



How will industry 4.0 reshape South African Manufacturing
Observations from a Design and Development perspective
Johann du Toit, CSIR Conference, October 2017



Industry 4.0

Overview

- Why is Product Development Important
- Industry 4.0, what is it all about
- Making it practical
- 10 Changes
- What Now

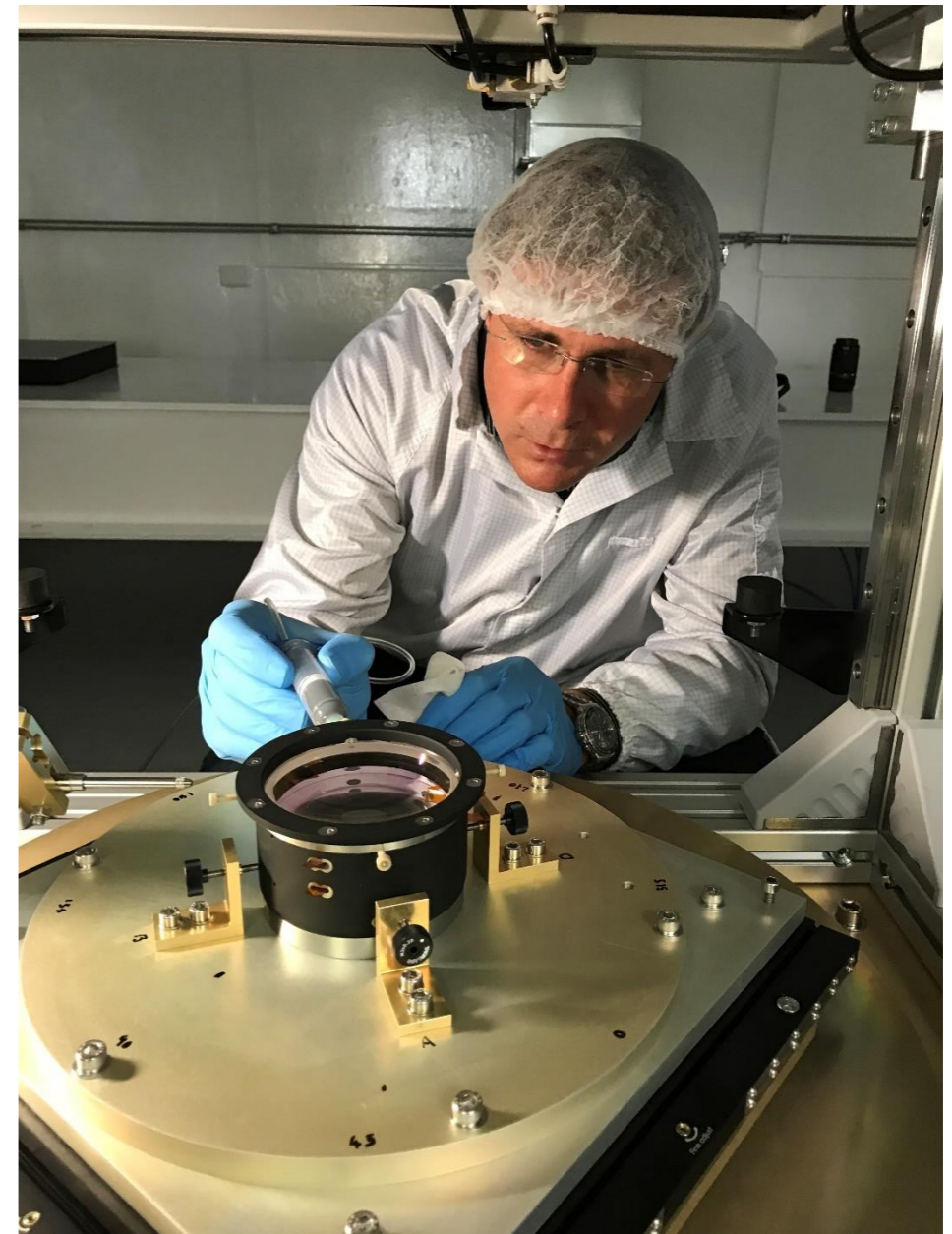
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But first, why is product development so important

First, it is important to recognise that product development plays an important part in building a sound economy. **By converting ideas to sellable products, you generate income.**

Somewhat clashing with my engineering training, and dreams of **beautiful flight** and **precision telescope systems**, products are far more than just tangible items. A new **biomedical datamining algorithm** will probably be more used (and likely more valuable) than a new piece of mining equipment.

