Designed in Mexico
Roadmap for design, engineering and advanced manufacturing
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1. General assessment

Mexico is the most important manufacturing center in Latin America. In fact, a large number of the products manufactured for North America and the world come from Mexico. Currently, Mexico accounts for 2.16 percent of world trade and 2.20 percent of non-oil world trade. This is due in large part to its economic openness and its extensive network of trade agreements (11 treaties that give it preferential status in 43 countries), notably including the North America Free Trade Agreement (NAFTA) and the Free Trade Agreement between Mexico and the European Union (TLCUEM).

Thanks to its competitive advantages, Mexico is the leading exporter in Latin America. In 2010, Mexico’s manufacturing sector exports reached almost 244 billion dollars, which represents nearly 48 percent of Latin America’s total exports.

Source: Ministry of Economy, 2011.
After signing the NAFTA agreement, Mexico gradually and successfully shifted to an export driven economy,¹ which naturally complemented the maquila industry that emerged in the 1960’s.

This convergence of treaties, along with the devaluation of the peso in relation to the dollar, as well as the experience acquired in the electronic and automobile industries, created a highly competitive region in which to develop a manufacturing industry devoted to exports. In past decades, this situation has managed to attracted a large number of companies interested in exporting from Mexico, taking advantage of the labor and qualified engineers, trade agreements and its position in a dollar zone (especially for European and Asian countries interested in exporting to the United States).

On the other hand, even though, this development model has managed to keep Mexico in a competitive position, in relation to its volume of exports, it has not generated a significant base of suppliers capable of providing endogenous innovation and nationally registered intellectual property, which, added to foreign investment, could increase the added value of its products and the strategic position of Mexico regarding the international innovation market.

¹ProMexico, Mexico at a Glance, 2009, with data from the Bank of Mexico (BANXICO).
Mexico’s Principal Export Sectors (2010)

(Millions of dollars)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Participation Rate 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic machinery and equipment</td>
<td>75,215</td>
<td>60,968</td>
<td>71,703</td>
<td>29.41%</td>
</tr>
<tr>
<td>Land vehicles and parts</td>
<td>42,822</td>
<td>33,698</td>
<td>51,777</td>
<td>21.24%</td>
</tr>
<tr>
<td>Mechanical mechanisms, boilers and parts</td>
<td>33,674</td>
<td>29,079</td>
<td>41,626</td>
<td>17.08%</td>
</tr>
<tr>
<td>Optical and medical devices and instruments</td>
<td>9,316</td>
<td>8,632</td>
<td>10,187</td>
<td>4.18%</td>
</tr>
<tr>
<td>Mineral combustibles and their derivatives</td>
<td>5,263</td>
<td>6,206</td>
<td>9,218</td>
<td>3.78%</td>
</tr>
<tr>
<td>Plastic and its products</td>
<td>5,370</td>
<td>4,649</td>
<td>5,705</td>
<td>2.34%</td>
</tr>
<tr>
<td>Furniture</td>
<td>5,293</td>
<td>4,146</td>
<td>5,434</td>
<td>2.23%</td>
</tr>
<tr>
<td>Iron and steel products</td>
<td>4,451</td>
<td>3,198</td>
<td>3,660</td>
<td>1.50%</td>
</tr>
<tr>
<td>Iron and steel</td>
<td>4,838</td>
<td>2,190</td>
<td>3,589</td>
<td>1.47%</td>
</tr>
<tr>
<td>Vinegar and other drinks</td>
<td>2,908</td>
<td>1,731</td>
<td>2,689</td>
<td>1.10%</td>
</tr>
<tr>
<td>Clothing and accessories except knitted</td>
<td>2,926</td>
<td>2,490</td>
<td>2,560</td>
<td>1.05%</td>
</tr>
<tr>
<td>Organic chemical products</td>
<td>1,907</td>
<td>1,669</td>
<td>2,061</td>
<td>0.85%</td>
</tr>
<tr>
<td>Copper and copper products</td>
<td>2,132</td>
<td>1,375</td>
<td>2,051</td>
<td>0.84%</td>
</tr>
<tr>
<td>Essential oils and resins</td>
<td>1,485</td>
<td>1,789</td>
<td>1,778</td>
<td>0.73%</td>
</tr>
<tr>
<td>Clothing and knitted accessories</td>
<td>1,851</td>
<td>1,567</td>
<td>1,699</td>
<td>0.70%</td>
</tr>
<tr>
<td>Rubber and its products</td>
<td>1,470</td>
<td>1,162</td>
<td>1,671</td>
<td>0.69%</td>
</tr>
<tr>
<td>Metal products</td>
<td>1,953</td>
<td>1,474</td>
<td>1,617</td>
<td>0.66%</td>
</tr>
<tr>
<td>Glass and its products</td>
<td>1,395</td>
<td>1,174</td>
<td>1,473</td>
<td>0.60%</td>
</tr>
<tr>
<td>Others</td>
<td>24,791</td>
<td>20,543</td>
<td>23,273</td>
<td>9.50%</td>
</tr>
<tr>
<td>Total</td>
<td>229,058</td>
<td>187,741</td>
<td>243,772</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: ProMexico Business Intelligence Unit with information of the Global Trade Atlas, 2011.
At first glance, the previous policy appears to be favorable in terms of the diversification of Mexican Exports and the increase of sophistication through the promotion of the maquiladora industry: the share of trade in Gross Domestic Product (GDP) has doubled in the past 20 years, with manufacturing rising from 20 to 85 percent. Mexican manufacture exports are tightly integrated to global chains. Still manufacture exports are mainly based on imported goods that are finally re-exported with minimal use of local supplies, thus implying a negligible quantity of added value to Mexican manufacture exports. In fact, value added as a share of GDP in Mexico has fallen since the 1990s and its growth performance has been poor. The causes of this disappointing performance are open for discussion, but a gradual “maquilization” of the Mexican economy has been cited, in which domestic industry has replicated the maquila model responsible pf several national competitive inefficiencies such as the growing share intermediary imported goods and the subsequent collapse of the export multiplier[...].

This becomes more relevant if you consider that Mexico today has more engineering students than any American country and three times as many graduates per capita in this field than the United States. This unprecedented window of opportunity, as well as the country’s comparative and competitive advantages, point to a privileged position for the development of an industry based on the innovation of high added value. This is even more surprising if you consider that the Index of Technological Sophistication of goods produced in Mexico (3.25) is higher than that of India (2.61) or Brazil (2.49). The ingredients are there; the only element missing is strategy.

