Industry 4.0 Roadmap for Mexico and Lessons for South Africa

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Where we are as Nations in terms of Manufacturing Competitiveness?
Drivers of Global Manufacturing Competitiveness

Market forces

1. TALENT
2. COST COMPETITIVENESS
3. WORKFORCE PRODUCTIVITY
4. SUPPLIER NETWORK
5. LEGAL AND REGULATORY SYSTEM
6. EDUCATION INFRASTRUCTURE

Government forces

7. PHYSICAL INFRASTRUCTURE
8. ECONOMIC, TRADE, FINANCIAL AND TAX SYSTEM
9. INNOVATION POLICY AND INFRASTRUCTURE
10. ENERGY POLICY
11. LOCAL MARKET ATTRACTIVENESS
12. HEALTHCARE SYSTEM
# Ranking as the Importance of each Factor to Competitiveness

<table>
<thead>
<tr>
<th>Rank</th>
<th>Competitive driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Talent-driven innovation</td>
</tr>
<tr>
<td>2</td>
<td>Economic, trade, financial and tax system</td>
</tr>
<tr>
<td>3</td>
<td>Cost and availability of labour and materials</td>
</tr>
<tr>
<td>4</td>
<td>Supplier network</td>
</tr>
<tr>
<td>5</td>
<td>Legal and regulatory system</td>
</tr>
<tr>
<td>6</td>
<td>Physical infrastructure</td>
</tr>
<tr>
<td>7</td>
<td>Energy cost and policies</td>
</tr>
<tr>
<td>8</td>
<td>Local market attractiveness</td>
</tr>
<tr>
<td>9</td>
<td>Healthcare system</td>
</tr>
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<td>10</td>
<td>Government investments in Manufacturing</td>
</tr>
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</table>
## Ranking as the Importance of each Factor to Competitiveness for South Africa

<table>
<thead>
<tr>
<th>SA rank</th>
<th>Competitiveness driver</th>
<th>Score</th>
<th>Global rank</th>
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<td>Cost and availability of labour and materials</td>
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<td>3</td>
<td>Energy cost and policies</td>
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</table>
# Global Manufacturing Competitiveness Index

## 2016 (Current)

<table>
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<th>Rank</th>
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</tr>
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## 2020 (Projected)

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Global Manufacturing Competitiveness Index

**Mexico**
- GDP 2013: $163.6 B
- Manufacturing GDP 2013: $309.1 B
- % of Total GDP: 17.6%
- 3-Year CAGR: 3.2%
- Researchers per Million 2011: 383
- or, roughly: 1 in 2611

**South Africa**
- GDP 2013: $40 B
- Manufacturing GDP 2013: $48.1 B
- % of Total GDP: 13.2%
- 3-Year CAGR: 1.80%
- Researchers per Million 2012: 405
- or, roughly: 1 in 2469

Labor Productivity 2014
- Mexico: $38,271.60 GDP/person
- South Africa: $44,631.60 GDP/person

Survey Avg.

2016 Competitiveness Rank of 40 Countries

2020 Predicted Competitiveness
What is Industry 4.0?
Industry 4.0 (R)Evolution

1st Industrial Revolution
Through Introduction of Mechanical Production Facilities with the Help of Water and Steam Power.

First Mechanical Weaving Room 1784

2nd Industrial Revolution

First Assembly Line 1870

3rd Industrial Revolution
Through Application of Electronics and IT to further Automate Production

First Programmable Logic Control System 1969

4th Industrial Revolution
On the Basis of Cyber-Physical Production Systems, Merging of Real and Virtual Worlds

Transparency
Predictive Manufacturing
Big Data Analytics

Responsiveness
Reconfigurable Manufacturing
Scientific Knowledge

 Variety
Flexible Manufacturing

1996

 Quality
Lean Manufacturing
Computer-Aided Operations Management

1980

 Cost
Mass Manufacturing
Interchangeable Parts

1913

 Manufacturing Paradigms
End of 18th Century
Beginning of 20th Century
Beginning of 1970 to 21st Century
Today

Complexity
Factory 4.0

**CYBER SECURITY**
- Stronger protection for internet-based manufacturing
- Technology products with longer life cycles

**BIG DATA**
- Making sense out of complexity
- Creativity
- Collaborative manufacturing

**CLOUD COMPUTING**

**RESOURCES OF THE FUTURE**
(Wind, alternative/non-conventional solar, geothermal)
- Clean and renewable energy everywhere
- Energy storage
- Alternative raw materials

