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ORCHESTRATING GLOBAL SUPPLY CHAINS, ENABLING HIGH VALUE MANUFACTURING

Report by the iN2015 Manufacturing
and Logistics Sub-Committee

Singapore: An Intelligent Nation, a Global City,
powered by Infocomm



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Preface

The manufacturing and logistics sectors have been the biggest adopters of infocomm. Today, infocomm is widely used in these sectors to enable more efficient operation, help companies manage their enterprises and orchestrate increasingly complex supply chains to respond faster to customers' needs. It will not be an overstatement that infocomm has become an essential part of the manufacturing and logistics sectors.

Indeed, infocomm is one of the key factors that enhance Singapore's status as a strategic manufacturing and logistics base. It enables manufacturing companies to collaborate closely and seamlessly with their partners, such as designers, suppliers, subcontractors and logistics providers. This has allowed companies in Singapore's manufacturing and logistics sectors to transform themselves over the years and move up the value chain to concentrate on high value activities.

However, as competition intensifies, we will need to find more innovative ways to leverage on infocomm to strengthen Singapore's competitive advantage in manufacturing and logistics. What matters for the sectors is not the infocomm spending per se. It is rather our ability to use infocomm strategically to strengthen our competitive position as the region's supply chain nerve centre, where companies can manage the entire supply chain out of Singapore, and as a manufacturing hub.

As the Manufacturing and Logistics Sub-Committee embarks on its task to define ways to enhance the sectors' competitive advantages, we ask ourselves what roles Singapore can distinctively play that will bring differentiating value to a globalised, networked economy, and specifically how infocomm can enable these roles.

This report presents our thinking on these issues. It proposes broad strategies and implementation plans that will help Singapore realise these distinctive roles.

Developing our national competitive advantages is an ongoing process. Along the way, plans may have to change. We therefore present this report not as a comprehensive, definitive roadmap but as a guide and basis for continued discussion between the private and public sectors.



Ms Chong Chiet Ping

Chairman

IN2015 Manufacturing and Logistics Sub-Committee

iN2015 Manufacturing and Logistics Sub-Committee

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Mr Peter Lam	Deputy Director Manufacturing & Services Infocomm Development Authority of Singapore <i>(from April 2006)</i>
Dr Lim Ser Yong	Executive Director Singapore Institute of Manufacturing Technology
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Mr Teh Chit Pin	Senior Director e-Business Supply Chain Seagate Technology International
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Executive Summary

The manufacturing and logistics sectors are important engines of our economy. Collectively, they contributed more than 30% of Singapore's GDP in 2005¹. These are also sectors that have experienced significant changes over the past decade. Forces such as globalisation, increased outsourcing and intense competition among manufacturers have compelled companies in these sectors to find ways to enhance their competitive advantage. These include shifting work to where it is best done, process optimisation, and increased automation.

Such forces will continue to exist and will intensify in the next 10 years. Supply chains will become even more complex as companies source for components from more locations. Collaborative partnerships will multiply and intensify as companies need to work more closely with their partners to react faster to customer demands and deliver products in a shorter time.

Companies will also need to cope with new trends. One is greater demands from consumers for personalisation. Customers will no longer be satisfied with mass products and will want to buy products that are more customised to their needs. Another trend is the increased regulatory requirements on security of supply chains and environmental impact of products and manufacturing processes. The growing threat of terrorism is pushing governments and industry to work together to secure global supply chains. There is also greater public pressure for corporate accountability in supply chains.

Our manufacturing and logistics sectors have to find new sources of competitive advantage to remain relevant in the midst of these trends. The Manufacturing and Logistics Sub-Committee believes that Singapore is well-placed to ride on these trends and position our manufacturing and logistics sectors to capture the high value areas. In particular, the Sub-Committee proposes the goal for Singapore to be "**a supply chain nerve centre and high value manufacturing hub, powered by infocomm**".

As a **Supply Chain Nerve Centre**, Singapore will be the location of choice with world-class logistics infrastructure where manufacturers design, monitor and control their regional and global supply chains; and from which logistics companies offer services to support these activities. Supply chain activities here will become more global and strategic rather than regional and operational in nature. Singapore will continue to maintain global leadership position as a sea container transhipment hub and air freight transhipment hub respectively. This is complemented by efforts to make Singapore a **High Value Manufacturing Hub** for complex processes, such as simulation and modelling, and new manufacturing business models.

Infocomm will be critical in making Singapore a Supply Chain Nerve Centre. It provides greater visibility, intelligence and flexibility to manufacturers, logistics companies and infrastructure operators like our airport and seaports.

¹ "Economic Survey of Singapore First Quarter 2006", Singapore Department of Statistics, 2006, "Logistics Skills Report 2005/2006", Singapore Workforce Development Agency, 2006

The following programmes will support this goal:

Adaptive Supply Chain

This programme will assist companies to build and manage adaptive supply chains out of Singapore. It will encourage companies to develop more effective supply chain processes and technologies, link up major networks of companies using supply chain and infocomm standards, and assist smaller companies to boost their supply chain capabilities using infocomm.

Companies can tap on this programme to pilot new processes and technologies in Singapore, develop local expertise in them and roll out these capabilities to their regional network. They will also benefit from being better integrated to their suppliers, service providers, customers and partners here in Singapore.

TradeXchange

This programme aims to link up existing disparate national trade information systems into a single integrated platform. Using this integrated platform for all transactions, businesses will find that it is easier to carry out international trade from Singapore. This programme comprises the development of a core platform by the Government to bring together critical trade facilitation systems to enable seamless transfer of information among these systems and the business community. The platform will also host other value-added services to provide users with unprecedented convenience and ease in coordinating and integrating the physical flows of goods with information and financial flows.

