

Reinventing Canada's electronics manufacturing sector



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The electronics manufacturing sector has changed tremendously in recent years. Global industry restructuring has shifted manufacturing to lower-cost countries and disaggregated the industry's supply chain, creating opportunities for new players as well as many winners and losers.

The impact of these changes on the electronics manufacturing sector in Canada has been mixed. Its successes include Nortel, JDS Uniphase, and 360networks in the late 1990s and early 2000s, and the more recent global achievements of Research in Motion (RIM). However, the challenges facing the sector are apparent in plant closures and job losses. Overall, this sector is underperforming and risks becoming marginalized in a rapidly growing global industry.

As part of a detailed analysis of Canada's and its businesses' global competitiveness,¹ McKinsey & Company Canada examined the electronics manufacturing sector in depth, mainly because its strengths and the challenges it faces are similar to those of companies in other manufacturing export sectors and so may provide beneficial insights to other firms. Accordingly, this report covers:

- The sector's importance to Canada's economy
- How competitors in other countries have successfully responded to the challenges of global restructuring
- The impact global restructuring has had on Canada's electronics manufacturing sector
- Strengths that the sector could build on to increase its global competitiveness
- Possible actions to revitalize the sector.

1 McKinsey & Company, *Breaking away from the pack: Enhancing Canada's global competitiveness*, October 2008.

Electronics manufacturing's importance to Canada's economy

In 2007, manufacturing in total represented 15 percent of Canada's GDP and employed over 1.7 million people. With trade activity exceeding \$650 billion, it was by far the largest contributor to international trade in the Canadian economy.

In 2001, however, its contribution was even larger. Since then, manufacturing employment has fallen 2.4 percent annually. In the first quarter of 2008, manufacturing dropped to second place behind the retail and wholesale trade sectors in terms of employment

To understand the root causes of this decline and identify possible actions to reverse it, McKinsey examined several manufacturing sectors. Electronics was chosen for more detailed examination because this sector:

- **Contributes significantly to Canada's GDP, employment, and trade.** In 2006, this sector employed 128,000 people and represented 6 percent of manufacturing GDP. It was also a significant participant in the global economy, accounting for approximately 10 percent of all traded goods and services in Canada, representing \$86 billion in combined exports and imports.
- **Includes high-profile, global Canadian companies.** Companies such as Nortel, RIM, and Celestica provide good examples of how and how not to compete globally. They also contribute significantly to the domestic economy through exports.
- **Is integrally linked to the global economy.** Global industry restructuring in this sector is highly advanced and has greatly influenced the electronics industry, creating challenges and opportunities likely to affect other sectors in the years ahead.

With its tight links to the global economy, the sector's composition and growth have changed significantly over the past 10 years. It suffered when the dot-com bust suddenly reduced demand for communications equipment, and GDP is only now beginning to recover to 1997 levels.

How electronics manufacturers in other countries have successfully responded to global restructuring's challenges

The process of building electronic products, getting them to consumers, and supporting them is one of the most advanced in global restructuring terms. Increases in modularization, technological developments, and lower labour costs in developing countries have reshaped the sector.

Electronics production is now taking place around the globe, concentrated among the most competitive component manufacturers and distributors and final assembly companies. In many cases, original equipment manufacturers (OEMs) such as Hewlett-Packard and Nortel have outsourced manufacturing to suppliers such as Celestica and Foxconn that, in turn, search the world for the most efficient suppliers and manufacturing locations.

Moreover, geographic specialization and competition are increasing. In recent years, developing countries with low-cost labour (e.g., China and Mexico) have become leading manufacturing centres for products ranging from semiconductors to computers to wireless and optical devices. At the same time, high-cost-labour countries, (e.g., Finland and South Korea) have had to reinvent themselves. They have responded by manufacturing products that require proximity to local markets and investing in cutting-edge R&D.

Global industry restructuring has resulted in an explosion in trade and also in worldwide production, which has grown at 5.2 percent annually since 1997. Consumers need only visit their local electronics retailers to see the evidence of this trend in the selection of higher-quality products available, typically at prices lower than 5 or 10 years ago.

The theme running through global restructuring in this industry is that the chain from electronics manufacturing to sales and support is breaking apart. Lower-labour-cost countries are focusing on the links with the highest labour component (and, typically, the lowest margin), whereas higher-labour-cost markets are focusing on the links with higher-value-added components in R&D and engineering.

Emerging markets are leveraging their compelling labour economics

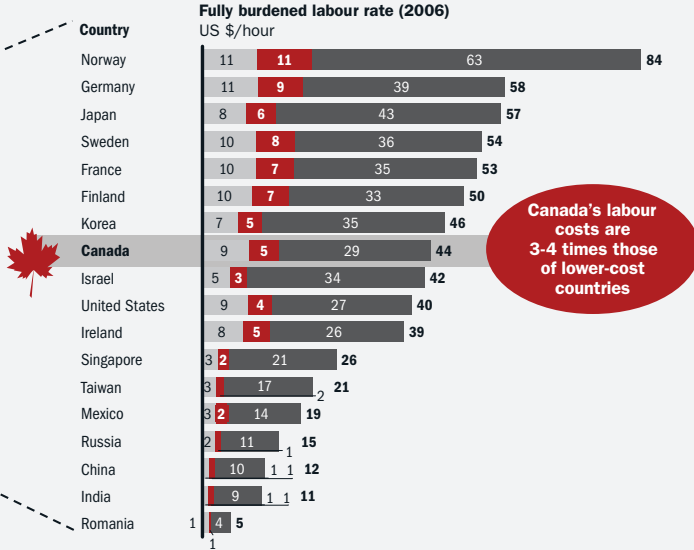
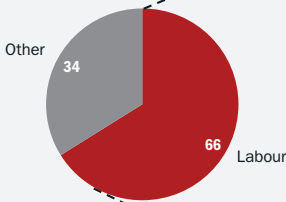
In electronics manufacturing, cost is one of the most important considerations in selecting a location for production facilities. Since labour wages and benefits make up two-thirds of location-sensitive costs, low-labour-cost countries like China are attractive. With fully burdened electronics manufacturing labour rates at US \$44 dollars an hour, Canada is among the higher-labour-cost manufacturing countries. This, however, is not an insurmountable competitive disadvantage: some players in several higher-cost countries such as Germany and Japan are able to be far more competitive than many in Canada.

EXHIBIT 1

Electronics assembly costs for specific locations*
Percent

Direct costs
Benefit costs
Overhead burden

Location-specific costs
100% = average
US \$11.2 million per plant



* Average of 10 countries from different regions
Source: ETP; KPMG; McKinsey & Company

An increasing challenge for producers in higher-cost countries is lower-cost producers developing the capabilities to improve value-added manufacturing, while maintaining their cost advantage. (See “China – A manufacturing partner to the world.”)

Developed countries are competing with higher-value-added goods

Given increased competition from lower-labour-cost emerging markets, higher-labour-cost countries have been forced to compete on quality, innovation, and differentiation. They have done this by increasing product specialization and focusing on building R&D capabilities.

Increased specialization. Countries such as South Korea and Finland have refocused their electronics manufacturing sectors on more complex, higher-value-added production.

South Korea has become a global leader in electronics manufacturing despite being a relatively high-cost country (US \$46 per hour) by concentrating on its strengths in semiconductors and electronic components. Driven by growth in

China – A manufacturing partner to the world

Relative cost advantages have encouraged many companies to manufacture their products in China. Since 1990, manufacturing GDP has increased by 10 percent annually, accelerating to 19 percent since 1999. Within manufacturing, electronics has experienced explosive growth – from 5 percent of the manufacturing sector in 1990 to 22 percent in 2006.

However, as the global sector evolves, many companies will likely move their manufacturing to even lower-labour-cost countries (e.g., Vietnam and Indonesia), and China will experience margin pressure. In response, manufacturers in China are exploring opportunities in more profitable parts of the value chain.