**SENSORS**
- Zero defect/deviation
- Reactivity
- Traceability
- Predictability

**ADVANCED MANUFACTURING SYSTEMS**
- Cyber-physical systems (CPS)
- Numerical command
  - Full automation
  - Totally interconnected systems
  - Machine-to-machine communication

**AUTONOMOUS VEHICLE**
- Flow optimization
- Increased security
- Lower costs

**LOGISTICS 4.0**
- Fully integrated supply chain
- Interconnected systems
- Perfect coordination

**3D PRINTING/ADDITIVE MANUFACTURING**
- Scrap elimination
- Mass customization
- Rapid prototyping

**ADVANCED MATERIALS**
- Smart value-added products
- Technical differentiation
- Connectivity

**ROBOT**
- Real-time autonomy/ productivity
- Full transparency (contextualization, comprehensiveness, collaborative robot) on data reporting

**INTERNET OF THINGS**
- Object tagging
- Internet-to-object communication via low-power radio
- Real-time data capture
- Optimized stocks
- Reduced waste

Plant of the future

Suppliers

Customers
Employment Relations 4.0

Voice 1

It’s strange to think about those old jobs were like. That commute, the road and the dreary canteen. The daily fights office space and the copier machine. How quickly forgets. Now there are other places where we connect. This park, for instance - a suit or flipchart in sight, where I sit and in the fading light of summer until this day fades good and waits for darkness to soften to

Voice 2

what bells will chime to mark our passing? What fire-works shall light the sky when we have gone? Who will pay for what we once made? Not these machines, one of which can do the work of a hundred, and may do it better besides. Thanks for applying, but you’re not quite what we’re looking for, they told me. work is different now, softer somehow - and no longer for everyone, it would seem. Not for us, from another time, the clocked off, with these, our useless hands.
Industry 4.0 - Beyond the Technology

• Techno-centric aspects:
  • Big Data & Analytics
  • Autonomous and Collaborative Robots
  • Simulations (of products, materials, and production)
  • Horizontal and Vertical Systems Integration
  • Industrial Internet of Things
  • Cybersecurity
  • The Cloud
  • Additive Manufacturing
  • Augmented Reality

• Human-centric aspects:
  • Social Impacts
  • Skills and Training
  • Ergonomic Workplaces
  • Human-Machine Interaction
  • Team Interaction
  • Organization of Responsibilities

• Economic aspects:
  • Cost-effectiveness
  • Quality Assurance
  • Local and Global Organizational Aspects
  • Transition models
Operator 4.0

Operator 1.0 = ‘Manual & Dextrous Work’ + Mechanical Tools & Manually Operated Machine Tools

Operator 2.0 = ‘Assisted Work’ by CAx Tools, NC OSs & Enterprise Info. Systems

Operator 3.0 = ‘Cooperative Work’ with Robots, Machines & Computer Tools

Operator 4.0 = ‘Work Aided’ by Machines (H-CPS)

First Modern Factory: Matthew Boulton’s Soho Manufactory (1761)

Numerical Control (1960s)
MRP I (late 1960s) towards Automation & Control

Industrial Robots Introduction (late 1970s) towards Human-Robot Collaboration

From Cyber-Physical Systems towards Human-CPSs

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Industry 4.0 Worldwide Initiatives, Policies and Plans
Industry 4.0 Worldwide Initiatives