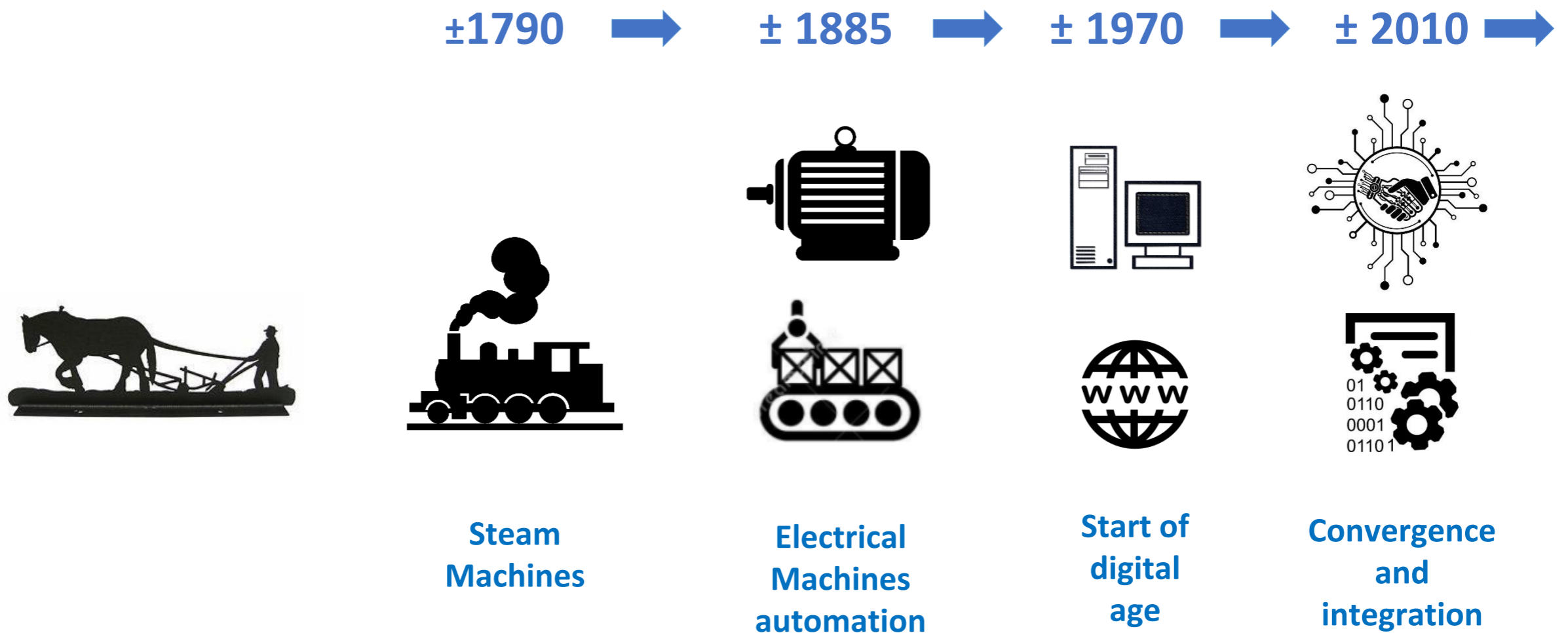
My talk is about Manufacturing in general, **tangible and intangible** products.



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What is it all about

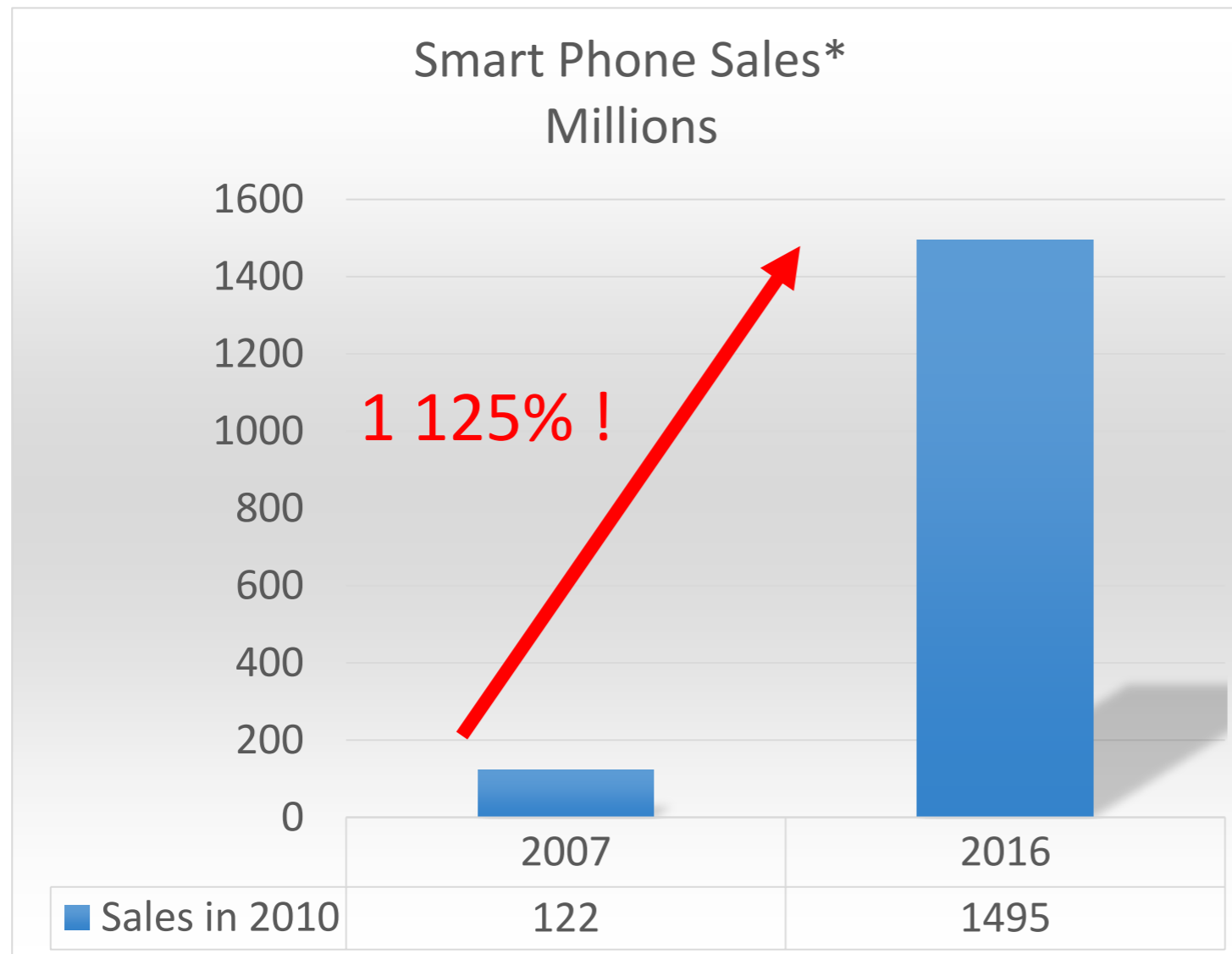
Whereas under the previous industrial cycles Steam, Electricity, Automation and computer was the enablers to change the way people live there daily lives, the current change is driven by **digital bi-directional integration at all levels.**