They are increasingly shifting their focus to higher-value activities, including product design, R&D, and complex manufacturing. Indeed, the multinational computer company Apple has already moved some of its R&D, product design, and complex manufacturing activities to China. Chinese companies such as Foxconn and Quanta were involved in designing and producing the new iPhone.

Several factors have contributed to China's increasing competitiveness across more elements of the electronics manufacturing value chain, including:

Large infrastructure investments in high-tech industrial parks

The Hangzhou High-Tech Industrial Development Zone, a government-supported technology cluster, has developed an

infrastructure that attracts multinational electronics companies. The cluster fosters education through the University Science Park and the Pioneering Park for Returned Overseas Intellectuals. It includes several incubators for startups and has attracted R&D and product design investments from companies such as Motorola, Handsome Electronics, and Alibaba.

A large, talented, and comparatively cheap workforce

In 2006, China's education system produced close to 5 million college graduates, and this number is expected to grow. The country's R&D and product design infrastructure supports the training and development of its large workforce. Furthermore, to employ graduates from this workforce is one-third to one-half the cost of employing their equivalents in developed markets.

The size and attractiveness of the local market

China's population is 1.3 billion – a huge potential market. Companies are building R&D and product design facilities in China so they can customize products to meet the needs of this large and growing market, as well as integrate with local manufacturing facilities.

large firms such as Samsung Electronics, Hynix Semiconductor, and DongbuAnam, the share of nominal sector GDP represented by semiconductors and electronic components increased from 37 percent in 1997 to 51 percent in 2007.

Finland (US \$50 per hour) is focusing on higher-value segments, like telecommunication, which represent 74 percent of the electronics sector's GDP. Much of Finland's growth in this area is due to Nokia, which produces its newest, high-value-added products locally. (Its lower-value goods are produced in lower-labour-cost countries.) In turn, Nokia's success stems partly from Finland's early liberalization of the telecommunications industry and capital markets and its targeted educational initiatives, as well as the availability of venture capital.

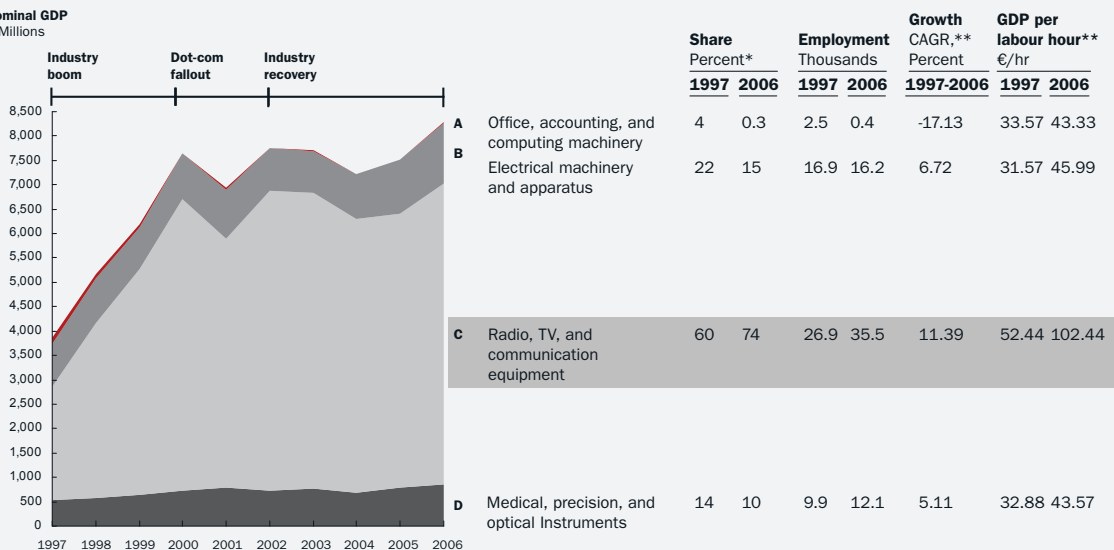
The results are impressive. From 1997 to 2006, Finland's electronics manufacturing GDP grew by 11 percent and its exports by over 13 percent.

Focus on research and development. Developed countries compete for higher-value links of the electronics value chain with world-class product design and R&D investment. This investment has several benefits. It helps keep specialized manufacturing – such as prototyping and testing, as well as development manufacturing and production – close to home which, in turn, stimulates a related supplier environment that ultimately fosters technology clusters. It attracts and

EXHIBIT 2

Composition of Finland's electronics manufacturing sector

Nominal GDP
€ Millions



* May not add to 100% because of rounding

** Nominal

Source: Statistics Finland

Finland – A highly technology-intensive economy

Since the mid-1980s, Finland has emerged as one of the most technology-intensive economies in the world, despite being one of the highest-labour-cost countries (US \$50 per hour). Its electronics sector has contributed almost 20 percent of the economy's cumulative productivity growth over the past 25 years. The Finnish manufacturing sector has largely shifted from wood, paper, food, and textiles to electronics – the country's dominant and fastest growing industry, representing 6 percent of national GDP in 2006.

Nokia has been a key player in growing this sector. Since 1996, Nokia's revenues have increased 18 percent annually, accounting for 24 percent of the total value of Finnish exports.

Nokia has also fueled the R&D sector by keeping a portion of research activities in the country and by localizing the production of its newest and most complex products. The incremental costs of local production are more than offset by the value gained from having the ability to rapidly provide the newest products to demanding consumers.

Finland's Science and Technology Policy Council, established in 1987, identified the electronics sector as a long-term strategic priority and accordingly has:

Liberalized the telecom sector and the capital markets

The early liberalization of the telecom service provider markets in the 1990s heightened competition, drove prices down, and led to

mass-market adoption of wireless communication. In turn, the service providers pressured handset suppliers like Nokia to become more innovative and cost-competitive in their products and operations. Around the same time, the liberalization of the capital markets provided access to more risk financing, which stimulated growth and diversified the sector.

Inspired the academic world

Throughout the 1980s and 1990s, the telecommunications sector was stimulated as government policies established clear ownership rights for academic inventors, created advantageous grant systems for students, and provided the right to free study for all scientific subjects in universities. These initiatives encouraged universities and technology villages to cluster around major sources of new business activity and many academics to become entrepreneurs.

Provided venture capital funding to technology-based startups and research

Tekes (a government-funded incubator) was tasked with funding new electronics companies and innovative research and development projects. It also helps new electronics companies establish networks of contacts to build their organizations. Since 2000, Tekes has funded 17,418 projects with over €3.3 billion in grants, low-interest loans, and equity.

retains the highly skilled workforce needed to compete in higher-value segments. And, through innovation, it enables developed countries to continue to compete for higher-value manufacturing activities like product introductions where speed, the ability to iterate, and the proximity to market are crucial.

Israel is one higher-cost country that has successfully attracted R&D investment and expanded its electronics manufacturing sector. In fact, it has become a global centre for R&D, innovation, and entrepreneurship – and it is among the most competitive nations in the world in this sector.