<table>
<thead>
<tr>
<th>Initiatives launched per country</th>
<th>Objectives</th>
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<tbody>
<tr>
<td>Industrie 4.0</td>
<td>Common approach BIKOM, VDMA &amp; ZVEI</td>
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<tr>
<td>Advanced Manufacturing Partnership 2.0</td>
<td>Create high quality manufacturing jobs &amp; enhance US global competitiveness</td>
</tr>
<tr>
<td>Catapult centers</td>
<td>Double manufacturing contribution to GDP</td>
</tr>
<tr>
<td>Intelligent factories clusters</td>
<td>Structure Italian manufacturing community to develop &amp; leverage research, with 4 projects</td>
</tr>
<tr>
<td>Revitalization / Robots strategy</td>
<td>Support the development of &quot;Factories of the future&quot;</td>
</tr>
<tr>
<td>Made in China 2025</td>
<td>Increase the productivity of service industries, significantly raise the deployment of robotics by 2020</td>
</tr>
<tr>
<td>Industrie du futur</td>
<td>Turn China into a strong manufacturing nation with priority on digitalization &amp; modernization of 10 sectors</td>
</tr>
<tr>
<td>Manufacturing Innovation 3.0</td>
<td>Support the development of specific products (Efficient car, electric airplane, etc.)</td>
</tr>
<tr>
<td></td>
<td>Create a manufacturing eco-system based on new technologies/encourage smart factories development</td>
</tr>
<tr>
<td>Rationale for Industry 4.0</td>
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</tr>
<tr>
<td>---------------------------</td>
<td>--</td>
</tr>
</tbody>
</table>
| **MAINTAIN ADDED VALUE THROUGH COMPETITIVENESS** | Lower labor sensitivity / Improve competitiveness  
Create entry barriers |
| **RELOCALIZE INDUSTRY VIA NEW BUSINESS MODELS** | Produce personalized products at mass production cost |
| **GAIN GLOBAL LEADERSHIP IN 4.0 SOLUTIONS** | Develop technologies & standards  
Create an export solutions |
| **INTERNATIONALIZE AT LOWER RISK** | Flexible production lines to reduce demand changing need  
Decrease capital cost of geographical expansion |
| **ENHANCE DIGITAL START UPS & ECOSYSTEMS** | Create platform to enable ecosystems  
Accelerate innovation via incubators clusters |
| **INCREASE EMPLOYEES SATISFACTION AT WORK** | Reduce pain point at work  
Increase meaning of work |
| **IMPROVE SUSTAINABILITY AND IMAGE** | Reduce use of natural resources  
Improve image of the industry |
Industry 4.0 Worldwide Strategies

• Industry 4.0 Industrial policies and plans:
  • Leading countries in technological innovation (usually capital asset developers),
    • Focused on implementing the necessary actions to complete the transition process.
  • Countries specialized in manufacturing services (limited capacities for developing capital assets),
    • Manufacturing sector is vital for their local economy, however, they don’t develop technological advances that would position them as a worldwide innovation referents.
Leading Countries in Tech Innovation: Germany - *Industrie 4.0*

<table>
<thead>
<tr>
<th>POLICY</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td><strong>Industry 4.0</strong></td>
<td>Implementation of the model to underpin the country as a leading supplier of technologies and a production hub.</td>
</tr>
<tr>
<td><strong>Smart services</strong></td>
<td>The use of smart devices has transformed the production processes and services. Due to the potential that these devices have, the government is planning to support companies so they can maintain control of their value chains and production processes.</td>
</tr>
<tr>
<td><strong>Smart data</strong></td>
<td>With the execution of the Smart Data program, the government expects to reduce problems found in medium and small companies with the use of applications such as Big Data. It is forecasted that the problems will be resolved through the promotion and testing programs of innovation services with the use of Big Data Technologies.</td>
</tr>
<tr>
<td><strong>Cloud computing</strong></td>
<td>The Trusted Cloud technological program pretends to boost among medium small companies, cloud-based solutions that are innovative and secure; this, with the purpose of allowing them to access new technologies to which previously only big companies could access.</td>
</tr>
<tr>
<td><strong>Digital Networking</strong></td>
<td>After considering secure communication networks, and the interoperability between various technologies as key pieces of intelligent applications and innovation services, the government is working to expand high-performance connectivity networks.</td>
</tr>
<tr>
<td><strong>Digital Science</strong></td>
<td>Digital technologies have opened multiple opportunities for science sector, specifically in research and cooperation. Thus, the government has decided to strengthen science-digital information infrastructures, along with ensuring access and use of digital information. For this purpose, the creation of an Infrastructure and Information Council is planned; this will provide recommendations to support science sector.</td>
</tr>
<tr>
<td><strong>Digital Education</strong></td>
<td>Since the education system needs to prepare individuals efficiently regarding the use of digital media, as well as on the cognitional requirements demanded by society, the government decided to emphasize the use of digital media in education.</td>
</tr>
</tbody>
</table>

Digital Education

Since the education system needs to prepare individuals efficiently regarding the use of digital media, as well as on the cognitional requirements demanded by society, the government decided to emphasize the use of digital media in education.