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2 Organization for Economic Co-operation and Development (OECD), Perspectives on Global Development 2010.

3 Ibid.
There is a clear example of this situation in the manufacture of molds and tooling in Mexico, an industry that imports goods with a value that reaches two billion dollars\(^4\) without a comparable local industry. The lack of capacity to produce this particular type of manufactures hampers the local productions of non-complex products, thus creating a dependency on foreign suppliers and also favoring the development of merely assembling companies. Local design and engineering capacity should be harnessed and developed for the manufacture of this type of products, attracting higher value and, above all, it should maintain control over capital goods.

Such trends and necessities were recurrent during the development of the national strategies for the aerospace and medical devices sectors, thus contained explained in their respective roadmaps. While developing these maps it was observed that one of the biggest challenges was the horizontal capabilities of advanced manufacturing, design and support engineering for these sectors.

### Technological Sophistication Index (TSI)

<table>
<thead>
<tr>
<th>Region/Country</th>
<th>1995</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>2.92</td>
<td>2.96</td>
</tr>
<tr>
<td>Asia (except Japan)</td>
<td>3.09</td>
<td>2.95</td>
</tr>
<tr>
<td>China</td>
<td>3.13</td>
<td>3.75</td>
</tr>
<tr>
<td>India</td>
<td>2.5</td>
<td>2.61</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2.19</td>
<td>2.22</td>
</tr>
<tr>
<td>Japan</td>
<td>3.98</td>
<td>3.69</td>
</tr>
<tr>
<td>South Korea</td>
<td>3.78</td>
<td>3.88</td>
</tr>
<tr>
<td>Taiwan</td>
<td>3.8</td>
<td>3.94</td>
</tr>
<tr>
<td>Latin America</td>
<td>1.98</td>
<td>2.16</td>
</tr>
<tr>
<td>Mexico</td>
<td>3.37</td>
<td>3.25</td>
</tr>
<tr>
<td>Argentina</td>
<td>2.05</td>
<td>2.06</td>
</tr>
<tr>
<td>Brazil</td>
<td>2.53</td>
<td>2.49</td>
</tr>
<tr>
<td>Chile</td>
<td>1.55</td>
<td>1.58</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>1.62</td>
<td>1.82</td>
</tr>
<tr>
<td>South Africa</td>
<td>1.82</td>
<td>2.44</td>
</tr>
</tbody>
</table>

Source: Perspectives on Global Development 2010, OECD, Based on Woo (2010).  
\(^4\) Ministry of Economy, Customs data, 2009.
Parallel to this, an analysis of development opportunities in the electronics sector and feedback from the representatives of the automotive and appliance industries, conducted by the Mesura network and ProMexico, agreed on the need to develop a strategy based on the roadmap methodology to be applied to the fields of design, engineering and advanced manufacturing.

For this purpose, talent is a critical factor and one of the key areas for developing a strategy which supports the future development of the sector. Concern for people working in manufacturing, engineering talent and the critical contribution they make to the economy are some of the issues, which have led to this roadmap. Manufacturing companies are partners in the effort to build a future for the market for new products and ideas. In a country like Mexico, a healthy manufacturing sector is key to providing better jobs, fostering innovation, increasing productivity and providing higher standards of living for the population.

The orientation of this technology roadmap (TRM) will be towards advanced manufacturing focused on the management of talent and the promotion of design, development and engineering capabilities in the processes, products and materials produced in Mexico. A paradigm shift from “Made in Mexico” to “Designed and manufactured in Mexico.”

A technology or innovation roadmap is a comprehensive, dynamic and organized plan which defines strategic milestones that bring support from various stakeholders for common goals. A well implemented TRM is accompanied by a plan of action that allocates the resources necessary to achieve them. On the other hand, as far as human beings are concerned, a TRM does not reveal the future, rather it is a draft, an unfinished document that should be revised and refined in a six-month planning horizon and a vision for global impact of not less than 10 years.

Here we present the results of this first proposal for an innovation roadmap for the design, engineering and advanced manufacturing sector. It is a plan that reflects the views and perspectives on the future of a group of leaders from the automotive, aerospace and electronics sectors as well as representatives from academia, research centers and government. Together they form a triple helix for the design and development of future advanced manufacturing in Mexico.
2. Manufacturing sector in Mexico

Speaking of manufacturing in Mexico is to talk about an area that includes capabilities in the most diverse sectors: the automotive industry, electronics and aerospace, to name a few; it is to focus on the maquila industry, on the development of suppliers and their integration into the overall value chain.

**Mexican exports volume**

(Millions of dollars)

2003: 140,301
2004: 157,487
2005: 174,006
2006: 201,753
2007: 218,650
2008: 229,058
2009: 187,741
2010: 243,772

Source: ProMexico Business Intelligence Unit with data of Global Trade Atlas 2011.
Even during the crisis, Mexico remained the leading exporter in Latin America. In June 2009, the volume of Mexican exports amounted 104 billion dollars, while total exports that year were 230 billion dollars.\(^5\)

After the crisis, for the comparative period January-April 2010, some manufacturing sectors already showed a recovery of up to 100 percent (automotive sector), compared with the same period in 2009.