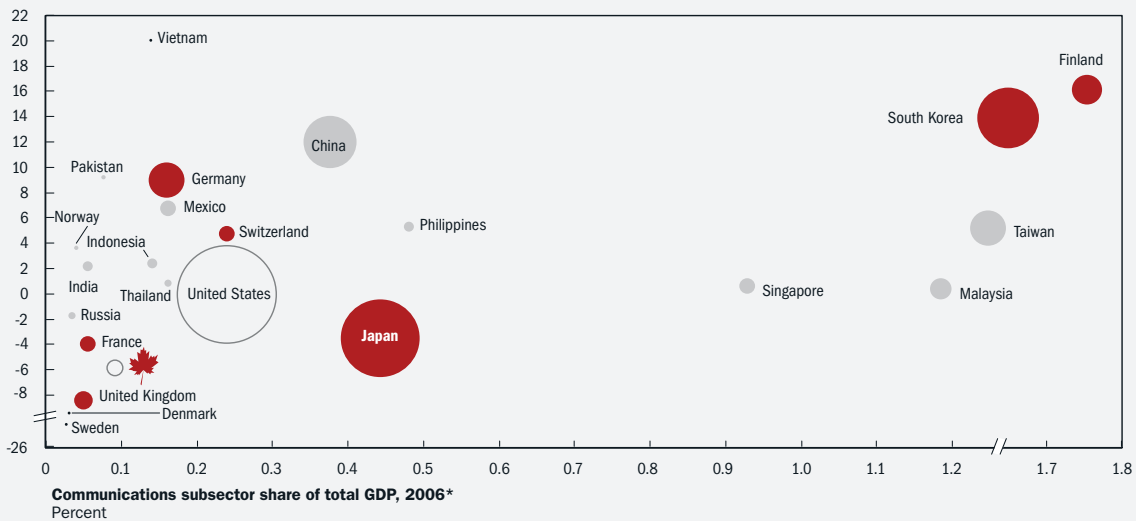
EXHIBIT 3

The communications subsector

Communications sector growth,* 1997-2006
Compound annual growth rate

\$5 Sector size
US \$ Billions

● Countries with higher labour rates than Canada's



* Statistics Canada nominal data used for Canadian data; comparable Global Insight data yields 2.8%
Source: Global Insight World Industry Navigator Rev 3; Statistics Canada; McKinsey & Company

Israel – A magnet for high-tech investment

Since the early 1980s, Israel's high-tech electronics sector with its highly skilled and technical workforce has become a hub for global R&D, innovation, and entrepreneurship. The information, communications, and technology sector represents 5.4 percent of Israel's GDP and has accounted for 7.2 percent of the country's total GDP growth since 1990. By 2006, nearly half of Israel's total manufacturing exports were high-tech products.

To spur this high-tech growth, Israel's political, public policy, and business leaders have fostered an entrepreneurial and innovative business culture by:

Investing heavily in education – and defense

Israel invests more of its GDP in education than any other OECD country, with the public sector funding the bulk of this investment. Nearly 30 percent of the country's 2005 graduates specialized in engineering and science. Israel's defense sector is also a key driver of growth, providing a strong domestic market for technology that requires cutting-edge R&D and innovation.

Developing the venture capital sector

By starting a venture capital community and attracting top-tier funds to the country, Israel fueled a local innovative and entrepreneurial culture that has generated thousands of startup enterprises in the major high-tech clusters. For example, Tadiran, RAD, ECI, Comverse, and Elrad Networks alone have launched over 700 spinoff and startup

companies. Tax incentives on capital gains have also attracted foreign venture capital funds (e.g., Apax Partners, Sequoia Capital, and Benchmark Capital), as well as encouraging local people to become entrepreneurs. Government-funded seed money from the Office of the Chief Scientist has also helped drive startup activity.

Providing incentives to attract multinationals – and to strengthen the sector as a whole

Government R&D grant programs and tax incentives for international investors have attracted R&D centres from companies such as Microsoft, Siemens, General Electric, Intel, HP, Oracle, and Google. The Ministry of Industry and Trade tends to customize the incentives based on the size of the company making the investments. For example, foreign companies investing more than US \$40 million receive R&D grants of up to 20 percent of the investment, as well as reduced tax rates for 8 years.

In addition to their investments, these multinationals bring global experience, knowledge, and sophistication that help Israel's technology sector continue to develop and grow.

The impact of global restructuring

Most Canadian companies – with a notable exception of Research in Motion – have yet to take full advantage of the opportunities presented by the global restructuring of electronics manufacturing. As a result, the Canadian sector's performance is falling behind, especially when compared to electronics manufacturing in countries such as Finland, South Korea, and Israel. McKinsey's analysis found this underperformance stems mainly from Canadian players failing to adapt quickly to the fast-changing global business climate and to take the risks required to capitalize on new trends.

Like Israel, for example, Canada has a highly skilled and educated – and high-cost – workforce. Some Canadian manufacturers have begun to successfully leverage this workforce, making a concerted effort to focus on the activities and products that add high value and reap high margins. Many, however, have not.

Loss of global market share

Since 1997, electronics manufacturing globally has grown 5.2 percent annually. Yet, in the same period, electronics manufacturing in Canada has only grown by 0.6 percent a year – the sector has lost share both to lower-cost countries (e.g., Taiwan and China) and to higher-cost countries (e.g., Finland and South Korea). Canadian firms have even lost their share of exports to the United States, Canada's primary trade partner. Electronics manufacturing imports to the United States from Canada declined from 6.7 percent in 1997 to 3.6 percent in 2006.

Low productivity growth

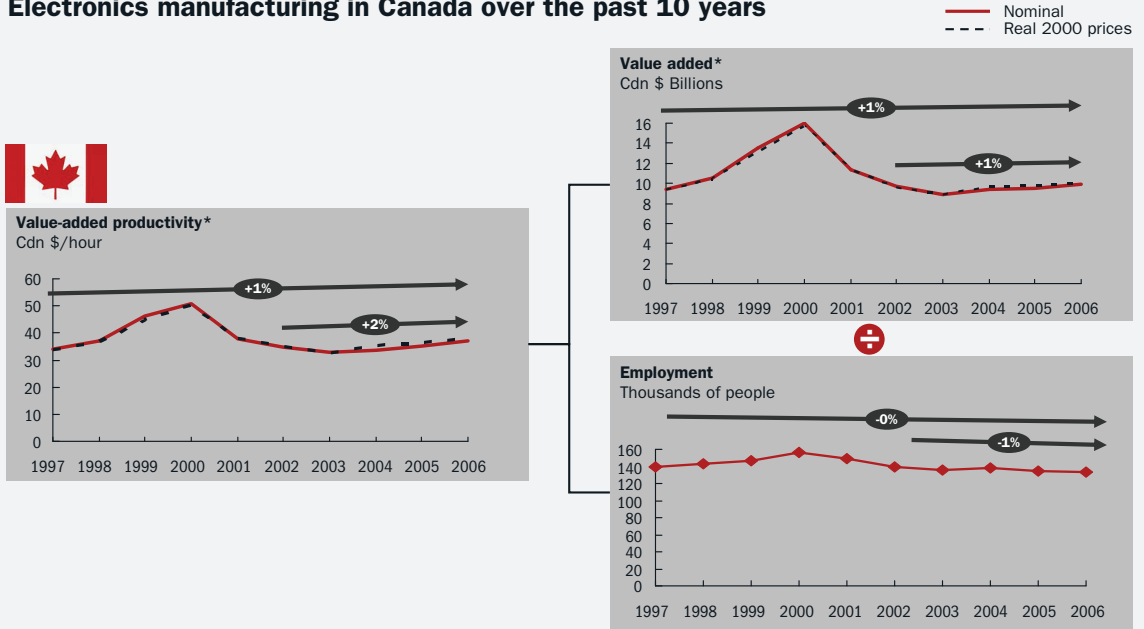
Canadian electronics manufacturing labour productivity has been flat since 1997. In contrast, the electronics manufacturing sector in the United States, with comparable cost levels and a shared border, has increased real labour productivity by 19 percent a year over the same period. It did this by shifting to higher-value products (e.g., active semiconductors) better suited to a higher-cost country and by reducing the workforce by 4 percent a year since 1997 and 7 percent a year since 2002. Labour flexibility is one reason why US productivity in electronics manufacturing has dramatically outpaced Canada's.