Digital life environments

Digital progress has impacted the daily life of individuals, creating new challenges and opportunities in the family sphere. Likewise, gaps have been created between individuals that follow this process and those who do not. Now the families have the necessity of being supported in leveraging the opportunities that come with the diffusion of new technologies.

INSTITUTES FOR BOOSTING TECHNOLOGICAL INNOVATION IN THE UNITED STATES

- National Additive Manufacturing Innovation Institute
- Digital Manufacturing and Design Innovation Institute
- Lightweight Innovations for Tomorrow
- Power America
- The Institute for Advanced Composites Manufacturing Innovation
- American Institute for Manufacturing Integrated Photonics
- The Flexible Hybrid Electronics Manufacturing Innovation Institute
- Advanced Functional Fabrics of America
## Countries Specialized in Manufacturing Services: Czech Republic - *Průmysl 4.0*

<table>
<thead>
<tr>
<th>Vision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Subsystems Integration</td>
<td>Considers all of the production stages, from the reception of the production order, security in shipment, and customer services. Termination of the product’s life cycle.</td>
</tr>
<tr>
<td>Vertical Subsystems Integration</td>
<td>Gives preference to automation processes (which react in milliseconds) from the production department to the company’s planning of resources (considering changes over time).</td>
</tr>
<tr>
<td>Computational vision for integrating all the engineering processes</td>
<td>Participation in the design, development, implementation, testing, and verification stages of the product, as well as its life cycle.</td>
</tr>
</tbody>
</table>
Countries Specialized in Manufacturing Services: India - *Make in India*

### Project Description

<table>
<thead>
<tr>
<th>Project</th>
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<tr>
<td>Construction, extension and improvement of</td>
<td>Increase manufacturing industry's share in the GDP to 25% in 2020.</td>
</tr>
<tr>
<td>Industrial corridors</td>
<td></td>
</tr>
<tr>
<td>Creation of Smart Cities</td>
<td>It is expected to build up 100 Smart Cities which will hold the labor force to boost the industry.</td>
</tr>
<tr>
<td>National Industrial Corridor Development</td>
<td>Creation of an authority with the power to integrate all the industrial corridors.</td>
</tr>
<tr>
<td>Authority (NICDA)</td>
<td></td>
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</tbody>
</table>
Reflection #1: A Dual & Joint Approach

Industry 4.0

Factory 4.0

Production 4.0

Machine 4.0

Operator 4.0

Economic Policies

Industrial Policies

National Roadmaps

Strategic National Projects

Manufacturing Base
Industry 4.0 in Developing Countries
Industry 4.0 in Developing Countries

Developing Countries need to capture the idea of appropriate levels of automation and digitization when considering the current challenges for flexibility, quality improvement and productivity that Industry 4.0 technologies can offer, but taking into account the socio-economic context as well as the local traditions and skills.
Industry 4.0 in Developing Countries

The Industry 4.0 (R)Evolution creates new scenarios and technological challenges, especially to the SMEs that clearly comprise the overwhelming majority of manufacturing enterprises worldwide.

Under the classical scenarios, SMEs will have big difficulties to access or benefit from the state of the art of Industry 4.0 technology, due to their limited human, financial, and material resources.
Industry 4.0 - Scenarios

Information leakages cause digital inefficiencies

- Data analysis to understand customer demand failed: product finally has more features than the customer is willing to pay for
- Information feedback is too slow: 1st prototype showed serious flaws in test, team is waiting for next one
- Data recording is done manually: worker spends time documenting process
- Information was not captured/used for forecasts: machine is down due to an incident
- Information was not captured/used: machine is serviced, although its condition was still perfect
- Information capturing or transfer: unclear inventory level led to an increased safety stock
- Information transfer failed: scrap produced due to wrong specifications of machine
- Information was not translated into action (shortcut for product): piece is waiting to pass through process station although it does not require processing at this station
Industry 4.0 - Scenarios

Eliminating these digital inefficiencies could unlock potential along 8 different value drivers:

- **Supply/demand match**
- **Time to market**
- **Labor**
  - Machine is down due to an incident – information was not captured/used to predict maintenance
- **Asset utilization**
  - Machine is serviced although condition was still perfect
- **Service/aftersales**
- **Inventories**
  - Unclear inventory level led to an increased safety stock
- **Quality**
  - Scrap produced due to wrong specifications of machine
- **Resource/process**
  - Piece is waiting to pass through process station although it does not require processing at this station
Industry 4.0 in Developing Countries

Frugal Innovation Strategy:
“The art of making more out of less”

Principles:

• P1: Engage & Iterate
• P2: Flex your Assets
• P3: Create Sustainable Solutions
• P4: shape customer behavior
• P5: Co-create Value with prosumers
• P6. Make Innovative Friends
industry 4.0 in Developing Countries

Frugal Manufacturing: “Stepping-up Efficiencies”

- The requirement of introducing newer models in a shorter span require manufacturing plants and lines to be flexible and capable of model changeover in a shorter time.
- The processes need to be simpler to be able to be adaptable for different models.
- The plants and processes need to be smaller, lighter, efficient and above all, simpler.