### Division of Mexican exports by sector in accordance with ProMexico’s projects (January-April)

(Figures in dollars)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2009</th>
<th>2010</th>
<th>Var (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>906,727,298.00</td>
<td>1,134,048,394.00</td>
<td>25.1</td>
</tr>
<tr>
<td>Car parts</td>
<td>5,023,120,540.00</td>
<td>9,547,041,891.00</td>
<td>90.1</td>
</tr>
<tr>
<td>Buses and truck cabs</td>
<td>2,815,259,046.00</td>
<td>4,534,990,785.00</td>
<td>61.1</td>
</tr>
<tr>
<td>Cars</td>
<td>3,466,129,172.00</td>
<td>6,999,410,915.00</td>
<td>100.8</td>
</tr>
<tr>
<td>Domestic appliances</td>
<td>1,272,800,352.00</td>
<td>1,761,892,610.00</td>
<td>38.4</td>
</tr>
<tr>
<td>Electronic equipment</td>
<td>14,341,790,484.00</td>
<td>17,273,786,328.00</td>
<td>20.4</td>
</tr>
<tr>
<td>Medical equipment</td>
<td>1,600,987,413.00</td>
<td>1,834,440,586.00</td>
<td>14.6</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>485,660,205.00</td>
<td>610,610,263.00</td>
<td>25.7</td>
</tr>
<tr>
<td>Petrochemical industry</td>
<td>1,124,920,750.00</td>
<td>1,702,025,679.00</td>
<td>51.3</td>
</tr>
<tr>
<td>Plastic products</td>
<td>798,011,990.00</td>
<td>1,053,288,578.00</td>
<td>32.0</td>
</tr>
<tr>
<td>Metalworking</td>
<td>2,776,513,101.00</td>
<td>3,757,280,299.00</td>
<td>35.3</td>
</tr>
<tr>
<td>Mining and metallurgy</td>
<td>581,564,592.00</td>
<td>892,876,981.00</td>
<td>53.5</td>
</tr>
<tr>
<td>Other industries</td>
<td>772,348,842.00</td>
<td>1,131,579,181.00</td>
<td>46.5</td>
</tr>
<tr>
<td>Paper, printing and publishing industry</td>
<td>542,040,631.00</td>
<td>654,444,912.00</td>
<td>20.7</td>
</tr>
<tr>
<td>Rubber and its products</td>
<td>318,596,530.00</td>
<td>503,081,572.00</td>
<td>57.9</td>
</tr>
<tr>
<td>Chemicals</td>
<td>1,570,994,658.00</td>
<td>2,226,440,866.00</td>
<td>41.7</td>
</tr>
<tr>
<td>Iron and steel</td>
<td>1,195,987,972.00</td>
<td>1,690,831,770.00</td>
<td>41.4</td>
</tr>
</tbody>
</table>

Source: ProMexico Business Intelligence Unit with information of Ministry of Economy, 2010.
This growth can be explained partially by the post-crisis rebound, but these proportions also includes a change of signal from manufacturing companies in the developed countries which seek world-class quality manufacturing platforms at competitive costs.

In the comparative study of total costs of the supply chain to supply the United States market, Alix Partners consultancy shows that Mexico is the most competitive country for costs. If it is compared with other low-cost manufacturing countries, the classification would be as follows:

1. Mexico
2. India
3. China
4. United States
5. Brazil
These circumstances make the Mexican export model attractive to investment, primarily as an export platform to the largest market in the world: the United States, which is in turn the largest producer of manufactured goods. By itself the US manufacturing sector represents the world’s fifth largest economy—larger than the entire Chinese economy. Additionally, more than 90 percent of total patents registered in the United States come from this sector. Even so, efforts to diversify export markets continue and Mexican exports increasingly find new markets. The main export markets in the European Union and the sectors in which European companies have invested in Mexico are shown as an example.

Source: ProMexico Business Intelligence Unit with information of Global Trade Atlas 2011.
## European investment in Mexico by manufacturing subsector (2010)

(Millions of dollars)

<table>
<thead>
<tr>
<th>Sector</th>
<th>European FDI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agri-Food industry</td>
<td>6,082.2</td>
<td>53.74%</td>
</tr>
<tr>
<td>Computer and office equipment</td>
<td>1,271.9</td>
<td>11.24%</td>
</tr>
<tr>
<td>Automotive industry</td>
<td>894.3</td>
<td>7.90%</td>
</tr>
<tr>
<td>Beverage and tobacco industry</td>
<td>778.4</td>
<td>6.88%</td>
</tr>
<tr>
<td>Other manufacturing industries</td>
<td>552.3</td>
<td>4.88%</td>
</tr>
<tr>
<td>Electrical equipment and accessories</td>
<td>529.4</td>
<td>4.68%</td>
</tr>
<tr>
<td>Manufacture of machinery and equipment</td>
<td>342.4</td>
<td>3.02%</td>
</tr>
<tr>
<td>Plastic and rubber industry</td>
<td>197.9</td>
<td>1.75%</td>
</tr>
<tr>
<td>Chemical industry</td>
<td>168.8</td>
<td>1.49%</td>
</tr>
<tr>
<td>Textiles</td>
<td>158.5</td>
<td>1.40%</td>
</tr>
<tr>
<td>Basic metal industries</td>
<td>123.9</td>
<td>1.09%</td>
</tr>
<tr>
<td>Others</td>
<td>296.5</td>
<td>2.62%</td>
</tr>
</tbody>
</table>


## European Union Foreign Direct Investment (FDI) in Mexico by country

(Total percentage)

Source: Ministry of Economy, DGIE 2011.
According to the Alix Partners study, Mexico has remained as the best low-cost country (LCC) for outsourcing operations in the U.S., maintaining a competitive position than countries like Russia, India and China. Stephen Maurer, Director General of the consultant and head of the Department of Manufacturing Improvement Practices, believes that “despite recent improvements in U.S. productivity, global competitors have become even more formidable, either as destinations outsourcing or as opponents of U.S. companies.”

European Union FDI in Mexico by sector
(Percentage)

Source: Ministry of Economy, DGIE 2011.

Relative costs: Mexico vs. US
Period (2005-2008)

2.1 Design and advanced manufacturing in Mexico

The situation mentioned in the previous section, although temporarily favorable to the country, should be exploited with the future in mind and as a source of opportunities for the development of capabilities beyond those of cost, which largely depend on cheap labor. It is necessary to focus on innovation capabilities, on the development of Mexican brands, product design, supply chain, productivity and all those factors that provide long-term benefits.

These opportunities are based on the development of an integrated platform for advanced manufacturing, from research, design and development of new products and processes to sales and marketing.

Advanced manufacturing is an industry very different from the stereotype with which it is commonly associated: of a dirty, dangerous and dark industry. Seeing a Mexican automotive or aerospace industry is sufficient to prove that it is just the opposite of this notion. In Mexico you can find experts in computers and a highly qualified workforce.

Source: ProMexico Business Intelligence Unit, 2010.
Unlike traditional manufacturing, advanced manufacturing is not supported by low labor costs and by the scale and volume of production; it is an industry concerned with the skills and creativity to manufacture complex, high specification products.

Additionally, it does not exist as a set of separate businesses, rather as a network made up of engineers, business developers, entrepreneurs, scientists, financial and other experienced professionals who collaborate and pool their creative potential around innovative solutions for users and customers.