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An example – at a personal level

Technology in this digital domain is developing rapidly. Hardware with massive market penetration was almost non-existing only a decade ago.



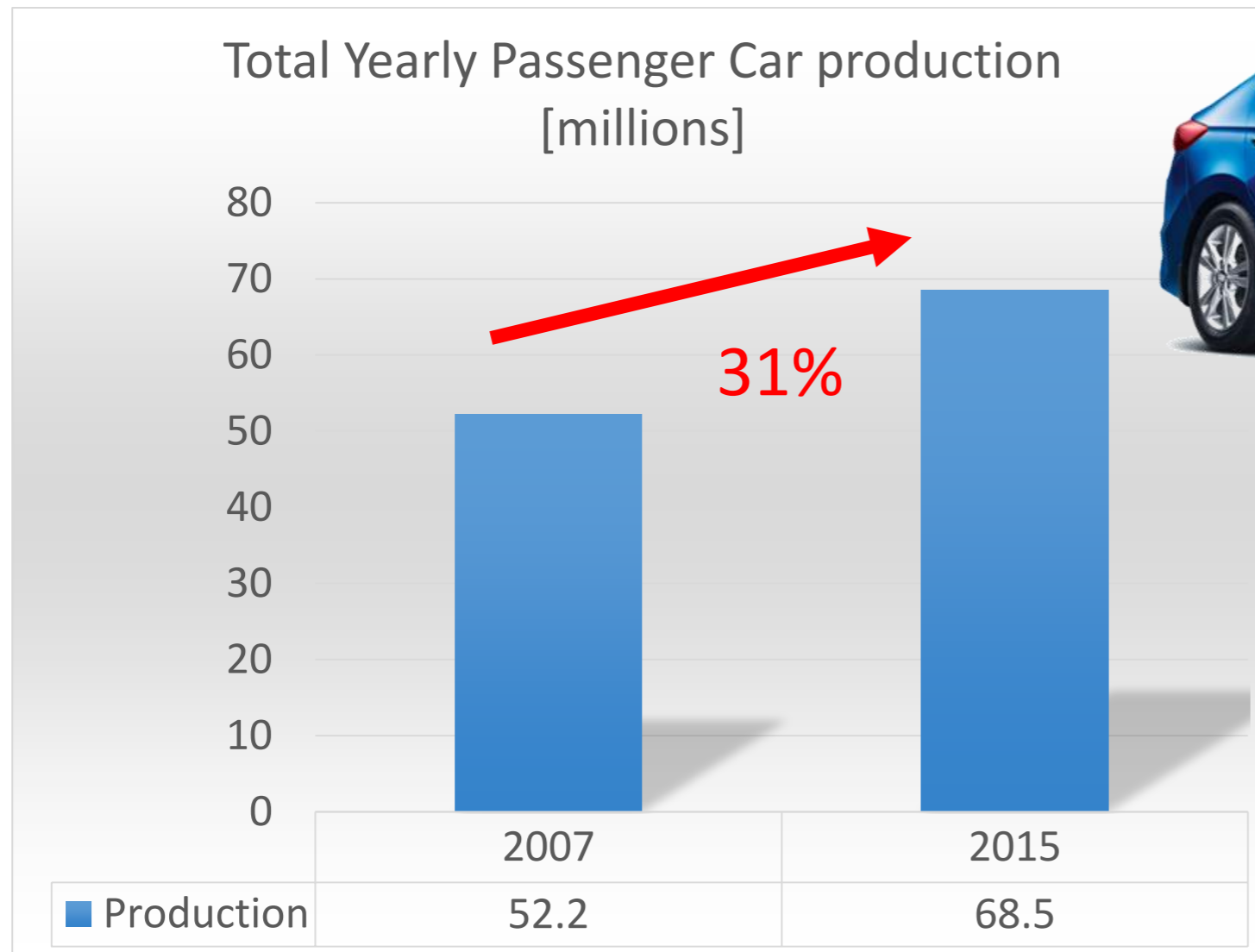
Only 10 Years
since first
iPhone!

*Source: www.Statista.com

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An example continued...

Compare this to a more conventional manufactured system which general public probably see as the foundations of a sound economy.



*Source: <http://www.oica.net>

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An example continued...



