locations, and of different stages of integrated e-business development, and to obtain a cross representation of manufacturing diversity. Eight organisations were SMEs (Table 1).

Table 1: Survey participants from the automotive components manufacturers and producers sector

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Stage of integrated e-business development</th>
<th>Supplier tier</th>
<th>Location</th>
<th>Business category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrec Pty Ltd</td>
<td>Intermediate</td>
<td>3</td>
<td>Geelong</td>
<td>Small</td>
</tr>
<tr>
<td>Berklee Limited</td>
<td>New developer - Intermediate</td>
<td>1 0.5 2</td>
<td>Ballarat</td>
<td>Medium</td>
</tr>
<tr>
<td>Cromtech Pty Ltd</td>
<td>New developer</td>
<td>3</td>
<td>Mordialloc</td>
<td>Small</td>
</tr>
<tr>
<td>Diver Consolidated Industries</td>
<td>Advanced</td>
<td>1 2</td>
<td>Reservoir</td>
<td>Large</td>
</tr>
<tr>
<td>EDAG Australia</td>
<td>Advanced</td>
<td>1 2</td>
<td>Dingley</td>
<td>Large</td>
</tr>
<tr>
<td>Flexdrive Cables Australia Pty Ltd</td>
<td>Advanced</td>
<td>1 2</td>
<td>New Gisborne</td>
<td>Medium</td>
</tr>
<tr>
<td>Forgecast Australia</td>
<td>New developer</td>
<td>1 2 3</td>
<td>Mitcham</td>
<td>Medium</td>
</tr>
<tr>
<td>Frontline Australia Pty Ltd</td>
<td>Intermediate</td>
<td>1 2</td>
<td>Dandenong</td>
<td>Medium</td>
</tr>
<tr>
<td>Henderson’s Automotive Group</td>
<td>Advanced</td>
<td>1 0.5 2</td>
<td>Geelong and Adelaide</td>
<td>Large</td>
</tr>
<tr>
<td>Lasslett Rubber and Plastics</td>
<td>Intermediate</td>
<td>2 3</td>
<td>Airport West</td>
<td>Medium</td>
</tr>
<tr>
<td>Marand Precision Engineering Pty Ltd</td>
<td>Intermediate</td>
<td>2 3</td>
<td>Moorabbin</td>
<td>Large</td>
</tr>
<tr>
<td>U.P. Industries Ltd</td>
<td>Advanced</td>
<td>1 0.5 2</td>
<td>Braeside</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The very close relationships with the four local vehicle manufacturers, incorporating the Mitsubishi plants in South Australia, are highlighted by the number of first tier suppliers, with eight of the twelve enterprises providing first tier products and services to the four manufacturers.
The type of components produced differentiates component suppliers. Of the firms included in the study:

- Eight (66%) Tier 1 companies supply pre-assembled components
- Two (17%) Tier 2 companies supply individual components, pressed metal fittings and tooling capabilities
- Two (17%) Tier 3 companies supply a range of smaller components, tooling or design services to Tier 1 & 2 firms

Only one Tier 3 supplier, a micro-tooling manufacturer, operates in a single tier, while seven firms operate in two tiers. The remainder operate in three or four tiers. However, all twelve firms have a majority of their business in the highest tier. For example, Henderson supplies across all tiers, but its revenue derive mainly from producing for Tier 1.

As noted above, the drive for the development of Tier 0.5 suppliers has been the outsourcing by vehicle producers of responsibility for product development. Thus, three (25%) of the eight Tier 1 suppliers are also Tier 0.5 suppliers.

Of the twelve organisations, only three are specialist component producers (SCP) producing exclusively for the automotive industry. These three SCPs (Tier 1 and Tier 2 suppliers with two also operating at Tier 0.5) produce for the global automotive industry. Seven of the other firms also produce for the global manufacturing market.

**E-business profile**

Each of the surveyed enterprises was connected to the Internet, and each operated or has access to a website. The main reason given for the adoption of e-business was for internal and external e-mail (especially to communicate with clients and suppliers), and for purchasing, procurement and materials management. Only eight, Tier 1 suppliers, utilised electronic resource planning (ERP) through AQPQ systems. The ERP systems were not integrated with other business systems within the organisation or with the vehicle manufacturers systems.