In the Mexican case, the advanced design and manufacturing sector has notable success stories. A few of these are listed below:

- Tremec transmissions designed for the Corvette, Mustang and Hummer.
- Chassis for Ram trucks designed and manufactured by Metalsa.
- Minnesota train designed and manufactured by Mexican engineers at Bombardier.
- Mastretta, sports car designed in Mexico.
- 787 Dreamliner interiors designed at Zodiac Mexico.
- Low pressure turbines at ITR.
- New bicentennial edition Jetta with 70 percent of its parts by Mexican suppliers, in which over 900 Mexican engineers were involved in design and development.  
- FX-05 “Xiuhcoatl” assault rifle designed and conceived by more than 64 military engineers from the Military Industry Centre for Applied Research and Technological Development (CIADTIM).
- The design of the Salamandra Lexion car for the Spanish company Yakey, conceived in Mexico, featuring a compressed air engine (top speed of 55 mph) and a hybrid version (combustion engine and compressed air) capable of speeds approaching 90 mph.  
- Zonda Telecom, 100 percent Mexican company that has designed cell phones since 2002, with a presence in more than 11 countries in Central and South America.  
- GX turbine designed by GE and more than 120 engineers. The company was also involved in the creation of the turbine for the world’s biggest aircraft, the Airbus 380.
• Chevy C2 designed and produced by GM in Mexico in 2004.
• Part design and prototypes for the new A350 aircraft, which will enter service in mid-2012, conducted by the Honeywell Aerospace Center for Research and Technology in Mexicali.
• Technological advances and continuous new product development have allowed Mabe to compete with new American, Asian and European brands as well as to expand its markets and manufacturing operations.
• International studies such as Consumer Reports have ranked Mabe washing machines amongst the top five worldwide.
• Delphi’s principal design center is located in Ciudad Juárez, Chihuahua. Many products and systems are designed at the Delphi MTC (Mexico Technical Center) for customers in Canada, Mexico and the United States.
2.2 Advanced manufacturing sector worldwide

Advanced manufacturing is one of the most important links in the development of a nation's industrial competitiveness. Due to its strong interconnection with other economic sectors (primary and tertiary), advanced manufacturing involves both the demand for raw materials and intermediate components, such as financial services, transportation, software and many other services within a national economy.

Even with the strategic importance of the advanced manufacturing sector since the 1970s, the economic development of most OECD countries has been marked by the decline of the workforce (employment) in this sector, coupled with growth in added value associated with increased productivity within OECD member countries and the growth of competitiveness of the emerging economies.\(^\text{11}\)

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\(^{12}\) ibid.

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**Share of manufacturing in total employment**

**1970, 1985 and 2003 (or last year available)**

Source: OECD, December 2005.
Despite the decline of the manufacturing side in OECD member countries, there are some advanced manufacturing industry sectors which by 2001 had still had not experienced a significant decline in jobs, or were stable, such as the food, chemical and automotive industries. This trend has to do with the fact that developed countries have maintained a strong comparative advantage with the rest of the world in these sectors (e.g. the pharmaceuticals and automobiles industries), or due to other international factors (e.g. the food crisis and food industry).

Employment in manufacturing by key activity
G7 countries. Period 1970-2001 (millions of jobs)

Source: OECD Indicators Database, 2005.
This trend has to do with the fact that developed countries have maintained a strong comparative advantage with the rest of the world in these sectors (e.g. the pharmaceuticals and automobiles industries), or due to other international factors (e.g. the food crisis and food industry).

**OECD growth**

Manufacturing employment by technological intensity

Average annual growth in percentages. Period 1990-2003 (or latest year available)

Source: OECD Indicators Database, 2005.

Added to this phenomenon of unemployment and the increase in value added to manufactured products, competitiveness is measured in terms of innovation and the capacity for nations to add value not only in terms of labor. Likewise, market share is measured as value added and in this sense we can observe a differential evolution depending on the region. Various regions have contrasting strategies to increase the domestic content of manufactured goods. In the case of Mexico, there is stagnation in the value added rates with one percent, while countries like China have quadrupled this factor to levels of about seven percent for the year 2000.
Share of manufacturing value added for the major developing regions

Manufacturing employment by technological intensity
Average percentage growth. Period 1990-2003 (or last year available)

Source: OECD Indicators Database, 2005.
3. Methodology

3.1 Technology Roadmap (TRM)

The TRM is a dynamic analysis tool for developing strategies based on innovation and technology. It is used increasingly by companies, industries, geographical regions or countries to support their strategies. It is based on the graphical representation of the main aspects of the strategy to be followed and on the definition of milestones that allow for the actions necessary in carrying out a strategy and for the resources necessary for its implementation to be set out over time. The graphical representation provides a framework for answering questions like: where is the industry now? Where does it want to get to? And what is needed to get to the desired destination?

TRMs can take many forms, but the most common is a graphic over time (horizontal axis) and a set of activities typically grouped into four major themes: market, product, technology and the relationship between them (vertical axis).

Planning horizons may be short-term (maximum one year) for sectors such as information technology, by virtue of the pace at which change occurs. For industrial design, engineering and advanced manufacturing, the horizon is usually medium to long-term given their complexity, covering a period of 10 years with intermediate horizons of three to five years and the immediate actions needed to achieve them.

Visual representation of the TRM is very effective in communicating the strategy as it allows for the visualization of the objectives defined. This process is not an attempt to predict the future, rather to create an agreed or supported vision of technological development over the medium and long-term, to identify areas for research and technological development to be followed. It is equally important to stress that a comprehensive planning system is a dynamic and living system that should be modified according to changes in the environment and the actors, a situation which requires the plan to be reviewed and agreed periodically.
3.1.1 TRM methodology

TRMs can be displayed in a variety of ways, but they are generally presented graphically in the following form:

![TRM Diagram]

The milestones and objectives for the market are shown in the upper part of the map, as well as the important trends for consideration in the sector being analyzed. This, in turn, is linked to specific programs or technology developments that are displayed on the map graphic, thus connecting future products and services as well as market and/or business opportunities.

The process for developing the TRM is based on the active participation of key industry players who represent the equity, which validates the planning.
3.1.2 TRM process

The TRM process focuses primarily on three stages, as shown in the figure below:


**Phase 1**

*Regional analysis of cluster capabilities and opportunities*
- Information from one-to-one interviews.
- Inventory of innovation undertaken by universities.
- Recent information, including among others federal topics, industry, employment and a focus on wages and risk capital.
- Account of technology programs oriented to the workforce and skills.
- Identification of potential opportunity objectives.

**Phase 2**

*TRM design and implementation*
- Putting together a trusted group of 18 to 22 participants from industry, academia, government and business leaders for the correct design of the TRM.
- Run a working group to identify and review the windows of opportunity.
- Creating a business plan, identification of project champions, resources and sustainable mechanisms for launching initiatives.