Infocomm@Airport/Seaport

This programme aims to give Singapore's airport and seaports, which are already world leaders, an even bigger edge over their competitors through development of new services using infocomm. Some of these services could focus on improving the security of trade and transport linkages between Singapore and other countries. These efforts will strengthen our position as a preferred transhipment hub. The Government can work closely with the port operators to identify innovative deployments of infocomm in the ports to strengthen these core infrastructures of our economy.

Digital Manufacturing

To stay competitive against the low-cost manufacturing locations, Singapore has to excel in activities that require complex manufacturing know-how that our competitors do not already have. This programme strengthens Singapore as a fast innovation manufacturing hub, where companies can rapidly turn their ideas into marketable products or new services.

Through this programme, the Government can work with manufacturers to implement infocomm technologies that will grow Singapore's capabilities in product development. Powerful modelling and simulation software will be made accessible and affordable for most companies over the national grid. This will further spur companies' product design capability. Manufacturers will also be encouraged to look into new business models that are made possible by advances in infocomm.

CHAPTER 1

MANUFACTURING AND LOGISTICS IN 2015

Orchestrating Global Supply Chains through Singapore

By 2015, Asia, with its rapidly growing economies, will likely account for a majority of the world's manufacturing output. Consequently, this region will also host a major portion of most multinational companies' (MNCs) supply chain activities.

At the same time, complexities in the supply chain will escalate along with the growing trend of outsourcing. There will also be rising demand for personalisation as customers want more options or for products to be configured in ways to suit their needs. This means that products could be manufactured in several locations before being customised locally. Hence, the rise in complexity will likely come about as a result of having to manage heterogeneous markets and production sites, to collaborate with a lot more partners than before, and to perform all these activities in the most optimal time to meet customers' needs.

Given such an operating environment, efficiency throughout the supply chain will be a major source of competitive advantage for companies. Supply chains will have to be more flexible and responsive. Capabilities and processes are likely to be more standardised and modular in nature. This will allow companies to easily pull together the necessary components from various partner companies in order to customise a product or service for their customers.

Such extensive sourcing and operation networks will warrant more complex supply chains, and more sophisticated software and processes to effectively manage the huge amount of data exchanged with both suppliers and customers. This calls for pervasive, robust, high bandwidth connectivity to link up the networks of companies, as well as the expertise to implement and manage the systems and solutions.

In such a context, Singapore will be recognised as one of the most ideal locations in Asia Pacific to site

a regional or global supply chain management team. More MNCs will also choose to set up their supply chain management centre of excellence here where they will deploy the latest technologies for supply chain efficiencies and set the benchmark for the rest of their organisations worldwide.

Most of these companies cite the availability of expertise in global supply chain management, many of whom are also skilled in using infocomm to manage processes, as one of the key reasons why they choose Singapore as their supply chain management hub. Other reasons include its world-class airport, seaports and robust telecommunications infrastructure and their strong connectivity with the rest of the world, pro-business policies and stable political environment.

Infocomm will be critical in enabling Singapore to be a supply chain nerve centre. Within Singapore, standardised and modular processes will enable supply chain transactions to be carried out automatically among software agents which can be linked to one another. Orders received can be analysed by the regional design HQs based out of Singapore using modelling and simulation applications to decide how best to meet the customer requirements and maximise profits at the same time.

Once a decision is made, the orders can be broken down into components and parcelled out by the agents to the appropriate departments in the company and other partner companies in the network, without the need for human intervention. These agents will also deal with any order changes, so a customer gets what he wants much faster than now. Singapore will be the supply chain management hub of choice for companies to coordinate these complex collaborative activities. This will be due to our excellent infocomm connectivity with the rest of the world and availability of experts in global supply chain management. It will also be due to our world-class airport and seaports, which will apply infocomm innovatively to entrench their global leadership position.

Realising Innovation in Half the Time

Efforts to help boost Singapore manufacturers' capabilities in product development will help Singapore achieve world-leading market shares in several high-end products e.g. complex medical equipment, emerging nano-technological products and manufacturing equipment. Our ability to quickly turn innovative ideas into marketable products through the clever use of infocomm plays a key role in convincing global manufacturers to site the development of their high-end products here in Singapore.

By 2015, manufacturing companies in Singapore will have access to powerful modelling, simulation and analysis capabilities. These will be provisioned affordably over a national grid. Companies can tap on this infrastructure for computationally intensive tasks like product design, data-mining and supply

chain optimisation to significantly shorten their turnaround time.

Future infocomm advances will likely allow manufacturers to implement new business models. One possibility is for a manufacturer to become more like a service provider. For example, products can have a combination of sensors, self-diagnostic software and wireless communication technologies built in to inform the manufacturer of impending breakdowns in these items. The manufacturer can fix the problem, thereby minimising losses by his customer.

There will also be pervasive infocomm adoption such that manufacturing and logistics workers will be able to communicate and collaborate seamlessly with team members, production equipment and other production robots. This will allow decisions to be made faster and more effectively.

Achieving Thought Leadership

In 2015, Singapore will be recognised as a thought leader in global supply chain management. As a thought leader, our companies will be at the forefront of setting supply chain best practices and standards.

This will be made possible by a cadre of managers who have amassed vast experience in managing regional supply chains over the decades. These supply chain professionals can offer their expertise in architecting and orchestrating global supply chains. The cutting-edge applied research from our research institutes and universities, as well as constant assimilation of new knowledge from overseas academic centres, will further complement this knowledge base.

CHAPTER 2

OVERVIEW OF SECTOR

Singapore has built up strong competitive advantages as a manufacturing hub over the past three decades. Strong political leadership, pro-business policies, conducive living environment, efficient transport and communications infrastructure, talented manpower and availability of strong supporting industries have helped to attract a critical mass of companies in the chemicals, electronics, and transport clusters. More recently, Singapore has also achieved success in developing the biomedical manufacturing cluster as a key driver of its economy. Growth in these clusters is illustrated in Figure 2-1 below.