Ravi Dayal, Executive Officer (Production Engineering)
Maruti Suzuki India Limited
Industry 4.0 in Developing Countries

Frugal Manufacturing: “Stepping-up Efficiencies”

- Frugal mfg. not only encapsulates the effective and innovative use of existing capabilities, but also stresses upon the simplification of processes along with value in volumes.
- An important feature that frugal manufacturing imbibes is to check every important parameter of the value stream.
Industry 4.0 in Developing Countries

Frugal Manufacturing:
“Stepping-up Efficiencies”

• **4M** – Man, Material, Machine, and Method – is to be continuously analyzed and optimized for desired outputs. In this respect, minimizing inventory level, material handling, and transportation lead to long-term benefits.

• Frugal manufacturing promotes encouraging shop-floor employees to observe and give ideas to improve manufacturing processes.

Ravi Dayal, Executive Officer (Production Engineering)
Maruti Suzuki India Limited
Frugal Manufacturing: “Stepping-up Efficiencies”

• Specialized trainings are provided to operators to think and install simpler material handling devices within stations.

• The operator gives feedback to engineers on their manufacturing processes and safety concerns, which can further be improvised and incorporated in design of machines and equipments.
Industry 4.0 Toolkit - Check-Up(s)

- Investment Decisions
- Maturity Model
- Critical Success Factors
- Implementation Plan
- Driving Forces of the Company
- Technology Scouting
- Cost-Benefit Analyses
- SWOT Analyses
- Scenario Techniques
- Database Toolsets

Critical Success Factors

Driving Forces of the Company

Implementation Plan

Maturity Model

Investment Decisions

Technology Scouting

Cost-Benefit Analyses

SWOT Analyses

Scenario Techniques

Database Toolsets
<table>
<thead>
<tr>
<th>Business models, product &amp; service portfolio</th>
<th>Market &amp; customer access</th>
<th>Value chains, processes and systems</th>
<th>Compliance, legal, risk, security &amp; tax</th>
<th>Organisation &amp; culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>First digital solutions and isolated applications</td>
<td>Online presence is separated from offline channels, product focus instead of customer focus</td>
<td>Digitized and automated sub processes</td>
<td>Traditional structures, digitization not in focus</td>
<td>Functional focus in “silos”</td>
</tr>
<tr>
<td>Digital product and service portfolio with software, network (machine-to-machine) and data as key differentiator</td>
<td>Multi channel distribution with integrated use of online and offline channels; Data analytics deployed, eg, for personalisation</td>
<td>Vertical digitization and integration of process and data flows within the company</td>
<td>Digital challenges recognised but not comprehensively addressed</td>
<td>Cross functional collaboration but not structured and consistently performed</td>
</tr>
<tr>
<td>Integrated customer solutions across supply chain boundaries, collaboration with external partners</td>
<td>Individualised customer approach and interaction together with value chain partners</td>
<td>Horizontal integration of processes and data flows with customers and external partners, intensive data use</td>
<td>Legal risk consistently addressed with collaboration partners</td>
<td>Collaboration across company boundaries, culture and encouragement of sharing</td>
</tr>
<tr>
<td>Development of new disruptive business models with innovative product and service portfolio, lot size of one, product &amp; component identification</td>
<td>Integrated Customer Journey Management across all digital marketing and sales channels with customer empathy and customer relationship management</td>
<td>Fully digitized, integrated partner ecosystem with self-optimised, virtualised processes, focus on core competency, decentralised decision making &amp; autonomy</td>
<td>Optimising the value chain network for legal, compliance, security and tax</td>
<td>Collaboration as a key value driver</td>
</tr>
</tbody>
</table>

Industry 4.0 Toolkit - Maturity Model(s)
Industry 4.0 pilot opportunities: Mapping-out an Industry 4.0 Strategy