**Phase 3**

*Launch of initiatives, sustainable implementation and performance/progress reporting*
- Creation of a working group, which combines federal, state and local efforts and other critical resources for regional innovation support.
- Implementation of the TRM for the sector analyzed.
- Ensure sustainability, momentum and resources to complete the effort.
3.2 University of Cambridge methodology

3.2.1 TRM launch process

The central element of the process involves a series of meetings in which the industry’s principal players actively participate: customers, suppliers, government agencies at the federal and state levels, universities and research centers. Their participation is essential to define the scope of the TRM (vision and desired objectives) as well as those key aspects of the industry in relation to the market, product and technology with the aim of supporting the design and implementation of a concerted strategy and therefore to increase its chances of success.

The fast track to developing a TRM seeks to facilitate its launch, establishing the most important relationships between the technological resources and the business drivers and identifying the most important gaps in the areas of markets, products and technologies.

The main objectives of the launch process are:

- Support for the process by specific companies within the TRM.
- Establishing key links between the technological resources and the business drivers.
- Identification of major gaps in the market, in products and in technological intelligence.
- Development of a first draft of the TRM.
- Support for the technology strategy and the planning initiatives.
- Support for communication between business and technical functions.
3.2.1.1 Launch stages

**Stage 1**
*Market analysis*
- Find and prioritize a set of markets.
- Define the sector and business drivers.
- Analysis of social, technological, economic and political-legal trends.

**Stage 2**
*Sectors/niches/product*
- Establish a set of sectorial niches that can satisfy the drivers identified in stage 1.
- Create a bridge between industry milestones defined by the way the market evolves and the niches of sectors and products that can meet these demands.

**Stage 3**
*Technology and technological platforms*
- Identify possible solutions and technological platforms aligned to market niches, to define a second analysis chart.

**Stage 4**
*Mapping stage*
- Draw technology and marketing lines for the development of the TRM.
- Define the TRM format in terms of timescale, levels and strategy for products and sectorial niches, taking into considering: the identification of the major milestones in the sector, the evolutionary line of the product and technology programs and the priorities of the market drivers.

**Stage 5**
*Implementation*
- Identify the gaps in the market, product, sectorial niches and technological knowledge as a whole.
- Conduct an assessment of the best implementation of the TRM in the industry.
3.3 TRM stages for design, engineering and advanced manufacturing

ProMexico and the National Center of Metrology (CENAM) developed the present Technology Route Map (TRM) in accordance to Cambridge’s methodology mentioned in the previous section. Thus, the work was divided into four main stages: planning, development of communication systems, collection of relevant information and design and implementation.

- Benefits of a TRM-

The main benefits are derived from the process, rather than the TRM itself. By bringing together key industry players, opportunities are created for each to share information and perspectives.

The most important benefit of this first TRM is to establish communication channels between the actors and a common basis for developing the strategy for the industry.

The TRM graphic facilitates the analysis of information obtained and summarizes the results of the meetings.

TRMs efficiently illustrate the path that the industry could move along from its current situation towards the desired vision and long-term goals.

3.4 TRM planning

The planning stage covered defining its objective, scope and approach. It also created a working group with key players from government, industry, chambers, academia, research centers and other bodies necessary for a correct approach to the subject.

In order to manage it in an organized manner, a schedule of working group meetings with specific objectives was defined:

Work schedule for the advanced manufacturing roadmap

![Work schedule diagram](source: ProMexico Business Intelligence Unit, 2009.)
3.5 Development of communication systems

At this stage a communication system was created through the SharePoint platform, in which the actors had access to the various contributions made by each of the industry participants. This virtual library includes documents defining the industry itself, as well as individual projects by the participating bodies.

The creation of this joint platform that facilitates communication among industry players is one of the main objectives of the project, since it enables to direct and bring together all the efforts to find synergies and common goals. The first phase of integration depends on the knowledge of the parties and promotes the shared use of information and collaboration on the production of documents.

3.6 Collection of relevant information

In this stage, the working group members exchanged documents on definitions and also information about the projects on which they have worked. These papers covered topics from various areas.

3.7 Design and implementation

The TRM design and implementation stage was divided into several workshops in which the participants in the working group discussed issues relevant to its structure. The markets workshop, products and sub-sector workshop, technology platforms workshop and the research + development (R & D) + talent inputs workshop were conducted like this.

3.7.1 Market workshop

This workshop included a SWOT analysis of strengths, weaknesses, opportunities and threats by the working group participants and an analysis that considers the cost-benefit analysis of the principal factors identified as strengths, weaknesses, threats and opportunities.
3.7.2 Products and sub-sector workshop

This workshop covered the study and analysis of the basic concepts, market matrices and the market strategies for the products and sectors.

3.7.3 Technology platforms workshop

This workshop addressed issues relating to technological solutions in the sector, the grouping of areas of technology and a matrix of areas and their main characteristics.

3.7.4 R+D+talent inputs workshop

The workshop covered the grouping of the R+D areas and a matrix dedicated to R+D and the technology current in the area.

The information gained and used in the various workshops enabled the working group to begin formulating a first approach to the TRM, in which the variables obtained became the main inputs in this first draft. Thus this first version incorporates market factors (drivers, trends, triggers, strategic milestones, legislative events and activities of the competition) and the key resources (talent, knowledge, partnerships, investment and items for discussion).

As a final phase of the TRM, a process of analysis was necessary in which the diverse participants putting together the national strategy validated the information it contained. Similarly, once validated, it is crucial to identify project leaders who make the development of mechanisms to sustain the initiatives possible.

In conclusion, it is necessary to specify and emphasize the dynamic nature of a TRM, i.e. that the initiatives and conclusions are changeable in conjunction with the internal and external aspects. Equally, consideration should be given to the fact that joint working and information sharing make the strategy an extremely valuable tool for the industry, which will enable the alignment of individual efforts of each actor in a sector in a direction that develops and prompts the industry’s evolution.
4. Innovation economy

4.1 Innovation life-cycle

According to the definition of the international financial consultancy New Economic Strategies (NES), the concept of innovation is not only based on the adoption and development of new technological tools, but rather a concept that should include: new models of governance, novel work schemes and innovative use of technology to address new challenges and exploit new opportunities, thus creating a model of continuous work.