1125% vs 31%



Impressive, but is it significant?

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An example continued...

	Cars	Smart Phones
QTY	68 539 516	1 495 000 000
Est. Unit	\$ 22 500	\$ 200
Total Revenue	\$ 1 542 139 110 000	\$ 299 000 000 000
	516%	100%



Add to this that Apple alone have **2.2 million Apps** on its App Store and in 2016 sales was **\$28 billion**, and 70% of this went to App developers, opening a next layer of income – **far displaced from California**. And on a next layer, the **app itself generate data and earn revenue**, or supply data (advertisements) again with Billions in value.



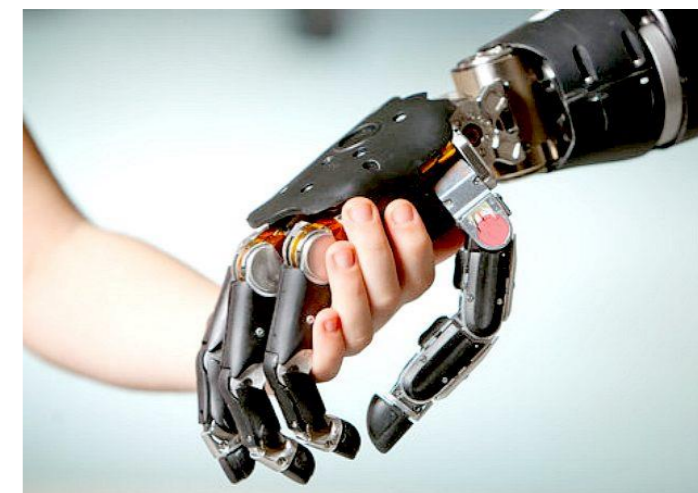
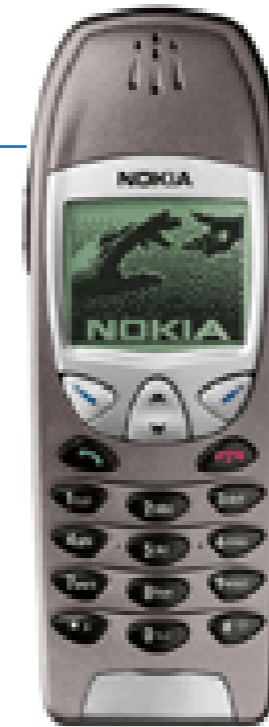
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An example continued...

But my talk its not about Smart Phones or Cars or Games.

Just as a new iPhone shares some features with a Nokia 6210, on a rudimentary level, they are actually very different devices from a user perspective.

In the same manner, new technologies will enter production arenas and change manufacturing. Just as a new iPhone opens a wealth of opportunities – in both directions - **SMART production systems will open a wealth of production opportunities**, likely beyond our traditional scope of understanding and expectations.



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Business, not as usual

The last interesting and important aspect of Smart Phones. Most of us in the audience were caught in a cunning plan. Sign a two year contract and get a phone for *free*. This business model is part of the reason why mobile phone sales were so high....even if people can not really afford them.



This is my first “how will the I4 change manufacturing” point: **New and creative Business Strategies understanding the various drivers and solutions around Industry 4, will need to be established. You also need to be creative in how you can leverage income from your products (over and over again).**

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Requirements development...also not as usual

Continuing on the Business Development and strategy track, I would argue that the biggest challenge for smaller SME's, and possibly for Larger Vertical Integrated Business as well, is going to be to **understand and predict its client needs**.

In a era of disruption, clients might not even now what they want.... or rather what they will want 3 years from now.

My second change Observation for I4: **Creating development specifications will need visionary insight, and will likely need specialists from outside your current organisation and up-skilling your current development team on the new technologies out there.**



The logo for Gizmodo, consisting of the word 'GIZMODO' in white, uppercase, sans-serif letters centered within a dark gray square.