Most firms indicated that e-business process integration has enhanced internal communication in product development and the shared use of project management
software. However, most firms (83%) did not have their project management software integrated with other AQPQ processes, and were not using the software to identify critical paths and for project risk identification, assessment and management.

Nine (75%) of the respondents engaged in collaborative engineering projects with external customers, including the transfer of manufacturing data for all Tier 1 and some Tier 2 suppliers. Six of those engaged in collaborative engineering communicated files and data only though email messaging and not via an Extranet with the vehicle manufacturer. (Figure 1).

![Figure 1: Use of integrated e-business processes](image)

Many of the enterprises acknowledged that they could be doing more with e-business. For example, only one Tier 2 supplier exploited the opportunities for conducting domestic and international e-business activities, such as Electronic Data Interchange (EDI) transactions and Computer Aided Design (CAD) file exchange for collaborative design and engineering projects.

The three automotive vehicle manufacturers with plants in Victoria have all established, corporate-driven e-business systems, including the processes of supplier agreements,
collaborative engineering and supply chain logistics with Tier 1 and some Tier 2 suppliers that provide unassembled components. The component suppliers have benefited significantly from such developments. Six Tier 1 enterprises already use the technology acquired for the automotive manufacturer’s systems to supply to the automotive aftermarket sector, and to other industries. However, not one respondent could claim that the external systems had been integrated across all internal processes. This highlights the nature of the systems dependence of the suppliers on the vehicle manufacturers. It also demonstrates the lack of understanding of the effects of e-business in developing a lean manufacturing program of management.

The major reason cited by the remaining four suppliers for not further exploring e-business was the cost of purchasing and upgrading CAD software of their many clients, and to train their technicians, designers and engineers in multiple systems. The cost of establishing and maintaining network systems and training employees in the networks that enable the electronic transfer of large CAD files was considered prohibitive by the smaller Tier 2 and Tier 3 suppliers. It is noteworthy that only one Tier 1 supplier was a member of the Australian Automotive Network eXchange (AANX), an automotive industry multi-provider virtual private network, that enables secure online data connectivity between participants for a range of applications.

When questioned on concerns regarding implementing and managing e-business systems, each business cited experience and training for all manufacturing and design staff as the primary issue (Figure 2). Even the supported Tier 1 firms expressed concerns about reaching their staff below middle management.

![Figure 1: Issues in implementing integrated e-business.](image-url)
With the exception of two Tier 1 suppliers, the firms surveyed felt that only client driven adoption and/or further development of advanced technologies would force the expansion of integrated e-business throughout the manufacturing process. Only 25% of respondents, all Tier 1 suppliers, had a formal adoption and development strategy in place (Figure 3). At the time of the survey, Computer Aided Design (CAD) was the only aspect of an advanced technology employed across the tiers and by all twelve suppliers, with I-Deas and Unigraphics the most frequently used CAD software.

![Figure 3: Advanced technology employed across the Tiers.](image)

**E-business training needs**

Component suppliers require a workforce capable of the developing, implementing and managing the strategic, technical, operational and functional requirements demanded by the automotive manufacturers. However, most of the respondents felt that the existing training frameworks, products and services do not cater adequately for their current and emerging knowledge and skill needs. Although each was a member of at least one major business association active in the promotion of e-business (for example, the Federation of Automotive Components Manufacturers (FAPM), Federal Chamber of Automotive Industries (FCAI), and Tooling Industry Forum of Australia (TIFA)),
only three suppliers had ever attended an e-business seminar or other training run by an association. Two of the suppliers belonged to TIFA, which provides a registered e-business trading and advertising site.

For Tier 1 suppliers, training on the Automotive Corporate integrated systems is conducted by the automotive manufacturing systems providers, and one Tier 1 supplier has RTO status for internal staff training purposes. However, only one Tier 1 and two Tier 2 suppliers have thus far provided e-business training for any personnel.

While most firms identified training as a concern in developing and implementing systems, most are wary of detailing specific future training requirements because their systems are driven by the demand of fixed term contract clients. Notwithstanding, all of the respondents expressed the need for any training to be short, customised and relevant to immediate needs due to time and cost constraints (Table 2).

