50 Years of Smart City Impact of Logistics Ecosystems

on social economical and environmental development

Keynote Abstract

Professor Elizabeth Chang

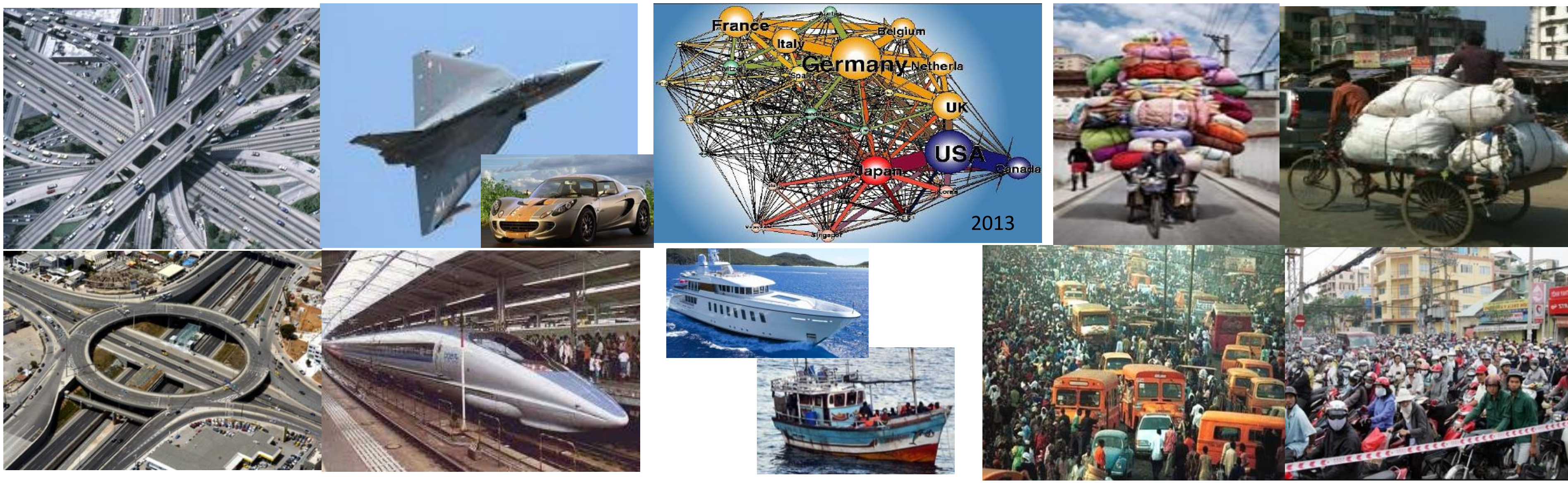
11th International Conference on Innovations in Information Technology -IIT 2015, Dubai

1-3 Nov 2015

Outline

1. **Smart City** – Where we are at
2. **The enablers of Smart City** – Innovation IT
3. **The iconic representation of Smart City –** Logistics Ecosystems
4. **World Wide Research Issues & Our Work**
5. **Smart City** – Where we are going – Hot topic
6. **Conclusion**

Iconic Representation of Smart City - Logistics

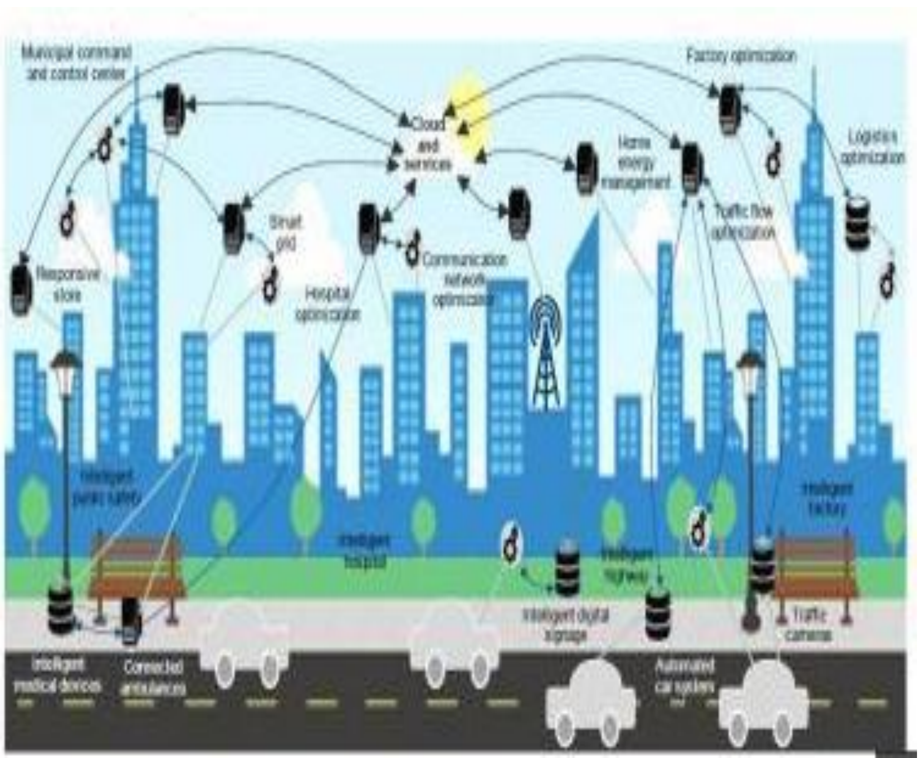


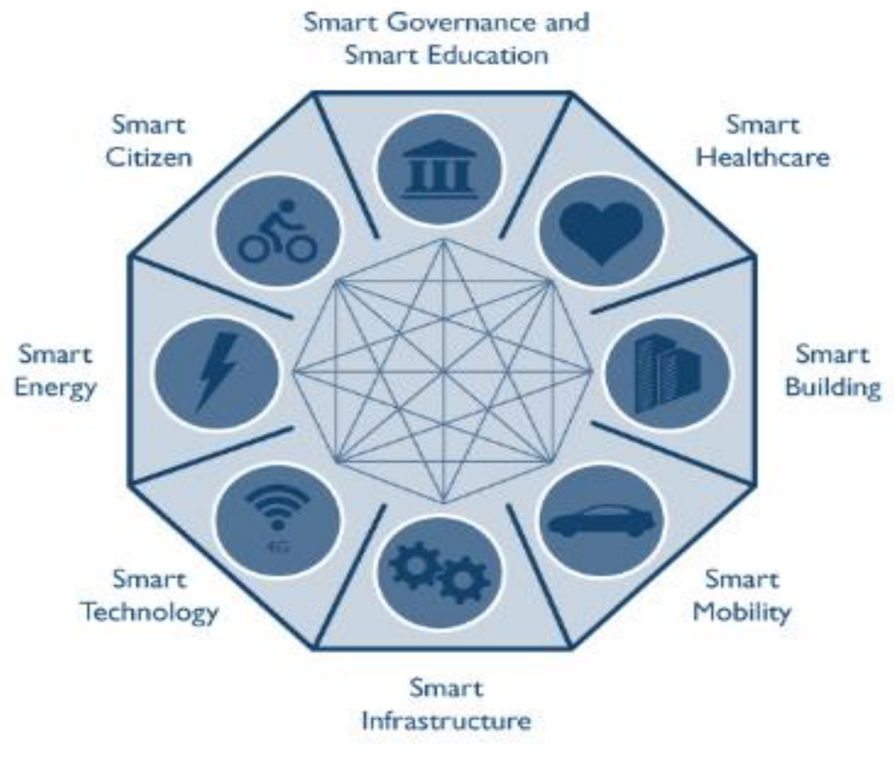
- **Logistics is one of the keys to distinguish RICH and POOR countries, the Logistics GAP continues;** [World Bank 2013].
- **Logistics is the 3rd largest industry sector in developed economies, contributing up to 15%+- of GDP. Germany, annual turn-over 210B Euros, US: U$1.4 T; Emerging economic countries, China, US$1.4 T;** [German House, NY 2013];
- **Logistics is THE KEY for economic competitiveness, growth and poverty reduction, [**World Bank Trade Logistics Survey 2013**].**
- **Logistics is THE enabler in Domestic and International Trade Flows** [World Bank 2013].
- **Logistics is the Chief driver for top performance.**
- **Countries that pursue progressive logistics reforms, continue to improve their economic performance.**
- **Developed countries continue to build the INFRASTRUCTURE and LOGISTICS and in Green logistics** [World Bank 2013].
- **How good your logistics is, determines how good your economy will be ➔ How Smart your city will be**

1. 50-100 years of effort - Smart City

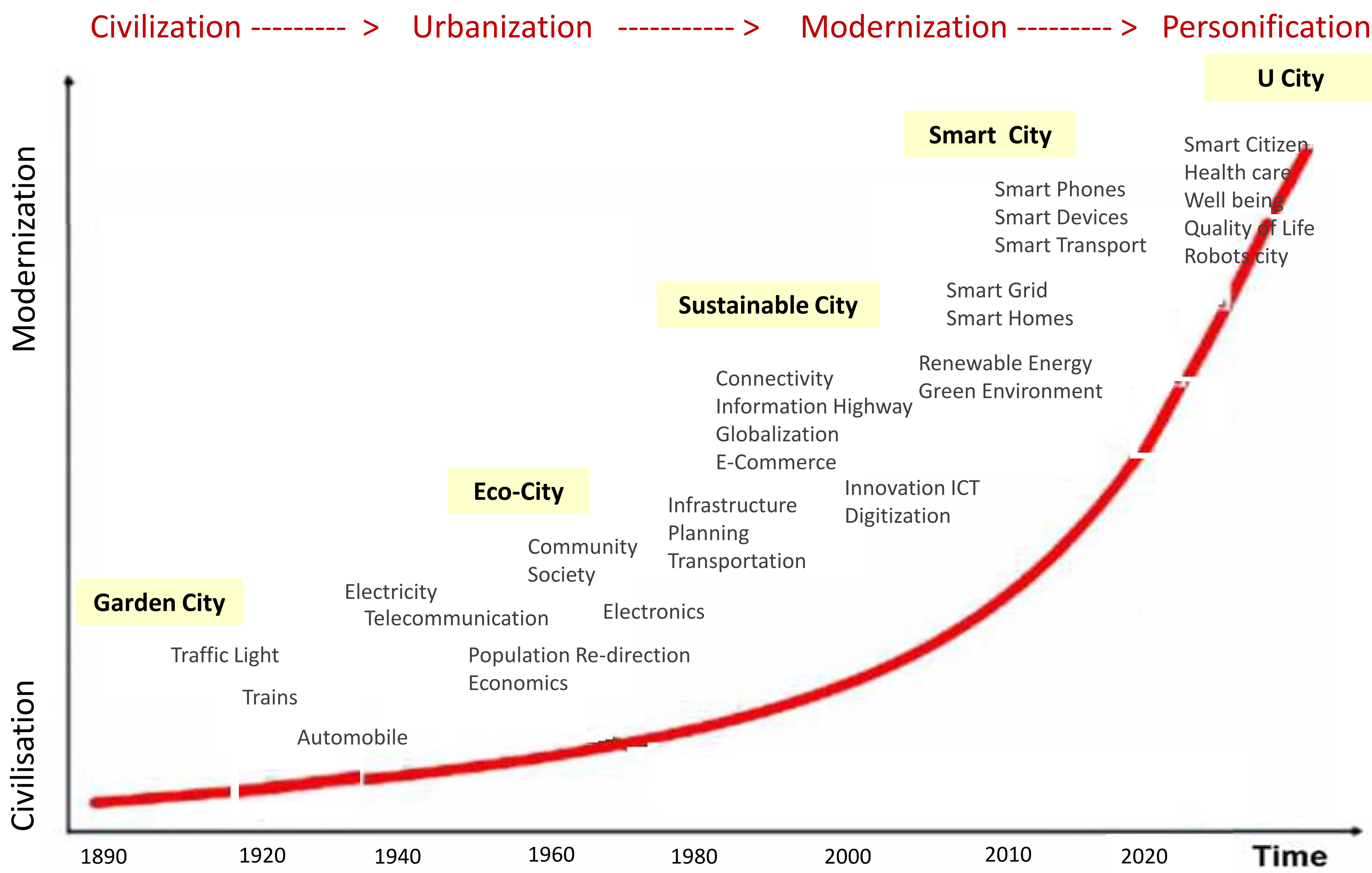
From civilisation to modernization

Where we are at


Municipal command and control center
Factory optimization
Cloud and services


Smart Governance and Smart Education
Smart Citizen
Smart Healthcare
Smart Energy
Smart Building
Smart Technology
Smart Mobility
Smart Infrastructure