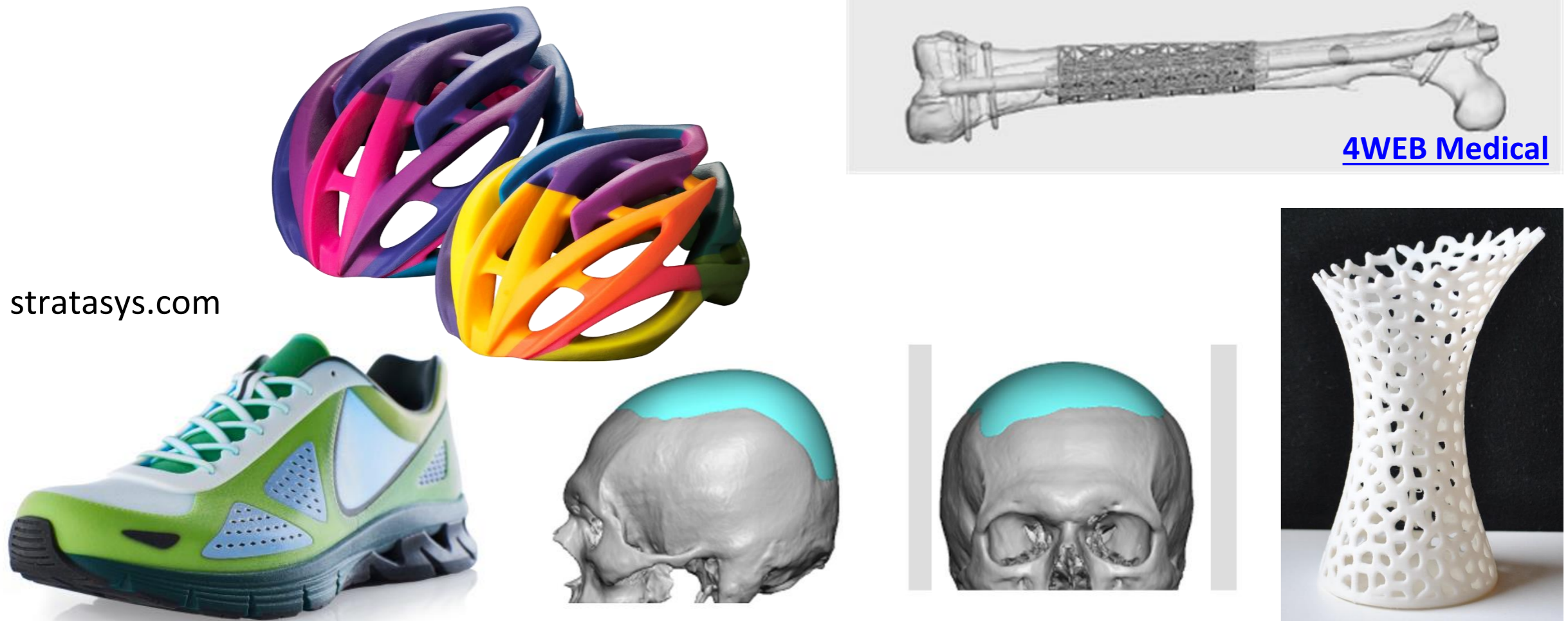
The logo for Mashable, featuring the word 'Mashable' in a bold, blue, sans-serif font.

The logo for Engadget, featuring the word 'engadget' in a lowercase, black, sans-serif font centered within a white rectangular box with a thin gray border.

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Time to market...what time?

To accommodate variable client needs, it is foreseeable that some items might be manufactured onsite. For instance, 3D printed shoes, helmets, or skull implants, tibia implants, even art.



3rd observation for I4: **“Just-in-time” will be replaced by “Just-now”.**

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Learn to handle data

In a era where DATA is becoming as precious as oil, you will need skills in your organisation which can handle data.

Sure, we all believe we can do anything in Excel.

But at the rate we are gathering data during the production, distribution and finally during operations , we will need better skills to visualise and extract sensible value from this data.

You will likely need data analysts, either as partners or upscale your team to at least understand the process, options and value that can be extracted.

This is observation 4 for I4: **Employees will need to understand Data Integration and Analytics, and companies will need new partners to help them survive in this brave new world.**



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The world is your oyster...and you can be the pearl

So in this light, we must start to think of the globe as clients and suppliers. This is my 5th change for I4: **Digital data does not know about borders. The world is there for you and you are available to the world. Products will be exported less, the digital data pack is the item of value.**

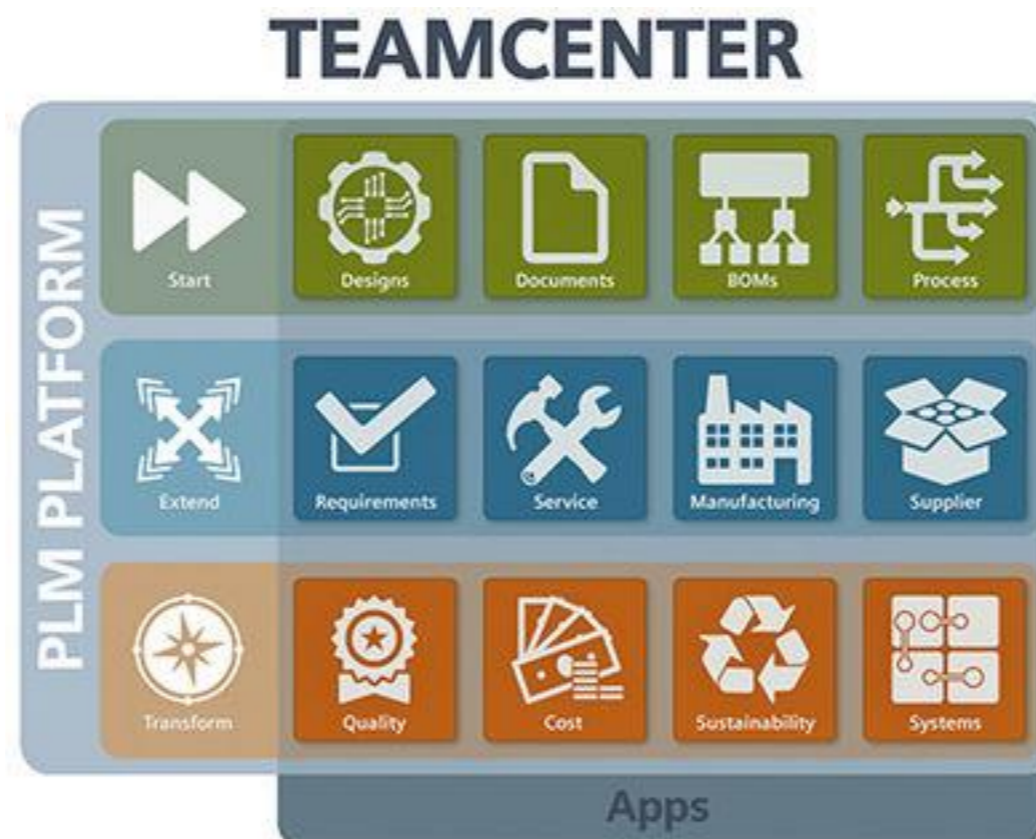


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However...