Slow reaction to global trends

In the late 1990s, driven by major communications equipment manufacturers such as Nortel and JDS Uniphase, a small but highly successful technology cluster sprang up in the Ottawa region. Over the past decade, however, Canadian manufacturers' specialization in particular subsectors has decreased because of the stalled growth in communications equipment and the downfall of some of the

EXHIBIT 4

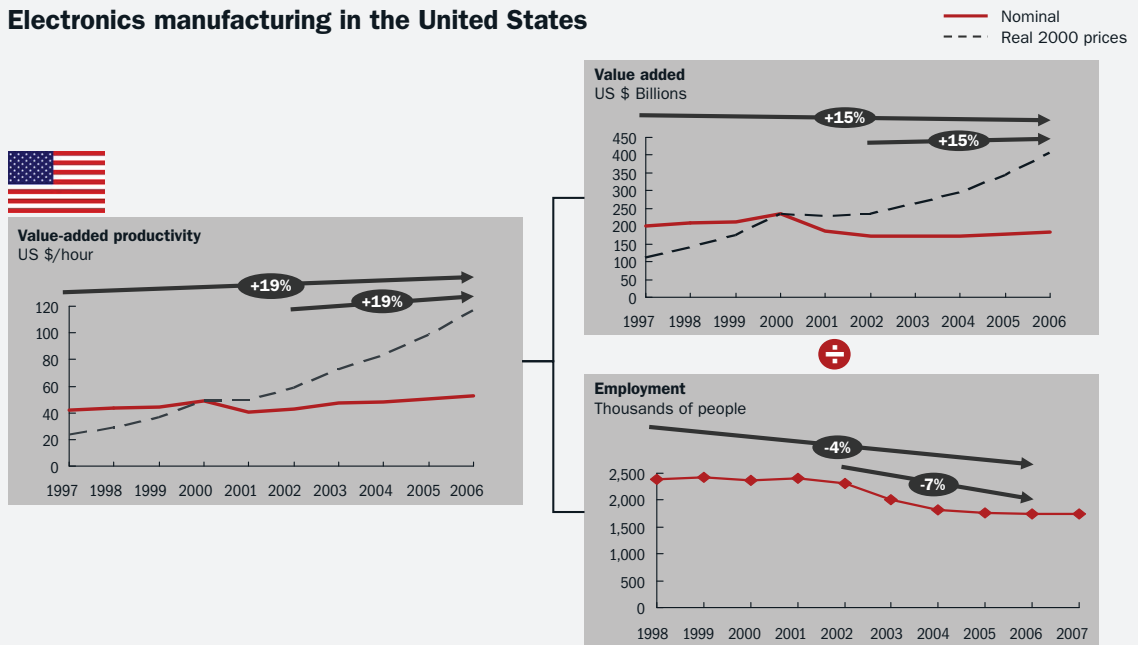
Electronics manufacturing in Canada over the past 10 years



* Real and nominal should be identical in base year; rebasing from Statistics Canada PPIs from the 2002 base year does not produce the same results
Source: Statistics Canada (Table 376-0027); McKinsey & Company

EXHIBIT 5

Electronics manufacturing in the United States



Source: BLS; BEA; Economy.com; McKinsey & Company

companies in the cluster. Canadian players have also been slow to take advantage of the global market evolution and refocus production on new and emerging opportunities. The communications subsector is now struggling to catch up as most of their global competitors have relocated lower-value-adding manufacturing activities to players in Asia.

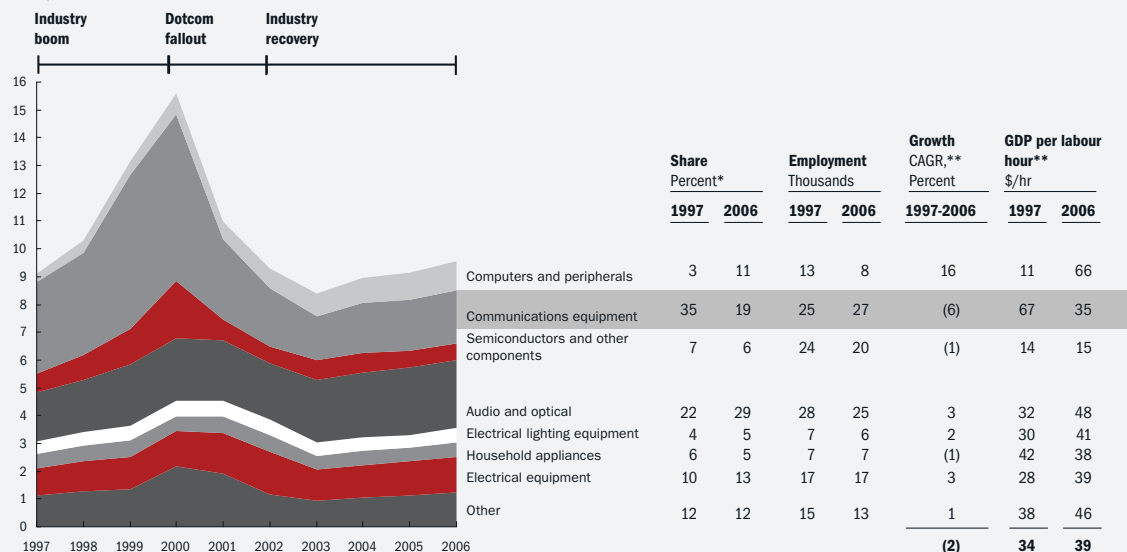
The communications equipment subsector, which historically accounted for 35 percent of electronics GDP, now represents less than 20 percent. And, while GDP has declined, employment in the electronics manufacturing sector as a whole has increased so that productivity has dropped from \$67 to \$35 per hour. Today, the absence of specialization means that no one subsector accounts for more than 30 percent of the electronics manufacturing sector's contribution to GDP.

In contrast, in the United States, the semiconductor subsector represents almost 25 percent of the total sector, whereas in Canada, it is only 6 percent. Moreover, US semiconductor producers have focused on the highest-value products – 72 percent of their products are complex “active” semiconductors (such as micro-processors), compared with only 21 percent in Canada. Furthermore, the United States has increased its concentration on active semiconductors to 72 percent in 2007 from 63 percent 10 years earlier.

EXHIBIT 6

Composition of the Canadian electronics manufacturing sector

Nominal GDP
Cdn \$ Billions



* May not add to 100% because of rounding

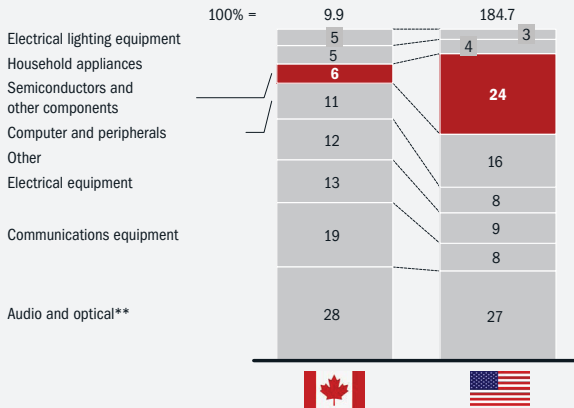
** Nominal

Source: Statistics Canada; Global Insight; McKinsey & Company

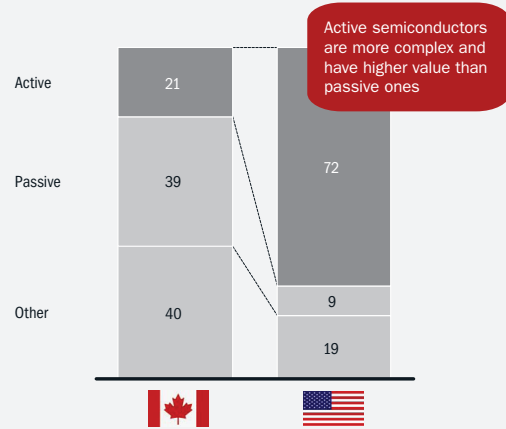
EXHIBIT 7

Product mix (and product quality) in Canada and the United States – 2006

Share of subsector mix*
Percent, US \$ Billions



Subsector production product mix for semiconductors manufacturing
Percentage of volume sample***



* Based on nominal shares
 ** Most are navigational, measurement, and electromedical products
 *** Not comprehensive but large enough to be representative
 Source: Statistics Canada (Table 379-0027, 28) – prices deflated to 2000 levels; BEA via Economy.com