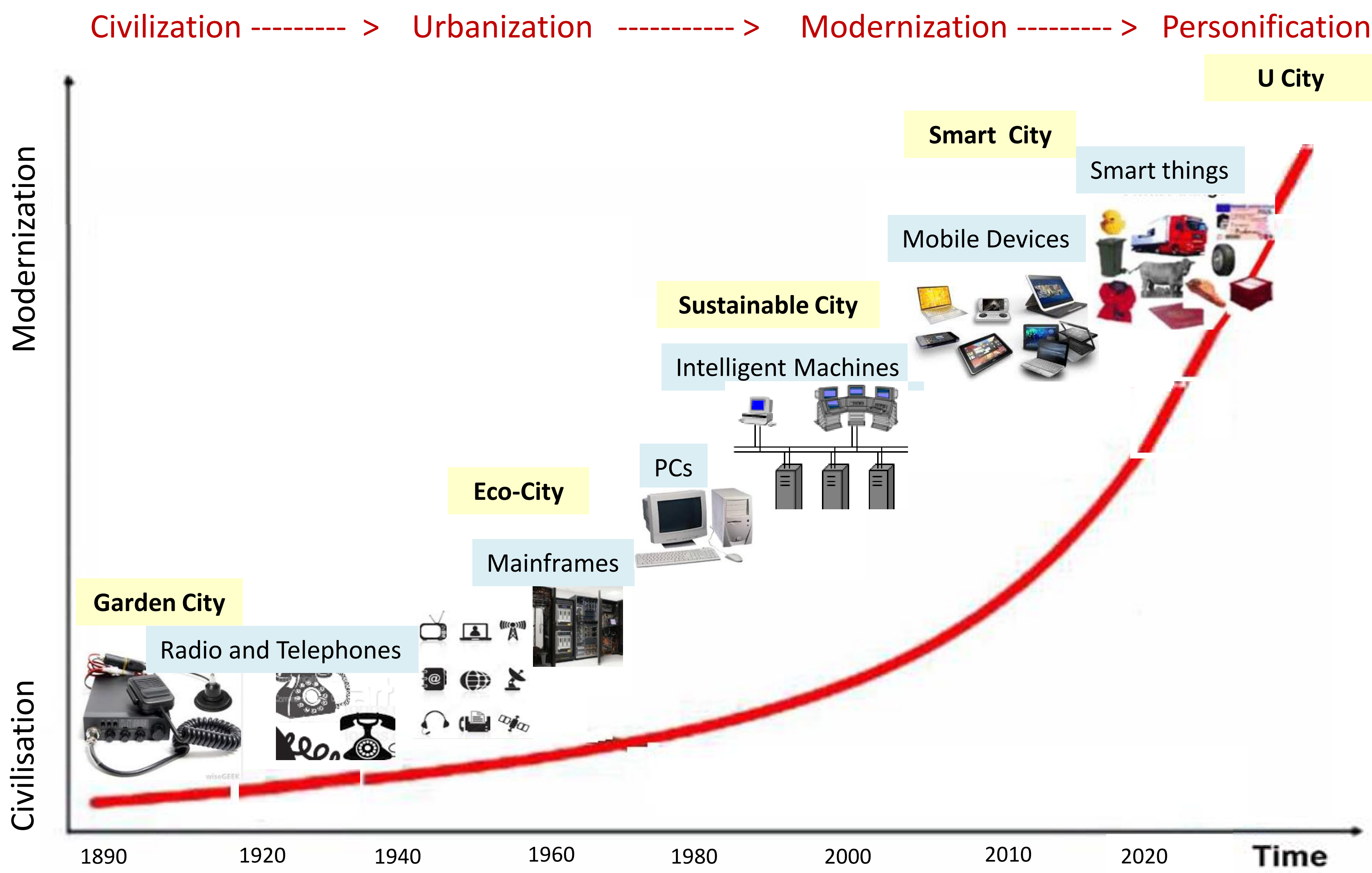
100 years effort – Smart City



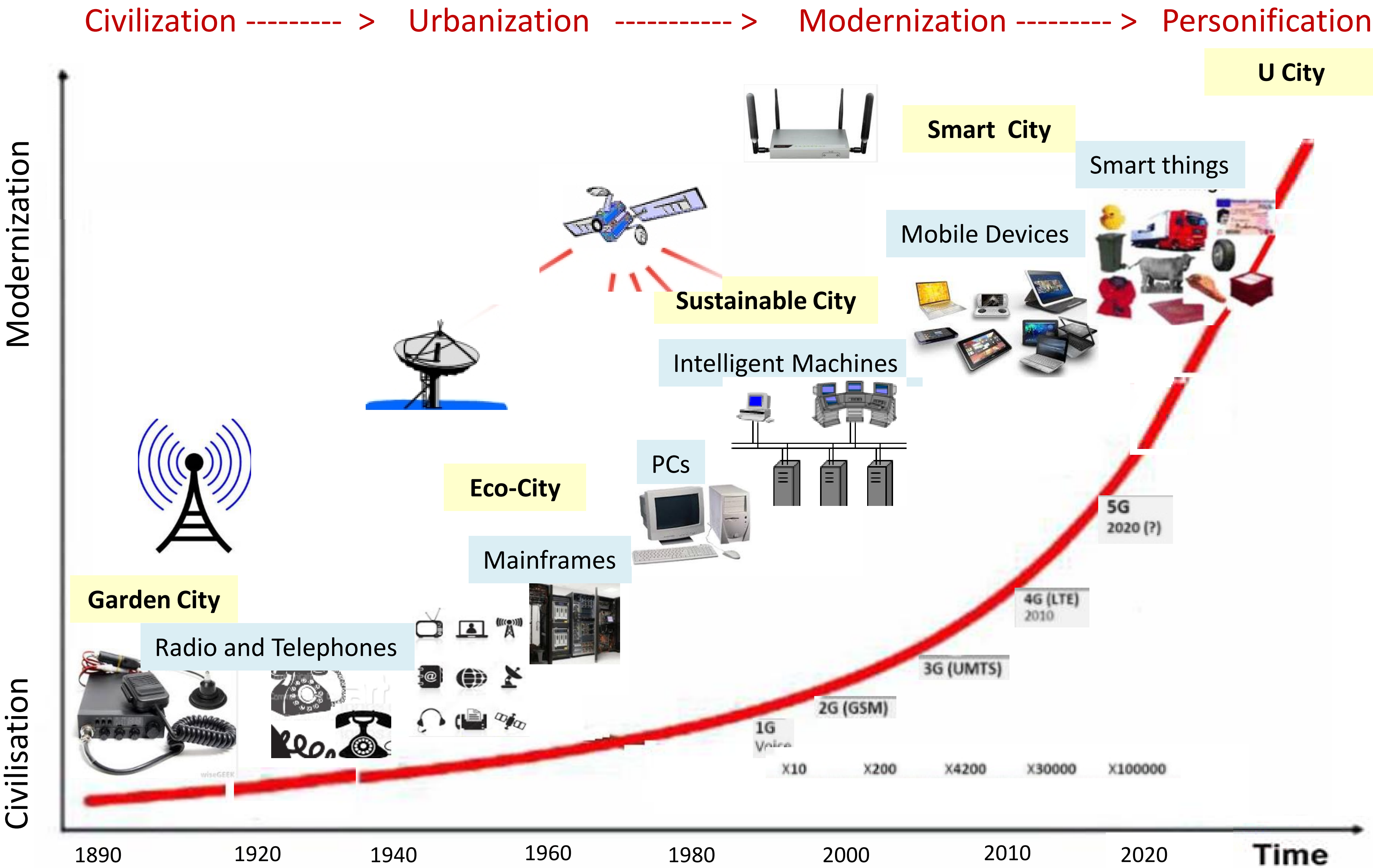
2. The enabler

Innovation ICT underpinning Smart City

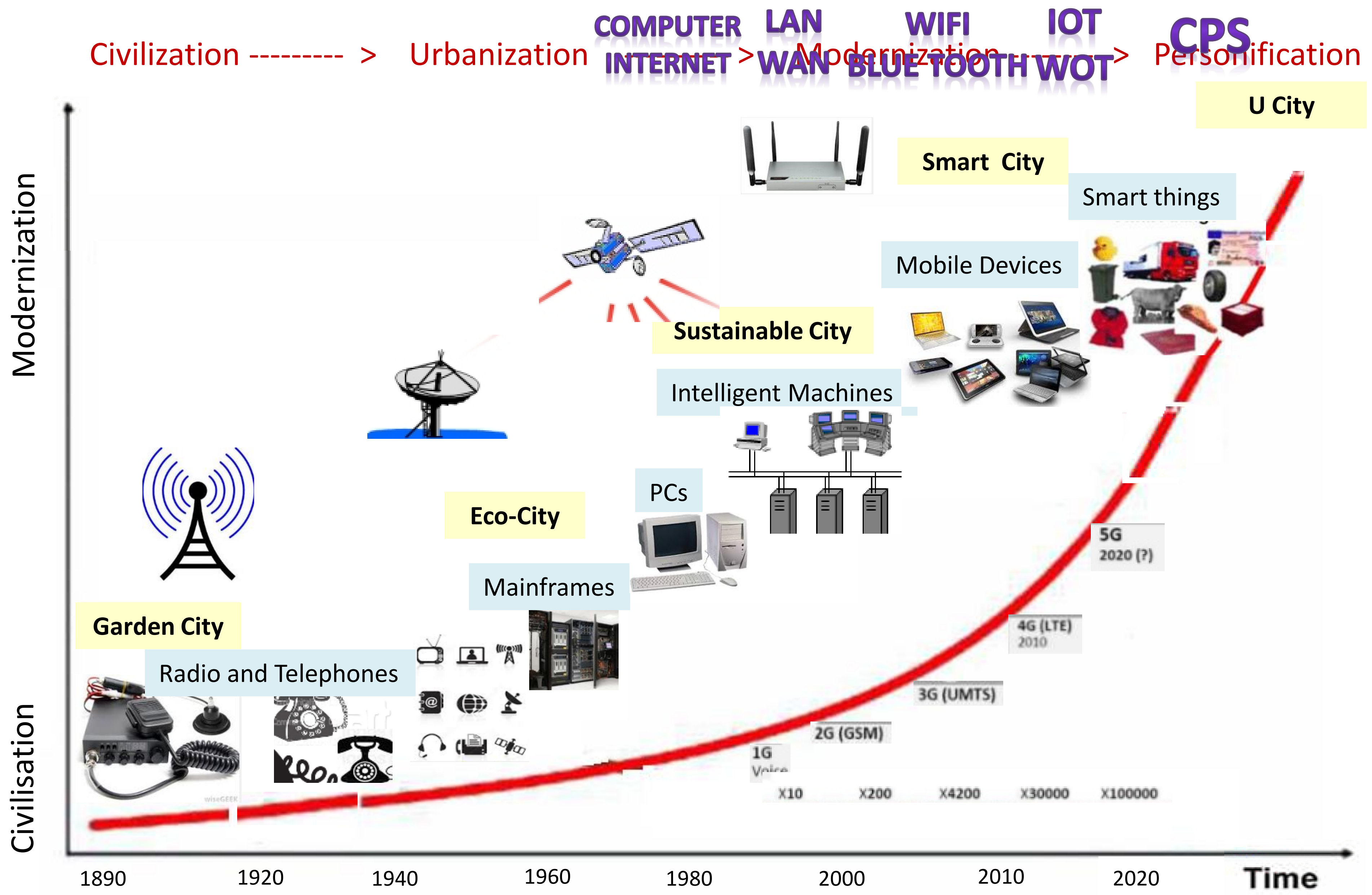
Enabler – Communication Devices



Enabler – Communication Infrastructure

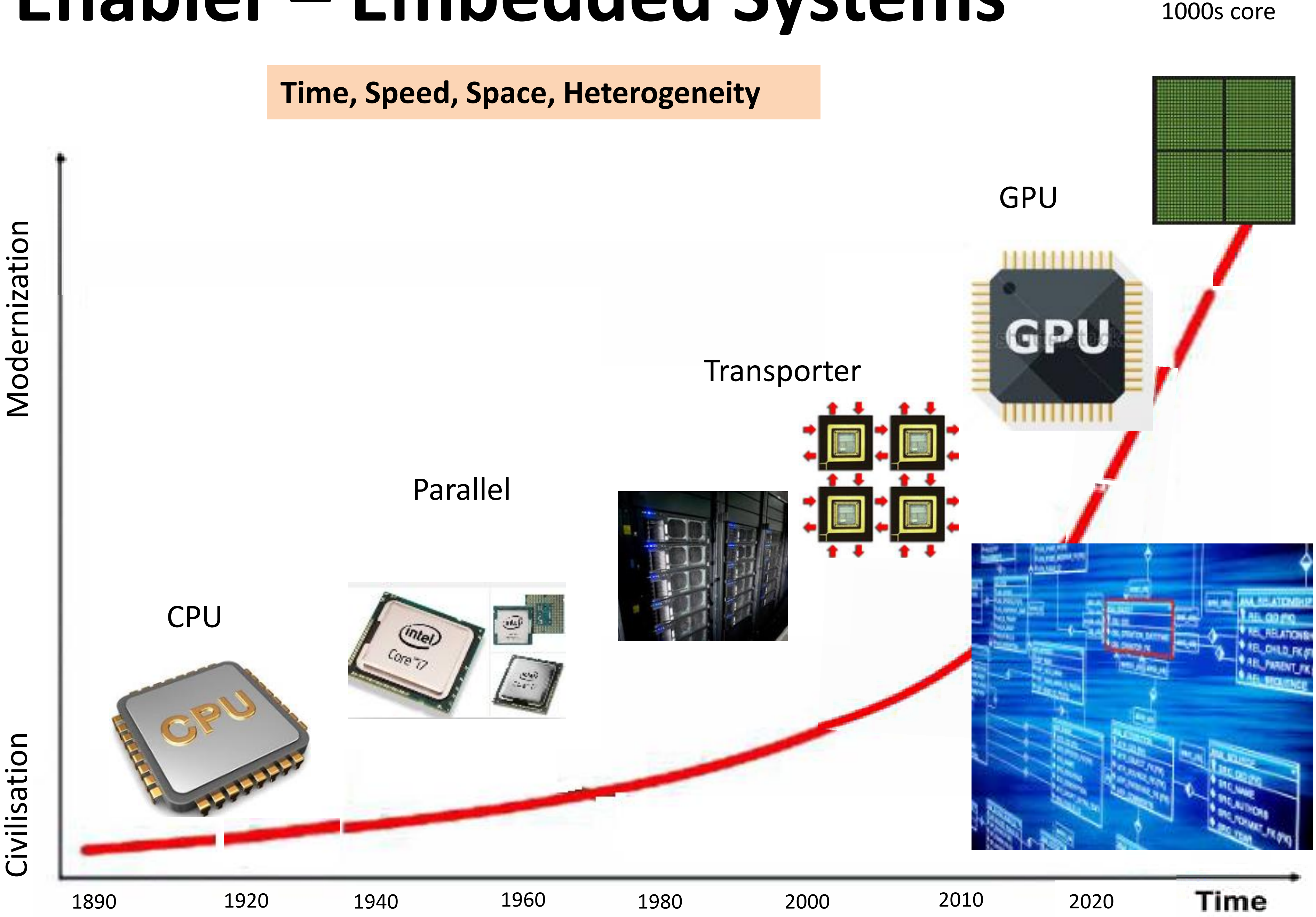


Enabler – Information Network



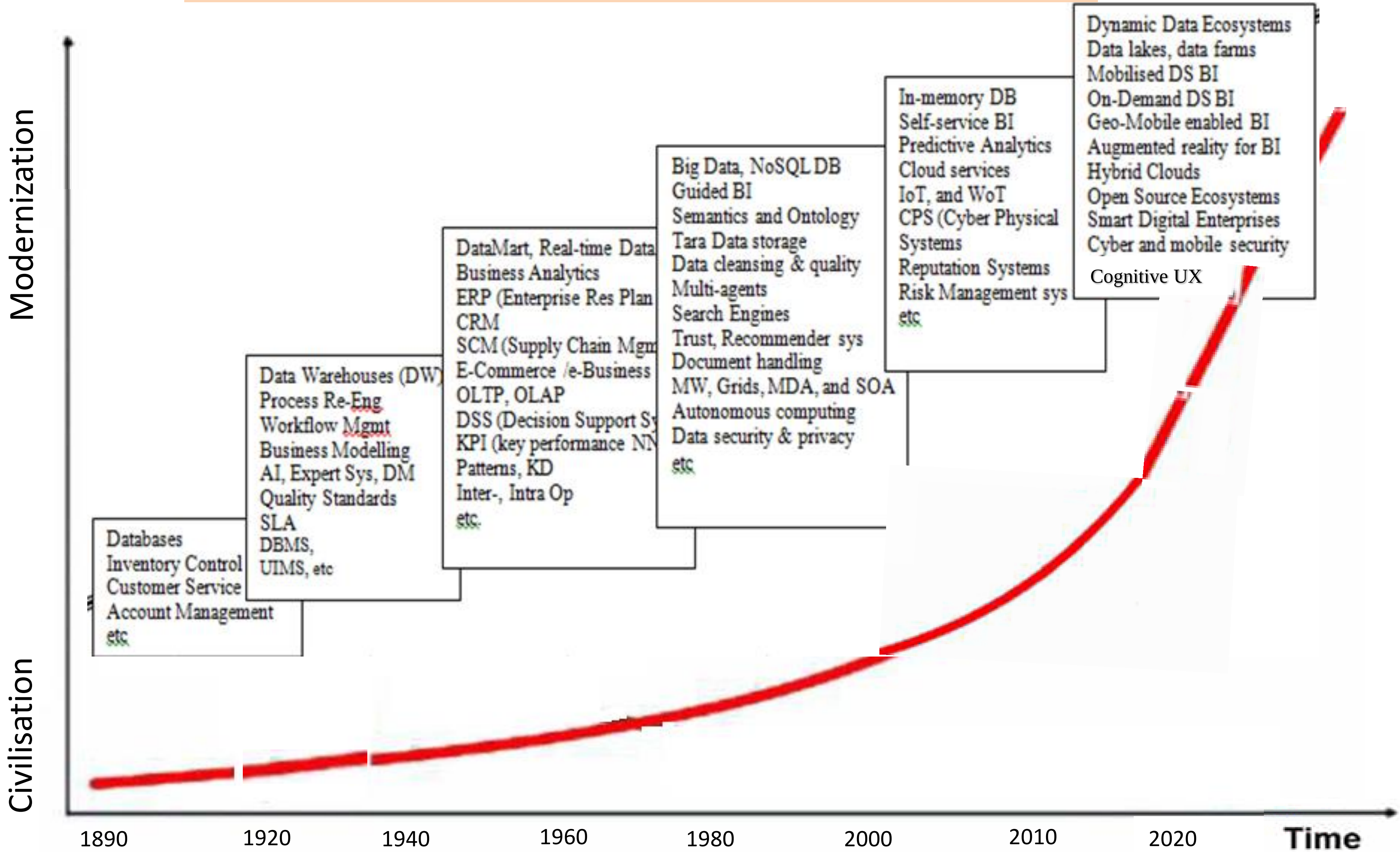
Enabler – Embedded Systems

Time, Speed, Space, Heterogeneity

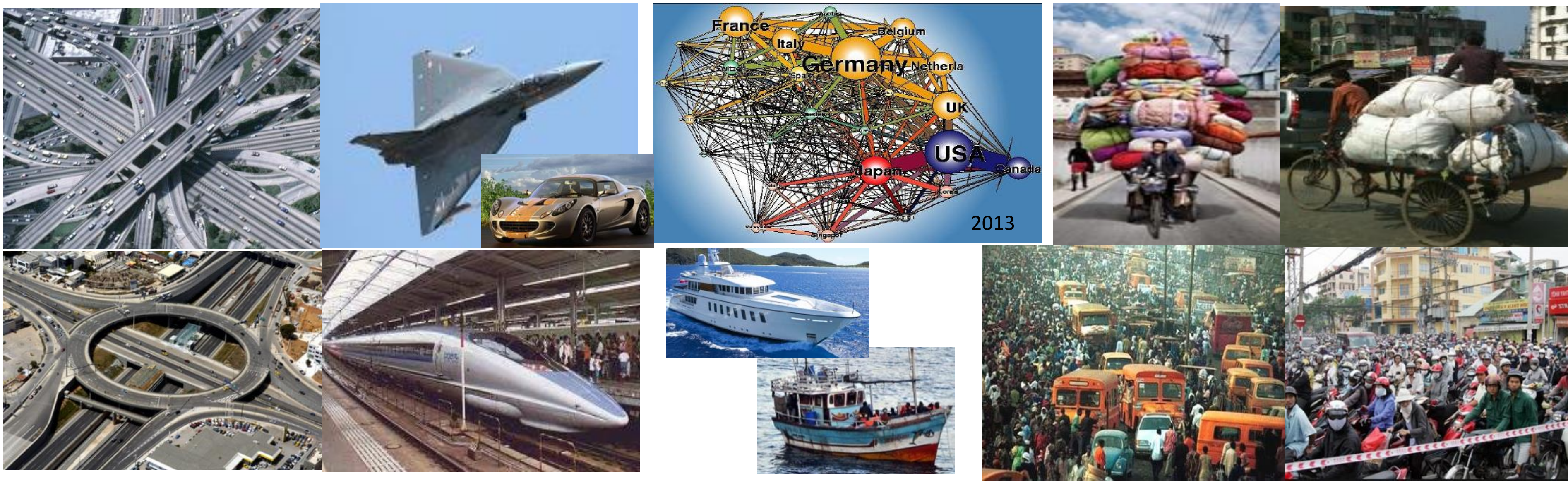


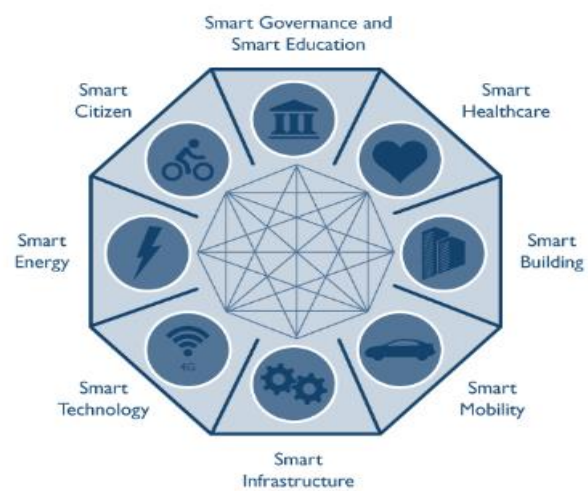
Enabler – Big Data Management

Mobility, Flexibility, Simplicity, Personalised & Cognitive UX



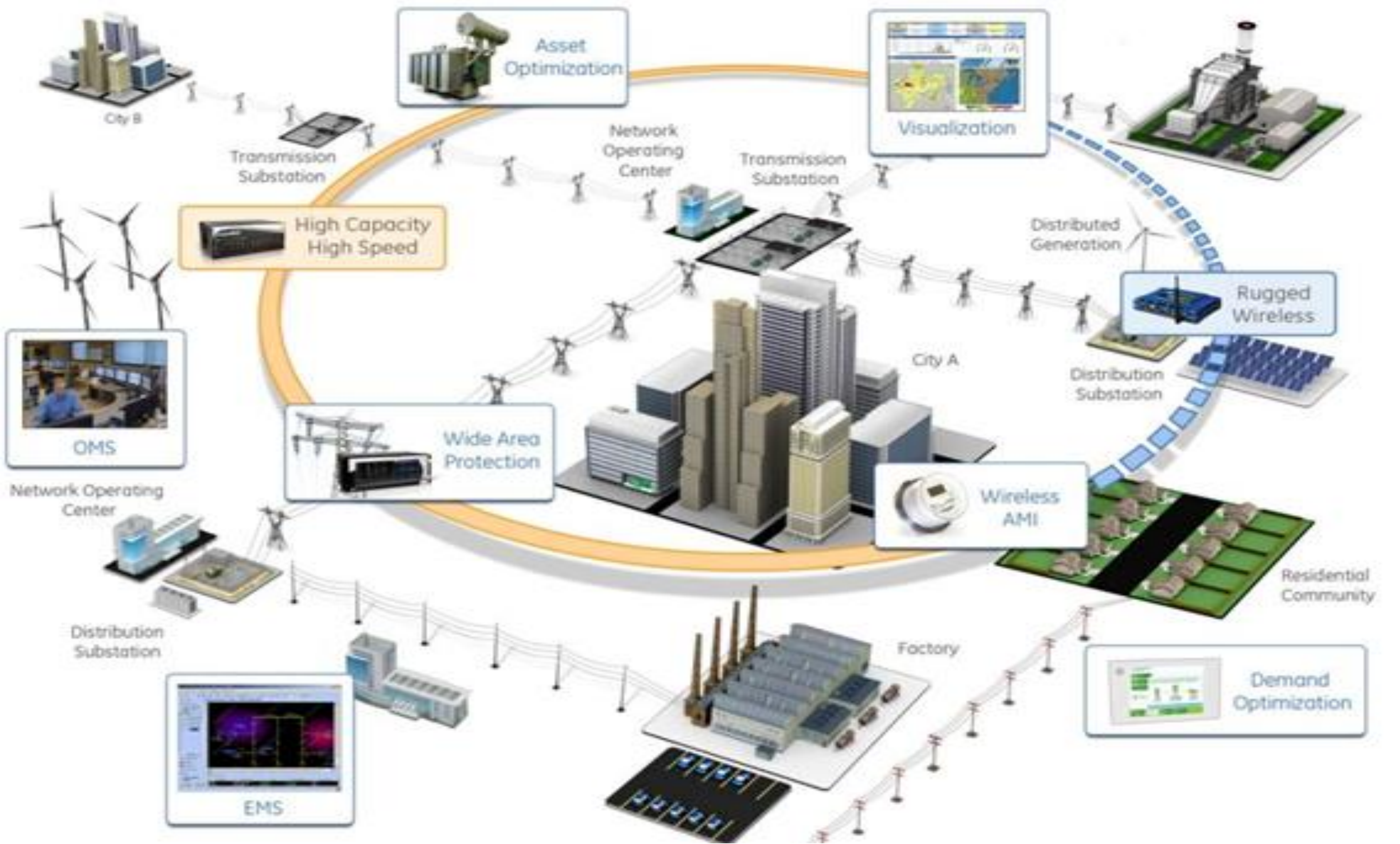
Iconic Representation of Smart City - Logistics





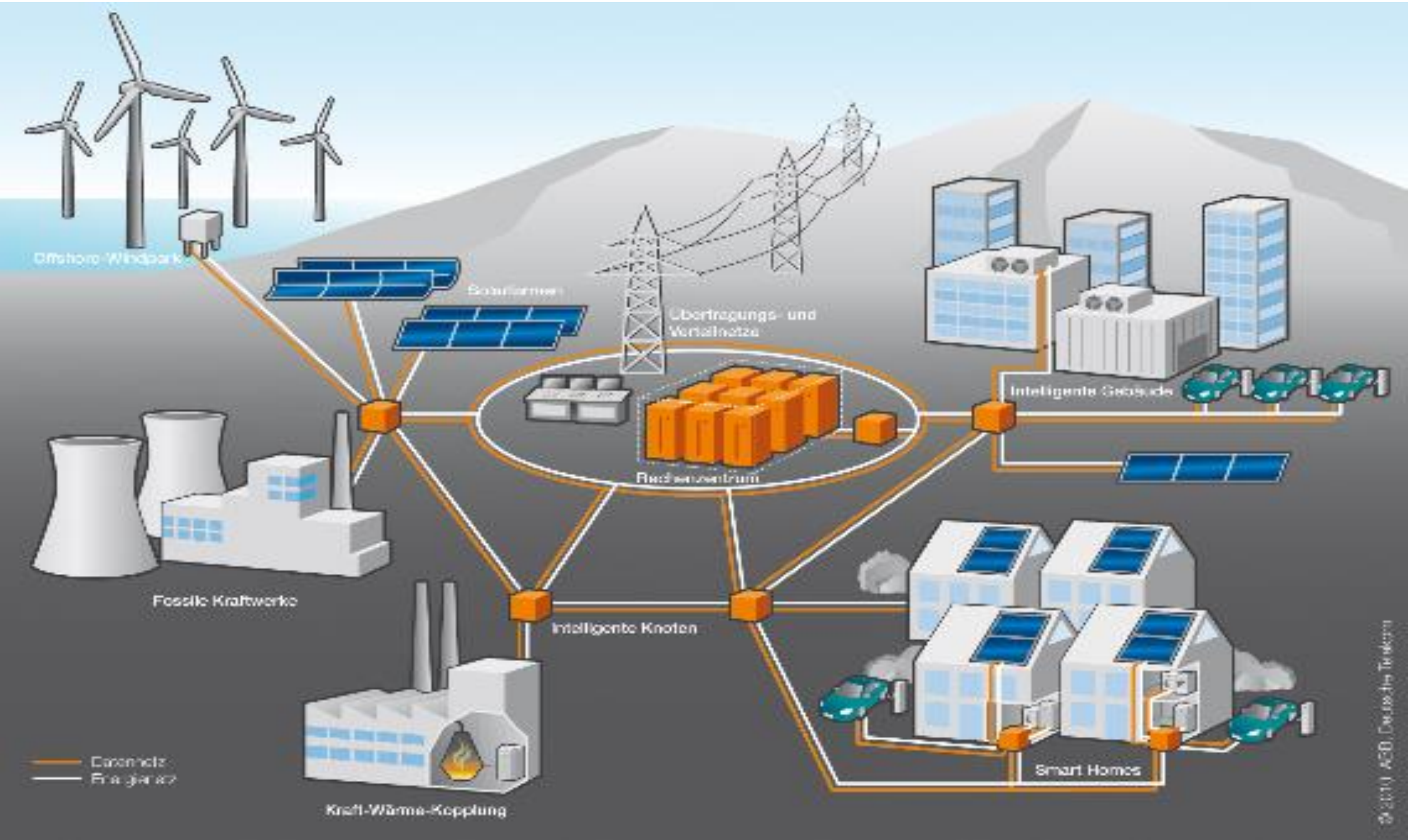
Smart City

The world since mid 2000s



Smart Grid

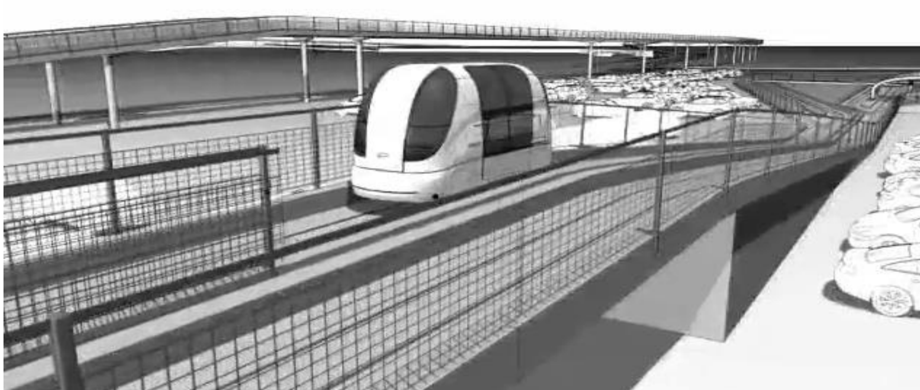
The No.1 successful evidence and RoI



Smart Transportation

The No.2 successful evidence and RoI

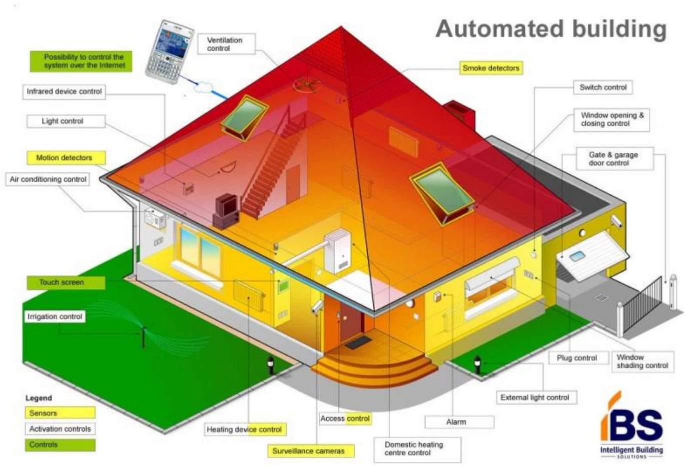
http://connectedcarexpo.com/smart-transportation-innovation-coalition-stic/

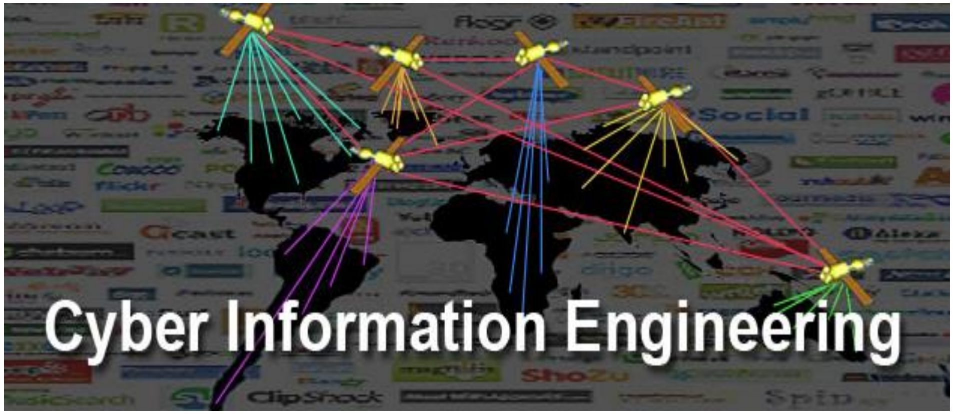


London Airport2013

Smart Home

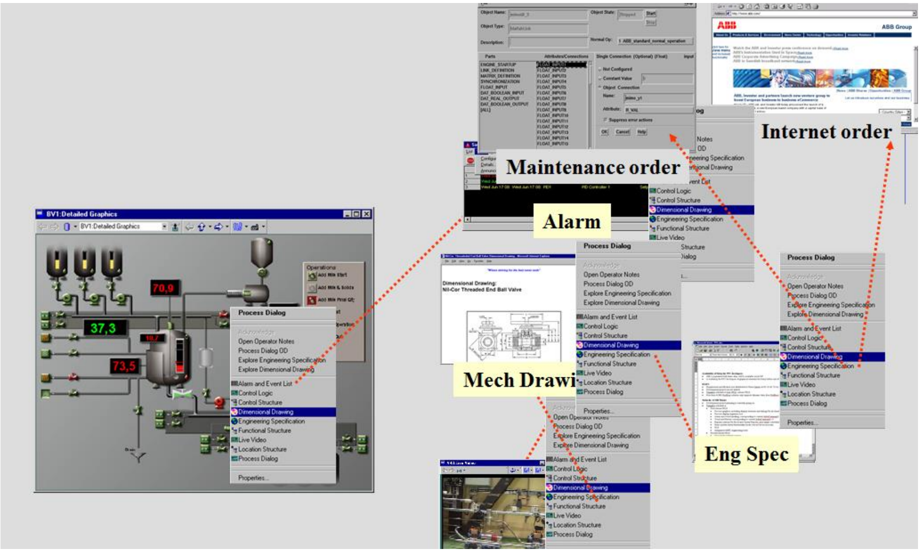
The world effort since early 2010s





Smart Manufacturing

The world effort since 1980s

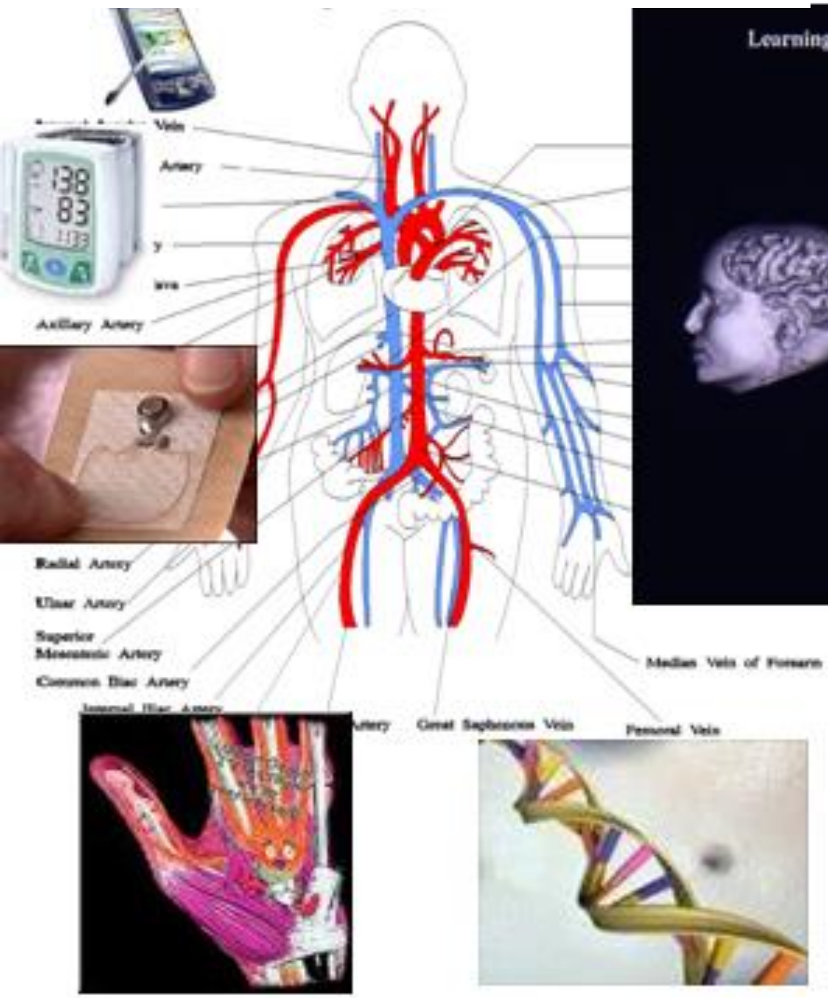


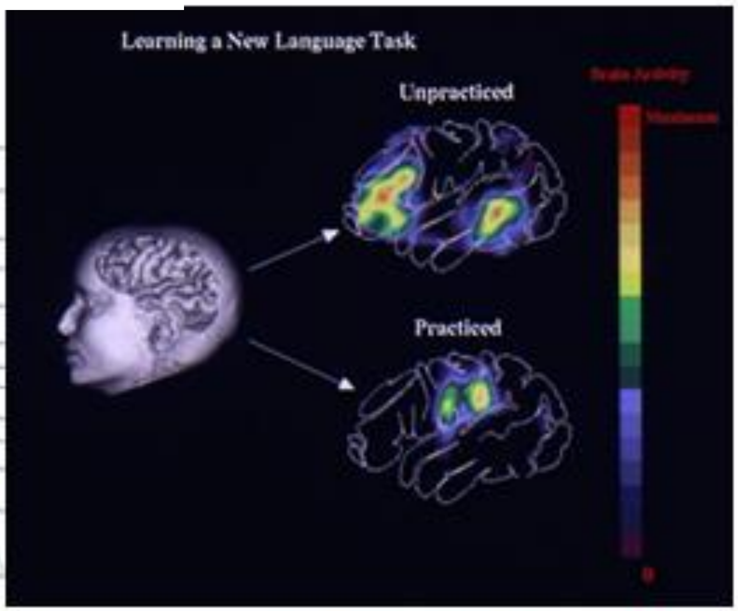
Power and productivity
for a better world™

Smart Medicare

The world effort Since 2000s

Robotic surgery and remote operation





Defence Modernization

5000 years of history, 2000BC vs 2000 AC, People and Technology

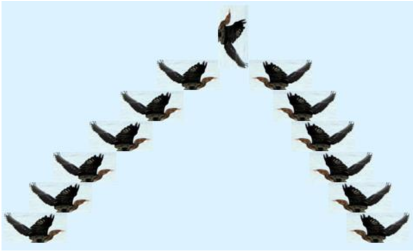




3. Logistics ecosystems

Ecosystem inspired Computing

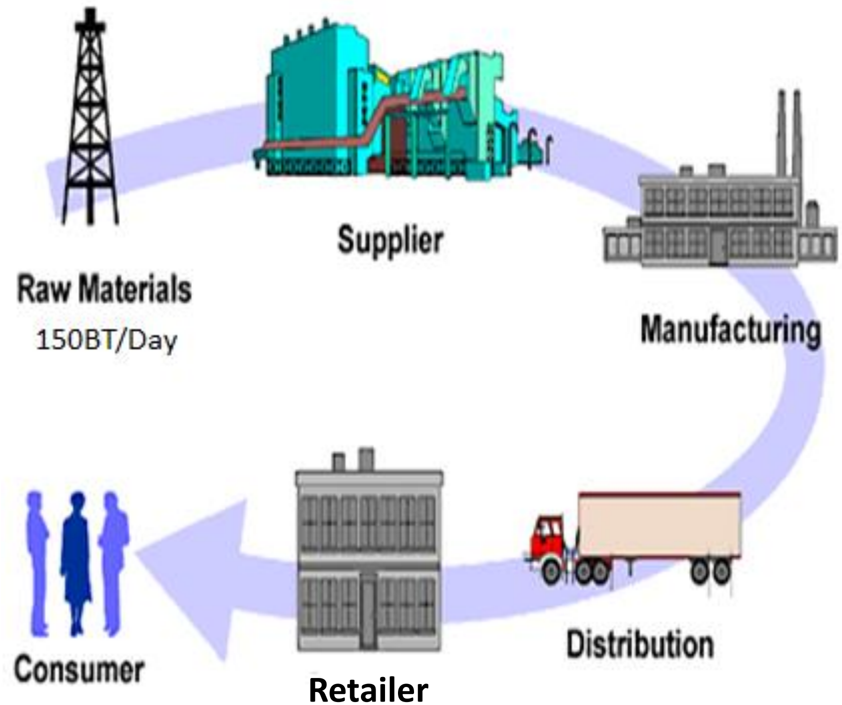
Key features
Self organization
Self sustain
Dynamic Architectures
Temporary coalition
Mutual benefit



Logistics

- Logistics is about movement of people, goods and services to the right place, at the right time, with the right people and material handling.