To help solve problems all over the world, or collect data all over the world, you will need the correct collaboration, data protection and creative tools and skills. You will likely need to invest in systems and your team training.

Change observation 6: **Companies will have to invest in data sharing, data protection and creative tools sets and train their teams to operate in this environment.**



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However...

We know **Change is Difficult**. But in the era we are living: **Change should be the Default**.

This is prediction 7: **Companies that embrace change, will prosper.**



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Work smarter, not harder

According to the World Economic Forum, South Africa is current in an Efficiency-driven state. **We should inspire to grow to an Innovation-driven state.**

Prediction 8: **Just working harder, will not make you successful, unfortunately.**

Table 2: Classification by each stage of development

Stage 1: Factor-driven (35 economies)	Transition from stage 1 to stage 2 (17 economies)	Stage 2: Efficiency-driven (30 economies)	Transition from stage 2 to stage 3 (19 economies)	Stage 3: Innovation-driven (37 economies)
Bangladesh	Algeria	Albania	Argentina	Australia
Benin	Azerbaijan	Armenia	Barbados	Austria
Burundi	Bhutan	Bosnia and Herzegovina	Chile	Bahrain
Cambodia	Bolivia	Brazil	Costa Rica	Belgium
Cameroon	Botswana	Bulgaria	Croatia	Canada
Chad	Brunei Darussalam	Cape Verde	Hungary	Cyprus
Congo, Democratic Rep.	Gabon	China	Latvia	Czech Republic
Côte d'Ivoire	Honduras	Colombia	Lebanon	Denmark
Ethiopia	Kazakhstan	Dominican Republic	Lithuania	Estonia
Gambia, The	Kuwait	Ecuador	Malaysia	Finland
Ghana	Monrovia	Egypt	Mauritius	France
India	Nigeria	El Salvador	Mexico	Germany
Kenya	Philippines	Georgia	Oman	Greece
Kyrgyz Republic	Russian Federation	Guatemala	Panama	Hong Kong SAR
Lao PDR	Ukraine	Indonesia	Poland	Iceland
Lesotho	Venezuela	Iran, Islamic rep.	Saudi Arabia	Ireland
Liberia	Vietnam	Jamaica	Slovak Republic	Israel
Madagascar		Jordan	Turkey	Italy
Malawi		Macedonia, FYR	Uruguay	Japan
Mali		Montenegro		Korea, Rep.
Mauritania		Morocco		Luxembourg
Moldova		Namibia		Malta
Mozambique		Paraguay		Netherlands
Nepal		Peru		New Zealand
Nicaragua		Romania		Norway
Pakistan		Serbia		Portugal
Rwanda		South Africa		Qatar
Senegal		Sri Lanka		Singapore
Sierra Leone		Thailand		Slovenia
Tajikistan		Tunisia		Spain
Tanzania				Sweden
Uganda				Switzerland
Yemen				Taiwan, China
Zambia				Trinidad and Tobago
Zimbabwe				United Arab Emirates
				United Kingdom
				United States

Stage 2:
Efficiency-driven
(30 economies)

Albania

Armenia

Serbia

South Africa

Sri Lanka

Thailand

Stage 3:
Innovation-driven
(37 economies)

Australia





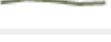














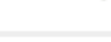



Austria

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Opportunities

Our **financial systems rank very** well. We should embrace this and think of clever ways to merge or fund manufacturing with financial systems.

Prediction 9: **RSA will leverage its strong financial sector and develop financing solutions for industry 4 era.**













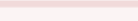
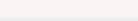






 8th pillar: Financial market development	11	5.2	
8.01 Financial services meeting business needs	2	6.0	
8.02 Affordability of financial services	27	4.6	
8.03 Financing through local equity market	1	5.9	
8.04 Ease of access to loans	12	5.2	
8.05 Venture capital availability	53	3.0	
8.06 Soundness of banks	2	6.6	
8.07 Regulation of securities exchanges	3	6.2	
8.08 Legal rights index 0-10 (best)	68	5	
 9th pillar: Technological readiness	49	4.7	
9.01 Availability of latest technologies	44	5.4	
9.02 Firm-level technology absorption	22	5.4	
9.03 FDI and technology transfer	52	4.6	
9.04 Internet users % pop.	75	51.9	
9.05 Fixed-broadband Internet subscriptions /100 pop.	86	5.3	
9.06 Internet bandwidth kb/s/user	21	147.6	
9.07 Mobile-broadband subscriptions /100 pop.	57	59.5	
 10th pillar: Market size	30	4.9	
10.01 Domestic market size index	27	4.8	
10.02 Foreign market size index	34	5.3	
10.03 GDP (PPP) PPP \$ billions	30	723.5	
10.04 Exports % GDP	81	30.8	

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Need for Scientists and Engineers

What is however strange from the World Economic Data, is that we do not have enough engineers!