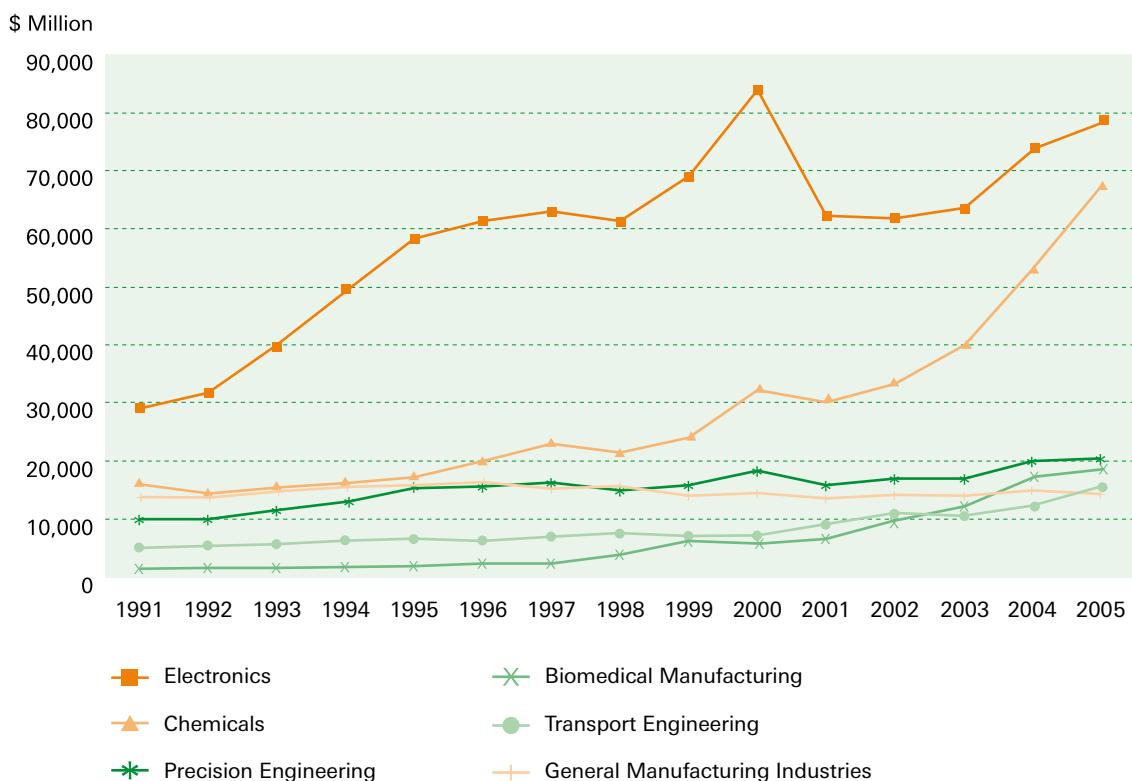


Figure 2-1: Output of the Manufacturing Clusters 1991-2005

Source: Singapore Department of Statistics

These advantages have enabled Singapore to build up leading market shares in various product markets.

For example, in the storage sector, Singapore produces 30 per cent of the world's computer hard-disk drives. In the offshore and marine sectors, Singapore accounts for 70 per cent and 50 per cent of the global production of jack-up rigs and semi-submersible rigs respectively².

Building on its geographical advantage of lying along critical trade routes connecting Asia to the European and US markets, Singapore has also successfully transformed itself into a world-class port and transhipment hub.

Its terminals handle 23 million TEUs³ in 2005 which accounts for about 20 per cent of global container transhipment throughput and about 6 per cent of the world's container throughput. It is the world's busiest port in terms of overall shipping tonnage and handles half of the world's annual supply of crude oil⁴. With thousands of ships making calls, Singapore is connected to over 600 other ports in 123 countries spread over six continents.

2 "Manufacturing 2018", Economic Development Board, September 2005

3 Acronym for 20-foot equivalent units. Used to describe 20-foot containers.

4 Source: PSA International, Maritime and Port Authority of Singapore

Singapore Changi Airport enjoys similarly strong connectivity as well, being linked to 152 cities in 51 countries worldwide⁵. In 2004, Singapore Airlines was ranked third in international air freight and sixth for number of international passengers carried⁶. Besides air and sea links, Singapore also boasts of 28Tbps of submarine cables connecting to over 30 countries.

This excellent infrastructure and connectivity have enabled both multinational manufacturers, like Hewlett-Packard, Seagate Technology and Venture Corporation, and international logistics providers, like DHL, Bax Global, Schenker and local providers like YCH Group and SembCorp Logistics, to manage their regional and global operations out of Singapore.

Today, these sectors are a significant part of Singapore's economy. In 2005, manufacturing is estimated to have contributed about a quarter⁷ of the country's GDP, while the logistics industry was responsible for about four per cent⁸.

The two sectors are big employers too. About 25 per cent of the workforce⁹ can be found in one or the other.

Infocomm in Manufacturing and Logistics

Both manufacturing and logistics sectors depend heavily on infocomm technology. Generally speaking, infocomm is used in two broad areas – to enable more efficient operations and to manage the enterprise.

In manufacturing operations, design software is used heavily for product development. Software, together with embedded electronics inside production machines, is also used to achieve more precise control of manufacturing processes.

Logistics operations require infocomm to track and manage the flow of goods, schedule vehicles and optimise delivery routes.

In both sectors, enterprise software like Enterprise Resource Planning, Customer Relationship Management and Supply Chain Management can be found in the larger companies. These are used to handle a variety of issues, e.g. human resource, finance and relationships with customers, suppliers and external partners.

The manufacturing sector alone accounts for about 25 per cent of all infocomm professionals employed outside the infocomm sector¹⁰.

Notwithstanding its strong foundation, Singapore's status as a manufacturing and logistics hub faces immense challenges due to rapid changes in its external environment. However, there are also opportunities brought about by such changes.