<table>
<thead>
<tr>
<th>E-business training suggestions</th>
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<tbody>
<tr>
<td>Short courses in e-business expansion and internal and external integration, customised to the manufacturing and engineering industries, followed with workshops for specific sectors.</td>
</tr>
<tr>
<td>Online self-paced courses for technicians, designers and engineers in advanced technology operations so small portions of training could be completed during downtimes at work, or accessed from home.</td>
</tr>
<tr>
<td>Short train-the-trainer workshops designed for engineers and designers to deliver to technicians onsite or off-site for half to one day at a time.</td>
</tr>
<tr>
<td>E-business skills training linked into accredited industry specific training.</td>
</tr>
</tbody>
</table>

**Existing VET training in e-business and new manufacturing**

The Victorian VET system currently provides qualifications for new manufacturing with advanced technologies through qualifications in Engineering Technology. These qualifications include:

- Certificate I in Engineering Technology
- Certificate III in Engineering Technology
- Certificate IV in Engineering Technology
- Diploma of Engineering Technology
- Advanced Diploma of Engineering Technology
In 2004 there are currently up to fifteen TAFE providers offering qualifications at varying levels, with Automotive Training Australia, the Ford Motor Company and a few private providers concentrating services at the Diploma and Advanced Diploma levels. Within the available qualifications there is very limited capacity for institute development of competencies or customisation for large organisations or networks. The advanced diploma courses offer subjects in the advanced technologies, but there is a lack of focus in using integrated technologies.

The industry-specific advanced diploma qualifications in manufacturing also focus on the technologies. The Automotive Manufacturing Training Package for passenger motor vehicles contains seven qualifications and seventy-three units of competency. However, not one competency directly focuses on using internal and external integrated advanced technologies.

In 2001, 59 e-business competencies were endorsed as part of the Business Services Training Package (BSB01). These competencies have been packaged into specialist e-business qualifications from the Certificate III to the Advanced Diploma levels.

However, few Victorian TAFE institutes deliver these qualifications, with the Swinburne TAFE Division being the only provider to offer a full suite of e-business qualifications from Certificate III to Advanced Diploma and beyond. Several private providers delivering isolated qualifications, but none are customised to meet specific industry needs. Moreover, although there are many e-business commercial short courses on offer, this training is not state or nationally accredited and is not likely to be attractive to organisations, particularly SMEs, due to its lack of customisation, flexibility and higher cost.
DISCUSSION

Victoria’s manufacturing sector is the largest in Australia, with Victorian manufacturing leading Australia in business expenditure on research and development. To maintain this growth and performance, a range of Commonwealth and Victorian Government initiatives have been developed. The Australian Government initiatives include:

- Cooperative Research Centres (CRCs), specifically the Centre for Intelligent Manufacturing Systems and Technologies
- Australian Government Information Management Office grants for implementing e-business systems
- Department of Industry, Tourism and Resources support for the international Intelligent Manufacturing Systems program.

The Victorian Government initiatives are delivered through the Agenda for New Manufacturing (May 2003), and they include:

- the Growing Tomorrow’s Industries Today strategy to develop the information and communication technology sector
- the Connecting Victoria strategy to expand information and communication technology skills, infrastructure and access
- Victoria’s E-Commerce Advantage strategy to promote e-commerce
- Science, Technology & Innovation Initiative which includes infrastructure grants, the Bio 21 biotechnology strategic development plan and support for cooperative research centres and technology commercialisation
- the Australian Synchrotron, Victoria’s largest ever single investment – $157 million – in science infrastructure, which will be ready to meet the needs of business R&D and advanced manufacturing in 2007.

At the new manufacturing industry advisory level, the need to assist new manufacturing and integrated advanced technologies development by equipping the workforce with specialised skills has been a high priority. This has been reflected in the development of the specialist Centre for New Manufacturing at Swinburne and industry involvement in the CRC for Intelligent Manufacturing Systems and Technology.
Despite these initiatives, only five of the twelve (42%) respondents have received government assistance in implementing advanced technologies, and only one in implementing e-business systems. In addition, only three (25%) of the suppliers have worked with CRCs, with one Tier 1 supplier a member of the Centre for Intelligent Manufacturing Systems and Technology.

In 2001, a research study to establish how the Victorian automotive manufacturing industry perceived e-business in Victoria was commissioned by the Office of Manufacturing. Key results included the following:

- Less than half of the companies surveyed had direct links with suppliers or clients.
- Implementation of direct company-to-company links and Extranets was lagging.
- Sophisticated use of web facilities for online sales or online collaboration was not widespread.
- Few companies engaged in electronic data exchange and collaboration beyond EDI messaging.
- Finding staff with e-business expertise was perceived as somewhat difficult.
- An important aspect was the lack of understanding each company had of the e-business strategies of their largest clients and/or their largest supplier.