- **New digital business models**
  - Digital hardware optimisation and uptime guarantee
  - Pay-per-use model
  - Total platform management
  - Big data analytics & performance management

- **Digital engineering**
  - Digital collaboration in R&D
  - Digital factory
  - Machine automation
  - Digital modelling, mockup & simulation

- **Vertical operations integration**
  - E2E product lifecycle mgmt.
  - Logistics visibility
  - Prescriptive Supply Chain analytics

- **Horizontal Integration**
  - Integrated E2E Planning and real-time execution
  - Integrated digital engineering
  - Augmented reality solutions
  - Integrated digital engineering
  - Digital sourcing
  - Smart Warehousing and Logistics
  - Smart spare parts management

- **Smart maintenance & service**
  - Predictive maintenance
  - Integrated digital engineering
  - Internal knowledge sharing

- **Digital workplace**
  - E-finance/controlling
  - Digital HR
  - Agile IT
  - Omni-channel commerce
  - Self-service portals
  - Dynamic pricing
  - Personalised sales & marketing services

- **Digital sales & marketing**
  - Digital customer relationship mgmt.
  - E-payments
### I4.0 Toolkit - Investment Quadrant

<table>
<thead>
<tr>
<th>Low Cost / Low Impact</th>
<th>High Cost / High Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Cost / Low Impact</td>
<td>Low Cost / High Impact</td>
</tr>
</tbody>
</table>
Industry 4.0 Toolkit - Marketplaces

Smart Manufacturing Apps & Service Marketplaces
Reflection #2:

Developed Countries provide the “Vision”.

Developing Countries must develop their own Industry 4.0 Model and Digitalization Strategy

We should not copy, but frugalize and leverage technology with innovate business models.

An Industry 4.0 Toolkit for SMEs is a must to facilitate their (R)Evolution.
CRAFTING THE FUTURE
A ROADMAP FOR INDUSTRY 4.0 IN MEXICO
### I4.0 Roadmap - SWOT - Strengths

<table>
<thead>
<tr>
<th>Political Willingness</th>
<th>Infrastructure: 250K Access Points</th>
<th>Amount and Availability of Human Resources</th>
<th>Automotive Industry as a Mature Strategic Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment of Interest between Stakeholders for the Development of IoT/Industry 4.0</td>
<td>Wide Academic Offer to Generate Specialized Talent</td>
<td>Growing Service Economy</td>
<td>Understanding of the National Environment</td>
</tr>
<tr>
<td>High-Tech Industries for Demand Generation</td>
<td>Competitive Prices</td>
<td>Increasingly Automated Manufacturing Industry</td>
<td>Availability of Creative Human Resources</td>
</tr>
<tr>
<td>Mexico, 2nd Largest Market</td>
<td>Government Support Programs Specific to the Industry</td>
<td>SMEs associated with Production Processes of Large Companies that may enter Production Systems for Industry 4.0</td>
<td>Electronics Industry is positioned as an Exporting Leader of Highly Sophisticated Goods</td>
</tr>
</tbody>
</table>
I4.0 Roadmap - SWOT - Opportunities

ICT as across side Industry represents an Opportunity for Strategic Sectors

Global Trend to create Intelligent Factories

Growing Demand for Intelligent System Applications

Costs Redefinition within the Value Chain

Collaboration between the Academy and Productive Sectors

IoT will Increase the Global Competitiveness within the Industry 4.0 Framework

Strong Economic Links and Geographic Proximity with the United States

Boost on Regional Development

10 Largest Economy in the World and one of the Most Relevant Manufacturing Economies

Telecommunications Legal Framework Reform

Competitive Skilled Labour Force Cost
### 4.0 Roadmap - SWOT - Weaknesses

<table>
<thead>
<tr>
<th>Inefficient Regulatory Framework</th>
<th>Insufficient and Deficient Technological Infrastructure</th>
<th>Low Access to Internet and High-Bandwidth</th>
<th>Undeveloped Internal Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Rate of Collaboration between Academy and Industry</td>
<td>Deficient Innovative Environment</td>
<td>Lack of Specialization and Experience in the Industry</td>
<td>Lack of a National long-term Strategy to Develop the Industry 4.0</td>
</tr>
<tr>
<td>Low Rates of Investment and IT Adoption</td>
<td>Lack of Public Policies Designed to Promote industry 4.0</td>
<td>Absence of Educational Programs Specialized in Digitalization and Automation</td>
<td>Absence of a Multi-disciplinary Vision</td>
</tr>
<tr>
<td>Limited Access to Capital and Credit</td>
<td>Low Propensity of Mexican Companies to develop their own Technology</td>
<td>Low Awareness of Industry 4.0 and its Applications among Companies</td>
<td>Weak support to Inventions and Patent Registration</td>
</tr>
</tbody>
</table>
### I4.0 Roadmap - SWOT - Threats