Logistics, Transportation, Supply Chain



Trade Logistics=SC; Logistics Providers = Transport Logistics Operators = Supply Chain Services Specialist. Concepts differences.
Logistics: horizontal: SC: Vertical. SC: inventory replenishment of goods; Logistics: transporting goods, & people & services.
SC: 90% by volume are materials/semi-products, 10% are consumer goods; 40% Cargo Goods by Value are transported by Air.
The more the trade, the more services, more jobs and better economy.

Time, JIT, QoS, Security, Safety, Heterogeneity, Optimisation, Efficiency, Productivity

Commercial vs Defence Logistics

Top 10 *Similarities*

Top 10 *Differences*

Commercial vs Defence Logistics
Similarities

Commercial Logistics and Defence Logistics

1. **Requirement** – place, time, space, cost, quality, quantity, handling, …definition
2. **Model** – Joint partnership, networked of operators and operations
3. **Intelligence** – Data & Information
4. **Tools**- Use of facilities, infrastructure, resources, technologies
5. **Services & Operations** – (WH, Distri…)
6. **Mode of Op** - air, sea, land, cyber, space
7. **Fuel** – lower the cost, sustainable
8. **Performance measures** - productivity, efficiency, optimisation, cost-benefit
9. **Environment** – complex, competitive, uncertainty, dynamic, un-predictable, crowded, connected, collective, constrained
10. **Attacks** – deny, corruption, interruption, disruption, security, safety, trust, risk

Commercial vs Defence Logistics

Differences

Commercial Logistics

1. **Purpose**-business growth, cut the cost, increase revenue
2. **Objectives** – bottom-line, customers
3. **Customer** - B2B, B2C
4. **Focus** - manufacturers and trade, supply chain
5. **Supply Chain** - value Chain
6. **Asset** - someone else asset, standards and automation
7. **Stock** – minimum
8. **Management** - distributed
9. **Providers** – partners, alliances, consortium
10. **Situation** - harmless

Defence Logistics

1. **Purpose**-enable capability, agility, sustainment
2. **Objectives** - save lives, win the war
3. **Customer** – gov, public
4. **Focus** - maintenance, sustainment, wind-up operations
5. **Supply Chain** – chain of supply
6. **Asset** –its own asset, safety, reliability, availability
7. **Stock** – maximum
8. **Management** - centralised
9. **Providers** - Coalitions forces, integrated services, Defence + civilian contracts
10. **Situation** – dangerous, violent, lethal

Difference between the three types of Logistics

	Business	Humanitarian
Goal	Customer, cost (profit) and time	Alleviate the suffering of vulnerable people and minimize the deprivation costs
Design	Customer demand	Vulnerability needs
Pattern of occurrence	Repetitive – less uncertainty	Unpredictable – high uncertainty
Demand for resources	Less fluctuations	High fluctuations
Competition	Yes	No
What is at stake?	Profits, reputation, business	Life, reputation, suffering

Keenan D. Yoho, Sebastiaan Rietjens, Peter Tatham, (2013) "Defence logistics: an important research field in need of researchers", International Journal of Physical Distribution & Logistics Management, Vol. 43 Iss: 2, pp.80 – 96

4. World wide research Issues and our work

World Needs Logistics

Economies, Humanity, Society

USA Trade Logistics Will Triple in 20 yrs

Example USA - the Economic Superpower

Thinking inside the box

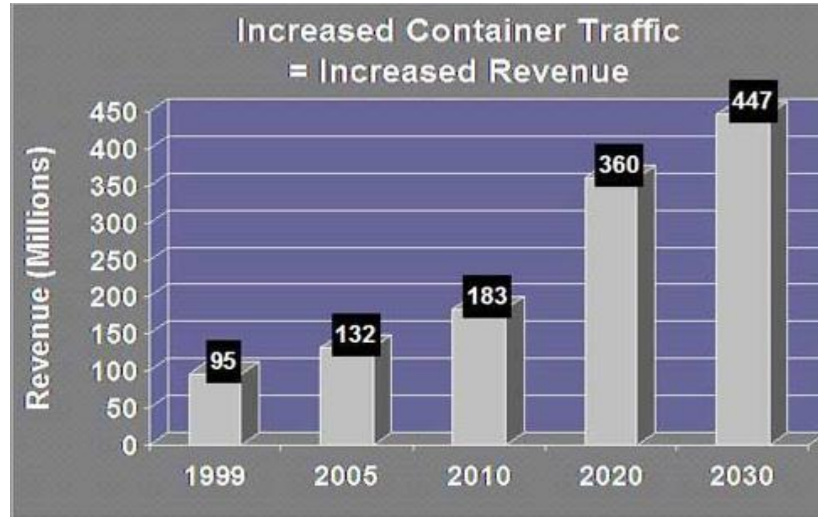
Shipping containers and the growth of global trade will double in the next decade [worldpress May 30, 2013 by Marty Lariviere]

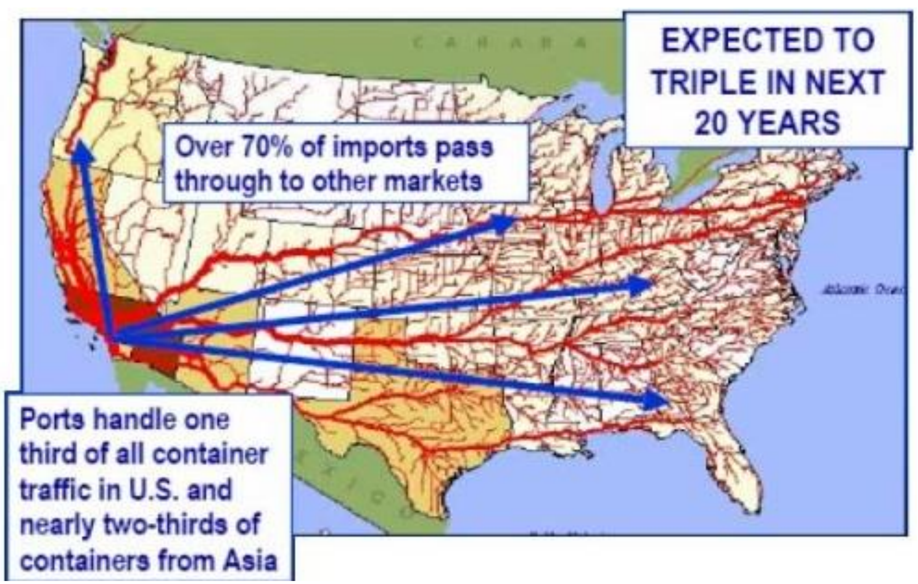
Ports worldwide

	1965	1970
Port labour productivity, tonnes per hour	1.7	30.0
Average ship size, tonnes	8.4	19.7
Number of loading ports in Europe	11	3
Insurance costs†, £ per tonne	0.24	0.04
Value of goods in transit‡, £ per tonne	2	1

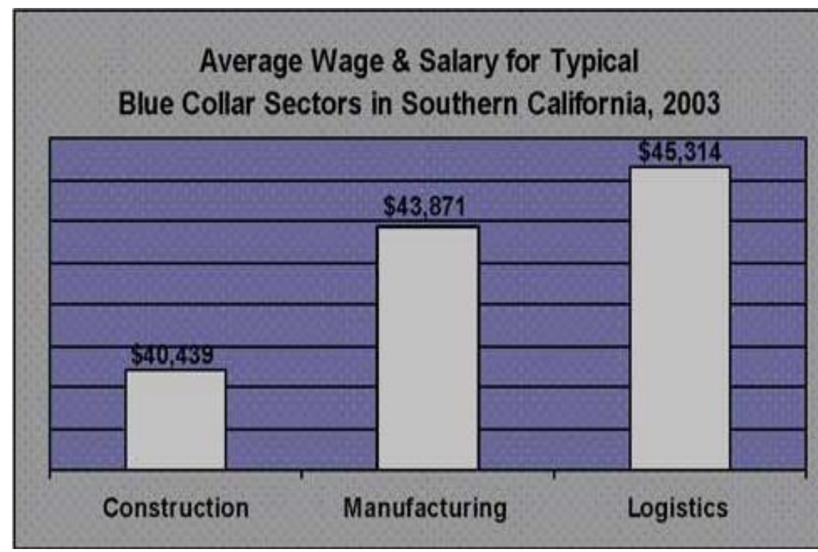
Sources: World Trade Organisation; US Bureau of Labour Statistics; Daniel Bernhofen *et al*; *The Economist*

*Deflated by US consumer prices
†Australia to Europe ‡Hamburg to Sydney





SCAG Goods Movement Task Force September 21, 2005

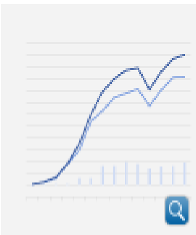


Blue Ribbon Panel of Transportation Experts Steve Adams, City of Riverside, CA Thursday, August 15, 2013

World Trade Logistics Will Triple in 20 yrs

Developed and Emerging Countries

Germany's foreign trade 2012: export +3.4%; import +0.7%



In 2012 Germany exported goods worth 1 097.3 billion euro and imported goods worth 909.1 billion euro. That means that Germany's exports increased by 3.4% and its imports by 0.7% in 2012 compared with 2011.

In 2012 the foreign trade balance closed with a surplus of 188.3 billion euro. In 2011 the foreign trade balance surplus amounted to +158.7 billion euro.

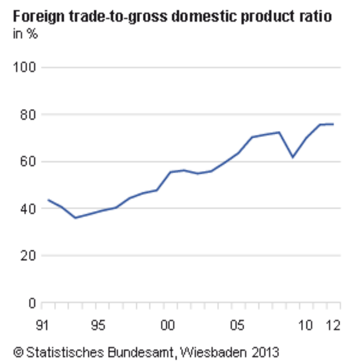
More›

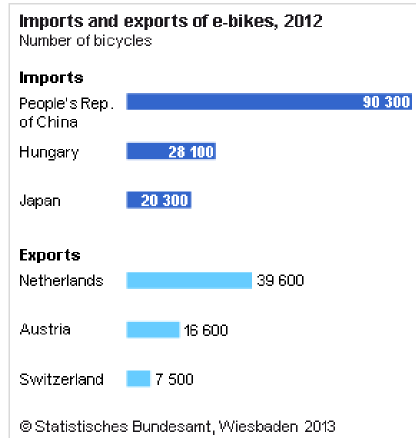
Foreign trade balance as a percentage of GDP $= \frac{\text{Exports} - \text{Imports}}{\text{GDP}} * 100$

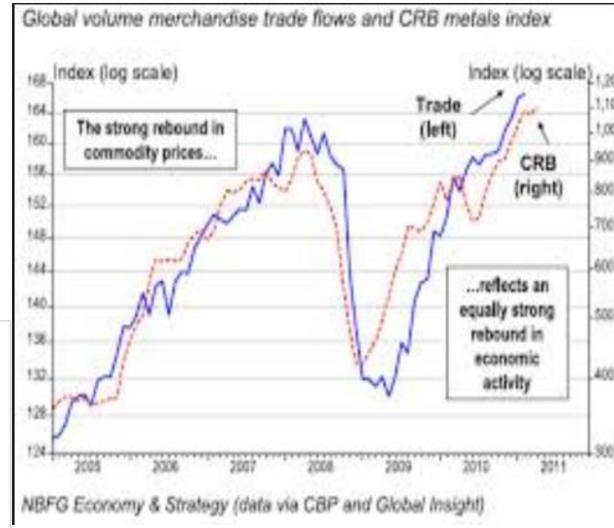
Typically, the term "balance of exports and imports" includes both goods and servi GDP ratio shown here covers only goods.

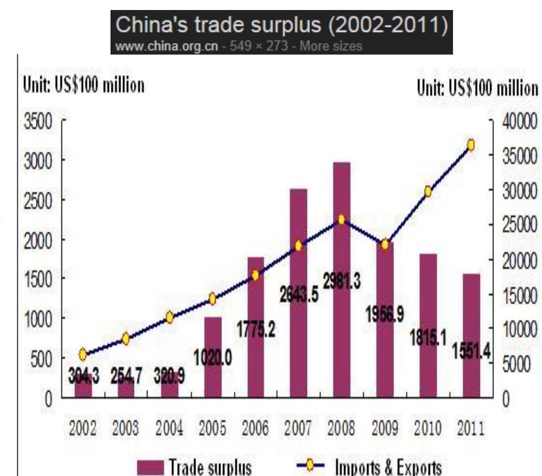
Foreign trade-to-GDP ratio $= \frac{\text{Exports} + \text{Imports}}{\text{GDP}} * 100$

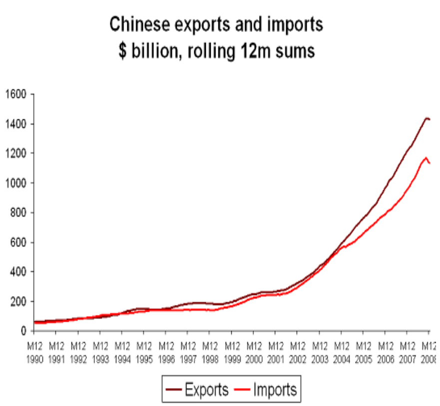
It reflects a country's integration in the world economy. The fo

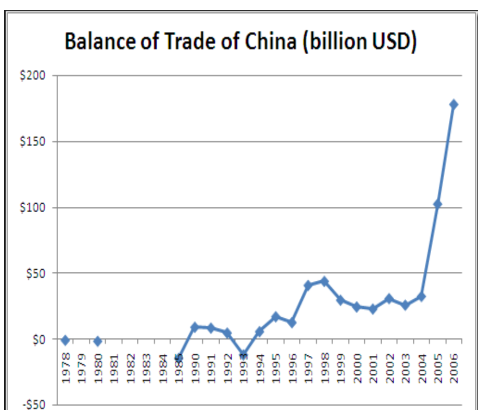










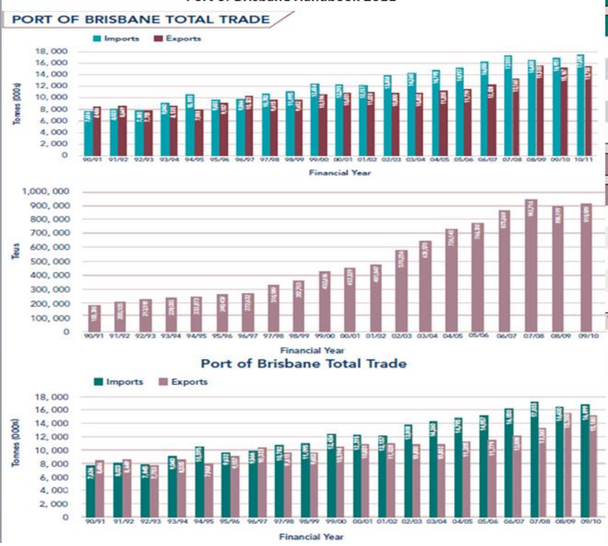


Australia Trade Logistics Will Triple in 20 yrs

Source: Port Handbooks 2011

Brisbane Port - Exports/Imports

Port of Brisbane Handbook 2011

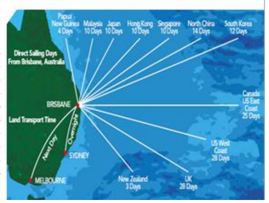


Top five trade commodities and markets in 2010/2011

Imports		
Rank	Commodities*	Country of Origin
1	Crude Oil	Global
2	Refined Oil	Malaysia
3	Cement	China
4	Iron & Steel	Japan
5	Building Products	Indonesia

Exports		
Rank	Commodities*	Destinations
1	Coal	Japan
2	Refined Oil	Australia
3	Cereals	Taiwan
4	Meat Products	China
5	Iron & Steel	South Korea

* by tonnage



Port of Melbourne Trade

Customer Handbook 2009/2011

PORT OF MELBOURNE

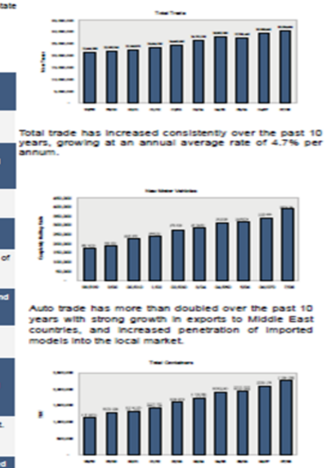
Trade statistics

As a significant and strategic asset of the state of Victoria, Port of Melbourne provides a range of benefits to the state economy through the facilitation and support of trade related industries.

A summary of these benefits is listed in the table below.

Jurisdiction	510 hectares of land for port-related development, 101,000 hectares of maritime jurisdiction and 81 kilometres of navigable channel.
Cargo	The majority of the port's trade throughput is containerised but it also handles breakbulk, liquid bulk, dry bulk, general cargoes and motor vehicles.
Trade	Total trade through the port in 2007-08 reached 75.7 million revenue tonnes. Of this total, containerised trade represented 70%; non-containerised general (breakbulk and motor vehicles) 19%; liquid bulk 7%; dry bulk 4%.
Economic contribution	The port contributes $2.5 billion to the national economy annually.
Employment	The port's activities are directly linked to more than 13,700 jobs.
Trade Value	In 2007-08, the value of the port's trade was greater than $90 billion. Nearly a quarter of the nation's international sea trade by value flows through the port.
Passengers	During 2007-08, 44 cruise ship visits were made bringing over 100,000 passengers and crew to Melbourne.
Vessel Movements	The port has over 7,000 vessel movements per year.
Facilities	Major assets and facilities include the shipping channels and 34 commercial berths located at five docks, river wharves, Gellibrand Pier (Williamstown) and Station Pier. These facilities include two modern, purpose built container terminals and specialised berths for motor vehicles, break bulk, dry bulk, liquid bulk and passengers.
Investment	In 2007-08, $167.2 million was invested by PoMC on infrastructure projects in the port. This included $118.7 million on the COP and $48.5 million on other projects.
Tenants	There are 35 major tenants in the port undertaking cargo handling and shipping related activities.
PoMC employees	To undertake its strategic management of the port, PoMC has 177 ongoing employees, 54 temporary employees and 15 contact employees (31 March 2009).

The charts below present a 10 year profile of Port of Melb…



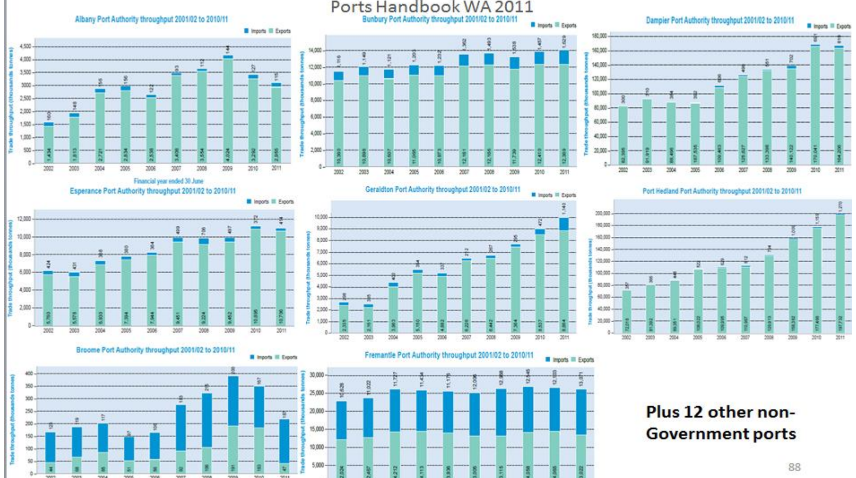
Total trade has increased consistently over the past 10 years, growing at an annual average rate of 4.7% per annum.

Auto trade has more than doubled over the past 10 years with strong growth in exports to Middle East countries, and increased penetration of imported models into the local market.

Containerised trade, which currently accounts for over 68% (by mass tonnes) of total trade, continued to expand with annual TEU growth of 8.0% per annum over the past 10 years.

WA Ports Total Import 10%, Export 90%

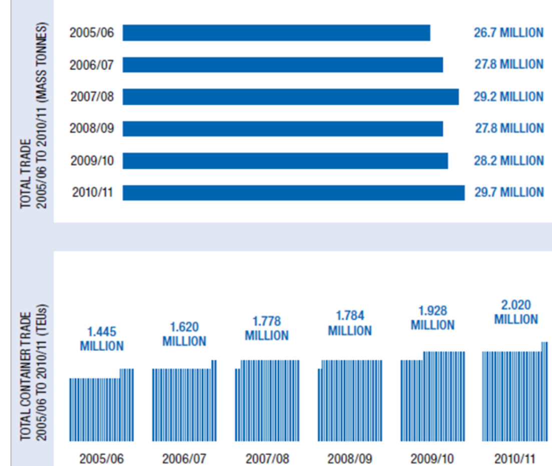
Ports Handbook WA 2011



Plus 12 other non-Government ports

Sydney Port Trade

Sydney Port Corp Annual Report 2010/2011



Global Issues

1. Homeland Security
2. Congestion (Roads & Ports)
3. Collaborative Logistics
4. Carbon Footprint
5. Big Data Management

Global Issue 1 – Homeland Security

Two key Areas

Regulations: Homeland security; National security measures; different countries, different priority; my way is the best way, mutual recognition; Information sharing between Governments; between Logistics and SC providers;

Technologies: X-Ray, Sniffer, CT-Scan facilities, Goods Tracking, Container tracking; Material tracking; RFID; Sensors; Facility scattered, no way to screen all; no methods to track beyond borders, information and data interoperability.

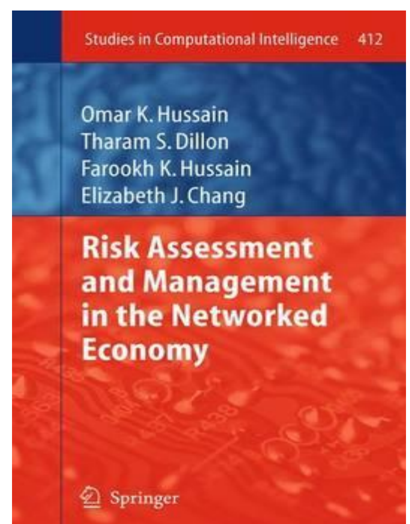
Research into Transport Security

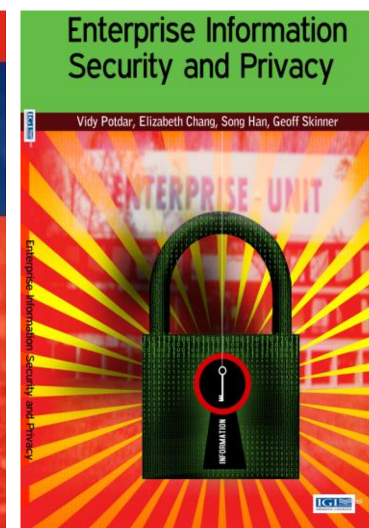
Our Work

1. **Ambient Security**, Logistics Network and Inter-modal;
   ARC LP0349100, 2003-2006; PATREC, 2003-2007; StatOilHydro 2009
1. **Trust** - ARC LP 0560346, 2005-2008
2. **Risk** - ARC LP 110200118, 2012 - 2015

Outcomes

- 5 grants obtained
- 5 preliminary patents filed
- 5 Post-Docs supervised
- 6 Keynotes delivered
- 12 PhD theses completion
- 3 Books Co-Authored
- 30+ Tier 1 Journal Papers
- over 200 Scientific Papers



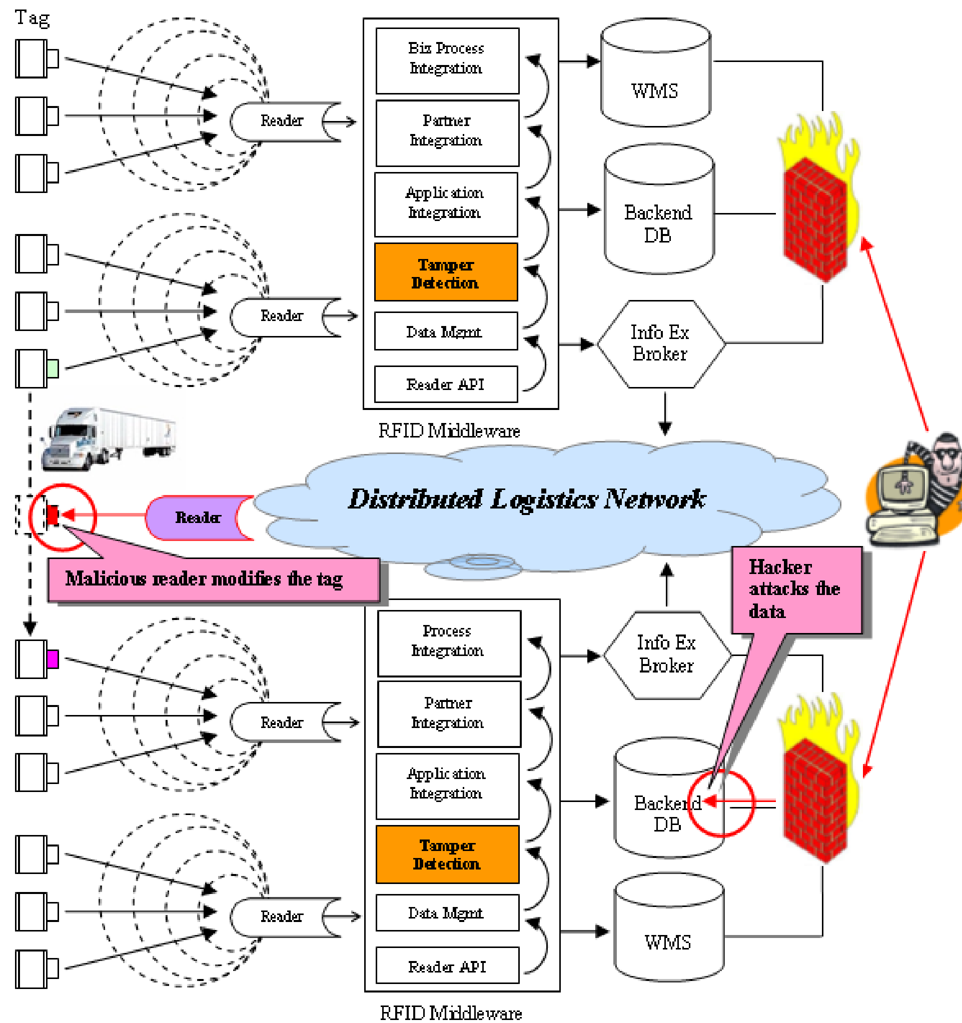


Inter-modal Security

Security help identify and measure the Logistics operation security and vulnerability, monitoring and control of malicious activities, through IT. It also detects the attacks, fraud, and intrusion etc.