Findings from the present study are entirely consistent with these findings, suggesting that there has been little progress in assisting automotive component suppliers to come to terms with the value, implementation, development and use of e-business systems.

In June 2003, Automotive Training Australia (ATA) conducted a review on the Automotive Training Package in acknowledgement of the technological and corporate changes that have occurred since the 2000 endorsement. Though the ATA recommended changes to existing competencies and/or the development of new competencies based on aspects of new manufacturing technologies, there was no specific recommendation for training on e-business implementation or processes. There was also a perceived need to provide pathways for up-skilling, but limited focus on advanced technology recommendations for the diploma level and above.
As the adoption of the lean manufacturing philosophy manufacturing increases, with the engineering and manufacturing focus shifting to integrate internally and externally collaborative e-business operations, the skill needs of the industry need to be re-developed. The implications of the uptake of new manufacturing are concerned with a reduced need for skilled tradespeople and operators, and an increased need for skilled technicians. According to the Engineering Skills Training Board (ESTB), it is unlikely that re-training of displaced production level employees will be of any benefit – the industry view is that these employees will need (and choose) to seek employment at a similar skill level. However, there is an increased requirement for up-skilling existing employees, increased demand for new entrants with higher education, and high demand for short, product-specific training.

In July 2003, OTTE delivered an analysis of industry and community needs, demand drivers and the supply of VET in Victoria between 1997 and 2006 (Vocational Education and Training Priorities in an Innovation Economy: a Victorian Learning and Employment Skills Commission Report on setting VET priorities to develop and grow Victoria’s innovation economy). It was suggested that workforce competency needs to be upgraded in response to technological innovation, shifts in relative cost relationships, emergence of new customer needs, and other sociological and environmental changes. It was further noted that there is no incentive in the profile funding arrangements for TAFE to take up new areas of delivery. This has been reflected in the sector’s reluctance to implement curriculum changes incorporating industry based e-business focussed competencies.

The client-driven nature of the manufacturing industry has highlighted the need for a new focus on building knowledge and skills around lean manufacturing processes incorporating integrated advanced manufacturing technologies. Issues associated with managing a lean integrated advanced manufacturing education include:

- Strategic and operational planning – lack of understanding of the processes of implementing, developing and managing integrated lean manufacturing systems.
- Knowledge and skills – lack of access to staff educated in integrated lean manufacturing systems limits the ability of enterprises to further develop e-business systems.
• E-business funding – SMEs within the private sector have to seek external expertise for e-business development. Further exposure to e-business funding programs is required and funding for e-business planning and support should be made available.
RECOMMENDATIONS

On the basis of the findings, it is recommended that:

- further research be undertaken to support the development of e-business training and uptake across SMEs in the new manufacturing sector
- a new short course be developed to educate middle to senior managers in new manufacturing SMEs on lean manufacturing and e-business integration, with emphasis on developing and managing the supply chain
- a new short course be developed to educate middle to senior managers on the specific application of e-business in their operations, enlisting the support of larger customers in clearly defining needs to help develop supplier strategies
- a new short course be developed to educate Tier 2 and Tier 3 component suppliers on e-business.
- more emphasis be placed, within current Advanced Diploma engineering courses, on global e-business strategic and operational planning, including the processes of implementing, developing and managing integration of internal and external e-business systems
- advanced manufacturing technologies skills competencies focussing on virtual and rapid manufacturing tools, incorporating collaborative e-business application be developed.
ACKNOWLEDGEMENTS

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**Websites**
- Australian National Training Authority: www.ANTA.gov.au
- Australian Government Information Management Office: www.agimo.gov.au
- Australian Motor Industry Portal www.motor.net.au, including links to Automotive Training Australia and AANX.
- Automotive Training Victoria: www.atv.org.au
- Engineering Skills Training Board www.estb.com.au
- FAPM: www.fapm.com.au
- FCAI: www.autoindustries.com.au
- MultiMedia Victoria: www.mmv.vic.gov.au
- National Training Information Service: www.ntis.gov.au
- Office of Training and Tertiary Education: www.otte.vic.gov.au
- Office of Manufacturing: www.business.vic.gov.au
- TIFA: www.tifa.com.au