5 Source: Civil Aviation Authority of Singapore

6 Source: International Air Transport Association

7 "Economic Survey of Singapore First Quarter 2006", Singapore Department of Statistics, 2006

8 "Logistics Skills Report 2005/2006", Singapore Workforce Development Agency, 2006

9 "Persons Employed Aged 15 and Over by Industry and Occupation", Singapore Department of Statistics, June 2005; "Logistics Skills Report 2005/2006", Singapore Workforce Development Agency, 2006

10 "Annual Survey on Infocomm Manpower for 2004", Infocomm Development Authority of Singapore, June 2005. Infocomm manpower figure for Logistics is unavailable.

CHAPTER 3

KEY DRIVERS AND IMPLICATIONS

Growing Complexity in Global Supply Chains

One of the most fundamental factors driving changes in the global marketplace is the rise of Asia. This region has become important, and will continue to gain significance, as a major production centre of the world's goods and also as a high growth consumer market.

Asia's attraction lies primarily in its low-cost labour and its large and growing consumer markets. These advantages, combined with the trend of outsourcing and globalised competition, have led to massive inflows of foreign direct investment. This has resulted in a global shift of supply chain activities from more developed economies of the West to the emerging ones in Asia.

Today, Asia accounts for a larger proportion of the world's manufactured goods than other parts of the world. One example is in ICT goods where China overtook the United States to become the world's largest exporter of ICT goods in 2004.

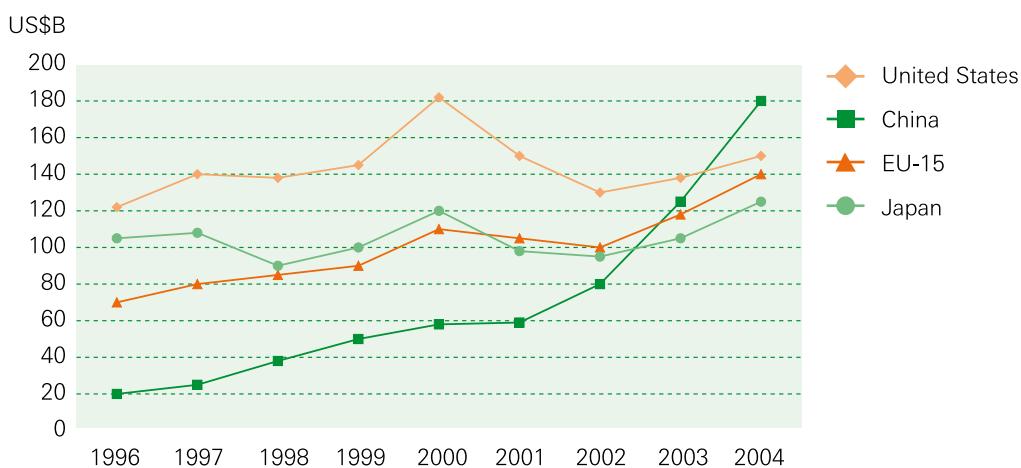


Figure 3-1: Export of ICT Goods
China Became the World's Biggest ICT Goods Exporter in 2004
Information Source: OECD

This explosive growth of supply chain activities in Asia has not come without its own share of challenges. The fragmentation of supply chains over geographically distributed sites has greatly increased their complexity. For instance, companies can now choose to shift work to where it is best done by their subsidiaries across several low-cost countries, or companies can outsource the production of components to many suppliers in a few countries. In comparison with the past where most of the activities were clustered together in one location, companies now have to manage activities across geographical boundaries, while trying to respond quickly to market fluctuations and pressing customer demands.

For example, Nokia operates a network of 14 manufacturing facilities in eight countries (Brazil, China, Finland, Germany, Hungary, Mexico, Korea and the United Kingdom)¹¹, and has research centres in 11 other locations¹². It has to work with a global network of suppliers and outsourcing partners, and has to distribute its mobile phones to retailers in every major market.

11 "Nokia Form 20-F 2005", Nokia, 2006
12 <http://research.nokia.com>

Increasing Regulatory and Compliance Requirements

The increased threat of supply chain disruptions due to terrorism has driven the US government and industry to put in place measures to secure their supply chains. Other countries, especially the European Union nations, might follow suit.

These measures, which include government and industry-led security initiatives, such as the 24-hour Advance Manifest Rule (AMR), and Customs-Trade Partnership Against Terrorism initiative (C-TPAT), have added significant compliance costs for supply chain operators. Previously, ocean carriers only had to submit general cargo description 48 hours before arriving in the US. With 24-hour AMR, carriers now have to submit cargo information 24 hours before the cargo is loaded onto the vessel. C-TPAT requires participants in the initiative to comply with an agreed set of supply chain security standards. In return, participants can expect benefits like fewer audits by customs, reduced border times, etc.

These security initiatives are expected to increase costs for the shipping industry by US\$8 billion over the next 10 years. Shippers will also incur up-front costs of US\$1.3 billion with US\$730 million of recurring costs¹³.

In recent years, there has also been an increased emphasis by governments for better corporate governance and corporate social responsibility. This has resulted in regulations that address issues like corporate transparency (e.g. Sarbanes-Oxley in the US), and environmental sustainability (e.g. Restriction of the use of Hazardous Substances or RoHS in the EU).

As a result of these regulations, companies are scrambling to put in place the appropriate processes and systems. These regulations are expected to have a significant impact on the operating costs of companies. For example, research shows that RoHS is expected to cost EU manufacturers US\$100 billion over the next decade¹⁴.

These onerous compliance requirements have not only added costs to the supply chains, they have also made it more difficult for companies to carry out international trade. The complexity of some of these requirements also means a higher risk of non-compliance due to inadvertent negligence.

Implication: Opportunity to be Supply Chain Orchestrator of Asia

The growing complexity of global supply chains presents an opportunity for Singapore to position itself as the ideal location from which companies can architect and coordinate their regional and even global supply chains.

This move will be supported by two advantages that Singapore possesses.