Lack of focus on high-value-added activities

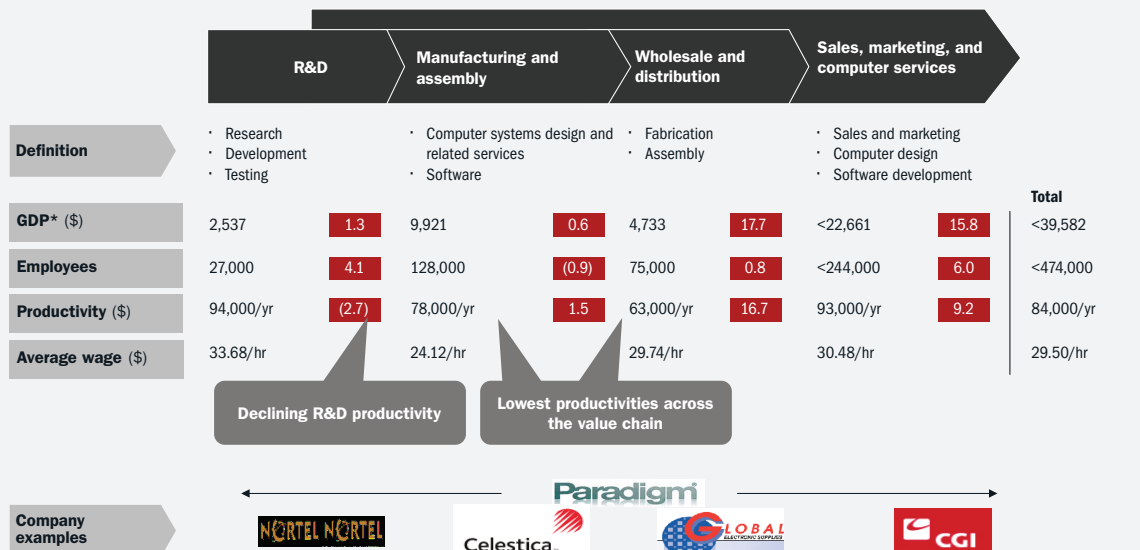
The highest productivity activities in the electronics value chain are R&D and services. These functions typically have 20 to 50 percent higher productivity than manufacturing and distribution and are suited to Canada's highly educated workforce. Unfortunately, Canada's electronics manufacturing sector has lagged in re-orienting labour and investment toward R&D and services, which has hampered the sector's growth and development.

Canada's total R&D expenditure as a percentage of GDP is about one-quarter that of Israel's and significantly less than those of Finland, Korea, and the United States. Electronics R&D investments help increase electronics manufacturing activities, as new products are typically produced locally. Intel is one of the many companies benefiting from Israel's strong R&D support. It has large R&D facilities in Israel and also continues to produce its most advanced fabrications there.

EXHIBIT 8

Value chain of Canadian electronics sector – 2006

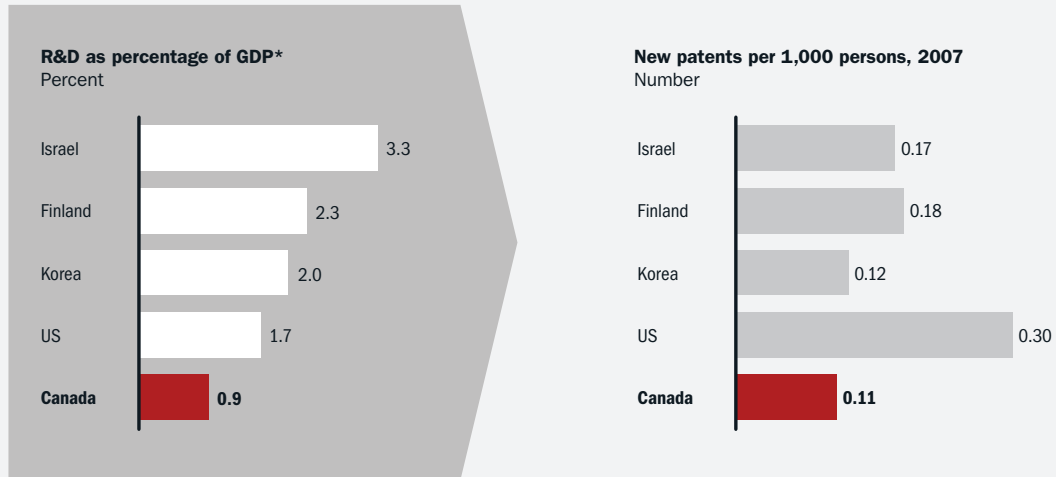
1997-06 CAGR %



* Nominal \$ and growth: to get from real to nominal: 1997 real GDP is inflation-adjusted, with CPI for services, wholesale, and distribution inflation adjusted to WPI, and manufacturing already had nominal data
 Source: Statistics Canada; BEA; Compustat; Global Insight; McKinsey & Company

EXHIBIT 9

Canada's lagging R&D in the developed countries – 2007



* If non-business R&D is included, the rank of proportionate spending is identical
 Source: CVCA; EVCA; PWC Moneytree; McKinsey & Company

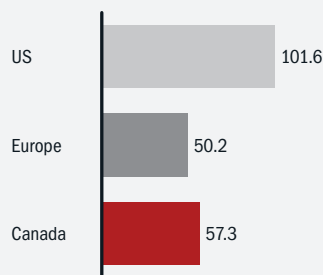
Restricted access to capital

As noted in the Israeli example, venture capital stimulates investment and entrepreneurship in high-tech opportunities. Unfortunately, the venture capital industry in Canada is small – it is roughly half the size of that in the United States – and it has yielded relatively poor returns² over the past 10 years. In fact, Canada’s annualized returns have lagged US returns more than 10 times during this period. In May 2008, the Canadian Venture Capital and Private Equity Association (CVCA) stated that the industry was “facing a financial crisis.” As a result, innovators in the Canadian electronics manufacturing sector can find it challenging to access the necessary financing.

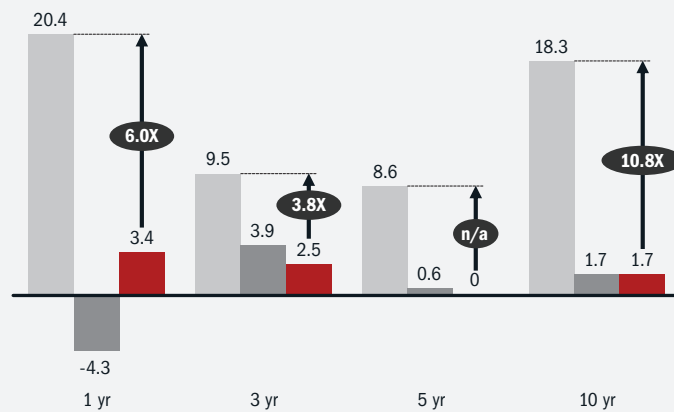
EXHIBIT 10

Venture capital investment

Per capita, 2007
US \$ per person



Returns by region at December 31, 2007
Annualized percent



* \$178 million in electronics/instrumentation
 Source: CVCA; EVCA; PWC Moneytree; McKinsey & Company

2 This is partly because of the Labour Sponsored Venture Capital Funds.

Canadian strengths to build on

Canada has several emerging competitive advantages in the electronics manufacturing sector that it can build upon to increase its global competitiveness.

The audio and optical subsector

Between 1997 and 2006, the audio and optical subsector grew from 22 to 29 percent of the sector's GDP, an annual rate of 3 percent. This was the fastest growing electronics subsector in Canada with the greatest total concentration. Audio and optical has also seen an increase in labour productivity from \$32 to \$48 GDP per labour hour.

The subsector is largely dominated by a mix of niche companies, such as Audio Products International (API) and Ross Video. Despite experiencing higher production costs in Canada, these companies are globally competitive, having invested heavily in R&D and delivering a differentiated product in a high-value marketplace.