<table>
<thead>
<tr>
<th>Priority to Technology Acquisition over Development of own Technology</th>
<th>Lack of access to Financial Resources for SMEs</th>
<th>The Risk of Being Left behind in the Use and Applications related to Industry 4.0</th>
<th>Non-existence of a Development Commission or Specific Entities to assist the Industry 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Theft and Cyber-security</td>
<td>Initial Pilot Programs should be Considered</td>
<td>Low Inflows of Foreign Direct Investment due to Insecurity Perception</td>
<td>Absence of a Common Vision for Legal Reforms to the Applicable Legal Framework</td>
</tr>
<tr>
<td>Global Systems with no Interoperability</td>
<td>Low Diffusion of Industry 4.0 Best Practices in Clusters and Technological Parks</td>
<td>Technological Slowdown as a Consequence of Interests of Non-related Third Parties</td>
<td>Other Countries with Lower Production Costs</td>
</tr>
<tr>
<td>Undefined Legal Framework</td>
<td></td>
<td></td>
<td>Influence of the American Policies in the Economic and Industrial Sector</td>
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</tbody>
</table>
Industry 4.0 Roadmap

2016

I4.0 Model Hub (Living Lab) RIS3

2018

Second I4.0 Competitiveness Hub (RIS3)

2020

Mexico as a leader in Design, Advance Manufacturing, and Product Development, with a focus on Generating new IoT Businesses and Services

2022

8 Billion USD Industrial IoT Mexican Market

2024

Mexico is Recognized as a Competitive Cluster in Collaborative Robotics; Integrated Systems; Modeling and Simulation; and Big Data Analysis

2028

Mexico among the 5 Leading Countries in Digital Solutions and Big Data Analysis

2030

Top 10 Ranking on Economic Complexity Index

Milestones

Combination with other Strategies

Strategic Projects

Strategy for Digital Economy

Developing a Digital Services Market

Developing the National Digital Strategy

I4.0 Marketplaces

Maturity Model

I4.0 Challenges in MX

Laboratories Network

Innovation Campus Replication

Smart Specialization (RIS3)

I4.0 Innovation Network

National Institute of Industry 4.0

I4.0 Cluster Model and Testing

Capacities Roadmap

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**Industry 4.0 Roadmap**

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- **2016**: I4.0 Model Hub (Living Lab) RIS3
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**Combination with other Strategies**

- Mexico as a leader in Latin America in Design, Advance Manufacturing, and Product Development, with a focus on generating new IoT Businesses and Services
- Mexico as a Leader in Talent Development for Design and Engineering
- Mexico is Recognized as a Competitive Cluster in Collaborative Robotics; Integrated Systems; Modeling and Simulation; and Big Data Analysis
- Mexico among the 5 Leading Countries in Digital Solutions and Big Data Analysis

**Focus on Technology**

- Big Data Analytics
- Modelling & Simulation
- Collaborative Robotics
- I4.0 Systems Integration

**Focus on Education**

- Automation and Autotronics Engineering
- Systems and Industrial Information Techs Eng.
- Process and Industrial Engineering
- IoT and Big Data Specialization

**Focus on Infrastructure**

- Infrastructure Creation (Cloud, Big Data, Telecom)
- 3D Visualization and Modelling
- IoT System Architecture

**Other Strategic Projects**

- High Tech Incubator for IoT Businesses
- Prototype, Manufacturing Services and Digital Design Centers
Analysis of Milestones & Strategic Projects for I4.0

• In 2019 and 2021, Mexico will build up two hyper-flexible manufacturing clusters.
  • The clusters will develop an I4.0 framework and a Manufacturing Operating System.

• I4.0 Cluster Framework
  • Platforms for systems integration and applications development according to the regional productive vocations.