Firstly, Singapore's concentration of third party logistics providers and financial institutions will enable supply chain management organisations to more easily consolidate and integrate their physical goods flow with information and financial flows.

Furthermore, several decades of managing manufacturing operations have allowed local management to build up significant expertise and practical knowledge in managing regional supply chains. This is further complemented with leading edge research from institutes like The Logistics Institute of Asia Pacific (TLIAP).

The need to strengthen supply chain security and satisfy onerous regulatory requirements means further opportunities to provide value-added services in these areas. For example, Singapore can be a hub where information on production materials for various products can be automatically collated from hundreds of suppliers, analysed and sent for regulatory declaration.

Singapore can also position itself as a trusted and secured logistics transhipment hub. As a result of our stringent screening processes, cargo passing through Singapore can get faster access through customs at their destination ports.

Infocomm will be critical in enabling Singapore to provide these new services. For example, RFID readers will have to be deployed at our ports in order to have a faster clearance process for containers fitted with E-Seals. Singapore's high international broadband connectivity will also put it in a good position to host bandwidth-intensive activities, e.g. data analytics for regional supply chains.

13 "Moving Targets", Deloitte Research, 2005

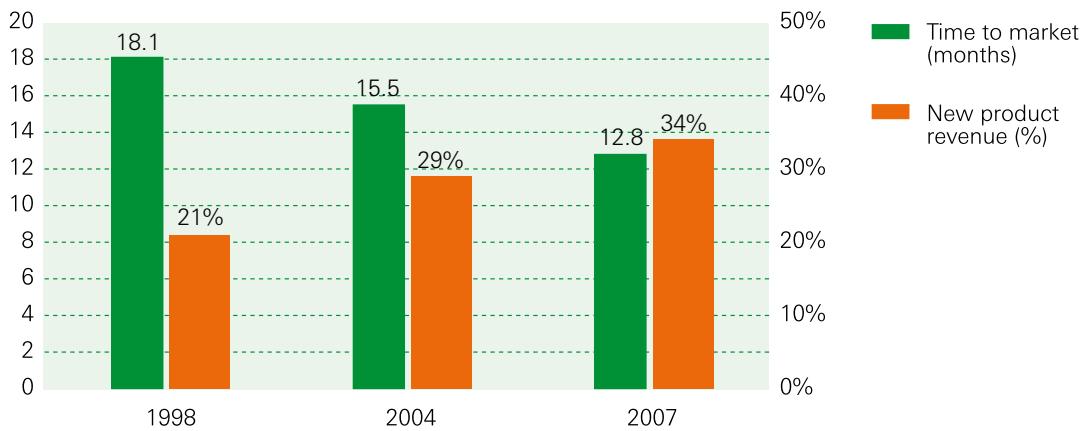
14 "Unlocking the Value of Globalisation – Profiting from Continuous Optimisation", Deloitte Research, 2005

Shortening Product Lifecycles

The immense challenges in coordinating supply chains are further exacerbated by the fact that intense competition is motivating companies to roll out new products faster in order to capture a greater share of the market.

According to Deloitte Research¹⁵, the average time between conceptualisation of a product and its going on sale across a variety of markets is expected to shrink from 18.1 months in 1998 to 12.8 months in 2007. At the same time, new products are accounting for larger share of total revenues. Refer to Figure 3-2 below.

However, with supply chains becoming more complex, pushing out new products faster has also turned much more challenging.



**Figure 3-2: The Twin Challenges of Product Innovation
Reducing Time to Market While Increasing Product Revenue**
Information Source: Deloitte Research

Implication: Need to Strengthen Capability in High Value Manufacturing Activities

The emergence of low-cost countries, in particular China and India, has precipitated structural changes to Singapore's manufacturing sectors over the past decade or so. Low value-added and labour-intensive activities have migrated to those countries even as we continue to attract higher value-added, knowledge- and research-intensive work.

In the face of low-cost competition that is also rapidly moving up the value chain, Singapore needs to continue strengthening its capability to attract and carry out such high value-added activities. Here, infocomm technologies will be essential in furthering research capabilities. For example, grid computing networks can help link up different research laboratories and allow them to collaborate in high computational research.

Besides research, Singapore manufacturers can also focus on building their product development capabilities. Given the market pressure to roll out new products faster, there is an opportunity for Singapore to position itself as the manufacturing hub known for its capability in bringing new product ideas to market rapidly for companies. The skilful application of infocomm to enable effective product development processes will help accelerate companies' capabilities in this area.