Technology underpinning the above are:

- RFID tamper detection
- Logistics Network Security
- Supply Chain Security
- Barcode Watermarking
- Information Security



Ambient Security

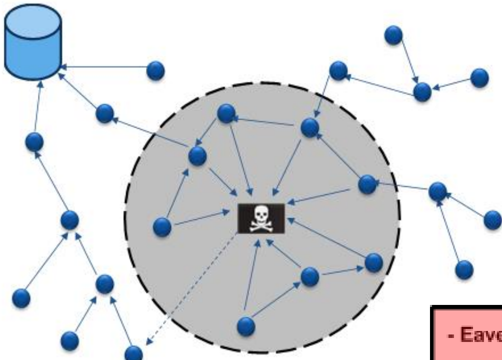


Figure 2-5: The Logistics Network Attacks

Logistics Network Attack is described as operations to disrupt, deny, degrade or destroy logistics communication data within nodes, hub and networks. Logistics Network is widely shared, it is easier and vulnerable against attack such as Eavesdropping and Traffic Analysis etc.

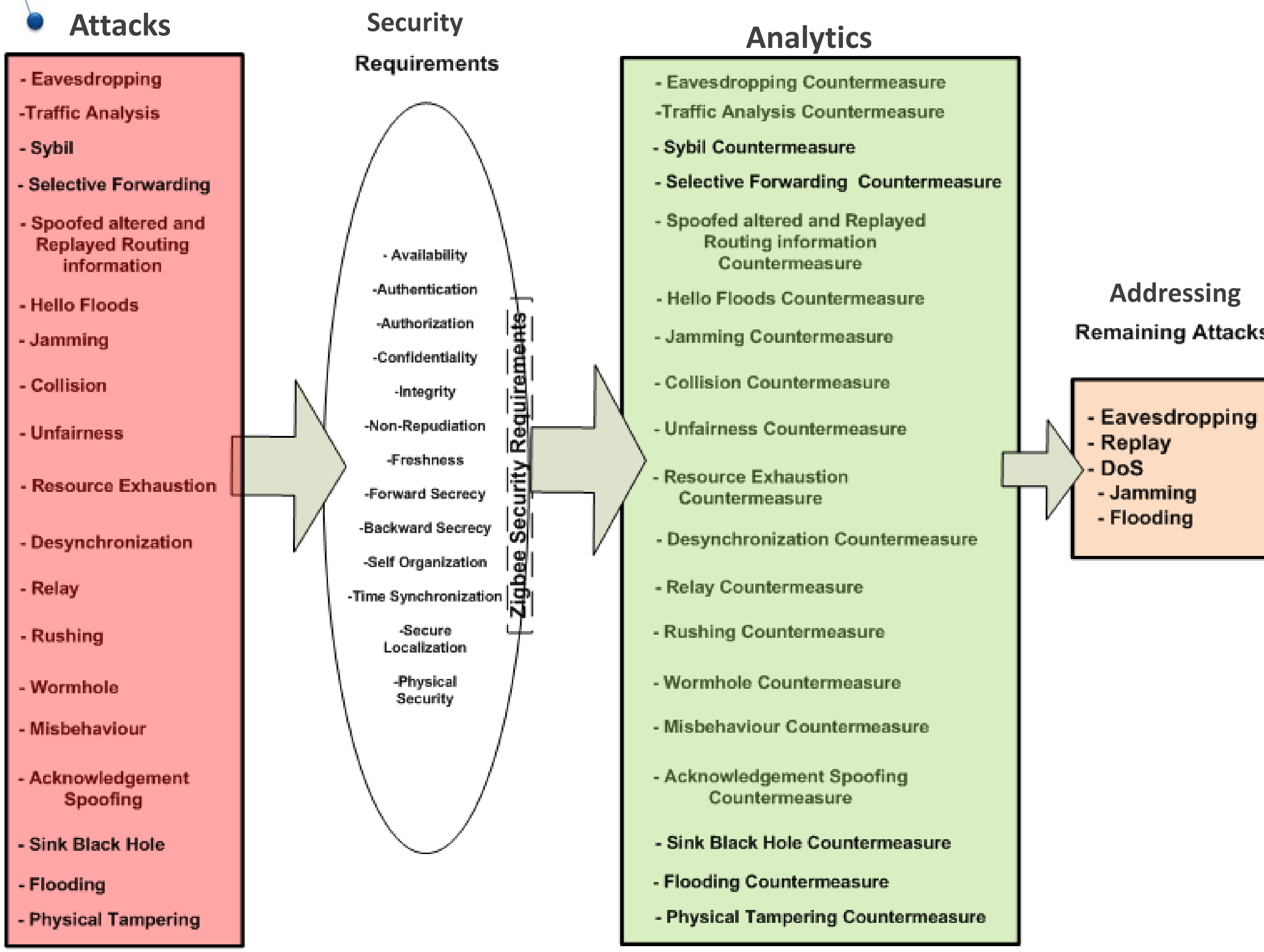
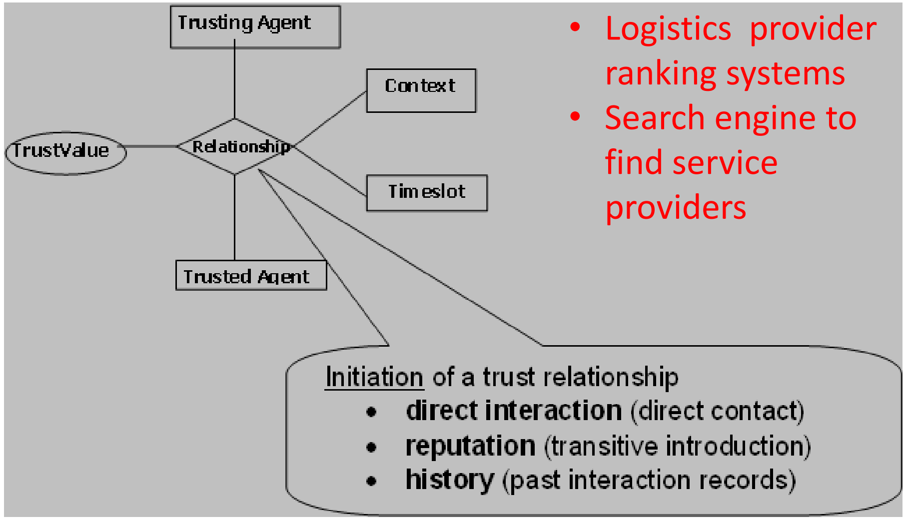


Figure 4-1: The process of Attacks Filtering

Trust

Trust is defined as *the belief the trusting agent has in the trusted agent's willingness* and *capability to deliver a mutually agreed service in a given context and in a given time slot.*



- Logistics provider ranking systems
- Search engine to find service providers

- **Trust**
- **Definitions of Trust**
- **Trustworthiness**
- **Reputation**
- **Definition of Reputation**
- **Ontology and Trust**
- **Trust Relationships**
- **Reputation Relationships**
- **Recommendation Relationships**
- **Third Party Relationship**
- **Reputation Query Relationships**
- **Reputation for Trustworthiness Prediction**
- **Business Intelligence**

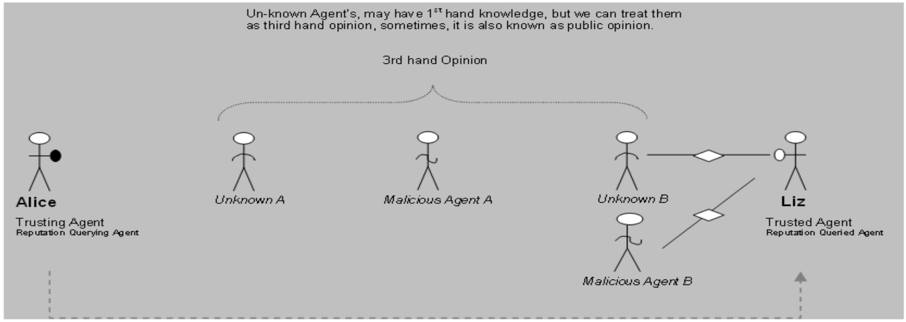
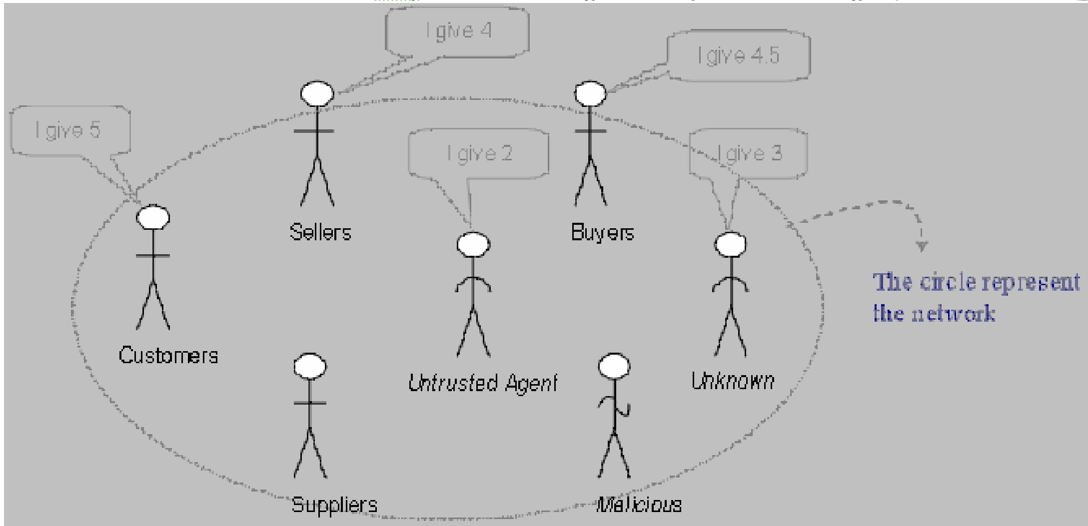


Figure 8.29 3rd Hand Opinion from an Unknown Agent (may be a Malicious Agent or may be an honest Agent)



Risk

- **<u>Risk</u>** evaluation involves the determination the probability of failure and the consequences of failure.

- The possible Risk is a combination of:
  - The probability of failure of the business activity
  - The consequences of failure, and
  - The financial, human or resources loss probability.

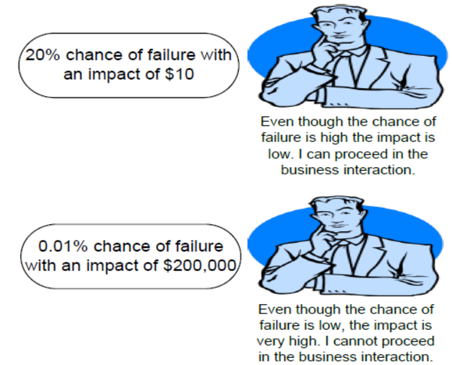


Figure 2.1: Importance of probability of failure and impact in transactional risk analysis

Determining Risks in an Interaction

- The expected behavior($ProCom_{Interaction}$) is determined by:

$$ProCom_{Interaction} = \sum_{i=1}^{n} (1 * Accu_{Criterion\ i} * Sig_{Criterion\ i})$$

where the value of 1 represents the degree of fulfilment of the criterion according to the expected behaviour.

- The level of un-commitment in the interaction ($Failure_{Interaction}$) is found by

$$Failure_{Interaction} = \frac{ProCom_{Interaction} - Assess_{Interaction}}{ProCom_{Interaction}} * 100$$

- The level of un-commitment can then be mapped to the Failure scale to determine the actual FailureLevel (Actual FailureLevel):

Actual FailureLevel = LEVEL (Failure Interaction)

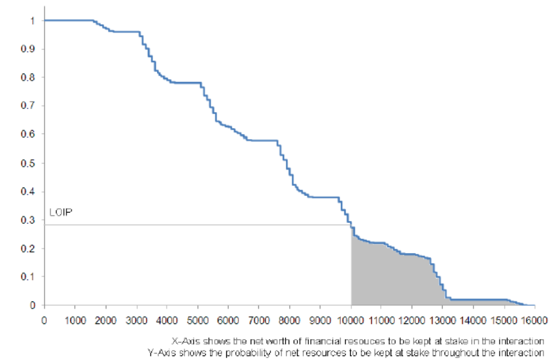


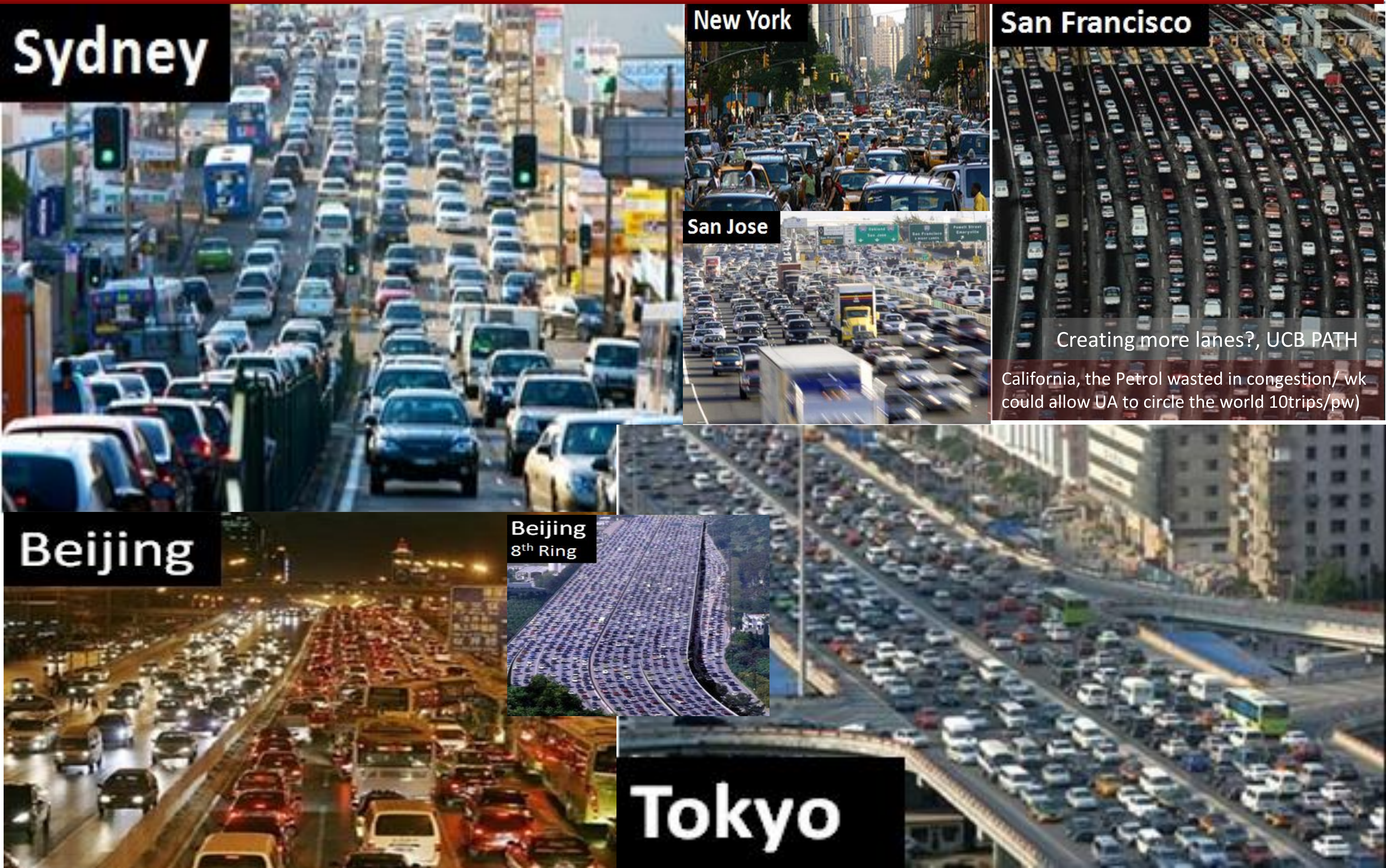
Figure 6.16: Determining the Financial Risk in the Business Activity

Semantics of Failure Level	Probability of Failure	FailureLevels	Star Rating
Unknown	-	-1	Not Displayed
Total Failure	91 - 100 % Probability of Failure	0	Not Displayed
Extremely High	71 – 90 % Probability of Failure	1	From to
Largely High	51 – 70 % Probability of Failure	2	From to
High	26 – 50 % Probability of Failure	3	From to
Significantly Low	11- 25 % Probability of Failure	4	From to
Extremely Low	0 – 10 % Probability of Failure	5	From to

Future Work

- Real Time Information Mining and Sharing for Ambient Security
- Building and maintaining the trust; and predicting trustworthiness of Partners; Trust relationship mining,
- Cascading failures arising from dependencies, Value at Risk models,
- Adoption in governments, extended enterprises and consortium logistics.
- Adoption in Defence Force. If we have logistics failure, it could result in high casualties, and high consequences.

Global Issue 2 – Congestion on Road




London


India


Auckland


Nigeria


Brazil


Pakistan

Congestion is a Logistics Issue

It is NOT the infrastructure itself or who built it, who use it, who planned it, who paid for it. Civil Engineers, Businesses, Governments or General public are not accountable or responsible for the congestion. The lack of Logistics professionals, their participation in planning and design of the logistics infrastructure are the key to the problem.

2 key Areas

- **Existing infrastructure**: Optimising of Infrastructure and Resources; **Our aim is to build Virtual Logistics Infrastructure for better use of physical infrastructure through** Internet Communication, WSN, Google Traffic, iApp, GPS, etc.. Traffic conditions prediction , routings and routes recommendations.

- **New infrastructure**: solve the problem, not just shift the problem, or not solve the problem. Based on demand, purpose of transportation: for work, business, to where, … requirement for the roads, ports, distribution, trade demand, population growth, budget; urban planning and regulations …. through **Complex System Modelling and Simulation**(Not 4 vars, but 20-100 vars, simulations)

Optimising Existing infrastructure

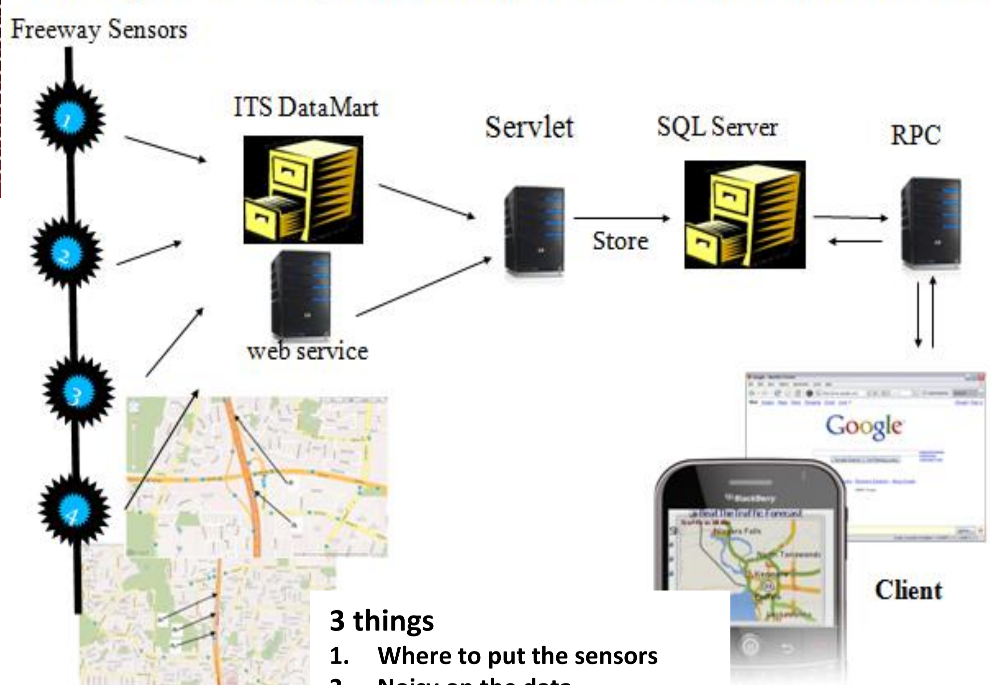
through Virtual Infrastructure for better use of physical infrastructure

Road

Our work –Traffic Prediction and Management

ARC LP 0990610, 2009-2012 Main Road WA

Design and Implementation of Visualisation Tool



3 things

1. **Where to put the sensors**
2. **Noisy on the data**
3. **Sharing of Information with road users**

Real Time Traffic Prediction using Wireless Sensor Networks & Data Mining

Aims:

- Traffic flow Prediction in motorways and arterial roads
- Traffic Congestion Forecasting and Management through Real-time data mining

Challenges:

- Smart system to predict traffic on existing infrastructure
- Traffic prediction models on arterial roads
- Manage congestion in real-time

Outcome :

- Traffic prediction and simulation System based on historical data and real time sampled data
- Develop new prediction algorithms
- Enable management congestion in real-time

Short-Term Traffic Flow Forecasting Using the Taguchi Method

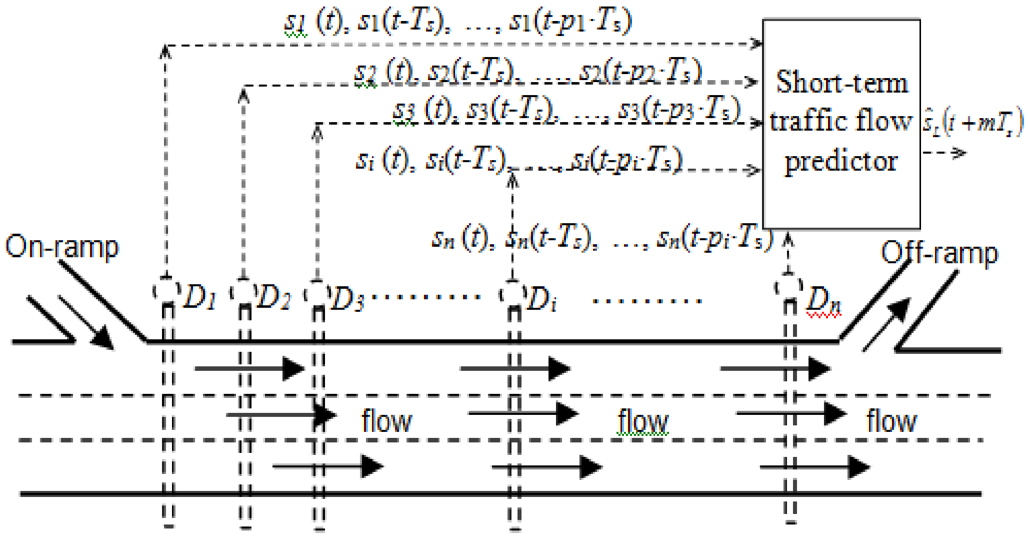
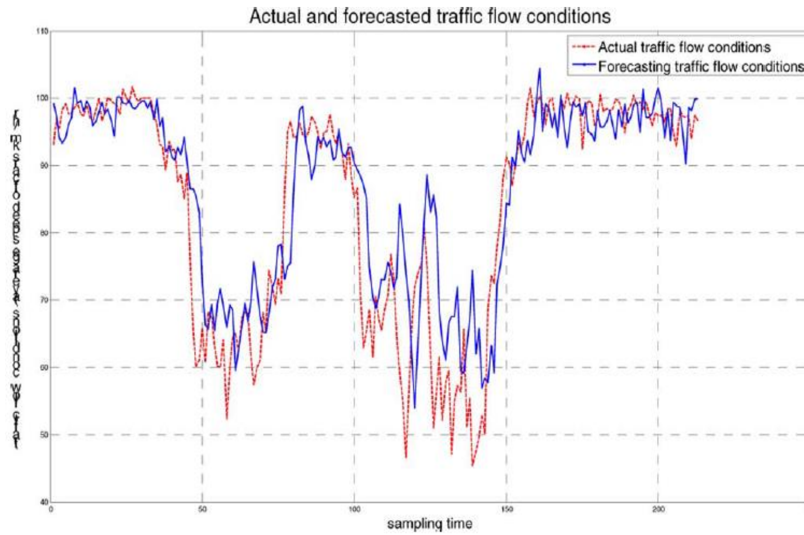


Fig. 1 Schematic of short-term traffic flow predictor for a section of the freeway



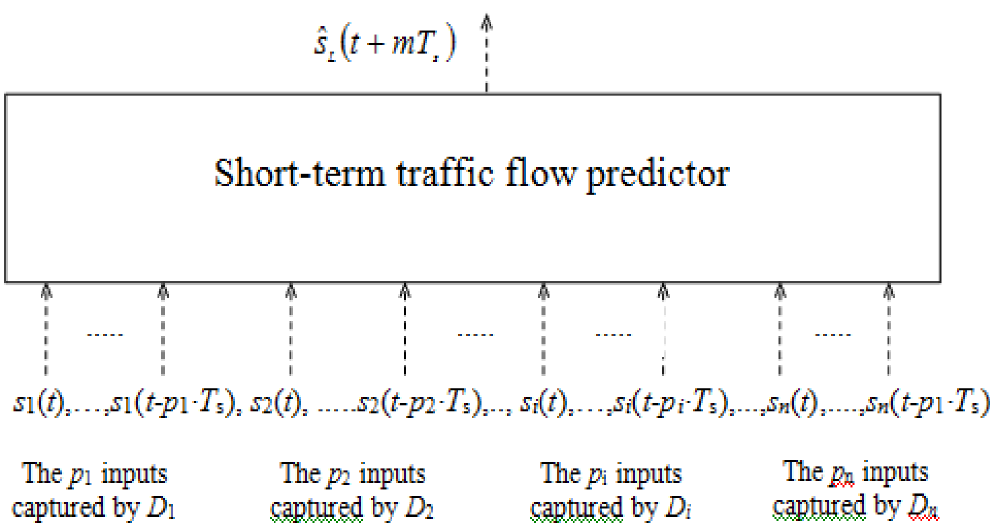


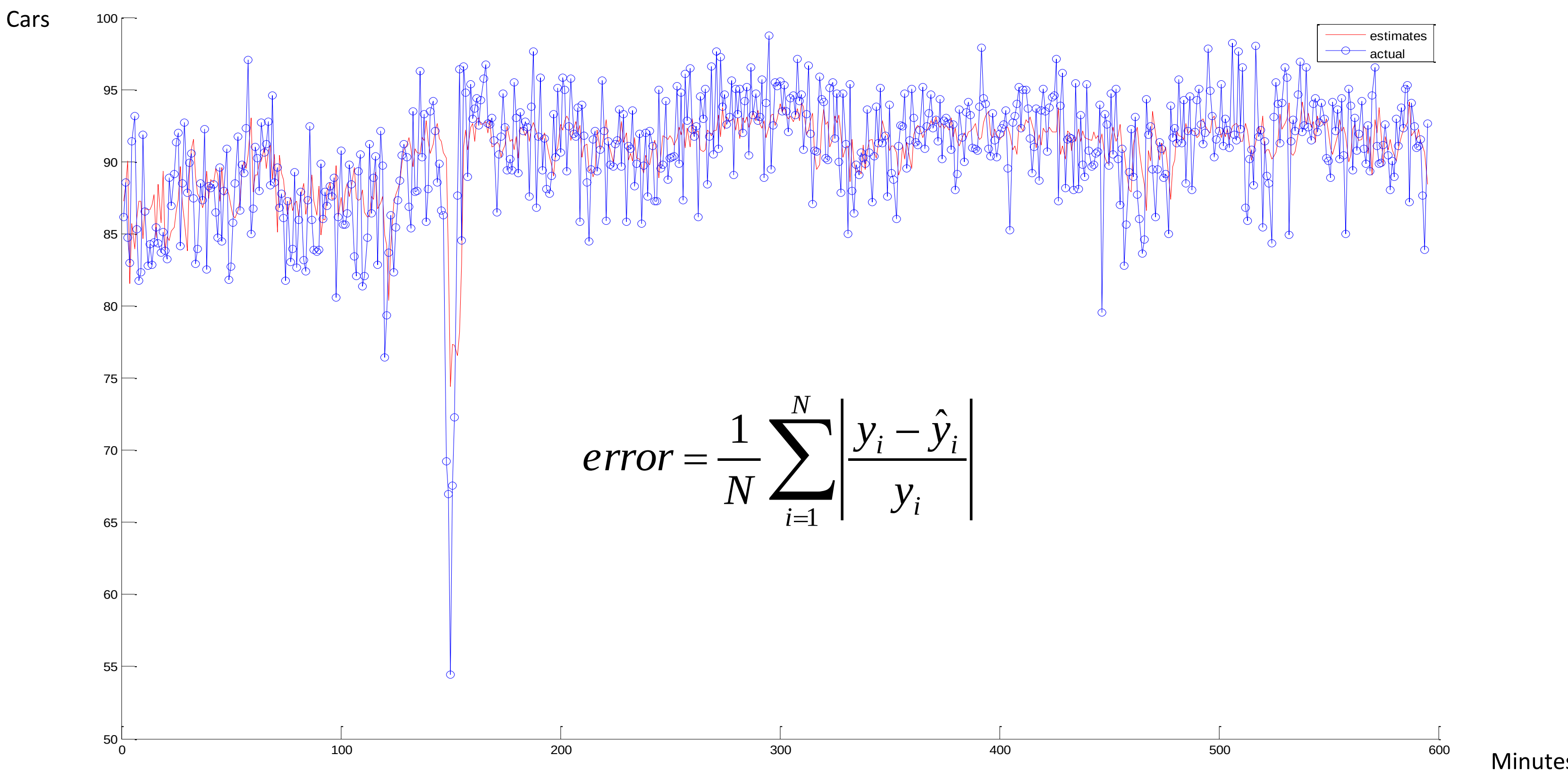
Fig. 2 Illustration of the inputs and output of the short-term traffic flow predictor

The amount of input patterns captured by the on-road sensors is large, not all input patterns are useful to predict the future traffic flow. The inclusion of useless input will mislead the neural network model prediction.