Prediction 10: **RSA will (need to) increase quantity of people studying in STEAM fields**

 11th pillar: Business sophistication	30	4.5	
11.01 Local supplier quantity	39	4.7	
11.02 Local supplier quality	34	4.9	
11.03 State of cluster development	30	4.4	
11.04 Nature of competitive advantage	71	3.4	
11.05 Value chain breadth	52	4.1	
11.06 Control of international distribution	31	4.3	
11.07 Production process sophistication	34	4.6	
11.08 Extent of marketing	16	5.2	
11.09 Willingness to delegate authority	26	4.5	
 12th pillar: Innovation	35	3.8	
12.01 Capacity for innovation	25	5.0	
12.02 Quality of scientific research institutions	29	4.9	
12.03 Company spending on R&D	30	4.2	
12.04 University-industry collaboration in R&D	27	4.4	
12.05 Gov't procurement of advanced tech. products	99	2.9	
12.06 Availability of scientists and engineers	112	3.4	
12.07 PCT patent applications applications/million pop.	47	6.5	

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Let's recap

- 1) New and creative **Business Strategies** understanding the various drivers and solutions around I4, will need to be established. You also need to be creative in how you can leverage income from your products (over and over again).
- 2) Creating **development specifications will need insight**, and will likely need specialists from outside your current organisation and up-skilling your current development team.
- 3) Just-in-time will be replaced with **Just-Now**
- 4) Employees will need to understand **Data measurement and Analytics**, and companies will need new partners to help them survive in this brave new world.
- 5) Digital data does **not know about borders**. The world is there for you, and you are available to the world.

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Let's recap

- 6) Companies will have to **invest** in the data sharing, data protection and creative tools sets, and train their teams to operate these new tools.
- 6) Companies that **embrace change**, will prosper.
- 8) Just working harder will not make you successful...unfortunately, **innovation is needed**.
- 9) RSA will leverage its **strong financial sector** and develop financing solutions for industry 4 era.
- 10) RSA will (need to) increase people studying in **STEAM** fields

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Help is needed!

For SME's, with limited resources and access to partners who can transfer the know-how and optimised implementation, the scope, complexity and financial risk can easily be a prohibitive barrier to entry to learn to incorporation Industry 4.0

So, for SME's, it might be that change is practically impossible.

SME's will require **guidance and help to implement Industry 4.0** systems and how to operate in this environment during establishment and early implementation phases.

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Help is needed!

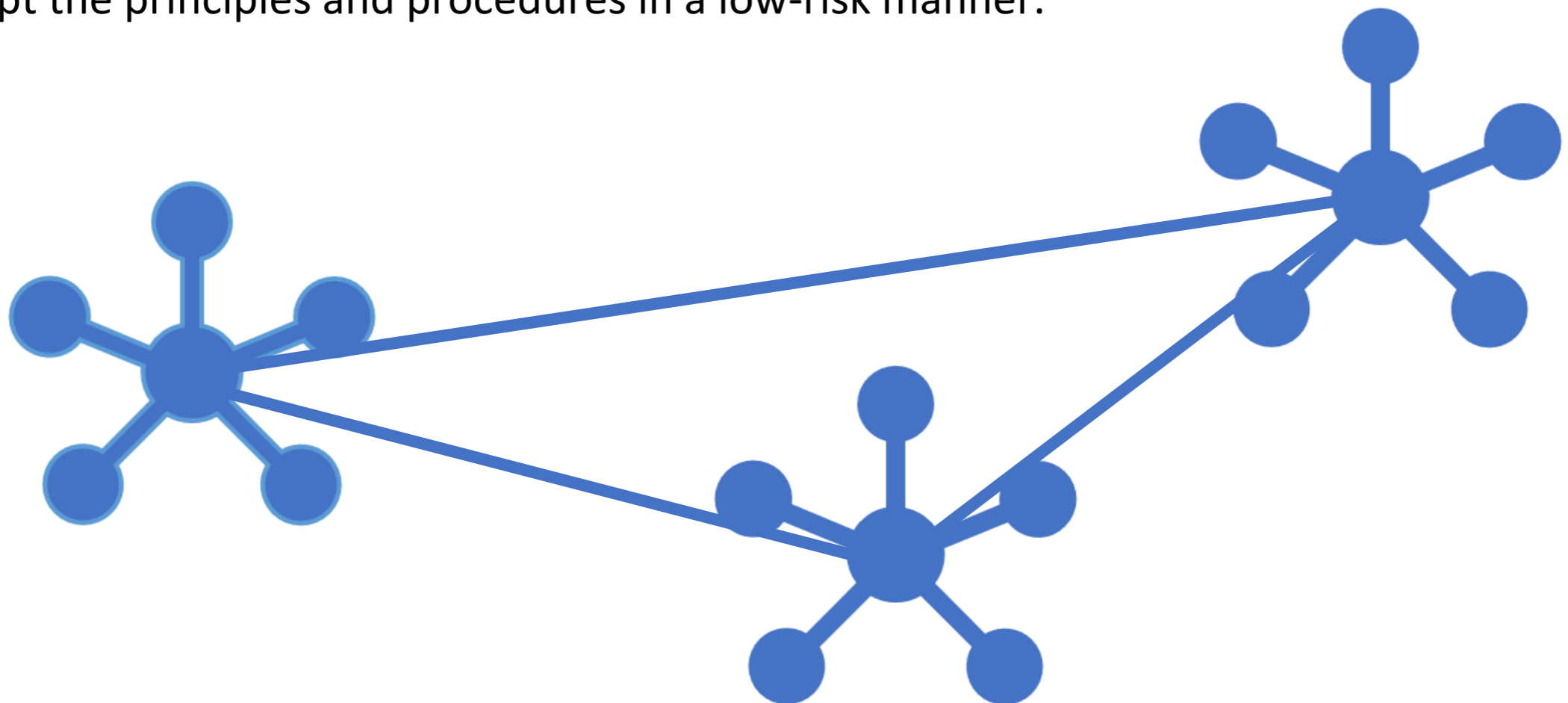
To truly create a vibrant **Economy and create JOBS**, a **vision for production innovation** is required:

- | | | | |
|---|---|---|---|
| • Traditional Research and Development Departments | ✗ | • Creating Innovative Industrial Foundations cross cutting all industries | ✓ |
| • Internal Strategic Focus Teams | ✗ | • Interlinked SME network | ✓ |
| • Incremental Development | ✗ | • Linked with Global Smart production systems and Industry 4.0 methods | ✓ |
| | | • Focused innovation using general industry and technology foundation | ✓ |
| | | • Development and training in modern production techniques. | ✓ |

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Product Development Centers

For these reasons, the establishment of **sponsored I4 centers is essential** that can assist SME's with all the aspects of becoming integrated into the I4 environment. The centers should have **specific industry focus**, but importantly, the various **Centers should interlink** with each other and form the epicentres of the Industry 4 network in South Africa and ideally abroad. Once they lead the path, SME's and Start-ups can adopt the principles and procedures in a low-risk manner.



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Changing the approach

Infrastructure		Offering		Customers	
Core capabilities	Supply chain	Value proposition	Customer relationships	Target customers	
Core manufacturing activities General Manufacturing Precision Manufacturing Quality Control & Reverse Engineering Rapid Prototyping - Mechanical & Electronics CNC Milling and Turning Composite Materials Investment Casting Coating Engineering services Production Management & Control Requirements Management Conceptualization, Design & Simulation Manufacturing Modeling & Programming Vocational Training Product design and innovation Product design Innovation, design thinking and ideation Research and development Technical expertise Industry 4.0 PLM NEMC Training	Training partners Technology partners Hardware partners Key activities Industry 4.0 product development Business support operations Training	The PDCs provide Saudi Arabia with the capabilities to establish and develop the product development industry in Saudi Arabia. The PDC does this using leading edge Industry 4.0 technology, equipment and specialised training, skills development and ultimately job creation, to Saudi Arabian Participants. The PDC focus is advanced manufacturing product development up to prototyping and proof of concept small scale manufacture phase.	Macro: long term project partnerships Micro: short term projects Channels Marketing Industry experts Commercial partners Training partners Innovation networks Academic institutions	Saudi Arabian cardinal projects SMEs	
Resources		Revenue potential of the PDC		Costs after CAPEX	
Industry 4.0 Training programs and experts Commercial partners		Equipment hire Consulting fees Training fees Rental of equipment and production time Partnership agreements Membership fees		Equipment maintenance Salaries Service providers Administrative and business overheads Marketing, networking and events	
Finance					

Original canvas	1. problem / need		2. Target customers	
Modified I04 canvas	What is the most accurate understanding of customer needs? The need to create a product development industry in Saudi Arabia, job creation, skills development for Saudi Arabians			
Core capabilities	Key partners	3. Value proposition	Customer relationships	2. Target customers
Core manufacturing activities General Manufacturing Precision Manufacturing Quality Control & Reverse Engineering Rapid Prototyping - Mechanical & Electronics CNC Milling and Turning Composite Materials Investment Casting Coating Engineering services Production Management & Control Requirements Management Conceptualization, Design & Simulation Manufacturing Modeling & Programming Vocational Training Product design and innovation Product design Innovation, design thinking and ideation Research and development Technical expertise Industry 4.0 PLM NEMC Training	Training partners Technology partners Hardware partners Data specialist partners SME startup incubation Alliances for sharing knowledge and resources	The PDCs provide Saudi Arabia with the capabilities to establish and develop the product development industry in Saudi Arabia. The PDC does this using leading edge Industry 4.0 technology, equipment and specialised training, skills development and ultimately job creation, to Saudi Arabian Participants. The PDC focus is advanced manufacturing product development up to prototyping and proof of concept small scale manufacture phase.	Macro: long term project partnerships Micro: short term projects Partners: collaborations Academic: research collaborations Automated service Co-creation Channels Marketing Industry experts Commercial partners Training partners Innovation networks Academic institutions	Saudi Arabian cardinal projects SMEs
Resources	Key activities	Differentiating advantage		
Technical: Industry 4.0 systems and processes Human: Training programs & experts Physical: Equipment & premises	Core manufacturing activities Engineering services Data analysis and usage Software operations Software updates / maintenance Specification, modelling & analysis Scalability & complexity management Employee capabilities Problem solving Networking / Platform Intellectual property Consumption dimension modeling	Supported financially by Saudi Arabian state institutions Supported in expertise and know how by global specialist network		
Costs after CAPEX	Revenue potential of the PDC			
Equipment maintenance Software upgrades Salaries Service providers Administrative and business overheads Marketing, networking and events	Equipment hire Consulting fees Training fees Partnership agreements Membership fees	Physical Freemium Digital Add-on Digital Lock-In Data Economy		

Thank you

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