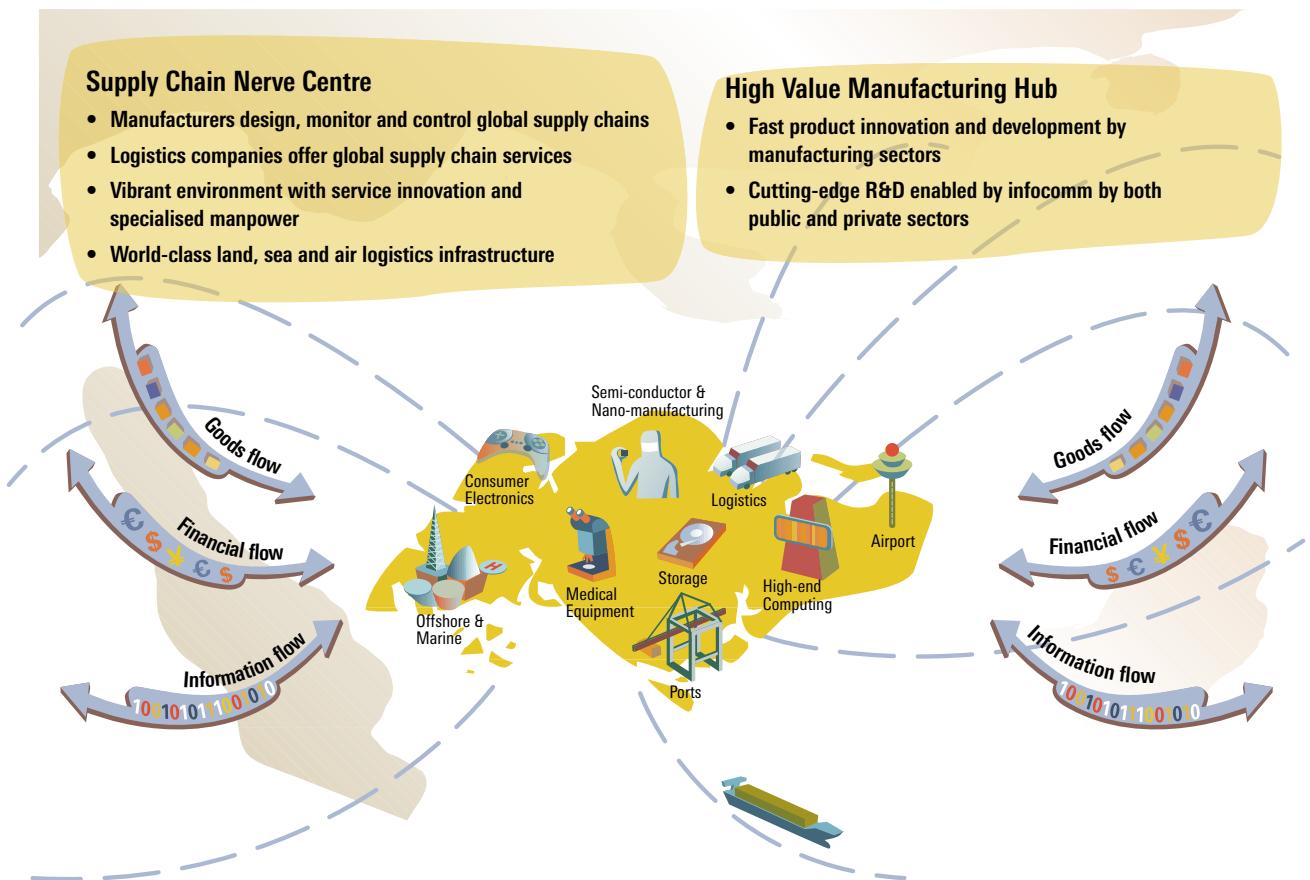
15 "Mastering Innovation: Exploiting Ideas for Profitable Growth", Deloitte Research, 2005

CHAPTER 4

iN2015 GOAL FOR MANUFACTURING AND LOGISTICS

Our goal is for Singapore to become

A supply chain nerve centre and high value manufacturing hub, powered by infocomm.



As a **Supply Chain Nerve Centre**, Singapore will be the location of choice with world-class logistics infrastructure where manufacturers design, monitor and control their regional and global supply chains; and from which logistics companies offer services to support these activities. Supply chain activities here will become more global and strategic rather than regional and operational in nature. Our airport and seaports will continue to maintain global leadership position as a sea container transhipment hub and air freight transhipment hub respectively.

Singapore will also have a vibrant environment that encourages the growth of these activities, where there is buzz arising from the development of new logistics-related services like innovative trade financing and derivative products, and specialised manpower with supply chain expertise. Singapore will also be recognised as a centre for innovation in the use of infocomm in supply chain management. Such innovation will be brought about by the strong linkages among user companies, research institutes and technology solution providers.

Elements of this nerve centre are already present in Singapore. Major manufacturing MNCs have located their regional supply chain operations here, orchestrating procurement from suppliers in different countries to feed into their manufacturing operations. Large logistics companies are using Singapore as a regional distribution centre, supplying their customers' operations across the world. Our port infrastructure offers world-class services like real-time visibility of vessel schedules and cargo space, intelligent berth allocation and B2B platforms for integration with customers.

As a **High Value Manufacturing Hub**, Singapore's companies will excel in high value-added activities such as research and product development. Innovative deployment of infocomm, such as grid technology, will help us attract more R&D activities here. The aim is to build Singapore into a location where new products can be developed and brought to market in the shortest time. Singapore will also be a location of choice for manufacturing companies to deliver new business models.

Role of Infocomm

Infocomm technologies are critical enablers in making Singapore a Supply Chain Nerve Centre and will provide visibility, intelligence and flexibility to manufacturers, logistics companies and infrastructure operators in the following manner:

- **Visibility** through the use of sensor technologies like RFID enables information and physical flows to be integrated, and provides the data points for supply chain orchestration and security to be carried out.
- **Intelligence** provided by optimisation algorithms enables better co-ordination and planning between partners which will result in supply chain efficiencies. Technologies like grid computing coupled with powerful software will allow companies to undertake more complex manufacturing activities and move up the value chain.
- **Flexibility** provided by international standards like Web Services and RosettaNet will allow disparate systems to identify and connect with one another for end-to-end integration. This will also enable closer collaboration among the manufacturing and logistics players, resulting in enhanced ability to innovate and manage collaborative design and production, or develop new manufacturing business models.

CHAPTER 5

RECOMMENDED STRATEGIES

Goal	A supply chain nerve centre and high value manufacturing hub, powered by infocomm	
Outcomes	Enhanced competitiveness of manufacturing and logistics sectors	
Strategic Thrusts	Establish Singapore as a supply chain nerve centre	Establish Singapore as a high value manufacturing hub
Strategies	<ul style="list-style-type: none"> • Build adaptive supply chains • Develop a national integrated infocomm platform for supply chain management • Catalyse process transformation at key supply chain infrastructure 	<ul style="list-style-type: none"> • Enable complex manufacturing capabilities

Strategic Thrust 1:

Establish Singapore as a Supply Chain Nerve Centre

- **Build Adaptive Supply Chains**

This strategy will assist companies to build adaptive supply chains and grow their local pool of supply chain expertise in order to anchor their global and regional supply chain management organisations in Singapore.