For example, R&D is the key to the success of Ross Video's broadcasting, event, and production products – it reinvests over 25 percent of its revenue in new

API – one of the largest speaker manufacturers in the world

API was founded in 1972 in Toronto. Today, it is one of the 10 largest speaker manufacturers in the world. Its 2007 revenue was approximately US \$200 million, and its 300 employees work in locations in North America, Europe, and Australia.

API's success stems from its focus on high-end, specialty, and customized products, such as the globally recognized Athena, Energy, and Mirage loudspeaker brands. It is renowned for product design, research ability, and innovation, and it has landed contracts like a 3-year global exclusive to produce Xbox speaker systems.

API's specialization strategy is enabled by its focus on R&D and its vertically integrated manufacturing process. Its 165,000-square-foot facility in Toronto houses offices, R&D, and speaker manufacturing departments. API designs and manufactures its entire line of products in-house. Making and installing all product components – rather than buying off-the-shelf parts from original equipment manufacturers and outsourcing – enables API to maintain control over the production and testing and to be uncompromising about performance and quality.

product development. It also manufactures key activities in-house to ensure high quality. As a result, Ross Video has won eight industry awards over the past 6 years.

Increasing productivity through employee redeployment

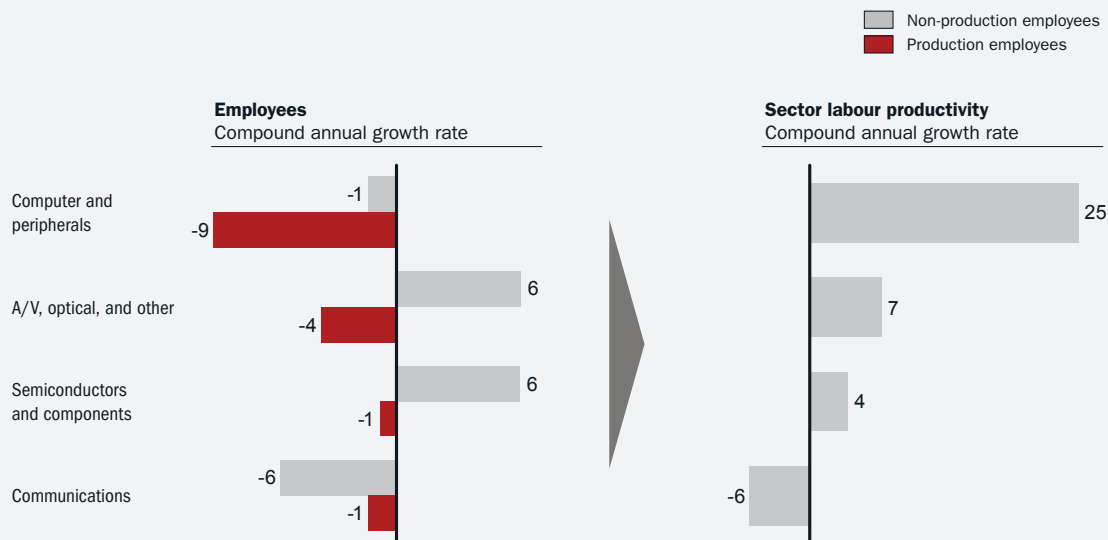
Some Canadian manufacturers have started to successfully redeploy workers to more productive activities and sectors. In a declining subsector such as computers and peripherals, for example, significant gains in productivity have been achieved by reducing total employment in the subsector. The same trend can be seen in the audio/video and optical and semiconductors subsectors, which have improved productivity by redeploying workers and increasing the number of R&D and service roles.

Geographic clusters as pockets of innovation and electronics excellence

Among others, Ontario's Waterloo region has emerged as a Canadian technology cluster. Industry-leading companies, high-quality post-secondary educational institutions, a highly skilled workforce, and world-class R&D organizations have gravitated to the area, attracted by opportunities for mutual benefit. The Water-

Exhibit 11

Canadian computer and electronic component manufacturing – 1997-2005



Source: Industry Canada report; Statistics Canada; McKinsey & Company

lo universities attract people like Bill Gates to speak with their students about careers at Microsoft and at other leading companies like Google, which recently expanded its local facility.

The labour pool is highly educated – 33 percent of the population aged 15 and over has a university education, compared with an average of 25 percent for Ontario. Over 150 research institutes attract global talent, while the entrepreneurial business culture, strong information networks, and localized access to financing combine to create a rich environment for the electronics sector. As a result, the region is attracting an increasing number of firms, from startups to related technology service firms, and over 400 high-technology companies such as Research in Motion, Descartes Systems Group, and Open Text.

Possible actions to revitalize Electronics manufacturing

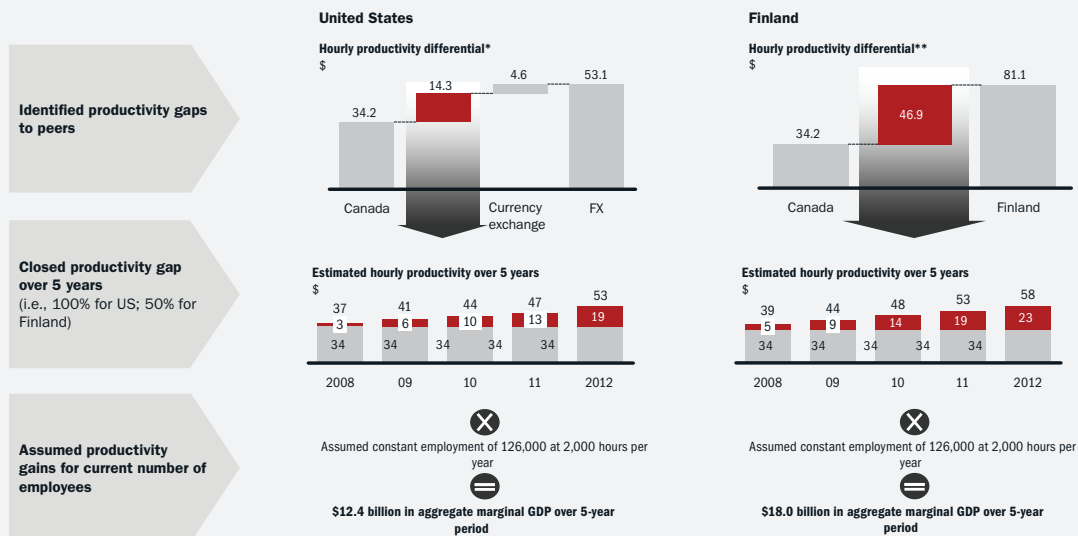
Canada's electronics manufacturing sector will probably continue to lag the sector's global growth unless Canadian players, like their competitors in other higher-cost economies, are able to specialize more and refocus their product mix on higher-value goods. Looking forward, it would be critical for Canadian firms to specialize in areas that show growth potential and would leverage the country's skilled workforce, leading engineering institutions, and capabilities in higher-value activities like R&D and design.

Revitalizing Canada's electronics manufacturing sector will require resolve and focus from multiple stakeholders in both the public and the private sectors and include public-private partnerships. They will need to determine where future opportunities are likely to lie and then find ways for Canadian firms to capture them. The rest of the sector can look to its home-grown global champions like RIM for ideas – and reasons for optimism.

McKinsey has drawn on this initiative's analysis, our global research on competitiveness, and our experience working with international companies in the high-

EXHIBIT 12

Productivity gap with the United States and Finland over the next 5 years



* Using nominal values for 2006; mix effect combines employment and GDP differentials between the two countries; although the two countries have different mixes, the mix effect is negated because the highest-productivity subsectors in Canada are different from those in the United States and vice versa
 ** No currency exchange assumptions made about the productivity gap with Finland
 Source: Statistics Canada, US BEA; McKinsey & Company

tech sector to develop six recommendations for the private sector that we believe could significantly improve performance and growth. We have also highlighted five topics that we think should be on the public agenda for further debate.