Taguchi method, a robust and systematic optimization approach for designing reliable and high-quality models,

Case Study, develop a short-term traffic flow predictor based on past traffic flow data captured by on-road sensors located on a Western Australia freeway

Hybrid exponential smoothing and Neural Network algorithm for short-term traffic flow forecasting

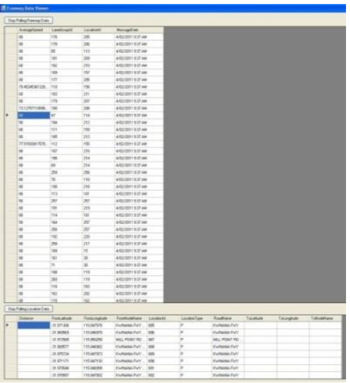


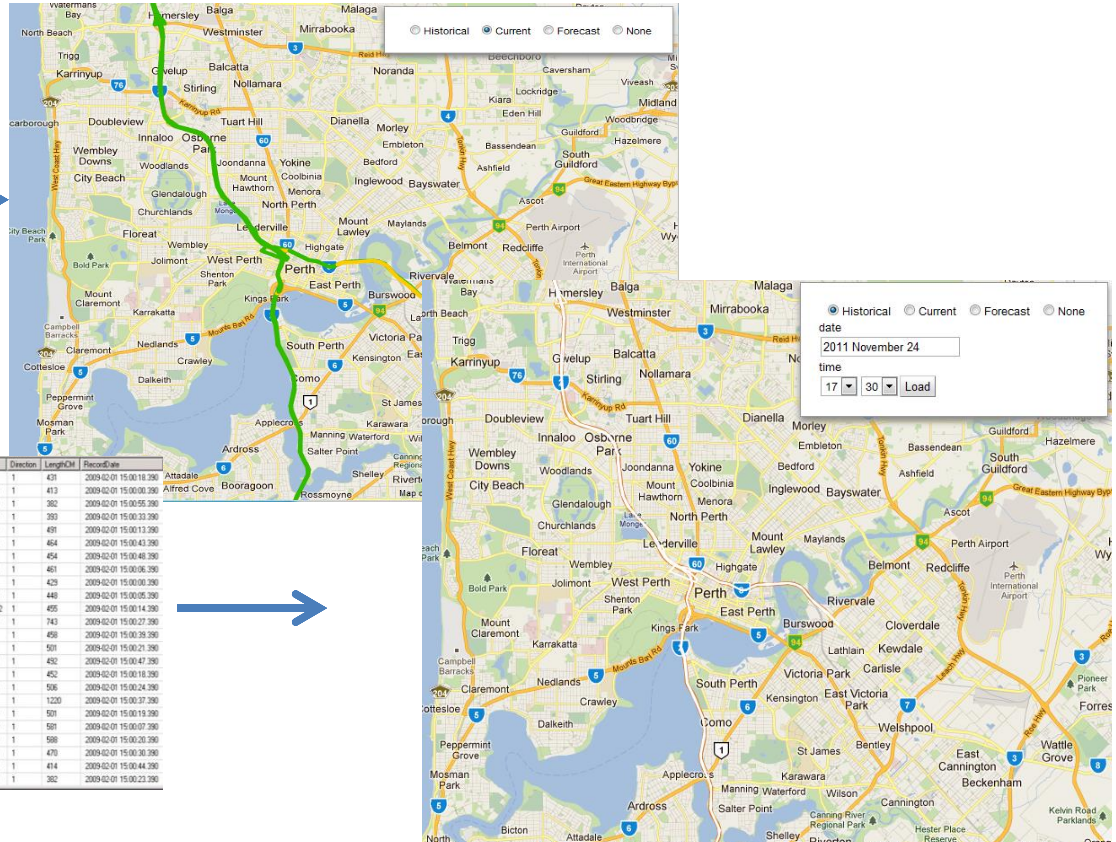
$$error = \frac{1}{N}\sum_{i=1}^{N}\left|\frac{y_i - \hat{y}_i}{y_i}\right|$$

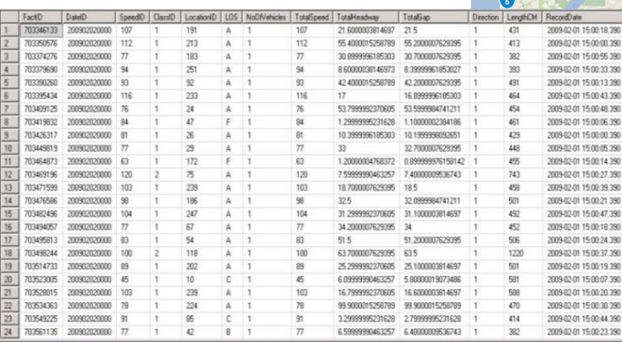
Blue represents the real data of traffic flow; y_i is the real data,
Red represents the prediction of traffic flow; $\hat{y}_i$ is the prediction
Sampling time is 60 seconds (1 minute).
Mean relative absolute error indicates the differences between the real data and the prediction.

The mean relative absolute error obtained by the neural network (with exponential smoothing) is 4.5648% and the accuracy is **95.4351%**

Real-Time Traffic Flow Visualisation







	FactID	DateID	SpeedID	ClassID	LocationID	LOS	NoOfVehicles	TotalSpeed	TotalHeadway	TotalGap	Direction	LengthCM	RecordDate
1	703346133	200902020000	107	1	191	A	1	107	21.6000003814697	21.5	1	431	2009-02-01 15:00:18.390
2	703350576	200902020000	112	1	213	A	1	112	55.4000015258789	55.2000007629395	1	413	2009-02-01 15:00:00.390
3	703374276	200902020000	77	1	183	A	1	77	30.8999996185303	30.7000007629395	1	382	2009-02-01 15:00:55.390
4	703379690	200902020000	94	1	251	A	1	94	8.6000003814697 3	8.39999961853027	1	393	2009-02-01 15:00:33.390
5	703390260	200902020000	93	1	92	A	1	93	42.4000015258789	42.2000007629395	1	491	2009-02-01 15:00:13.390
6	703395434	200902020000	116	1	233	A	1	116	17	16.8999996185303	1	464	2009-02-01 15:00:43.390
7	703409125	200902020000	76	1	24	A	1	76	53.7999992370605	53.5999984741211	1	454	2009-02-01 15:00:48.390
8	703419832	200902020000	84	1	47	F	1	84	1.29999995231628	1.10000002384186	1	461	2009-02-01 15:00:06.390
9	703426317	200902020000	81	1	26	A	1	81	10.3999996185303	10.1999998092651	1	429	2009-02-01 15:00:00.390
10	703449819	200902020000	77	1	29	A	1	77	33	32.7000007629395	1	448	2009-02-01 15:00:05.390
11	703464873	200902020000	63	1	172	F	1	63	1.2000000476837 2	0.899999976158142	1	455	2009-02-01 15:00:14.390
12	703469196	200902020000	120	2	75	A	1	120	7.59999990463257	7.40000009536743	1	743	2009-02-01 15:00:27.390
13	703471599	200902020000	103	1	239	A	1	103	18.7000007629395	18.5	1	458	2009-02-01 15:00:39.390
14	703476586	200902020000	98	1	186	A	1	98	32.5	32.0999984741211	1	501	2009-02-01 15:00:21.390
15	703482496	200902020000	104	1	247	A	1	104	31.2999992370605	31.1000003814697	1	492	2009-02-01 15:00:47.390
16	703494057	200902020000	77	1	67	A	1	77	34.2000007629395	34	1	452	2009-02-01 15:00:18.390
17	703495813	200902020000	83	1	54	A	1	83	51.5	51.2000007629395	1	506	2009-02-01 15:00:24.390
18	703498244	200902020000	100	2	118	A	1	100	63.7000007629395	63.5	1	1220	2009-02-01 15:00:37.390
19	703514733	200902020000	89	1	202	A	1	89	25.2999992370605	25.1000003814697	1	501	2009-02-01 15:00:19.390
20	703523005	200902020000	45	1	10	C	1	45	6.09999990463257	5.80000019073486	1	581	2009-02-01 15:00:07.390
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22	703534363	200902020000	78	1	224	A	1	78	99.9000015258789	99.9000015258789	1	470	2009-02-01 15:00:30.390
23	703549225	200902020000	91	1	85	C	1	91	3.29999995231628	2.79999995231628	1	414	2009-02-01 15:00:44.390
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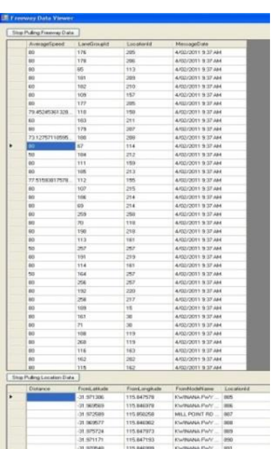
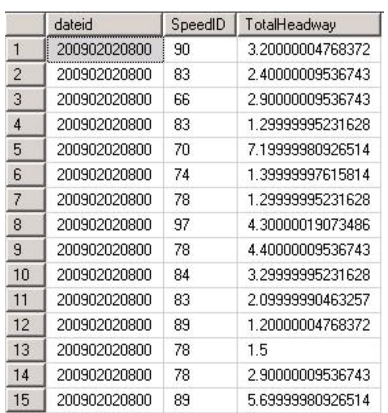
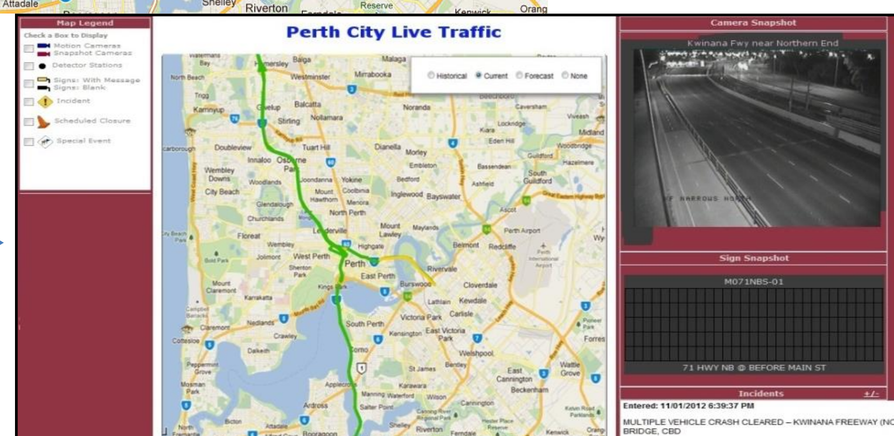




	dateid	SpeedID	TotalHeadway
1	200902020800	90	3.20000004768372
2	200902020800	83	2.40000009536743
3	200902020800	66	2.90000009536743
4	200902020800	83	1.29999995231628
5	200902020800	70	7.19999980926514
6	200902020800	74	1.39999997615814
7	200902020800	78	1.29999995231628
8	200902020800	97	4.30000019073486
9	200902020800	78	4.40000009536743
10	200902020800	84	3.29999995231628
11	200902020800	83	2.09999990463257
12	200902020800	89	1.20000004768372
13	200902020800	78	1.5
14	200902020800	78	2.90000009536743
15	200902020800	89	5.69999980926514
16	200902020800	83	4



Contribution of Research

- Compare with Google Traffic Systems
- Neural Network Models Based on a Hybrid Exponential Smoothing and Lm Algorithm for Short-Term Traffic Flow Forecasting, ***IEEE Transactions on Intelligent Transportation Systems****,* Volume: 13 , Issue: 2, Page(s): 644 – 654, 2012 with K.Y. Chan, J. Singh and TS Dillon
- Selection of Significant On-Road Sensor Data for Short-Term Traffic Flow Forecasting using the Taguchi Method**, *IEEE Transactions On Industrial Informatics***, Volume: 8 , Issue: 2, Page(s): 255 – 266, 2012with K.Y. Chan, S. Kadem, V. Palade, J. Singh and TS Dillon
- Prediction of Short-term Traffic Variables using Intelligent Swarm-based Neural Networks, ***IEEE Transactions on Control Systems Technology*,** Volume: pp , Issue: 99, Page(s): 1-12, 2012, with K.Y Chan, TS Dillon, J. Singh
- Traffic flow forecasting neural networks based on exponential smoothing method, 6th **IEEE Conference on Industrial Electronics and Applications**, pp. 376-381, 2011, with KY Chan, J. Singh, T.S. Dillon
-

Optimising Existing infrastructure

through Virtual Infrastructure for better use of physical infrastructure

Port

Global Issue 2 – Congestion in Ports

- truck queuing and bottlenecks in & out
- poor productivity,
- poor interoperability
- no shared responsibility
- no collaborative workflow

Port Congestions

The Australian, 7 Jan 2011

- "..<u>bottlenecks</u> at Australian ports increased the <u>cost</u> of doing business and reduce the competitiveness of Australian Businesses. *Stephen Cartwright, Chief Executive, NSW Business Chamber.*
- "Rail and Road lines to ports were too often <u>incapable of servicing the resources boom</u>". *Anthony Albanese, Minister of Infrastructure.*
- "Australia's ports would <u>not be able</u> to handle growing demand without a national coordinated approach". *Paddy Crumlin, Maritime Australia*
- "..Drivers are spending an average of <u>22 hours</u> a week unpaid waiting in line to load and unload containers in the port". *Tony Sheldon, National secretary, Transport workers. The Australian*
- <u>Queues</u>, either by ships at sea or trucks and rail on the landside can have significant impact on the national economy". *Paddy Crumlin, Maritime Australia*

Truck Queuing Reasoning

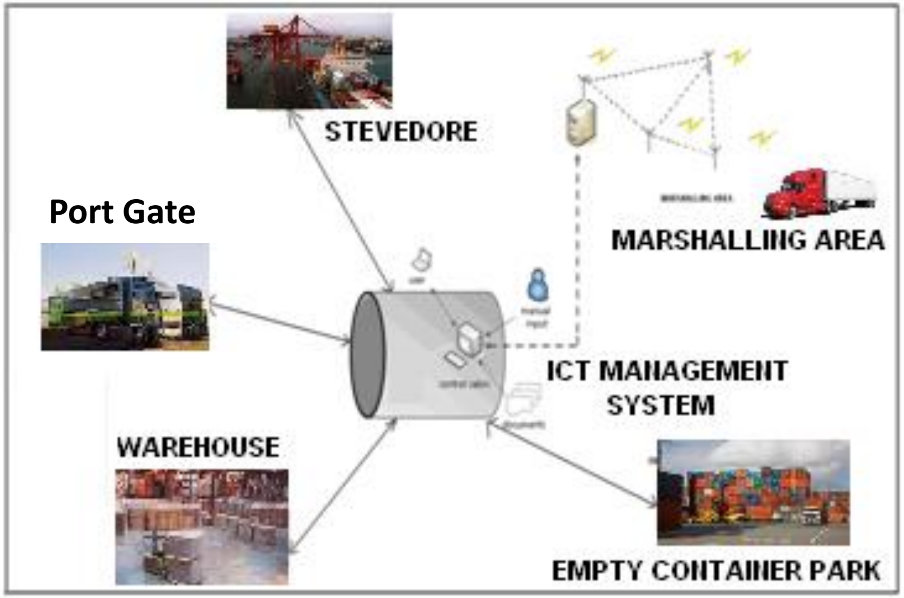
(1) The VBS is at the centre of all the recorded complaints

From Stevedore’s view, too many carriers using VBS; From Transporters’ view, it is VBS.

(2) 95% of SMEs,
(3) Road carriers have no control of time, and it costs them money, with extra journey, or waiting time, fines for lateness
(4) DP World (Stevedore) lost $1million in Federal court 2010
(5) Jayde Logistics loss $260,000 in fines to stevedores in one year

Existing and Future Work on Smart Port

Through virtual infrastructure to support port, rail and road carriers communication, seamless integration with the cyber-physical infrastructure to permit real-time congestion management.



Information Integration VBS, TCS, EPBS

- VBS and TCS Integration, scheduling & reporting
- VBS and pre-gate operation and workflow
- VBS and Marshalling area, RFID, tagging and pre-gate operation.
- For Stevedores, Road carriers, and Port Authorities

Automated Marshalling Area Pre-gate Operations

- Co-ordinate stevedore, warehouse, empty container part, trucks,
- Provide expected waiting time,
- Wired-Wireless technology,
- GPRS, Broadcast, Mobile, LCDs
- Hybrid technologies.

Container on-demand Booking

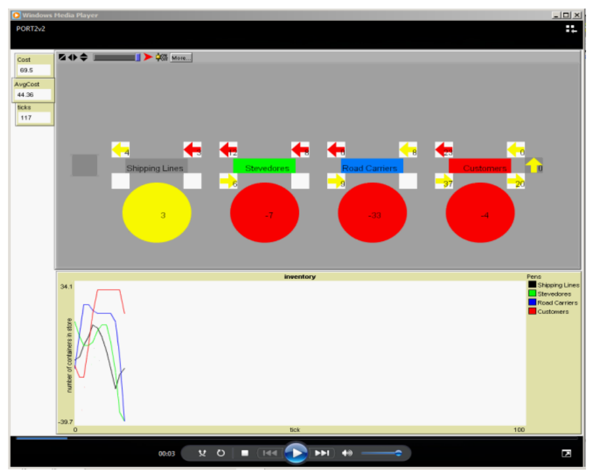
Container on-demand Booking System, integrated with Road Transport Portal, VBS and TCS

Our Work on Complex System Simulation

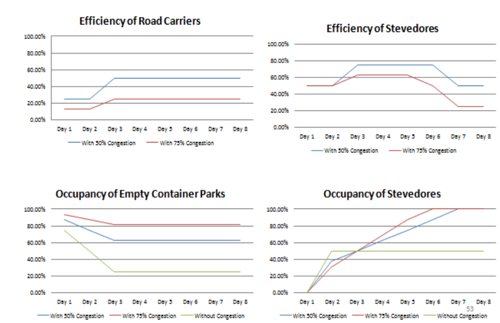
"..Infrastructure planning has been developed and implemented in isolation, resulting in different approaches in each state, neither sensible nor efficient". Anthony Albanese, The Australia Jan 2011.

".. each operate under its own board of directors, required by local law to operate trade with care to the environment". "..Led to layers of red tape and regulatory overlap, and ad-hoc management" (Hon Troy Buswell MLA, Minister for Transport, WA, Ports Handbooks WA 2010);

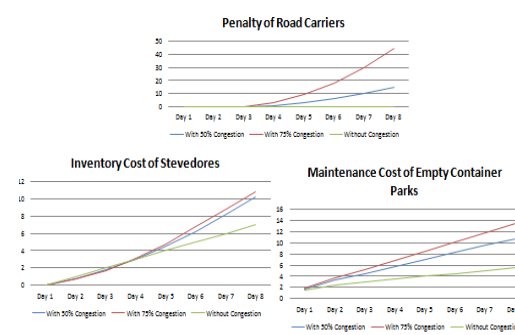
"The processes have become more <u>complex</u>, more <u>expensive</u> and more capricious in their administration". *David Anderson, Chief Executive, Port Australia, The Australian, 7 Jan 2011*



Impact on Productivity



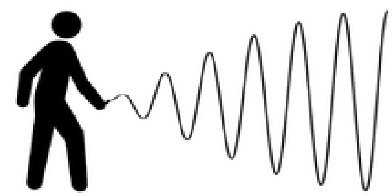
Impact on Cost



We simulate heterogeneous policy changes, its impact on the congestion;
we simulate heterogeneous partners cooperation and how that impact on productivity, congestion, …
We simulate business and population or throughput growth, how that impact on congestion….

Our Work on Complex System Modelling

- Self-regulating networks
  - Agent-oriented Self-regulating systems
  - Dynamic graph Single/Multiple level deep dynamics approaches
  - Multi-level supply chain dynamics
  - Game Theory and group dynamics
  - Swarm intelligence
  - Spatial Temporal model
- Performance analysis
  - Chaos theory,
  - dynamic optimisation,
- fuzzy-analysis,
- Perturbation theory
- Uncertainty
- Dynamic theory
- Probability
- The TLC Model (Patent filed)



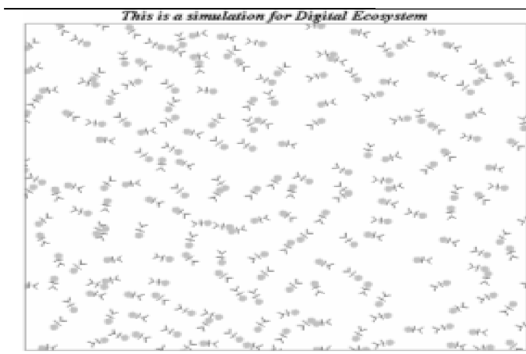


Figure 9 Loosely coupled environment

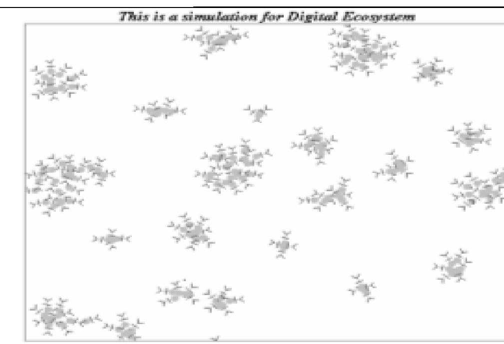


Figure 10 Self-Organization

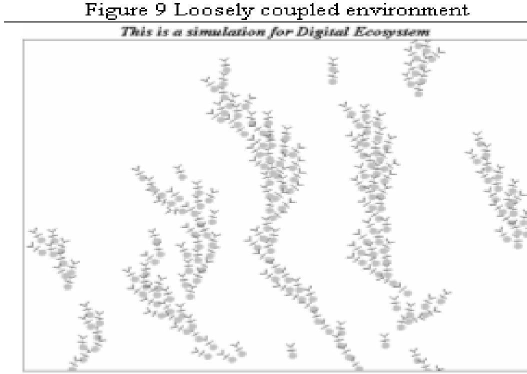


Figure 11 Collaboration

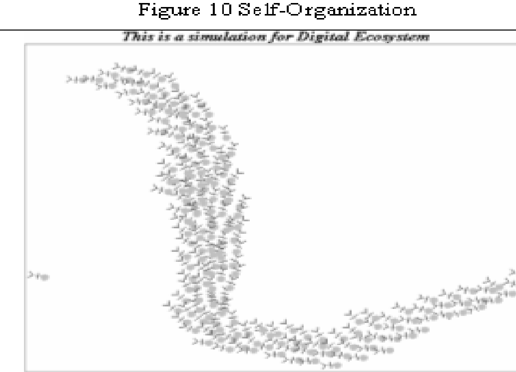


Figure 12 Swarm Intelligence

Future Work – Next Generation of Congestion Management

- **Harmonising urban and regional logistics infrastructure development** for long term transit and congestion management; embarking consortium logistics and heterogeneous partnerships to work together to develop plans, strategies, regulations, and technical standards for strong economic development, the national Agenda.
- **Bridge across different standards,** national and international**;**
- **Bridge across different state policies,** jurisdictions, red tape;
- **Bridge across silo based operations** (Gov, Industry & R&D); to foster Inter-disciplinary Infrastructure development;
- **Bridge across multi-disciplinary R&D,** Engineering, Business and Social Science**.**

- **Logistics Professionals are the key for solving the problem of Congestion.**

Global Issue 3 – Collaborative Logistics

- Gartner Report - the introduction of collaborative logistic systems can achieve a 500% return on investment [Gartner 2002]

- Australian Logistics Council (ALC) estimates that every 1% increase in efficiency will save Australia around $1.5 billion [2011].

- Transport operators could save 10% to 30% through optimisation of road networks and fleet resources including automated routes.

(Andrew Verden, Intelligent Fleet Logistics 2011)

- Heterogeneous and distributed Partners or consortium logistics, geography, ownership and operation;
- MNC (10% -) vs SMEs (90%)
- Operation beyond its own region operation
- Inter-modal transportation, domestics trade logistics 4-6 inter-change; International 6-20+
- Shared responsibility and accountability
- Segment Pricing

Productivity addressed within company and between companies.