• Innovation Campus replication for I4.0
  • Identifying regions that fulfill the requirements to reply the innovation campus model, whose main objective is to establish a collaborative environment between the academy and the private sector to develop innovation projects in Industry 4.0.
Analysis of Milestones & Strategic Projects for I4.0

- **I4.0 Maturity Model**
  - The execution of Industry 4.0 strategies requires the analysis of the innovation capacities of clusters and companies.
  - It is necessary to classify them according to their ability to adopt and implement I4.0 projects in Mexico.
  - This will provide the tools needed to design public policies and incentives required to improve the competences of the clusters and companies.
  - This analysis will help to identify the gaps between large companies and SMEs and, to create strategies to make them converge into common solutions and a shared vision of I4.0 evolution.
Analysis of Milestones & Strategic Projects for I4.0

• In 2025, the Mexican IoT market will represent 8 billion dollars (as market share of the world’s manufacturing exports).

• Competence Map
  • Unified data bank of businesses, research centers, and higher education institutions operating in Mexico according to their productive and innovation capacities for reconfigurable, adaptive, collaborative, non-hierarchical, and hyper-flexible manufacturing.
  • The roadmap should take into consideration the existing infrastructure and talent available for developing I4.0 strategies.

• Research and Innovation Strategies for Smart Specialization (RIS3)
  • Development of complementary strategies aligned to the regional innovation agenda established by CONACYT, through the identification and development of regional productive vocations for ICT clusters and strategic sectors.

• Challenges regarding I4.0 in the Mexico’s model - “Reto México”
  • Identifying major national challenges for the development of value-added manufacturing capabilities, and promoting I4.0 solutions.
Analysis of Milestones & Strategic Projects for I4.0

• In 2030, Mexico will rank among the top ten in the Economic Complexity Index published by Harvard University and MIT.

• National Institute of Industry 4.0
  • It is a public-private entity in charge of the development, coordination and implementation of I4.0 national strategies. The institute will propose public policy recommendations to boost the inter-institutional collaboration system in order to integrate Mexico as an emerging leader of the I4.0 paradigm.
  • The institute should act as a central hub and intelligence unit of the national Industry 4.0 environment aimed to connect and coordinate players and ideas. In addition, it will communicate and spread sectorial analysis and best practices.

• Innovation network for Industry 4.0
  • A collaborative network of key players in I4.0 topics should be developed, with the purpose of improving innovation capabilities in Mexico. The network must be connected to global networks and challenges.
Analysis of Milestones & Strategic Projects for I4.0

• **National Policy for Adoption and Use of ICTs in the National Digital Strategy.**
  • According to the National Digital Strategy, “public policies shall be created, aimed at boosting the supply and demand of digital assets and services, as well as the adoption of ICTs in economic processes”.

• **Development of Digital Assets & Services Market: I4.0 Marketplace**
  • B2B platform to link supply and demand of I4.0 services and products.
  • The open digital platform will be used for the identification and deployment of industrial challenges, I4.0 solutions and stakeholders.

• **National Digital Strategy**
  • “Digital Mexico” is the digital action plan the Government will implement over the next few years. This strategy was devised to meet the need to harness the potential of Information and Communication Technologies as a catalyst for the country’s development.
Lessons for South Africa

• Translate your challenges in opportunities!
• Focus on your strongest industrial sectors.
• Promote intersectoral collaboration.
  • ICT and Manufacturing sectors should joint forces.
    “Industry 4.0 is simply and something more than the convergence of digital and industrial technologies”
• Build a common business platform, a digital marketplace.
• Develop competences to support the digitization and servitisation of the manufacturing sectors.
• Gain labor flexibility through entrepreneurship.
• Evolve your workforce skillset.
  • Current generations are as important as future ones.
A Vision of your Own: IIoT in Mining

Opportunities for I4.0
Transitions in Emerging Economies: Digital Disruption of the Mining Industry in South Africa

Dr. Kruschen Govender
University of KwaZulu-Natal
“Manufacturing the Future”
Industry 4.0 as One of the Main Conference Themes
+
“Fourth Industrial Revolution for Emerging Economies”
International Policy Workshop
6-7 December 2016, Pretoria, SA
Contact: gart.williams@dst.gov.za
Current IMS Regions I4.0 Activities

Technology & Knowledge Transfer of Industry 4.0 Models & Technologies from Developed Countries (EU + US) to Developing Countries (SA + MX) and viceversa
Thank you for your attention...

Questions?

Acknowledgements to:

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