McKinsey estimates that improving competitiveness in the electronics manufacturing sector along the lines of the following recommendations could contribute an additional \$2.5 billion to \$3.6 billion in GDP annually, representing growth in the sector of 7 to 9 percent a year, or 25 to 40 percent of the total value of the current electronics sector (approximately \$83 to \$120 per Canadian). This estimate assumes that firms in the Canadian sector will, on average, be able to achieve the same levels of labour productivity as their peers in the United States and Finland.

Additional benefits would include:

- Globally recognized thought leaders within the sector at the forefront of emerging technologies, products, services, and business model innovations including green technologies, wireless, energy storage, and software services
- Participation for Canadian firms in the highest-value areas of the electronics value chain (e.g., R&D) with spillover effects into activities such as rapid prototyping and high-value manufacturing
- Use of the full global supply chain, including partnerships with lower-cost countries for activities that would be more advantageous to complete offshore
- Canada recognized as a leading choice for global multinationals seeking to invest in R&D and complex product manufacturing, because of the quality of its research efforts, symposiums, and informal networking opportunities
- A flourishing startup community for new high-tech businesses, collaborating closely with leading academic research institutions and an emboldened venture capital community.

Recommendations for business leaders

1. Take a more granular view of the market to capture growth opportunities

In the face of global industry restructuring, companies in winning developed countries have demonstrated an ability to shift their focus to subsectors that show growth potential and to higher-value activities within those subsectors. To capture the sector's growth opportunities, Canadian companies need to understand precisely where growth opportunities lie and where they are best suited to compete.

In *The Granularity of Growth*,³ McKinsey studied 400 large companies and found that 65 percent of growth is achieved by capturing market opportunities. This approach requires companies to understand their markets at a deeper level than the sector, looking within subsectors for promising opportunities.

Samsung is one company that has achieved great success by making choices based on deep and detailed market insights. Looking at its telecommunications operations, Samsung made two major choices: to commit to promising CDMA (code division multiple access) technology and to adopt a fast-integrator approach. The company caught a growth “tailwind” by participating in a fast-growing market segment and by securing an important, high-value-adding role in the value chain.

Within the electronics manufacturing sector, Canada should consider focusing on subsectors and products that show strong growth and increasing productivity. For example, the optical and audio subsector is increasing its share of Canadian sector GDP and improving productivity. It includes several companies that are prioritizing R&D and specialized manufacturing – both areas where Canada could have a competitive advantage. While no standard approach exists for capturing growth opportunities, great innovators are able to:

- **Anticipate the latest technology innovations** by systematically leveraging insights on customers, technologies, and broader industry dynamics. The rise of consumer technology trends with shorter product life cycles is accelerating model turnover (much like fashion trends), so a deep understanding of the consumer is critical.
- **Develop a corporate environment to generate and capitalize on innovation** by structuring incentives and cultures to encourage risk taking and ride potential emerging trends. This means encouraging, celebrating, and acknowledging trials and failures, as well as deploying skills flexibly to develop successes as swiftly as possible.

2. Design to value

To capture these pockets of growth, initiatives must be implemented at the product development and R&D levels. Canadian electronics manufacturing companies should strive to deliver functionality at the optimal cost point. The concept of design to value focuses R&D and product development on projects that offer the best value-creation opportunities.

3 Patrick Viguier, Sven Smit, and Mehrdad Baghai. *The Granularity of Growth: How to Identify the Sources of Growth and Drive Enduring Company Performance*. Wiley, April 2008. McKinsey Large Company Growth Decomposition Database.

In McKinsey's experience, leading design companies take a consumer-driven design approach to better meet consumer needs. This means understanding what customers value and what they are willing to pay for. This insight then enables companies to identify critical product features and quantify the value of different product options.

An opportunity also exists to eliminate waste in product development and thus reduce time to market, which is particularly important in today's increasingly fad-driven consumer electronics sector. Speed to market can be improved by adopting decision-based processes – clearly identifying critical decisions and the information required to make them quickly.

Finally, an important aspect of design to value is direct material optimization. By optimizing across the supply chain, procurement and product development can:

- Become equal partners in creating supplier strategies and a long-term core component road map
- Jointly use the entire suite of available cost management tools to reduce critical cost drivers at the design stage and provide leverage in negotiations with suppliers
- Co-own cost-reduction targets for both new and existing products.

3. Tailor the configuration of the supply chain

Many Canadian companies have not yet taken full advantage of the capabilities and cost advantages represented by locating some activities in other countries. As companies look to expand, they should consider outsourcing lower-value manufacturing activities to lower-cost countries and shift their Canadian operations toward R&D, product design, services, and high-end-product manufacturing.

Global production is inherently complex because of the multiple suppliers, sales channels, and customers. To minimize supply chain complexity and develop an effective global manufacturing network, companies will need to segment their supply chains by geography, product, or customer characteristics. For example, it can be helpful to separate fast- and slow-moving goods to determine which supply chain model is most appropriate. In addition, companies can measure the total cost of ownership for each component, subassembly, and final product to optimize sourcing and supply chain and supplier performance.

4. Optimize production approaches for product and design complexity

Managing complexity is one of today's greatest challenges for manufacturing companies. Beyond supply chain improvements, optimizing for complexity across the dimensions of product, life cycle, and design provides an opportunity for Canadian manufacturers to further minimize cost and generate additional revenue.

- **Product complexity**, as indicated by a high number of product SKUs, is often driven by the desire to achieve market coverage and meet each customer's unique specifications, as well as a culture of innovation and emphasis on developing new products. Mapping existing products and platforms to customer segments helps companies identify product complexity. Often, this highlights redundancies and opportunities to migrate toward a more focused and manageable range of products while weeding out old or underperforming products.
- **Design complexity** is indicated by a high number of parts, material specifications, and design layouts across the product range. Companies will need to ensure they have a central design directive to facilitate communication between design teams and oversee compatibility of different product categories. Additionally, products should be only as complicated as necessary, with specifications driven by customer needs rather than what is technologically possible.

5. Implement lean operating practices to reduce waste

Canada is unlikely to become a low-cost producer, but it can become more efficient. Companies that adopt a lean management philosophy achieve improved quality and reduce production time and costs. The concept of lean manufacturing emerged from the Toyota Production System, which has enabled Toyota to achieve 6 percent annual productivity improvements while maintaining industry-leading quality and defect levels. In this system, the key sources of waste to eliminate are: overproduction, waiting time, transportation, overprocessing, inventory, motion, and scrap.

Applying lean principles increases value for customers by creating a system where all the elements interact to continuously remove waste. To implement a lean manufacturing system, companies must consider three essential elements:

- **Operating system.** Companies need to optimize across material and information flows and quality, people, and maintenance systems. A number of approaches can be used to drive improvement, including solving problems at the source, eliminating all non-value-adding activities, and pulling products from the consumer end rather than pushing them from production.

- **Management infrastructure.** Performance management, organizational design, and capability-building and support function processes should all align to drive continuous improvement. For example, incentives should closely link behaviours to desired activities, process design should include fail-safes, and performance management should include problem solving, frequent reviews of key performance indicators, and skill building.
- **Mindsets and behaviours.** Fostering the right mindsets, (i.e., the way people think, feel, and conduct themselves in the workplace, individually and collectively) is essential to make significant and lasting improvements. In lean operations, this can mean creating focus, a compelling purpose, and a clear sense of direction; supporting execution to encourage people to work together to get things done; and building skills to ensure people work effectively in their roles.

6. Explore new markets beyond the United States

Canada has historically relied on the United States for approximately 70 percent of its electronics manufacturing exports, but the sector's share of US trade is decreasing due to competition from low-cost developing countries. Canada's cost advantage has also eroded with the rising Canadian dollar. Fortunately, there are many opportunities for increasing sales elsewhere that Canadian companies could take.