Logistics Performance strongly influences <u>between company</u> productivity.

Our work –Virtual Collaborative Logistics Hub

ARC LP 0219627, 2002-5; CoE: 2004-6; e-Logsitics 2001-2, iPower Logsitics; e-Warehouse 2001, Kersley

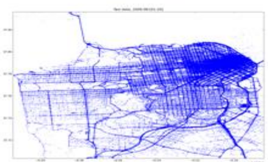
- Seamless integration between heterogeneous partners, consortium logistics and operations.
- Permit good Goods Track n Trace around the world through the logistics network, does not matter who handling the goods, who's company the customer belongs to, …
- Tracking of operations, document, RFID and Bar Code Tracking, QoS, performance…
- Truck Security, Trust, Risk, Security, SLA

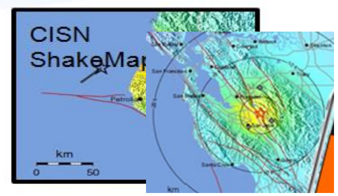
Contribution

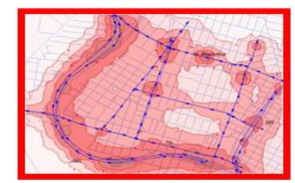
- Seamless Real-time information sharing; cooperation management of SME Logistics Providers through **e-Hub** (a <u>Virtual Logistics Hub</u>);
- track and trace of vehicles, goods and services across regions and beyond borders; enabling technologies from service-oriented approach, data exchange XML to real-time data analytics and data mining.
- delivered 11 keynote papers; supervised 10 PhD theses to completion, 6 Masters, 2 Post-docs: and produced over 100 publications.

Future Work– Ad-Hoc Virtual Collaborative Logistics Hub

for Defence Logistics, Emergency and Humanitarian Response





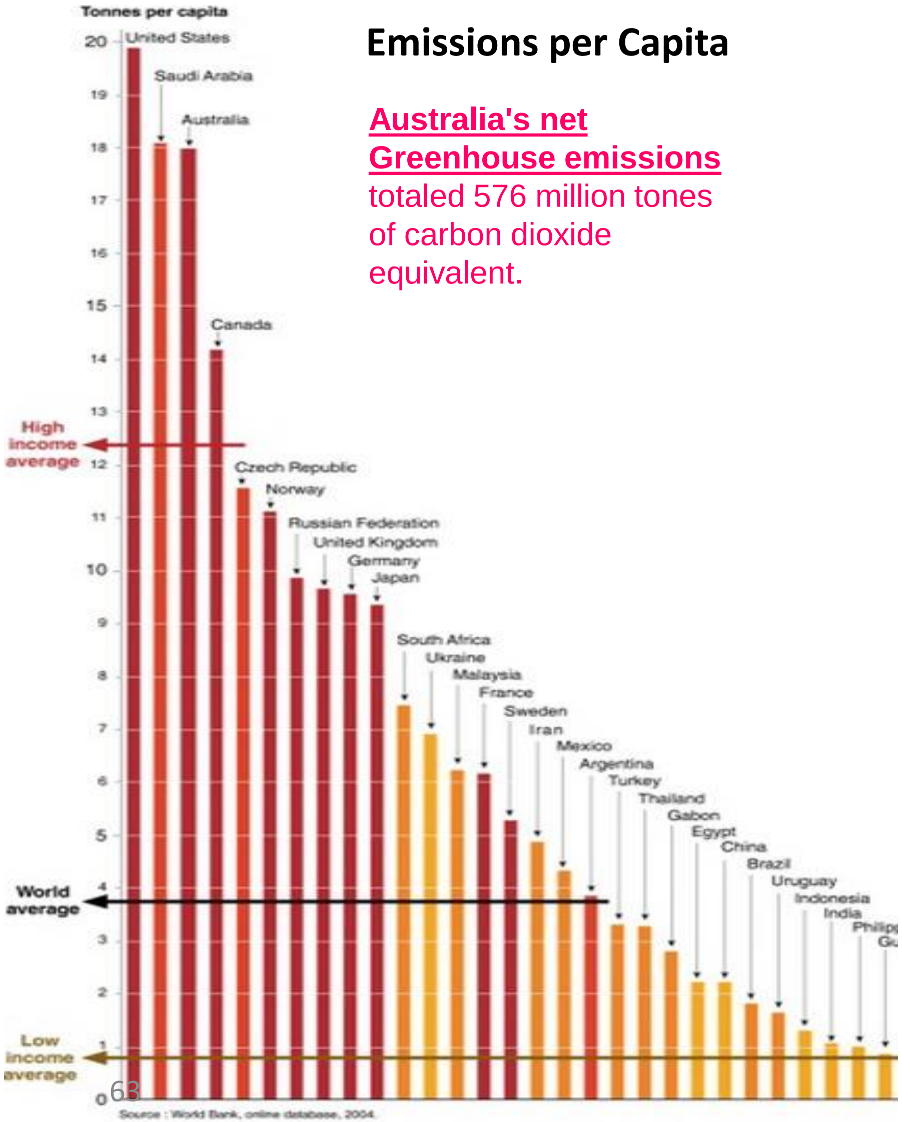


Crowdsourcing + physical modeling + sensing + data assimilation

Quickly assemble logistics network, provide intelligent environment, resource and local support information for Defence; emergency recovery and humanitarian relief; it also can provides **Security**, **Trust** of Logistics and Supply Chain providers; and **Risk**.

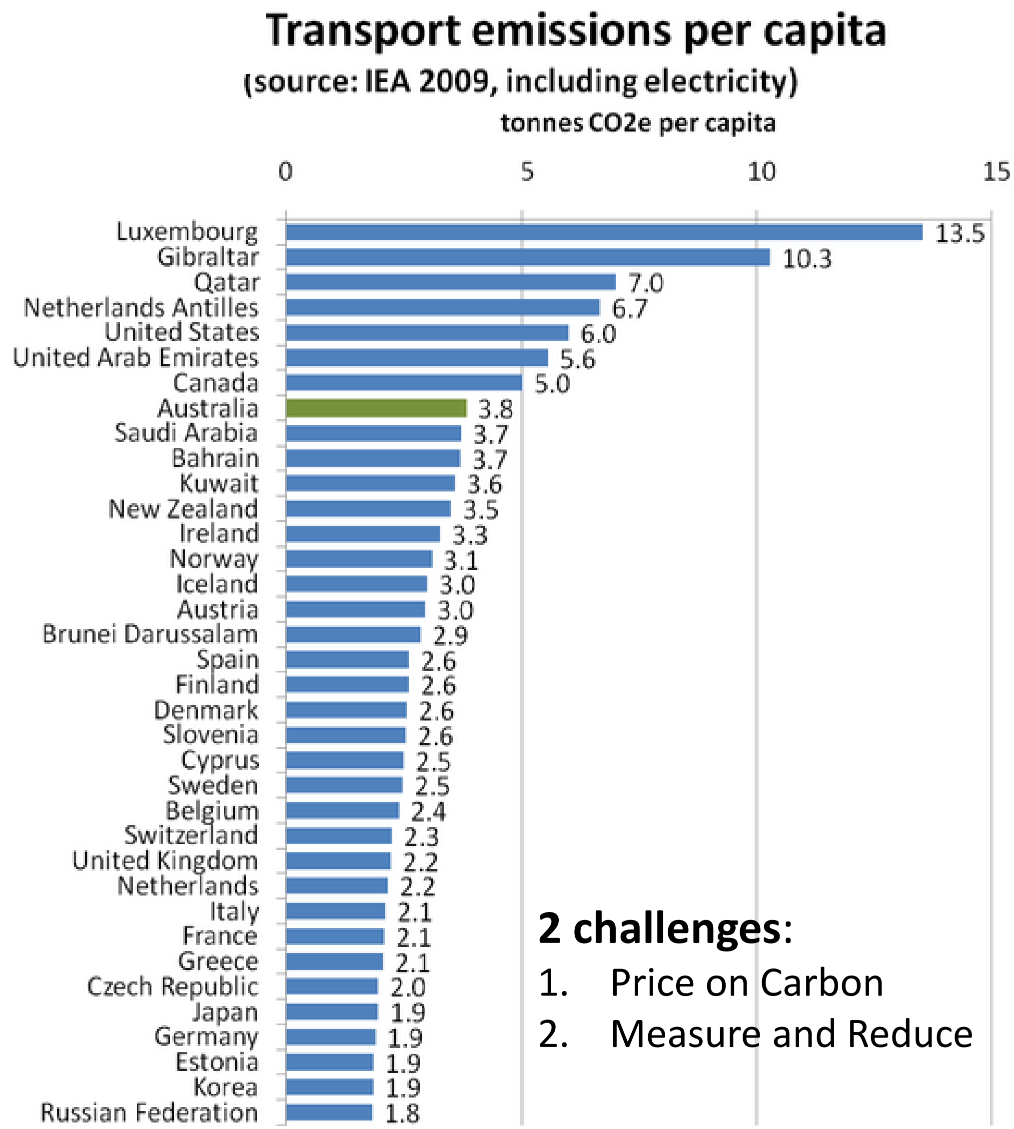
Enabling Technology: capability for intelligent use of Infrastructure, environment and resources. Real time data and text mining. Enabled information sharing, transparency, control and intelligence.

Global Issue 4 – Carbon Emission



Emissions per Capita

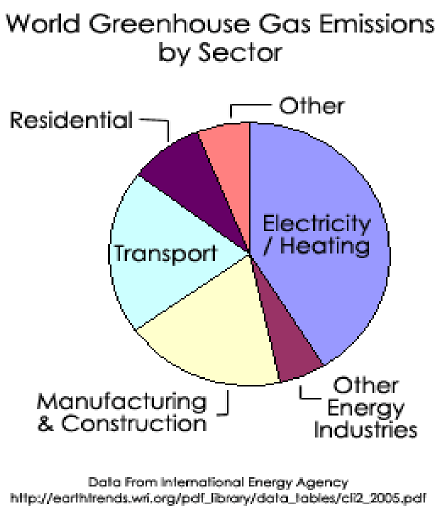
[Australia's net Greenhouse emissions]() totaled 576 million tones of carbon dioxide equivalent.



2 challenges:

1. Price on Carbon
2. Measure and Reduce

Electricity and Transportation are major causes for Emissions in Australia and working against Smart City.



- Australian target 300,037 metric tons, current levels 367,000 [2010]
- 30% penalty if emissions targets not achieved by 2020

	Public electricity	Other industries	Manufacturing industries	Transportation	Residential	Agri. sector
World	37.2%	4.7%	16.8%	18.4%	7.8%	5.6%
Developed countries	41.0%	4.5%	15.0%	23.6 %	8.6%	6.1%
Developing countries	37.6%	6.6%	24.5%	16.4 %	7.4%	5.8%
Australia	**60.2%**	**5.1%**	**14.8%**	**21.2 %**	**2.0%**	**2.3%**
Europe	40.2%	4.2%	16.9%	19.2 %	12.1%	6.0%

Source: International Energy Agency (IEA)

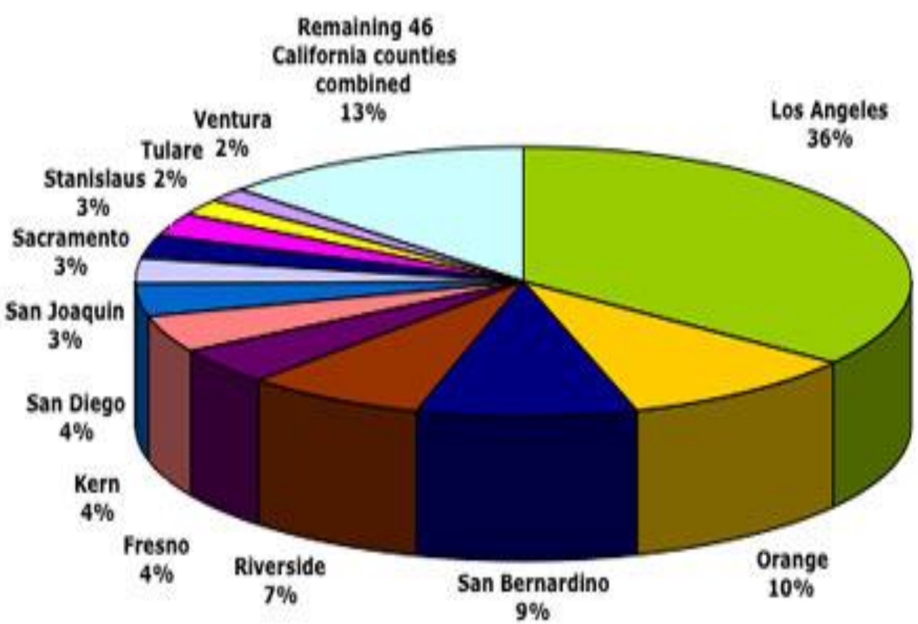
Australia's Transport CO2

Australia's transport CO_2-e emissions 2006		
	Emissions (Mt CO_2-e)	Per cent of total
Civil aviation	6.1	7.7
Road transportation	68.9	87.1
Railways	1.9	2.4
Navigation (domestic)	2.2	2.8
Other transportation	0.0	0.0
Total	**79.1**	**100.0**

limate Change, National greenhouse gas inventory, 2006, p. 17. http://www.climatechange.gov.au/inventory/2006/pubs

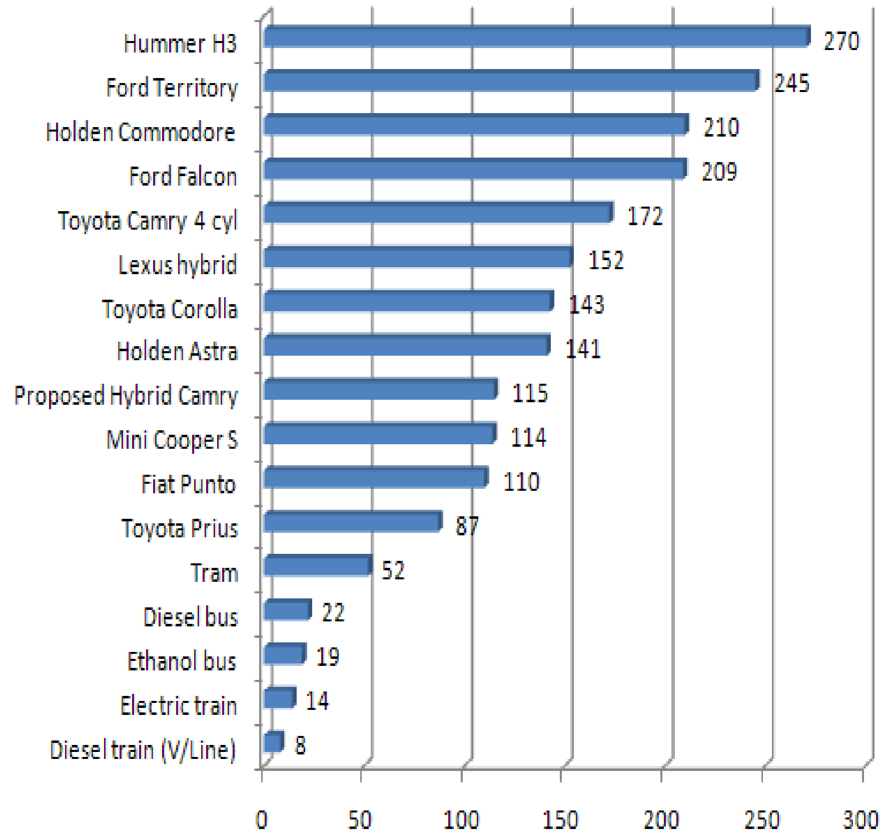
Pollution increase, impact on health, environment and businesses
Price on Carbon, emission trading scheme, cost Logistics up

Costs of five health impacts attributed to smog pollution tops $521 million per year

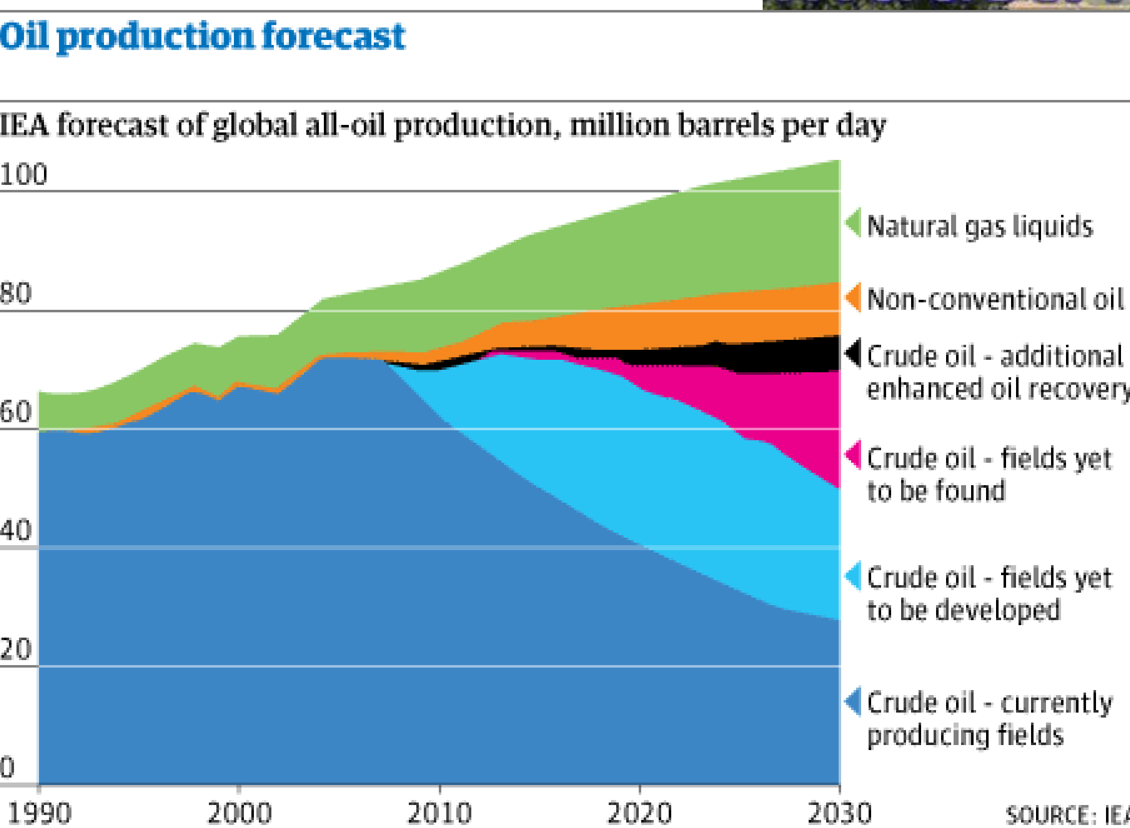


Economic costs attributed to school absences, restricted activity days for adults, respiratory hospitalizations and asthma Emergency Room visits due to smog pollution. Other smog-related effects are not included in this tally.

Grams of CO2 per km per person



Alternative Fuel for Green Energy



Our work

- **capture** & **measure** emissions in real time from different sources
- **analyse** emissions information
- **control** & **reduce** emissions

Underlying Technologies

1. Wireless Sensor Node development for measuring Emissions,
2. CO_2 sensor enabled wireless node, FPGA enabled processing,
3. GSM/GPRS enabled real time communication
4. Real Time Data Mining and Behaviour Mining

CO2 Sensors: CO2 transmitters targeting indoor air quality and energy conservation applications.

Air Test Technologies, Measures: 0-2,000 ppm CO2 (0-5000 ppm range also available)

Filter based design used to reduce the CO2 emissions

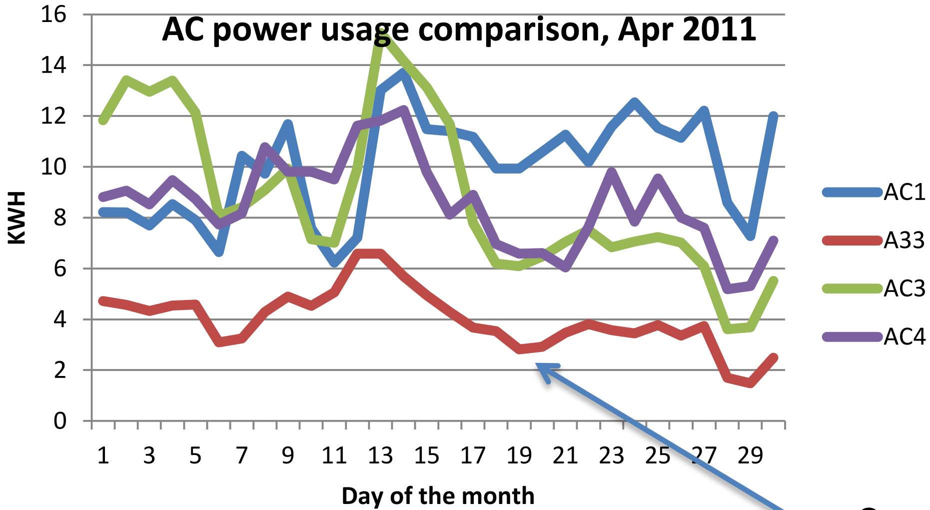
Carbo QC: Accurate and traceable CO2 measurement. Data memory for measurements

Air Quality Monitor: Measures carbon dioxide,
temperature and humidity. It has 4-20mA analog output or optional digital display.

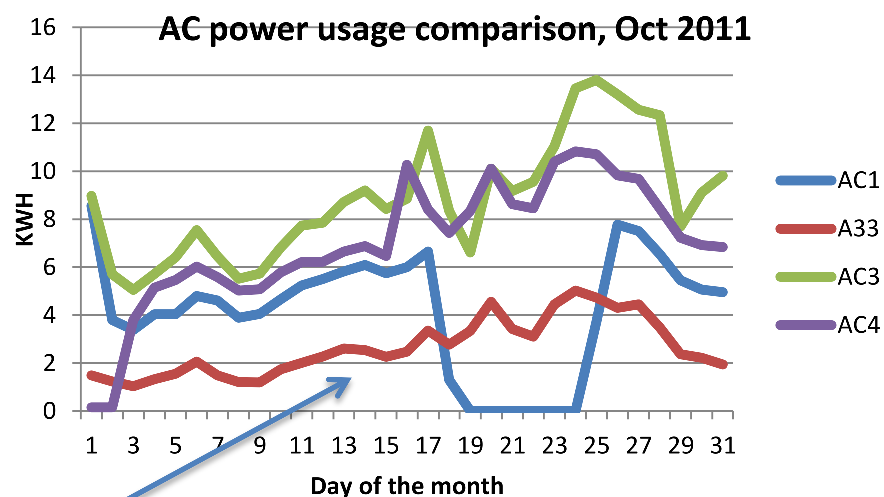
Smart Controller for Energy Consumption Control
2010-2013 ARC LP 100200693 with Fleetwood Corp

Smart Fleet Camp Project is funded by **Fleetwood Int Corp** and Australian Research Council. This project addresses the issues of high cost and high consumption of energy in mining Industries. we develop a world class unique wireless, infrared, sensor monitoring system. This system is going to save hundreds of thousand dollars per year from Industry and will help the world to cope with the energy shortages.

April 2011 – Results (1)

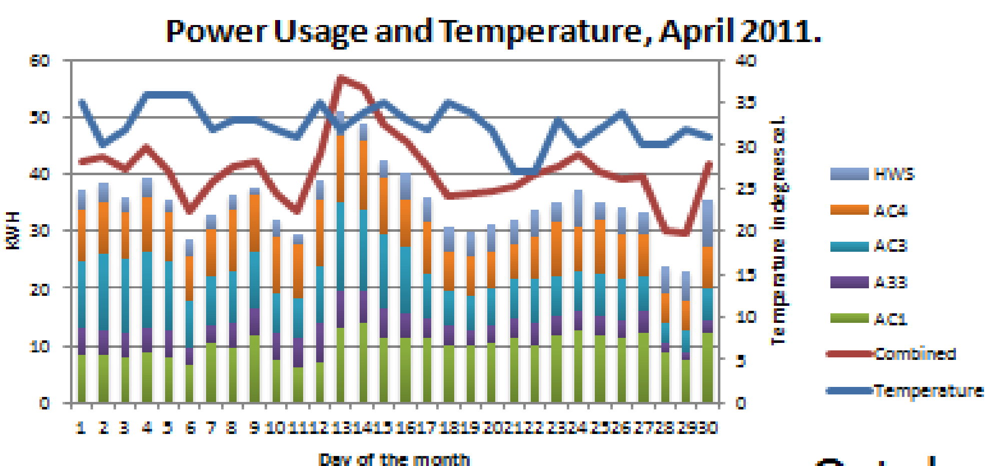


October 2011 – Results (1)

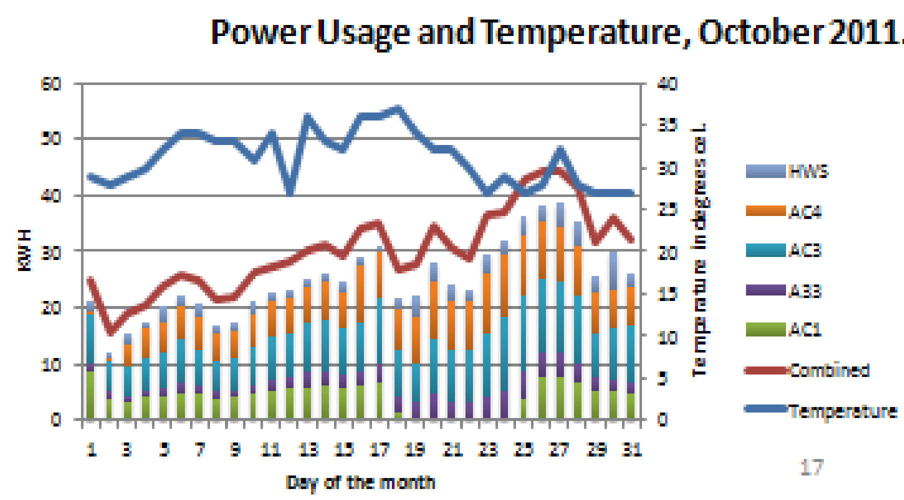


Smart controller

April 2011 – Results (2)



October 2011 – Results (2)



Future Work – Green Logistics

- Real time measures of Green Energy, Fuel performance and CO2 Emissions to provide evidence for Green Logistics, reduction in carbon footprint, reduce environmental pollutions, reduce cost; enabled by underlying technology of Real Time Data Sampling, Cyber-Physical Systems, Data mining and system interoperability.

- Infrastructures in Supply Chain for Domestic Usage, refuelling Stations, Cryogen Tanks Development, Storage Facilities, Engine Conversion enabled by joint effort of industry leaders in Logistics, Gas Technologies and Supply Chain.

Global Issue 5 – Big Data and Data Quality

1 ARC DP0556443 2006-2008; 3 grants: Dept of Transport, Dept of Planning & Infra 2009-14

Changing nature of logistics – powered by information!!!