With the appearance of a new paradigm based on knowledge, resources of innovation and talent have become the new capital of nations and enterprises which are even more strategic than financial resources. And this transformation is only the threshold of entry into a more complex and dynamic society, driven by talent and intellectual capital: a network society based on knowledge.\(^{13}\)

Corporations are defining more of their value in terms of intangibles: the creativity of their designers, the effectiveness of their software architects, the knowledge of their marketers, the strength of their internal organization or culture and their links with external partners. These are the goods that are recognized on the global stage in the search for efficiency improvements. Collecting technology and applied knowledge (know-how) is now more important than the combination of plant and equipment or the construction of new installations. To extend their reach, firms buy access to specialized brands and niches in the market. The “dematerialization” of much of economic activity, delineates the new patterns of globalization.\(^{14}\)

In this new society of multiple connections and sustainable development, the level of competitiveness is defined by the ability to draw together numerous actors in a synergistic system that promotes innovation and continuous learning. This new environment sets out new challenges and opportunities for businesses, institutions of higher education and research, business support organizations and government.

From a market standpoint, the network economy changes the perspective of competition and competitiveness from a local perspective of businesses against businesses to a global view of trade blocs versus trade blocs.
The reference point is no longer the regional and local leader; more often businesses should compare themselves with global leaders and should penetrate markets more deeply that were once considered exclusive to local or national suppliers.

Transnational corporations pour multimillion-dollar efforts into understanding local markets and they harmonize their products and services in accordance with the needs of countries and regions, sometimes in accordance with small groups and even individuals. This global vision and local action gives them the strength to contemplate a broad and global market with flexibility of action in accordance to local “Glocal” needs.

And while these transnational companies achieve increased penetration in economies that that were traditionally restricted, local businesses with short-range and short-term vision lose competitiveness and the business environment disappears because of a simple Darwinian matter of survival of the fittest.

It is therefore necessary to define a strategy that promotes and improves the competitiveness of Mexican companies in order to strengthen the national economy and the sustainable social development of our country. We believe this strategy should focus on: increasing the systemic competitiveness of enterprises, productive articulation and teamwork, the development of business communities in the pursuit of a grand vision and that promote the creation of a new generation of “glocal” Mexican business people.

4.2 Importance of innovation

Innovation is currently a critical concept for any industry, especially those in which technology is crucial.

Science and technology require leadership and an action plan geared towards meeting goals that result in innovation. To be an effective concept and a useful tool, innovation must fulfill a cycle of various stages in which leadership should be conveyed effectively in order to continue the cycle, otherwise the innovation process may be interrupted in one of the stages, resulting in failure to reach the goal of innovation.
The purpose of the innovation cycle is that it should be continuous, that is, self-generated and that each time it is repeated it results in an innovative process, product or service.

**Cycle of innovation**

![Diagram of the innovation cycle]


Much of the success of an industry depends on the connectivity of its members, which derives from the ability to transform economic, political and social relations on a regional or global scale, which gives the industry greater reach. This is achieved through the effective transmission of one stage to the next in the innovation cycle.
Stages of the innovation cycle

For this cycle to be complete, each stage must have the following ingredients: intellectual capital, human capital, financial capital, equity and connectivity.

These ingredients are crucial to developing the innovation cycle; however each has some importance which should be evaluated individually to see if it is necessary to improve its capabilities and so to improve its contribution to the innovation cycle.
5. TRM Working Group

5.1 Collection of data, analysis and scope of study

The working group collected data and analyzed it in order to find out about the current status of the Mexican advanced manufacturing industry and with the intention of creating short and long term strategies and ways forward, towards a joint strategy.

This data collection and analysis was carried out with a collaborative work system, which allows the simultaneous communication of views by the participants, as each person has a keyboard and these are connected to the central computer. This system has the advantage of receiving anonymous statements, therefore the participants are not inhibited, creating a platform of trust without censorship.

5.2 SWOT

As mentioned in previous sections, the orientation of the TRM working group is focused on building design, development and engineering process capabilities for the products and materials in Mexican manufacturing. In this sense, it was decided to cover the sub-sectors of design, engineering and advanced manufacturing in order to give greater impact to the recognition of innovative applications and new technologies, making it possible to turn “Made in Mexico” into “Designed and manufactured in Mexico.”

The above sub-sectors cover the development of capacities such as: design for reliability/maintainability, design, simulation and modeling of advanced structures including micro and nano systems, design for assembly, disassembly and recycling, validation of large-scale systems, including non-destructive testing and non-contact inspections, to name a few.
A SWOT analysis was prepared in order to understand the industry's situation, from which a diagnostic report was obtained for decision making in the sector.

The working group conducted a SWOT analysis of the sub-sectors of design, development and advanced manufacturing. The factors identified gave rise, according to their degree of development, to positive implications and at the same time issues inhibiting progress. Understanding the dual nature of the factors allows a deeper analysis of the degree of momentum necessary to trigger a positive impact in the sector.

**Analysis of design**

- Threats
- Opportunities
- Weaknesses
- Strengths → Implications

Source: ProMexico Business Intelligence Unit, Results of the focus group session, 2009.
The main strengths that support the design subsector in Mexico are those relating to the availability of human resources. Talent and creativity stand out as the main factor in Mexican engineering. In second place, the growing market and the current infrastructure available in the industry were identified.

In contrast, the weaknesses involve factors such as a lack of quality professionals, the poor design culture and poor alignment between industry and academia that lead to a high level of design imports.

The main opportunities for Mexican design focuses on the relationship between horizontal integration of capabilities worldwide and the globalization of technology markets (the offshoring trend). These opportunities, in turn, will be threatened by increased international competition, mainly from emerging countries, adverse factors in the international economy and the limited degree of recognition for Mexican design worldwide.

Source: ProMexico Business Intelligence Unit, Results of the focus group session, 2009.
The SWOT analysis for the engineering sector identified as its key strengths the existing capabilities in relation to research and development centers doing certified tests and the cost competitiveness that the country has in relation to other nations. These strengths are the main guidelines for the exploitation of the opportunities presented by the growing global market demand for development and the emergence and growth of new business sectors related to this sub-sector.

Conversely, the low level of investment in new technologies and the current poor infrastructure for testing and prototypes exacerbate the danger posed by the major threats identified. These have to do with the perception of Mexico as a simple trade bridge with a low capacity for development.
The advanced manufacturing sub-sector in Mexico is a sub-sector with a higher level of experience and capability development. For this reason its main strengths are related to topics such as: the DFI attracted in recent years, the current capacity of the Mexican industry to absorb and work with technologies and the signing of various trade agreements with different regions of the world.