At the moment, Canada is underinvesting in emerging markets. For example, foreign direct investment outflows to China from comparable developed OECD countries⁴ are three times higher than those from Canada, and outflows to India are five times higher. McKinsey research indicates that by 2025, the middle class in India will have grown from approximately 50 million (5 percent of the population) to an estimated 583 million people (41 percent of the population). Now is the time to be early to market and capture brand loyalty. Canadian firms should grasp such opportunities and be willing to explore and develop their capabilities to compete in new markets.

When creating strategies for serving the growing middle class in countries such as India and China, Canadian companies could leverage the knowledge and relationships of their diasporas in Canada to identify unmet market needs and build supplier relationships. Companies entering emerging markets can adopt a test-and-learn approach by piloting operations in smaller markets – either smaller regions or defined niche markets. Lessons from these pilots would enable Canadian companies to compete more effectively as their operations expand, along with the burgeoning middle class of the emerging markets.

4 Austria, France, Germany, Italy, Netherlands, the United Kingdom, and the United States.

Suggested topics for the public agenda

1. Encourage the development of specialized skills in research, product development, and commercialization

Canada's education system is strong in accessibility and quality. It could leverage these strengths to ensure its graduates are better equipped with the specialized technical skills and capabilities required by the global economy. This would entail:

- **Focusing education where it is needed.** In Israel – which, of all the OECD countries, invests the largest portion of its GDP in education – 30 percent of 2005 graduates specialized in engineering and science, as opposed to only 20 percent in Canada. Finland, where students receive free scientific educations, targets educational spending to create the skills required to work in R&D and design. Canada could establish more of these types of targeted government grants and incentives, as well as increasing public and private financial support – for example, by increasing the availability of scholarships that target particular skills. The Research in Motion Graduate Scholarship provides financial support to students conducting research in mobile communications. This type of aid encourages specialization in areas where companies require new innovation and capabilities.
- **Encouraging commercialization of ideas.** Academic centres are sources of innovation and idea generation. With the right encouragement, these ideas can become executable and marketable.

In addition to technical skills, the Canadian education system could provide students with more exposure to business. A number of emerging joint business and science programs indicate that Canada may be developing an advantage in this area.

At the University of Waterloo, students can combine the strengths of its science program with business courses; at the University of Western Ontario, students can earn a joint degree in science or engineering and business (through the Richard Ivey School of Business). More of these joint programs are required to help develop the next wave of Canadian entrepreneurs to fuel growth in electronics and other high-tech sectors.

- **Protect intellectual property rights.** Like Finland, Canada could provide clear ownership rights to academics so they benefit from the execution of their ideas. While the University of Waterloo has a creator-ownership policy that encourages commercialization of research results, most other Canadian universities do not. As noted in Canada's Competition Policy Review Panel's June 2008 report, Canada's post-secondary educational

institutions could support the transfer of intellectual property rights and the commercialization of university-generated intellectual property. Moving to an “innovator ownership” model may be a good option to encourage commercialization.

2. Provide financial incentives to encourage R&D in the electronics sector

Canada lags most developed countries in R&D expenditures as a percentage of GDP spending per capita. Furthermore, Canada has not attracted R&D investment from multinationals to the same extent as other higher-cost countries. What would it take to vault Canada to the short list of top destinations for foreign direct investment that includes countries such as Finland, Germany, Ireland, and Israel?

Canada ranks 15 out of 30 OECD countries in private investment in R&D. While decisions about the type of R&D should be made by the private sector, the government could consider incentives like those offered in Finland and Israel. Investment from multinational corporations could bring sophistication and experience to Canada's technology sector. Government stakeholders could review granting, funding, and tax policies to ensure they are competitive and encourage private R&D investment in Canada. For example, the scientific research and experimental development tax credit program could be reworked to ensure it encourages business investment in R&D and innovation.

3. Support the development of geographic/industry clusters

Over the years, Canada has successfully developed regional clusters like Waterloo and Ottawa, where government organizations, corporations, and education centres collaborate to create a stimulating infrastructure to support the electronics sector's development and growth.

What would it take to create additional clusters with similar scale and scope? Through private-public partnerships, Canada could develop the infrastructure and support for two or three electronics clusters focused on promising subsectors. Government investments in educational support and R&D incentives could be focused on supporting the regions that demonstrate potential in high-opportunity subsectors. For example, further investment in Ottawa could facilitate its transformation from a hub for communications to a powerhouse in the promising optical and audio subsector. The government could support educational institutions, provide incentives for companies to relocate, directly invest in research facilities, and also encourage venture capital.

4. Assist in redeploying less-skilled employees to higher-value activities or to other industries through retraining and removing barriers

If Canada aspires to become more flexible in the types of products it chooses to produce and the areas of the electronics value chain it chooses to compete in, it will need to determine how to redeploy labour to where it will be most productive. This would require putting in place joint public and private channels to effectively retrain and redeploy labour to higher-value-added activities within the sector or in other high-productivity sectors. Canada has initiatives in place to support labour training programs. However, the next step is to move beyond general support for skills applicable across labour bodies to targeted redeployment programs focused on matching employees to specific promising sectors.

The United Kingdom is already doing this. Government programs such as Job Centre Plus and other regional development agencies offer services to workers made redundant by manufacturing companies, including counselling and search advice and training for jobs with skills shortages and for specific positions. In addition to these services, the Engineering Employers Federation (EEF) actively matches skills among its members. For example, if one of EEF's member companies is reducing its workforce, it attempts to match the skills of the individuals facing redundancy with other member companies that are hiring. Canada could adopt a similar approach.

In addition to redeploying workers, Canada could better leverage immigration as a source of highly talented labour. The points system could be used to encourage the immigration of engineers and other skilled workers who would contribute to higher-value activities. The system could facilitate the transferability of international credentials so that new Canadians could quickly and easily integrate into the sector and contribute to the economy.

5. Foster and develop technology-focused venture capital providers

Venture capital is an important element in Canadian industry. For the electronics manufacturing sector, venture capital is particularly significant as it provides crucial support for the innovation and renewal required to make electronics manufacturing a competitive sector.

Overall, Canada's venture capital sector is underdeveloped and chronically underperforming. While investors and venture capitalists can do much to improve the sector, the government may be able to act as a catalyst.

For example, in Israel, a number of highly effective government venture capital funds (e.g., Yozoma) in the 1990s helped encourage early stage R&D and startup

activity. Israel also changed tax incentives on capital gains to attract international private venture capital funds. Israel is now a major venture capital hub, having attracted over 150 funds like Sequoia Capital over the past 10 years.

British Columbia and Ontario have recently launched venture capital programs. However, these programs are likely to be small in terms of the capital required to truly kickstart Canada's competitiveness. It is likely that significant industry restructuring (e.g., consolidating the numerous small and underperforming Canadian venture capital investors to capture scale benefits and reduce costs) will be required to help increase this critical sector's impact.

A debate on the role the government should play in helping kickstart a venture capital community similar to Israel's, focused on stimulating startup activity from universities and the high-tech sector, would be timely. Canada needs to provide access to more targeted venture capital, like the recently announced RIM, RBC, and Thomson Reuters BlackBerry Partners Fund, which invests in mobile applications and services for the BlackBerry and other mobile platforms.

* * *

Global industry restructuring has created significant opportunities and challenges for the Canadian electronics manufacturing sector. This sector has a strong foundation and some notable global leaders. However, revitalizing it will require resolve and focus from multiple stakeholders. Both the public and the private sectors will need to work together to determine opportunities that could significantly accelerate growth and improve performance – and develop strategies to capture them.

Addendum, September 2009

The bankruptcy and subsequent liquidation of Nortel has closed a chapter on this once global champion. This raises questions of whether Canada can support global champions with the scale, skills, leadership talent, production innovation, etc., that is needed for successful competition. Did Nortel solely make serious business errors, or were there structural disadvantages in competing against other leading telecommunications providers?

If you have any comments or questions about this report, please call McKinsey & Company at 416 313 3700 or email Andrew Pickersgill at andrew_pickersgill@mckinsey.com.

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