- ✓ **real time monitoring black box**
- ✓ **GPS vehicle tracking systems and location tracking**
- ✓ **sensors and WSN for tracking and monitor materials and containers**
- ✓ **video surveillance environmental monitoring and incident analysis**
- ✓ **driver fatigue monitoring and alerts**

Virtual Infrastructure for Logistics Intelligence

Challenges:

- ➢ No conjoint data management;
- ➢ no conjoint data mining.
- ➢ Interoperability, integration between Silo based systems.

Smart Information Use

- security, trust, risk,
- productivity,
- fuel performance,
- CO2 emission,
- vehicle performance;
- Material handling;
- weights

Example: 157 Tables in Container Material Tracking, only 10-15 are used, -10% usage

Data Warehouses are out of date

Data Marts have no future

Interoperability should be forgotten

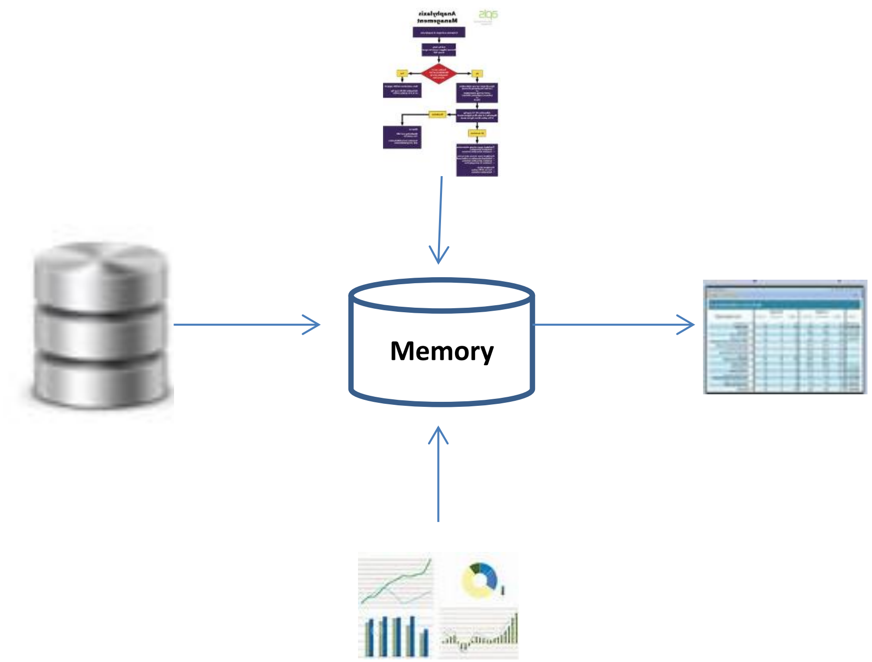
= Essential Core for BI before 2010

They did not contribute to BI Success

Data for BI

Simply

1. BA and BI is a Tool
2. It applies a set of algorithms or methods to a set of data of your choice; and
3. generate possible useful information, and
4. Require iterative processes to generate sound cases for any decision making.



Data for BI

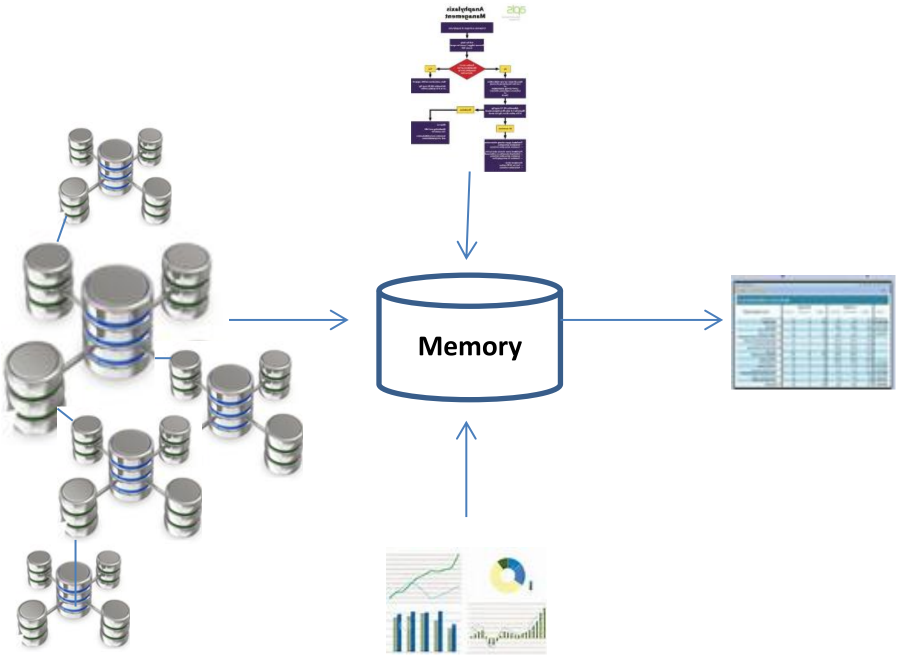
Business Growing

Data Growing

Databases Growing

Extended Enterprises

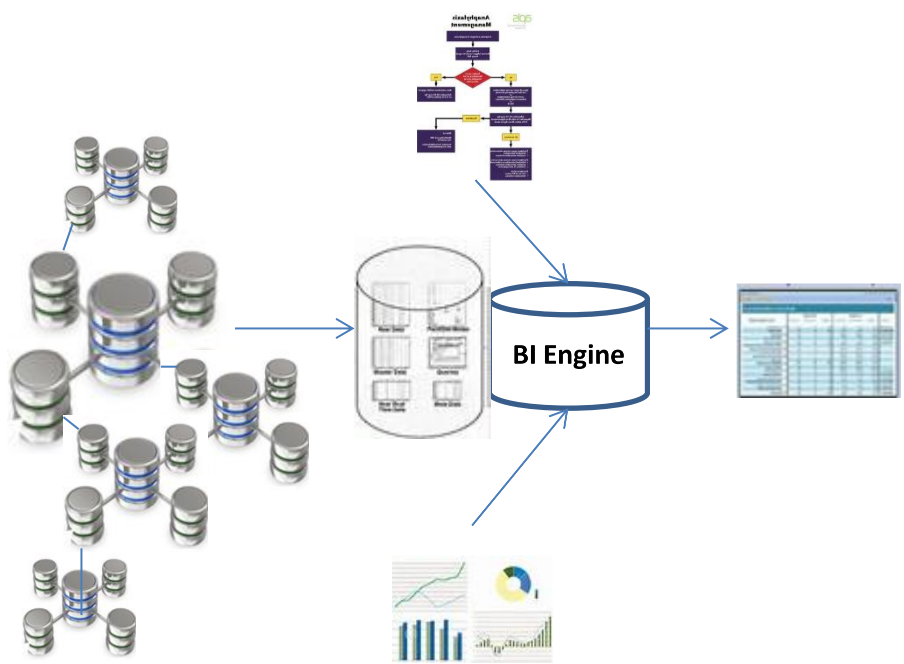
Alliances, Partnerships etc..



The source of the data, information and knowledge are both internal organizationally collected as well as externally supplied by partners, customers or third parties as a result of their own choice.

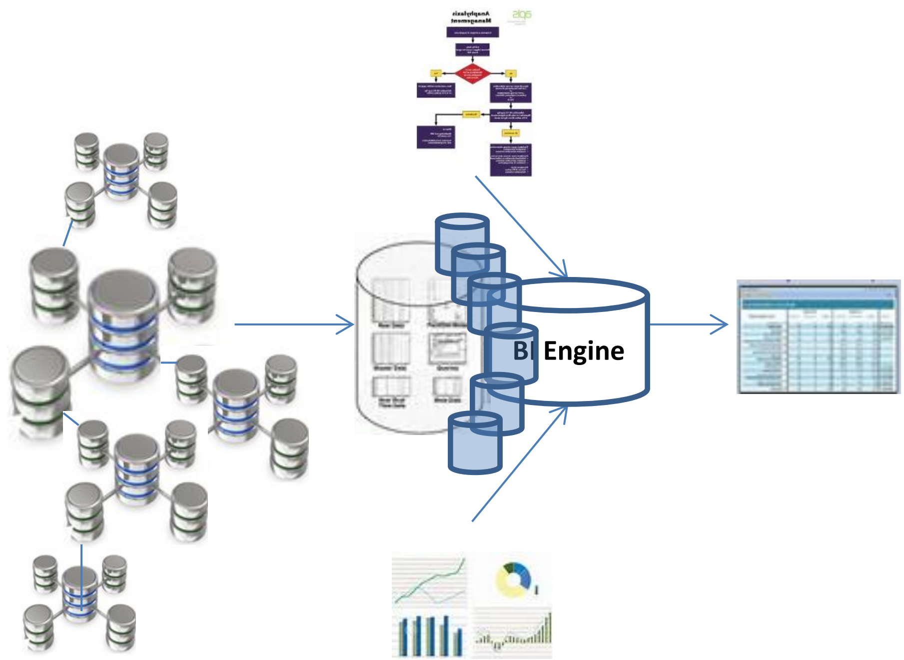
Data Warehouses for BI

- Data Warehouses are constructed by experts,
- They followed the best practice and answer most business questions
- For middle and top end managers, who needed to answer the business questions



Data Warehouses and/or Data Mart for BI

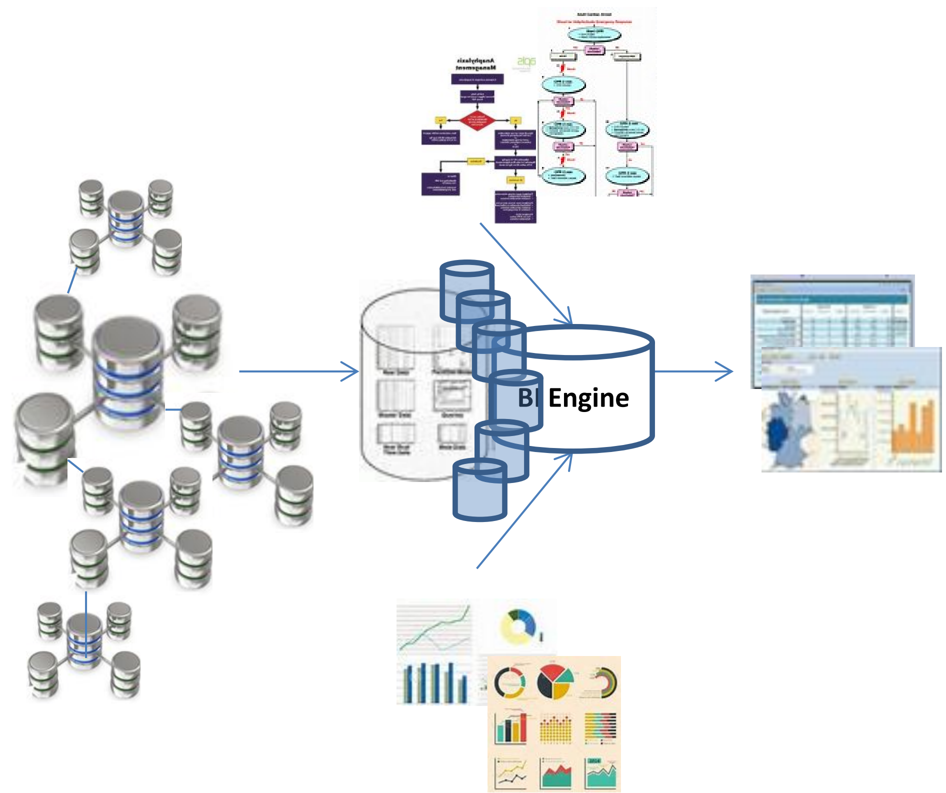
- Original **Data Mart** is the access layer of the data warehouse environment that is used to get data out to the users.
- Data Marts could be a subset of the Data Warehouse (if DW is existing)
- Data Marts contains conformed dimensions or materialised views
- Data marts improve end-user response time



Data Warehouses and BI

DW

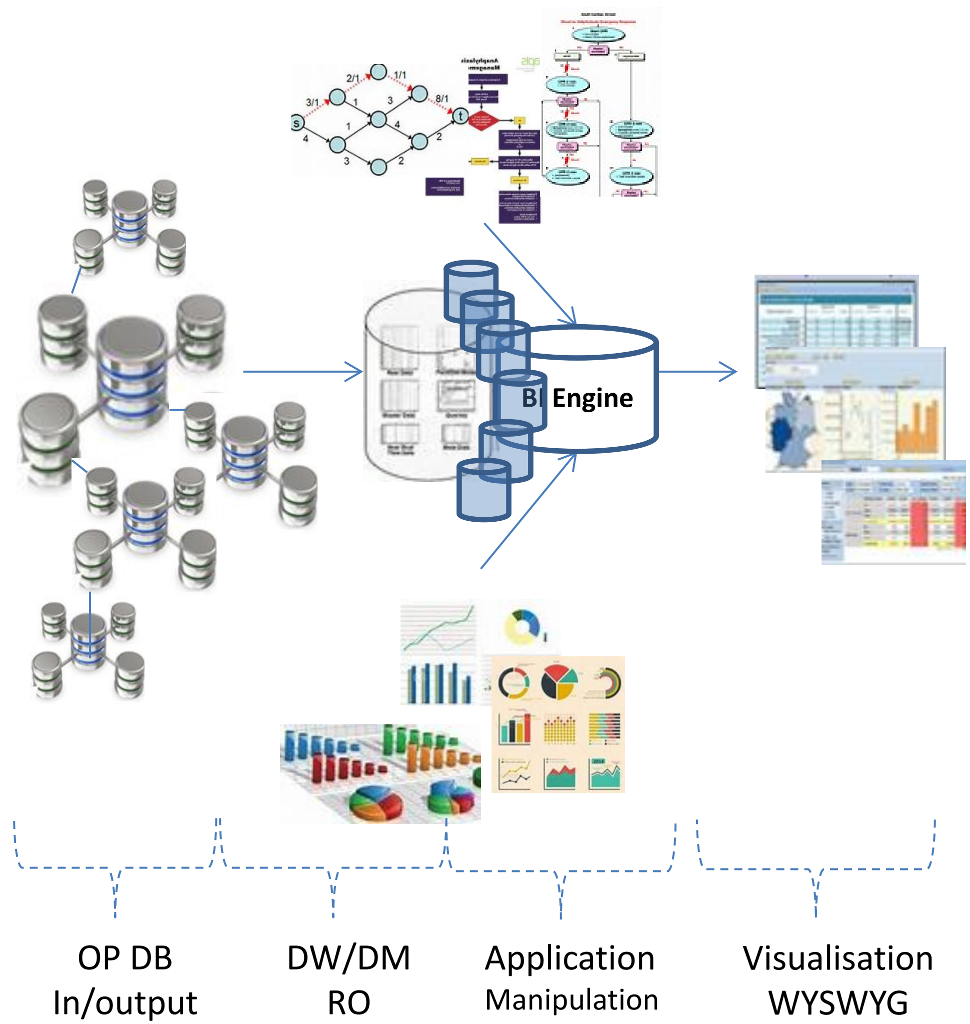
- Data are extracted from operational databases using ETL,
- Data are cleansed, transferred, sorted, organized, and
- Data are then loaded into a data warehouses and
- Some times in conjunction with Data marts
- made available to end users



Data Warehouses and BI – *Iterative process*

BI is a Tool that applies a set of algorithms or methods to a set of data of your choice and generate possible useful information and such iterative processes could generate sound cases for any decision making.

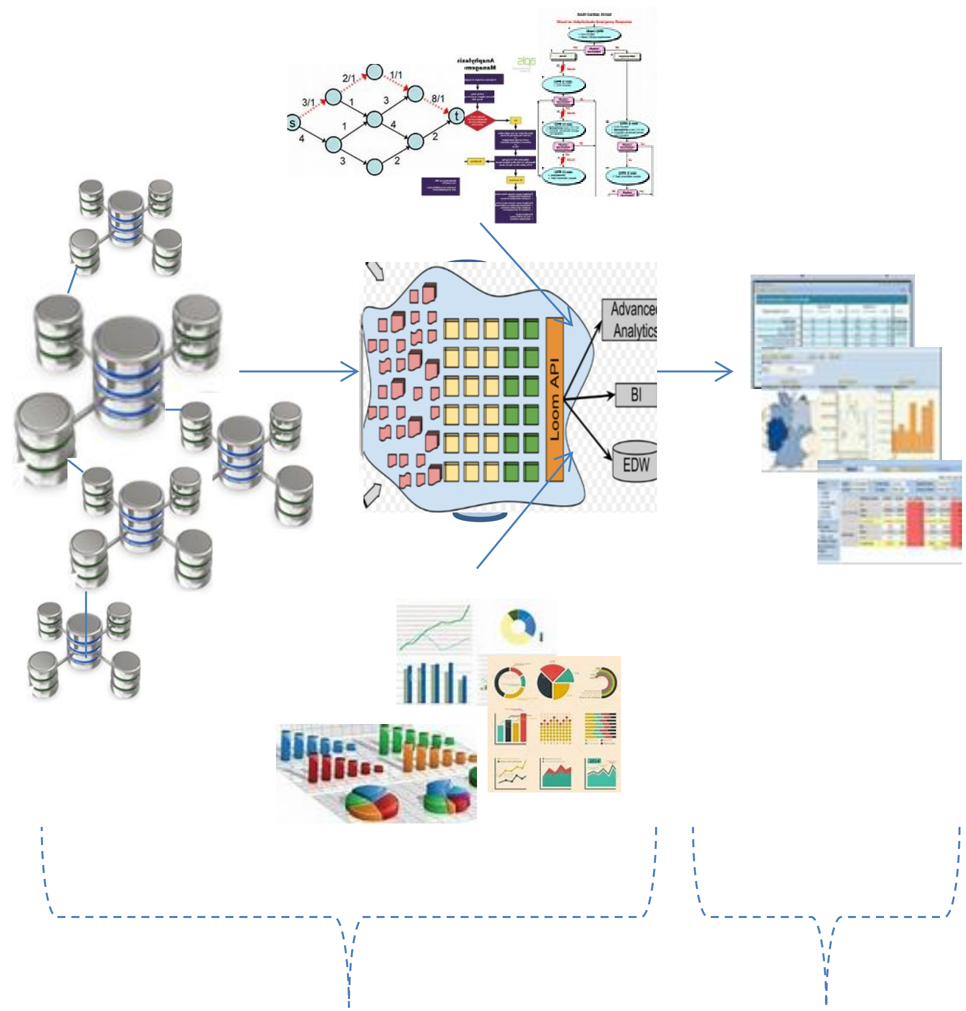
DW is essential core for BI, but not the key to BI success! **Might be the key to BI failure?**



3 tier and 4 tier architecture

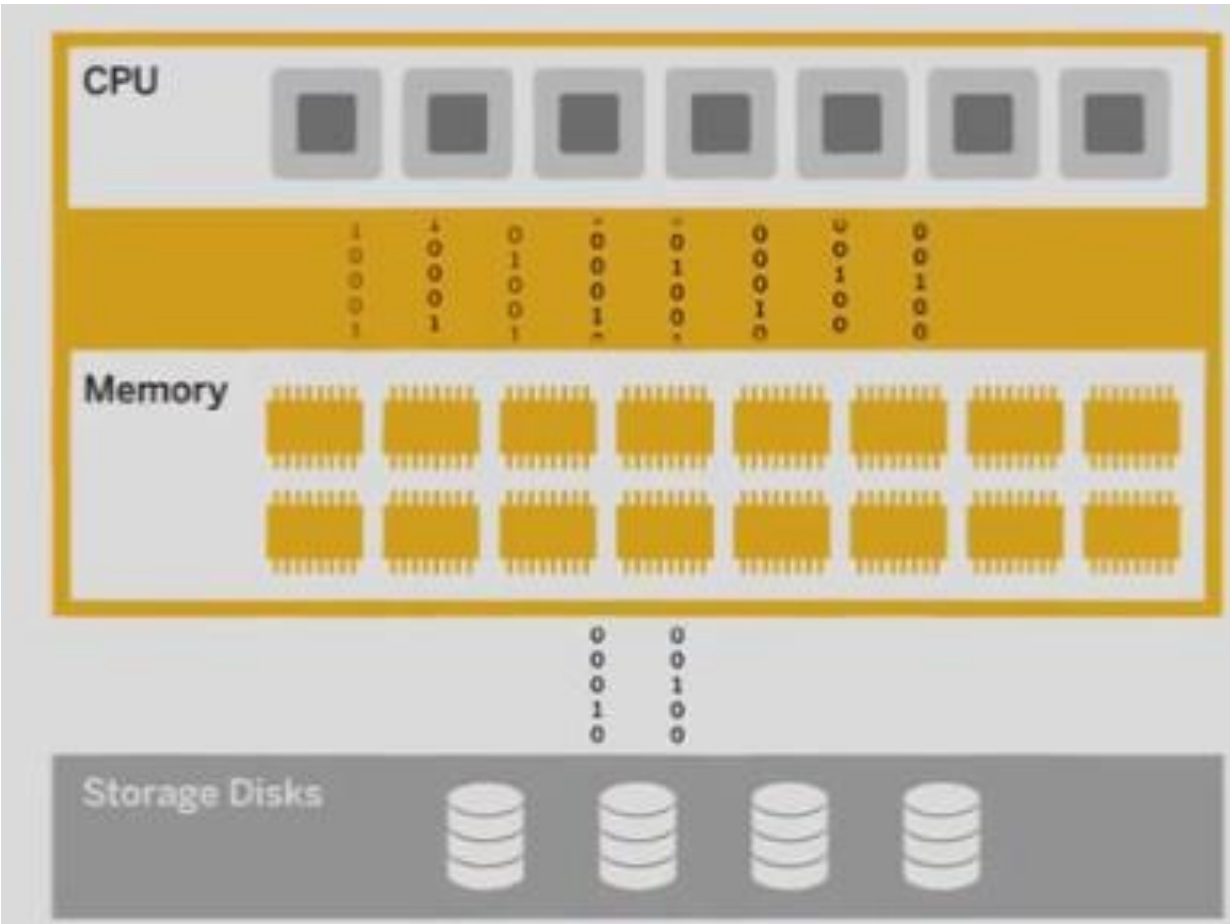
DW, DM and Data Lake for BI

- **Data lakes** are data dumps
- Data stored in original native format, not formatting or merging or integration, until when you need them
- It is the end of data silos era
- Single source of truth
- Bring agility to the enterprise
- Major Hadoop vendors are still working on it



Today In-Memory DB (since 2010)

http://go.sap.com



Multi-core processes, massive parallel 10x faster

Compression tech 9x

Logging and back up Persistent DB

High Speed, Real Time (Analytics, Application and platform),
Structured and Unstructured Data, 100% ACID compliant, 1st release Nov 2010

Today In-Memory DB

1TB RAM, support 5 TB uncompressed Data	**2010**
8 TB RAM, support 40 TB uncompressed Data	**2011**
100 TB RAM, support 500 TB uncompressed Data	**2012**

(Hardware/super computers, IBM, HP, Dell, NEC etc, ..)

Today most large public sectors: over 3000 employees…. With duplicate 20-50 TB

Today large private sector*: over 10,000 employee 100TB-500TB …*

DW is dead, DM has no future!

Interoperability should be forgotten!