The proven experience in the advanced manufacturing sector, especially in the automotive industry, represents one of the most important opportunities in the sector; in particular, the successful experiences of companies in Mexico and the advantage offered by the country in terms of their total manufacturing costs. The cost advantage is also a challenge, since although it puts the country in a unique position to attract manufacturing projects, it is an ephemeral advantage, to the extent that logistics and labor costs do not generate other centers of competitiveness. This may lead to the fact that strategy should focus on developing capabilities to maintain national competitiveness being overlooked, even when other countries can do it more economically.

In contrast, the main threats identified by the SWOT analysis are the adversities generated by global competition, particularly those faced by the emerging economies. These threats will be reinforced if Mexico fails to overcome its main weaknesses, which involve a low level of investment in research and development capabilities.
6. Roadmap for technology insertion

6.1 TRM

The TRM is the result of analysis of the advanced manufacturing industry over a period of 15 years, starting in 2004 with a projection to 2019. It is comprised of four sections: trends and drivers, technology platforms, critical success factors and resources.

6.1.1 Trends and drivers

This section presents the main trends and drivers of the world’s advanced manufacturing industry, which provide an overview of the various market drivers to consider when defining the lines of future development.

Environmental

In recent years, the planet has suffered over-exploitation of natural resources due to the expansion of economic activity. Equally, the heavy industrialization of nations has caused drastic climate changes, the product of high-energy consumption and high levels of carbon gas emissions, among other factors.

This has led some industries, including advanced manufacturing, to focus on actions that promote environmental conservation. Because of this, the TRM working group identified global trends as well as new business opportunities for manufacturing, arising from the growth of the low-carbon economy, the development of more environmentally efficient technologies, the drive for and implementation of efficient processes of energy consumption, increased competition for natural resources, new environmental regulations and increasing demand for green products.
Environmental trends in the sector worldwide

Strong industry action to combat climate change

New business opportunities for manufacturing due to the growth of the low-carbon economy

Development of technologies with greater environmental efficiency

Development and implementation of efficient energy consumption processes

Greater competition for natural resources

New environmental regulations

Increased demand for green products

Source: ProMexico Business Intelligence Unit, 2010.

Political-legal

The development and growth of the industry of design, engineering and advanced manufacturing will depend in large measure on trends of a political-legal nature, which involve such issues as: regulations, dual-use technologies and harmonization of international regulations, among others.

It will be observed, above all for the purposes of the market, that there will be a proliferation of more stringent regulations, especially in the areas of the environment and security. This phenomenon will have a regional focus which will impose non-tariff barriers to inter-regional trade.

Another important aspect to consider is the system for the control of exports and information for dual-use technologies, the purpose of which is to ensure the non-proliferation of weapons of mass destruction. Countries interested in using and developing state-of-the-art technology, professionals and goods, should guarantee their peaceful or controlled use to allied countries.

Export control is necessary, both to attract investment, projects and dual-use offsets, as well as for security issues. Naturally, Mexico does not represent any risk in the use of such technology; however, some industries have approached the borderline in the utilization of dual-use technologies.
As part of the actions, work should be carried out on the establishment of a harmonization of international regulations for the registration, monitoring, control, safety and quality of manufactured products.

Likewise, the working group acknowledges future changes in the Law on Science and Technology to encourage the creation of new products and knowledge-based companies.

**Political-legal trends in the sector at a global level**

<table>
<thead>
<tr>
<th>Stricter regulations / increased security</th>
<th>Common international regulatory frameworks by region</th>
<th>Export control systems / dual-use technology</th>
<th>Harmonization of international regulations</th>
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</table>

Source: ProMexico Business Intelligence Unit, 2010.

**Social**

The growth of demand in China and India represents a trend with multiple consequences. On the one hand, the two countries represent potential markets for manufactured products that their chains have not yet been able to develop and which, owing to the size of these markets, are highly attractive for various products in the world. Moreover, this trend will be a major driver for attracting investment and manufacturing towards these centers, with the consequent loss to areas with less important markets.

The most important strategic implication to be watched will be (although today it is already visible in some cases) that these large markets will create standards and business models that favor their own development and will act as inhibitory strategies for other players in the world; paradoxically there is a great and rising shortage of engineers, especially in countries where the manufacturing structure needs them. These countries with economies based on innovation have not found sufficient human resources to meet that demand from their own populations.
In this situation, Mexico has an advantageous scenario that combines a large supply of human resources and engineering and on the other, an experience in the production of highly sophisticated goods, with world-class levels of quality.

Gradually Mexican industry has been able to offer suitable conditions for investments in design, product development and R&D. These conditions have helped attract companies and projects in advanced manufacturing, design and engineering in recent years.

However, despite the advantage represented by the manufacture and development of engineering and design projects in Mexico, this is not the general perception.

Social trends in the sector at a global level

Source: ProMexico Business Intelligence Unit, 2010.
Economic

The trends in the economic sphere present great opportunities and challenges that should be considered.

The importance of outsourcing and the increasingly demanding nature of contractors create a more competitive environment, demanding ever-lower costs and seeking suppliers of subcontracted services with a high level of expertise that ensure operation without delay and long learning processes.

In global industry there is a particular interest in finding the most complete and robust supply chains possible, both in infrastructure and process capabilities, such as certifications and qualified talent, looking to establish itself under the best conditions.

The ongoing search for optimal costs faces the entire industry as it locates itself in places where it can take advantage of the exchange rate or cheaper sources of finance, and gradually abandon those regions, which increase its cost structure.

Economic trends in the sector worldwide

[Diagram showing trends such as outsourcing to companies that require no learning curve, working with suppliers with broad capabilities and experts who do not require supervision, economic recession, use of suppliers with global presence and facilities close to global customers, strong cost pressure, in Mexico, support is given first to production and then to product development, manufacturing sector growth, stable exchange rate (USD-MXP range between 12.99-14.23), worldwide growth of value chains (outsourcing of goods and services), greater emphasis on closed-loop value chain development, increased market share through specialization and cost reduction, increase in the transfer of particular tasks to subsidiaries in low-cost areas, increase in demand for SMEs with specialized external technologies and services, loss of capacity to design and produce capital goods in Mexico, increased product differentiation.]