As product lifecycles shorten and business conditions become more volatile, supply chains will need to be more flexible and responsive. At the same time, companies will also need to redesign their supply chains in order to cope with surging complexity due to outsourcing and globalisation.

These ends can be more easily met if there is a central body to architect, integrate and coordinate the different parts of the supply chain. As supply chain activities shift to Asia, Singapore can position itself to host this organisation.

Key Programme: Adaptive Supply Chain

This programme aims to help companies build and manage adaptive supply chains out of Singapore.

Larger companies can enhance their ability to coordinate regional and global supply chains by tapping on this programme to pilot and deploy new technologies. Small companies can benefit through having affordable and scalable supply chain solutions that this programme aims to develop together with technology providers and research institutes.

The immediate outcomes from this initiative will be increased efficiency in supply chains and lowered operating costs. These new capabilities can also enable companies to generate additional revenue due to enhanced competitiveness.

Over the longer term, by continuously encouraging companies to improve their supply chain capabilities, the Government can anchor their supply chain management organisations here in Singapore. Using Singapore as a base, these organisations will be able to help their companies architect and coordinate regional or even global supply chain activities, some of which may not even touch Singapore.

The following components are proposed under this programme:

Catalysing Innovation

This component aims to raise the level of supply chain innovation and technology development in Singapore. It will attract MNCs to set up their supply chain centre of excellence in Singapore to help drive innovation in supply chains. Other international organisations can also be encouraged to set up technology development centres here. Linkages between industry, research institutes and institutes of higher learning, both local and overseas, can also be strengthened to accelerate the rate of innovation.

There will also be a focus on catalysing systems and projects that have industry-wide impact. The Sub-Committee proposes that the Government look at co-developing new systems with industry, such as e-logistics and e-payment, as well as the promotion of sensor technologies like RFID that provide the interface between the flow of physical goods and infocomm systems.

Linking Up End-to-end Supply Chains

This programme should also aim to link up end-to-end supply chains from design to manufacturing to distribution in key economic sectors, among them high-tech manufacturing, chemicals, aerospace and retail. Companies can be encouraged to link up with one another through the use of relevant supply chain and infocomm standards, e.g. RosettaNet and Web Services.

It should also work on enabling more efficient cross-industry linkages, e.g. between the chemicals and high-tech sectors, and among logistics, finance and high-tech sectors. Such linkages will require appropriate process standards that are currently nascent. Singapore can work with international organisations to spearhead the development and adoption of such standards. It is an ideal location to carry out such work because of the strong presence of multiple sectors.

Levelling Up Capabilities

This component involves working with infocomm companies to develop new solutions to help small and medium-sized businesses better adopt supply chain technologies so that they can stay connected and nimble in the global production network.

- **Develop a National Integrated Infocomm Platform for Supply Chain Management**

One of the key factors why Singapore has been consistently ranked among the world's top transhipment hubs is its fast turnaround for goods moving through its ports. This has been made possible by trade information systems such as TradeNet, Portnet and the Cargo Community Network that were developed a number of years ago.

While they have served Singapore well, a quantum leap in efficiency and innovation would be possible if these disparate systems were integrated. To this end, Singapore is embarking on efforts to develop a new nation-wide information platform called TradeXchange. The new platform will be able to host various value-added services. For one, it will eliminate the need to duplicate data, which will in turn cut down mistakes in information.

In this environment, manufacturers, logistics service providers, traders, banks and other supply chain partners will be able to just plug into the system and be connected to the whole business community.

Once the platform is in place, the other important step will be to work with industry to enhance supply chain processes.

Key Programme: TradeXchange and Value-added Services

IDA is currently working with key stakeholders such as Singapore Customs and the Economic Development Board to develop TradeXchange as a national integrated trade information system.

Once fully developed, businesses can use this system as a 'one-stop platform' to enter and access trade-related information, rather than go through multiple systems. Businesses can also enjoy additional information services developed by third-party providers like banks and logistics providers.

There will be three parts to this programme:

Development of Core Platform

This platform will bring together critical trade facilitation systems such as TradeNet, Portnet and Cargo Community Network with the aim of enabling seamless transfer of information among these critical systems and the business community.

Building of Value-added Services

In addition to the core platform, the Sub-Committee proposes that the Government co-develop with industry partners other value-added services, such as trusted hub services, which may include the validation of compliance to regulatory requirements and e-document preparation, and e-trade finance, where trade information available in TradeXchange is used to facilitate faster and more convenient payments for international trade.

It will also help to promote the adoption of these services, especially among the SMEs, in order to create a self-sustaining system.

Forming International Linkages

Singapore should also explore international linkages, providing electronic "highways" to facilitate international trade flow. One such highway could be a certified channel for advanced manifest reporting to the US. This will help expedite the clearance of goods through customs upon arrival at the destination.

- **Entrench World-class Status of Key Supply Chain Infrastructure**

Singapore's ports and airport, while already among the best in the world and exploiting infocomm extensively, will have to continuously improve their productivity and service quality in order to maintain those leading positions. Infocomm will be critical in enabling new processes and services.

Infocomm can be used to improve the efficiency, security and connectivity of our ports and airport. This will help to strengthen the Republic's competitiveness as a major air and sea hub and boost the flow of cargo through both gateways.

Key Programme: Infocomm@Airport/Seaport

This programme aims to catalyse iconic projects at the ports and airport, to entrench our global leadership position.

Research institutes and solution providers can be involved in developing and implementing innovative solutions, e.g. RFID at seaports and airport, that will give Singapore the first-mover advantage in exploiting infocomm to develop new services and improve business processes.

For example, to ensure the security of containers without compromising the speed at which they are cleared, our ports can deploy RFID readers to provide faster clearance for containers fitted with E-Seals and RFID tags. Such services, together with related cargo security information services provided by TradeXchange, will over time enhance Singapore's reputation as a trusted transhipment hub.

Besides improved operations for the infrastructure operators, this programme will also benefit the solution providers. Because of their global scale of operations and reputation for excellence, our airport and seaports make good reference sites for solution providers to develop world-class infocomm solutions.

Strategic Thrust 2:

Establish Singapore as a High Value Manufacturing Hub

- **Enable Complex Manufacturing Capabilities**

To compete against low cost locations, Singapore has to excel in more sophisticated and high value-added manufacturing activities like product development, complex manufacturing and engineering processes.

At the same time, the demand for speed by companies presents an opportunity to position Singapore as the manufacturing hub that turn innovative ideas into quality products faster than anywhere else in the world.

All these require vastly improved manufacturing process capabilities. Infocomm will likely play a critical role in enabling many of these capabilities. This strategy therefore aims to develop and encourage the adoption of new infocomm tools by companies, e.g. grid computing for computationally intensive tasks and software agents for process automation.

Beyond innovative products and efficient processes, the effectiveness of business models also affects the strength of the manufacturing and logistics sectors. Consider Dell's business model. It has been able to customise PCs for the masses through its direct build-to-order model. This has allowed Dell to cut out the middleman and save on inventory costs, which generated higher returns for the company.

In future, widespread use of technologies such as RFID, sensor networks and intelligent software agents is likely to lead to innovative and perhaps hugely profitable business models.

Key Programme: Digital Manufacturing

In support of the strategy, this programme aims to significantly improve firms' capabilities in carrying out complex processes through the innovative use of infocomm.

Companies can hope to have better control over complex operations. This can translate into less errors, faster turnaround time and higher quality of products. Management will also be able to make more effective decisions through the use of modelling, simulation and decision analytic software that helps to holistically analyse the interaction of multiple variables throughout the manufacturing system.

These improved capabilities can attract more design activities and generate new revenues for companies here in Singapore.

This programme consists of the following parts:

Use Product Lifecycle Management (PLM) applications to effectively and efficiently innovate and manage products and related services throughout the entire product lifecycle. These are kinds of enterprise software that help manage information flow among different parties involved in the creation, modification and retirement of a product. They can help companies significantly reduce the time and costs needed to develop a product. Quality will also be improved as they help reduce design errors.

This part of the programme can focus on selected manufacturing sectors with high levels of design activities, e.g. offshore and marine, aerospace and high-tech manufacturing.

Besides focusing on technology adoption, this component should also support researchers and technology providers in developing cutting-edge tools that help companies in product development, e.g. 4D-CAD software.

Leverage on grid computing to allow companies to tap into powerful computing resources.

Companies can therefore have access to more powerful software for collaborative design, modelling, simulation and analysis in product development. It will drive the formation of the Grid Manufacturing Network to link up research institutes and several industry Grid Innovation Zones.

Encourage new manufacturing business models using infocomm. The Government can work with industry organisations like Singapore Manufacturers' Federation, thought leaders and research institutes to improve industry's awareness and to stimulate discussions of technology applications and their business possibilities. Relevant agencies and venture capitalists can also be roped in to provide necessary seed funding to realise innovative business models.

Thought Leadership

The success of these efforts will not only help to boost the competitiveness of Singapore's manufacturing and logistics sectors but also offer the infocomm industry the opportunity to develop new exportable infocomm solutions for these areas.

More importantly, these strategies will help position Singapore as a thought leader in innovative application of infocomm, for manufacturing and supply chain excellence. To further strengthen this thought leadership, Singapore could attract

international organisations, e.g. RosettaNet, UN/CEFACT and SWIFT, to establish a stronger presence here. Not only will this help spur supply chain innovation activities here, it will also help bring our local research community closer to other global thought leaders.

All these will make Singapore more attractive as a location for manufacturing and logistics companies to pilot leading edge infocomm solutions. At the same time, it will also be an ideal location from which technology providers could develop and market their solutions.

CHAPTER 6

CONCLUSION

The competitive advantage of Singapore's manufacturing and logistics sectors depends on the ability to manage increasingly complex supply chains, and to constantly innovate in developing new products, streamlining processes for greater effectiveness and efficiency and creating new business models.

The innovative application of infocomm will support the manufacturing and logistics sectors in building these capabilities.

This report paints a long-term vision in which infocomm is pervasively used throughout all parts of the supply chain – from product development to manufacturing to distribution – to transform processes and implement new, exciting business models. The Sub-Committee has recommended strategies and programmes that the Government and the private sector can take to achieve this vision. These strategies focus on developing and introducing new infocomm technologies to the industry to entrench Singapore as a Supply Chain Nerve Centre and enhance its high value manufacturing capabilities.

Infocomm must ultimately be combined with managerial ingenuity to transform businesses and bring about quantum leaps in business performance. Hence, this report serves as a starting point to spur further discussion and collaboration between the public and private sectors on innovative applications of infocomm in the manufacturing and logistics sectors.

Just as infocomm possibilities are endless, the Sub-Committee urges both public agencies and the industry to be imaginative and bold in creating the future.

Annex A: IDA Secretariat for Manufacturing and Logistics Sub-Committee

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Infocomm Development Authority of Singapore

IDA is committed to growing Singapore into a dynamic global Infocomm hub. IDA uses an integrated approach to developing info-communications in Singapore. This involves nurturing a competitive telecoms market as well as a conducive business environment with programmes and schemes for both local and international companies.

For more information, visit www.ida.gov.sg

Singapore Computer Society

SCS, established since 1967, is the premier professional body for IT practitioners and IT users in Singapore. With a membership of over 22,000, it is an invaluable network for its members. SCS administers various certification programmes that help individuals gain professional recognition for career development.

For more information, please visit their website at www.scs.org.sg

Singapore Infocomm Technology Federation

SiTF is Singapore's national infocomm industry association. It brings together 500 corporate members from MNCs and local companies, who collectively account for over 80% of the industry revenue. The SiTF assists its members in business development, market intelligence, overseas trade missions, networking and alliances.

For more information, please visit their website www.sitf.org.sg

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