Source: ProMexico Business Intelligence Unit, 2010.
Technology

In the field of technology, the trends anticipate the development of more sophisticated models and prototypes, as well as more structured development processes, which require the creation of a solid platform to raise the technological level of Mexican manufacturing and the efficiency of processes employed. The interest in reducing times and costs in the engineering and development cycle will prompt new investment in R+D+i, with the objective of obtaining higher benefits through improved time to market and in the time needed before new product lines become profitable.

A more intensive use of information technology is considered to be a fundamental tool to improve not only certain business operations, but also to increase the efficiency of the entire manufacturing process and to reduce the development time of new products. Advanced materials, nanotechnology and biotechnology are some of the areas in which an early progression to advanced manufacturing is envisaged, which will be reinforced by technological changes such as the large-scale migration to electric and hybrid engines in the automotive industry.

Likewise, the development of new information technologies, especially those that offer support to telecommunications and Internet product development, will result in various areas of opportunity for the sector.
Index of technological sophistication
For selected countries

OECD
Philippines
Hong Kong, China
Taipei, China
Korea
China
Japan
Singapore
Malaysia
Thailand
Mexico
Costa Rica
Asia (except Japan)
Mauritania
India
Brazil
South Africa
Indonesia
Latin America
Colombia
Argentina
Sub-Saharan Africa
Chile
Peru

6.2 Management of talent

Design, engineering and advanced manufacturing will require a workforce with higher capabilities in engineering and science, to be complemented with skills and competences that enable good performance in different disciplines. Internationally, we are seeing a clear reduction in sources of talent for scientific and engineering disciplines, mainly in the developed world, also the new generation shows very little interest in these professional areas. This presents a scenario where there is fierce competition for talent, which extends from industrialized countries to rapidly developing areas, in which Mexico plays an important role.

The national perspective takes in the fact that Mexico has become the reservoir of talent for North America, generating more engineers than any other country on the continent, making it a very attractive alternative for companies that foresee complications arising for their operation derived from a shortage of talent. Efforts in human capital management must be focused on identifying high-level professionals, on the development of personnel in accordance with the requirements of the areas of advanced manufacturing that will be relevant according to the analysis in this document and on the retention of national talent.

### Sector talent management trends at a global level

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<tbody>
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<td>1. Reduction in the sources of talent in developed countries</td>
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<td>2. Decreased emphasis on master’s degrees in advanced manufacturing</td>
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<td>3. New generations less interested in engineering and science at a worldwide level</td>
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<td>4. Intense competition for talent</td>
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<td>5. Growth in sources of talent in rapidly developing countries, but with a lack of skills</td>
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<td>6. Greater importance of competencies and values in recruitment</td>
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<td>7. In advanced sectors, engineering is one area where drop-outs are increasing</td>
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<td>8. Reduced loyalty, as the most capable people may change jobs rapidly</td>
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<td>9. High-level professionals will have greater authority and decision-making ability in the job market</td>
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<td>10. Lowering of standards for recruitment, focus on training and fitness</td>
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<td>11. Higher value placed on intellectual capital and knowledge management</td>
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<td>12. Extension of virtual collaboration schemes (BPO + design)</td>
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Source: ProMexico Business Intelligence Unit, 2010.
6.3 Definition of strategic milestones

The setting out of strategic milestones is one of the cornerstones for the definition of the sector’s strategy. The TRM working group for design, engineering and advanced manufacturing defined the principal short, medium and long term milestones.

Thus the principal strategic milestones set by the Mexican advanced manufacturing industry are:

Short-term (2010-2011)
Incentive program for capacity building in design, engineering and advanced manufacturing.

- Development of talent. Support for flexible training programs (academic programs, technical and industrial scholarships, nationally and internationally), to ensure that 15 percent of engineering graduates quickly become integrated into industry R+D+i functions.
- Creation of infrastructure. Supporting the development of infrastructure for design, engineering and advanced manufacturing, to achieve at least three centers or networks of excellence at national level covering the entire process and with an orientation to user sectors of aeronautics, automotive, electrical-electronic, domestic appliances, energy and so forth.

Medium-term (2012-2015)
Creation of a revolving PPP (Public-Private-Partnership) fund of one billion pesos to support the area of design, engineering and advanced manufacturing.

- Development of talent. Creating a database of notable engineers in design, engineering and advanced manufacturing, recognized (certified or approved) by their peers in other countries, at least 30 percent carrying out activity with a high R+D+i content.
- Creation of infrastructure. Consolidation of three centers or networks of excellence in design, engineering and advanced manufacturing, which meet all international requirements for product design and validation for their respective original equipment manufacturers (OEM).
Long-term (2015-2020)

To increase the infrastructure capacity in the country to carry out physical and virtual testing, making use of existing capabilities to consolidate six world-class manufacturing and design testing centers with their respective networks in Mexico (five percent of GDP contributed by this sector).

- Development of talent. Consolidation of Mexican engineers with high international prestige.
- Creation of infrastructure. Global recognition of the three centers or networks of excellence in design, engineering and advanced manufacturing, generating at least one percent of patents worldwide in their respective fields.
- Formation of partnerships and knowledge transfer units. Global scope for the relationships and projects managed by partnership units, with 60 percent of their projects in interdisciplinary and international groups, and with 30 percent of resources managed destined for research.
7. Participating bodies

National Metrology Centre (CENAM)

CENAM is the national laboratory of reference for measurements. It is responsible for establishing and maintaining national standards, providing metrological services such as calibration of instruments and standards, as well as certification and development of reference materials. It also works with national laboratories and international organizations involved in metrology in order to ensure international recognition of national standards in Mexico and, consequently, to promote acceptance of our country’s products and services.

Because of its leading role in the advanced manufacturing sector, CENAM was invited by ProMexico to preside at the TRM meetings for design, engineering and advanced manufacturing.

ProMexico

ProMexico is the Mexican Federal Government’s body in charge of strengthening Mexico’s participation in the international economy. To do this it supports the export activity of firms established in the country and coordinates actions to attract direct foreign investment to Mexican soil. ProMexico was established by presidential decree in 2007 as a public trust under the auspices of the Ministry of the Economy. It has a network of 25 offices in Mexico and 33 offices abroad.

ProMexico has invited the principal public and private actors in the advanced manufacturing industry in Mexico to make up the TRM working group with the purpose of facilitating the definition of a national strategy for the industry, in order to increase its exports.

Ministry of Economy (SE)

The SE is the Federal Government department that promotes the creation of quality jobs and economic growth in the country through the promotion and implementation of public policies that boost competitiveness and productive investment.
Designed in Mexico
Roadmap for design, engineering and advanced manufacturing