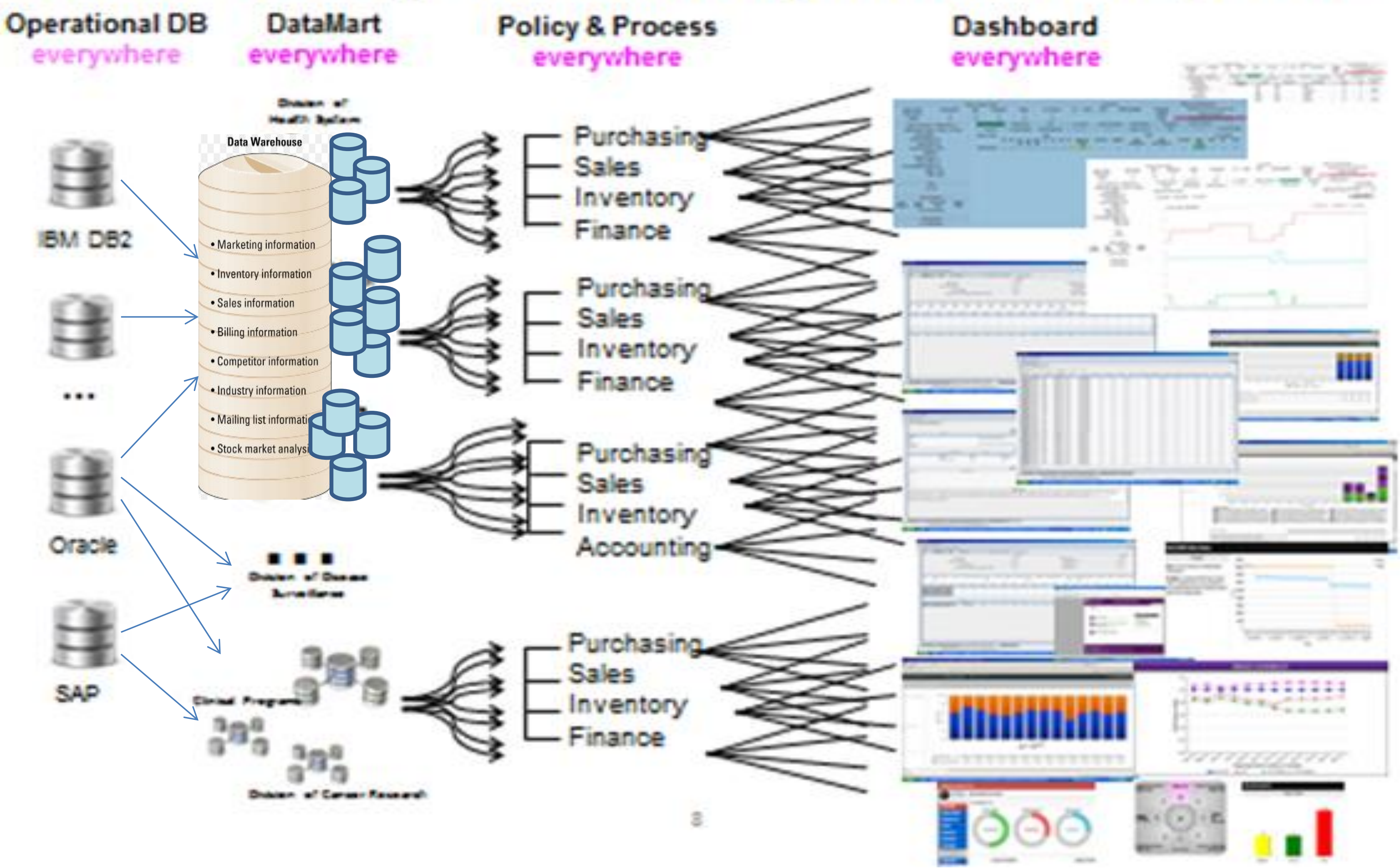
1. Inflexible – build by Expert
2. Multiple Data Marts – no single source of truth
3. Require Expert to operate
4. Not for managers or end-users (of BI)
5. Expensive and low RoI
6. Vendor in control – Data and Data Warehouse
7. Security, privacy, trust
8. Data procurement is difficult

Issue 1: Inflexible – Build by Expert

- Expensive One-off service, build once, last once.
- Don’t adapt to the changes of business processes and policies.
- Requires DW and DM to change, when the business or processes are changed, but only Expert can do the job.
- Long lead time to get the change done
- Overtime, the one-off DW/DM only capture or use in-complete data, not the total data set
- hinder the org or enterprise development

Issue 2: Multiple Data Marts

– no single source of truth



Issue 3: Require Expert to operate

- BI expert, Data expert, DB expert

- Real DW/BI Operations requires

  DW + Algorithms/BA + Business Expert + Data Expert

  => which data + which formulae + business knowledge + good report developers + Interpretation

  => leads to answer specific business question(s)

- DW + BA/BI ≠ Decisions
- Require expert to interpret (missive tables, load of data, add mental load)
- Require expert to change
- Expert ≠ Domain Expert ≠ Decision making

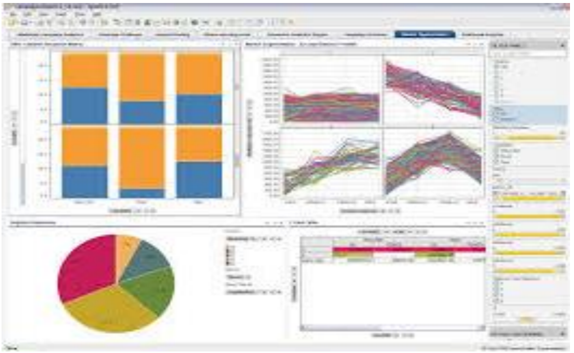
Issue 4: Not for managers or end- users

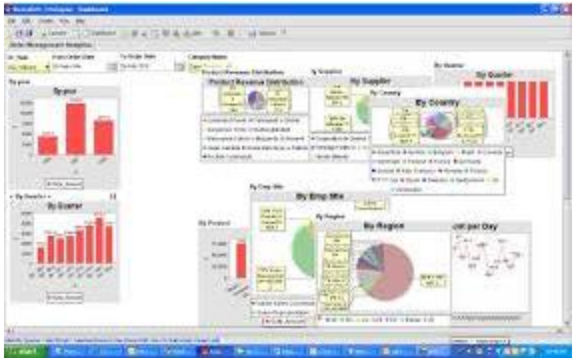
- Plenty tables and graphs, no decisions, no decision support, no recommendations

- BI is part of every employee, and current systems are too complex for mangers (low, middle, head or executives)
- Not for end users

- Expert ≠ Decision making
- What we have now ≠ what we should do now

- Require DSS as part of automated DW/BI





Issue 5: Expensive and low RoI

- Common best practice = one size fit all ≠ not fit for purpose or domain specific => cost for customization
- Separation of concerns : DW + BA/BI + Visualisation Tools = 3+ systems => More cost
- Expert Employees BI/Data/DB Experts => add cost

Issue 6: Vendor in control – Data and Data Warehouse

- My server, your data = Vendor in control
- Who owns my data = Who owns my money
- Vendors are not sharing between vendors systems = Vendors own the data they manage
- Vendor are in control of usages and real traffics, itemised clicks, application logs, web logs, interface logs, database logs
- Capture usages, capture the decision support process = > Organization knowledge/Asset

Issue 7: Security, privacy, trust

- My data, your data, who’s data, where is the data
- Single source of truth?
- Data manipulation => reports conflict/contradiction
- Pollution control, who’s job
- Trust and risks
- Enterprise Data/Secret Security => only apply to its employees, not apply to vendors => put org in risk

Issue 8: Data procurement is difficult

- Vendors are not sharing the data between Vendors or 3rd parties
- Vendors are software orientation, own agenda, not all in the interest of your org performance or cost
- Create data procurement issues, => lead to incomplete data set => more decisions => long lead time to aggregate the reports.
- Inefficiency in using the data, poor decision support, poor performance => poor org performance

DW & BI Adoption Challenges

1. Inflexible – build by Expert
2. Multiple Data Marts – no singl… …rce of truth
3. Require Expert to oper…
4. Not for manage… …end-users (of BI)
5. Expensiv… …low RoI
6. V… in control – Data and Data Warehouse
7. …ecurity, privacy, trust
8. Data procurement is difficult

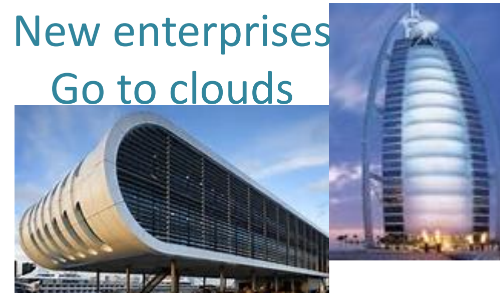
Failure to address these issues in the next 10 years, Big Data Management will not be successful

Dynamic Data EcoSystems – DES

Top 8 Challenges and Dynamic Data Mart

New enterprises

Go to clouds



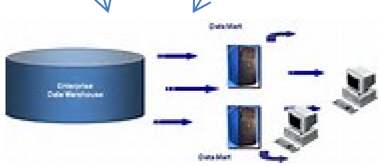
Existing/old New enterprises-
stuck with existing systems

Mobilised DS BI

Self Service BI

Guided Analytics

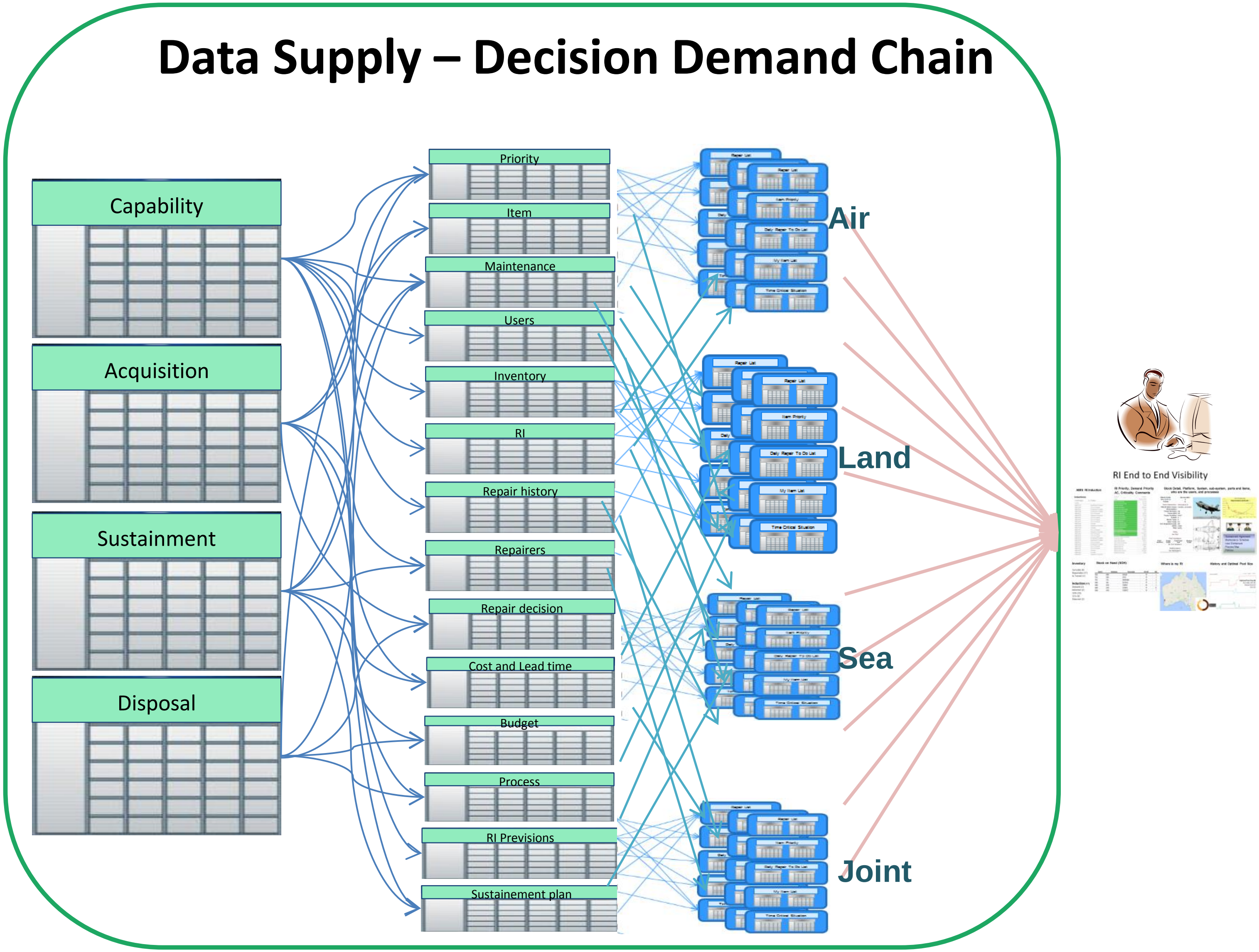
Dynamic Data Mart solution
For existing Enterprises who has many structured DBs



Top 8 Challenges

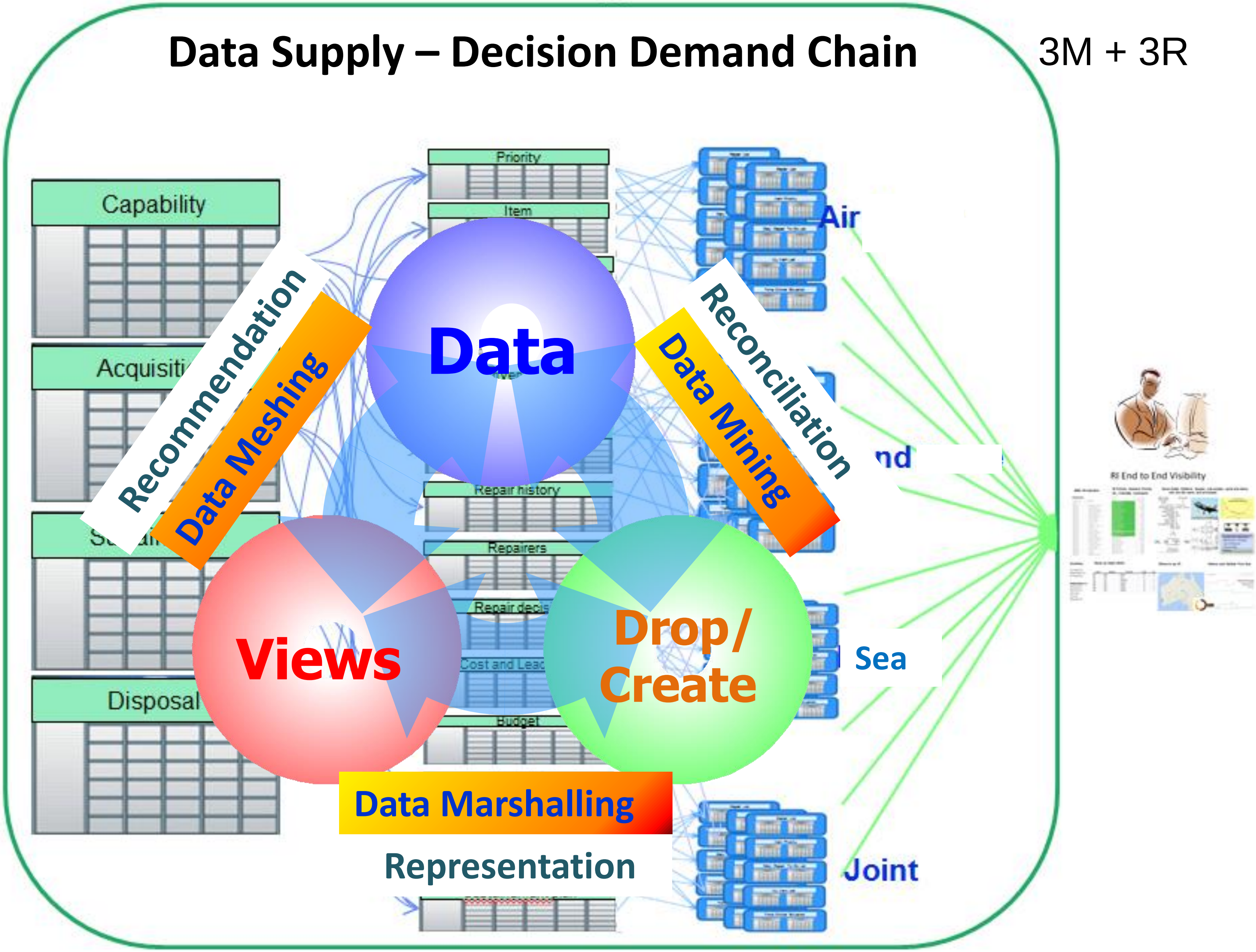
1. Inflexible – build by Expert
2. Multiple Data Marts – no single source of truth
3. Require Expert to operate
4. Not for managers or end-users (of BI)
5. Expensive and low RoI
6. Vendor in control – Data and Data Warehouse
7. Security, privacy, trust
8. Data procurement is difficult

The heart of DES is



Data Supply – Decision Demand Chain

3M + 3R



User Behaviours Mining, Log Mining and Usage Mining for Data Supply Chain

- We track the logs from a configured user's windows. The dashboard shows number of areas, each area we track number of sessions, number of distinct users, peak concurrent sessions, cumulative duration of sessions and a user ratio.
- It is a forward and backward loop that carries out 3M and 3R functions, that provide forward data supply chain and backward demand Chain

3M – Data Supply Chain

- <u>Data Mining</u>: mining the application log, that mines the user's behaviours/user's decision makings and usage rates of each view and window widgets clicks, providing usage rates.
- <u>Data Marshalling</u>: for low usage rate views, we collect the data set, put them on Rest or probation area, evaluate use and reuse.
- <u>Data Meshing:</u> based on the data mining and Logs, we create new views that potential will attract the usage.

3R – Decision Demand Chain

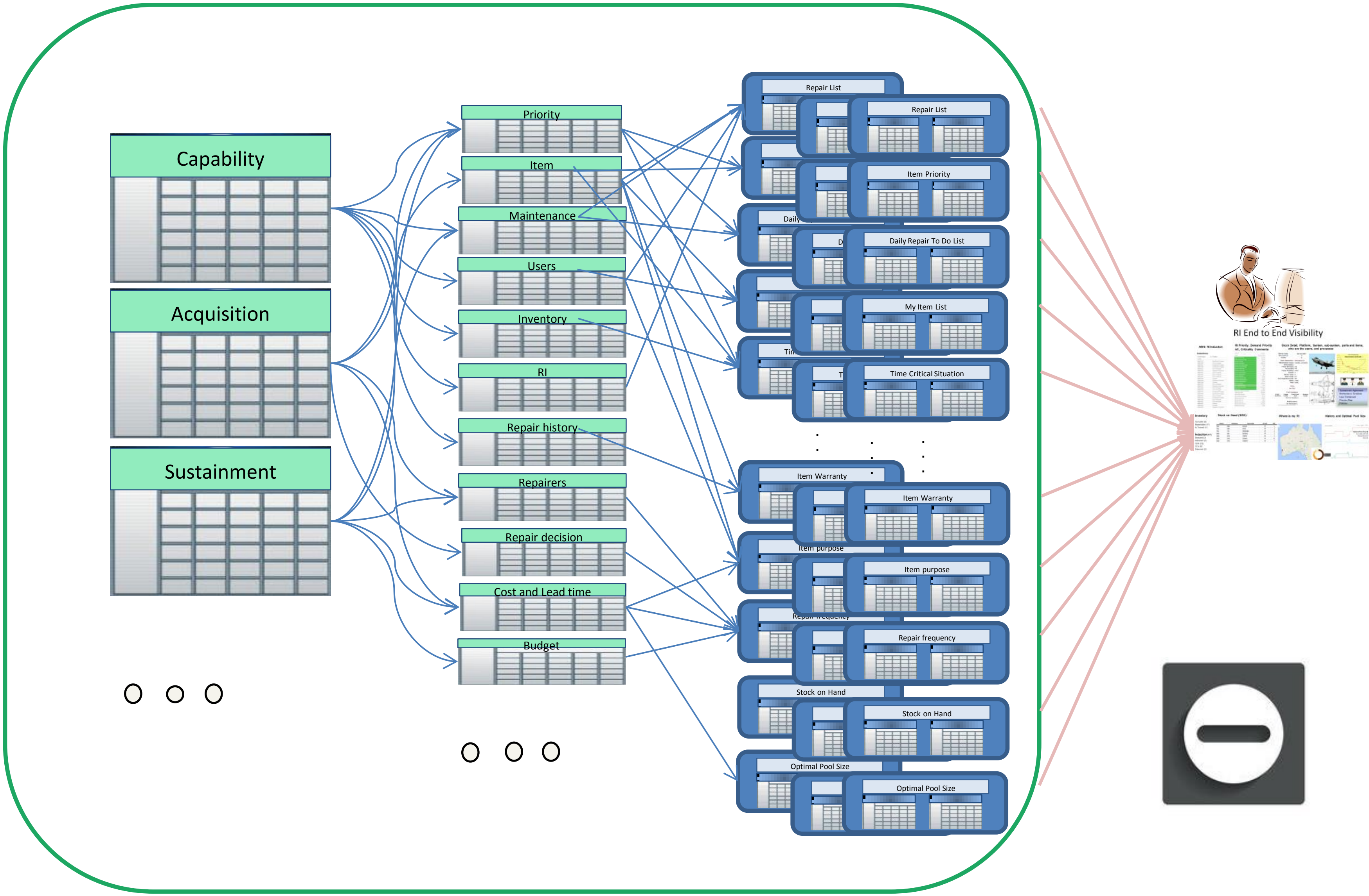
- Recommendation: Following up 3M, we provide decision recommendation to the user, just like how Amazon.com gives it to people who have purchased a book by recommending them other similar books that other people have bought to the RI managers, that are likely to use the similar data set and making similar decision, but this decision making is now recorded and reused.
- Reconciliation: If the data with high hit rate, but the decision is not useful to finish a task, we reconcile all the window view widgets and data set, provide new decision workflows or view workflows.
- Representation: We then represent a new decision view to replace the old decision view to the user.

Data Supply Chain and Decision Demand Chain

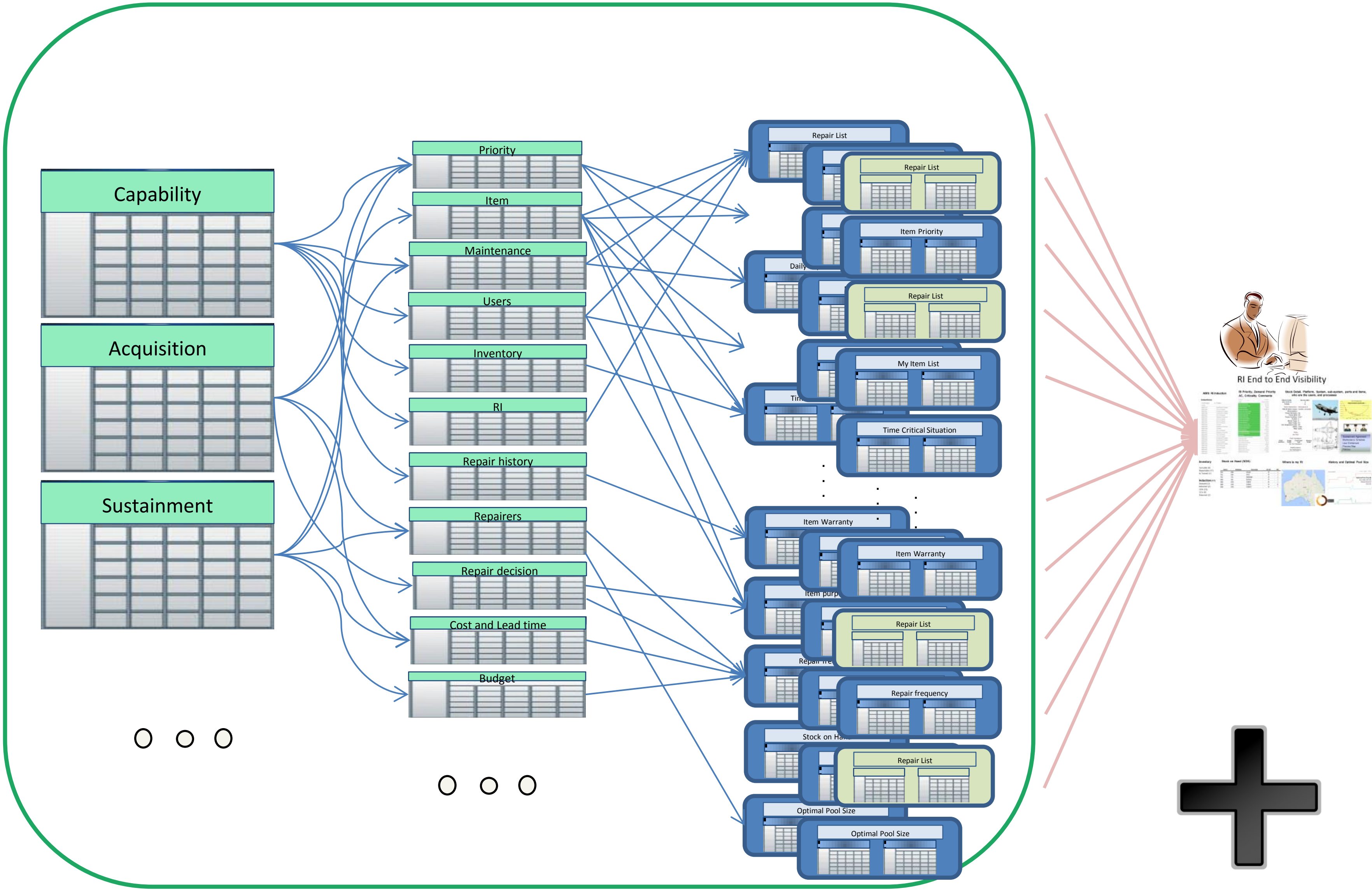
- Our 3M3R engine analyses peak concurrency events, solution adoption, decision making process, most active users, and it drills down to individual session details (sessions tab) at each Window Area. Use the trend chart on the concurrency tab to drill down to the minute level of detail!

- We track how many times users open the model through the server log files and which user accessed the dashboard. By using Audit Logging you can track which objects and tabs are accessed by users, for this you have to select an option Enable audit log.

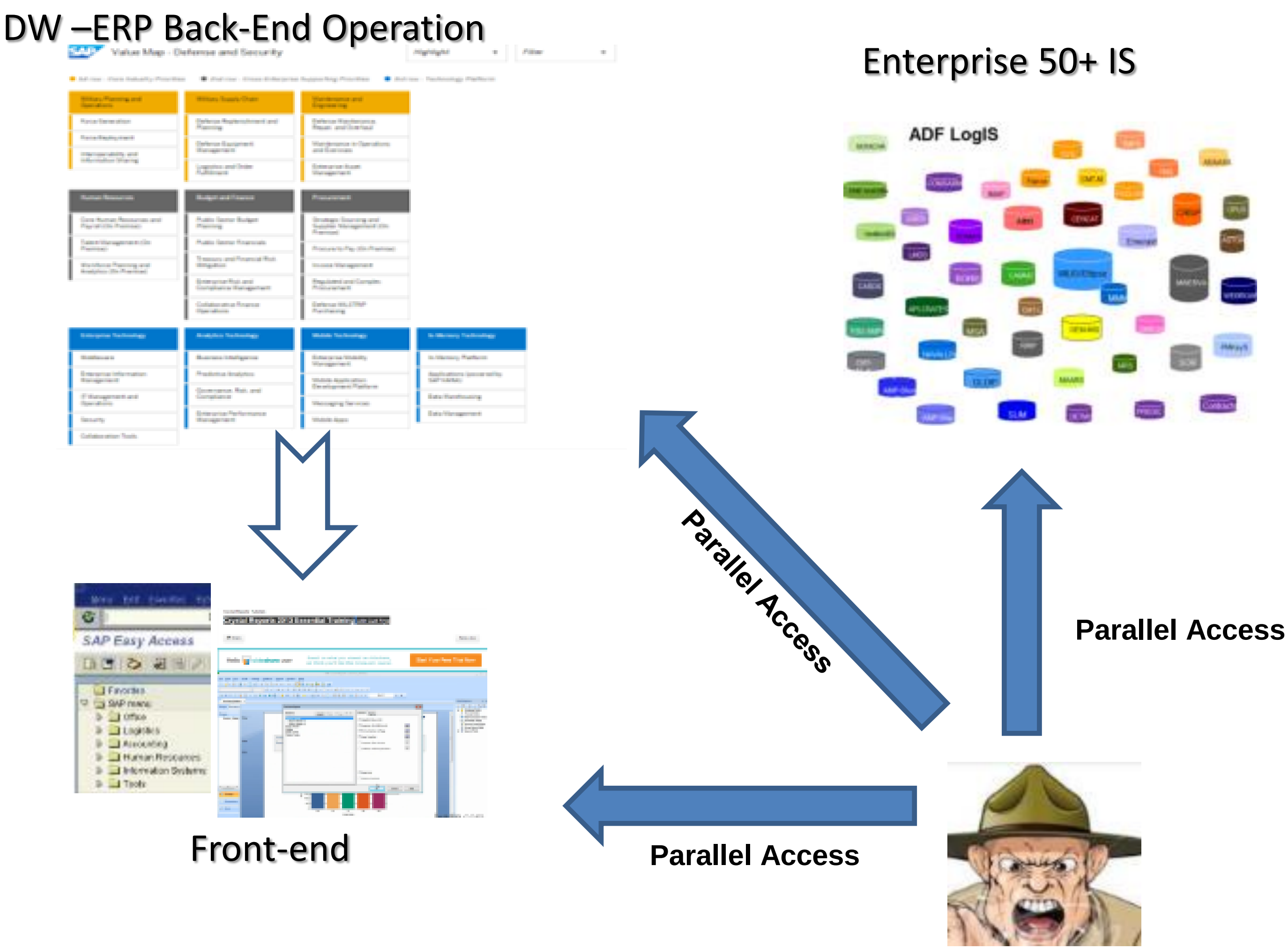
User and Usage mining, drop the views



User and Usage mining, create the views

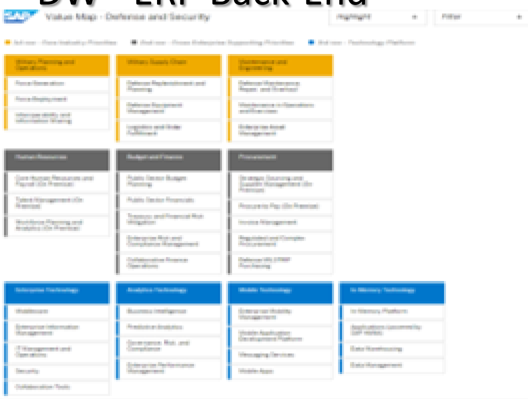


Traditional DW solutions

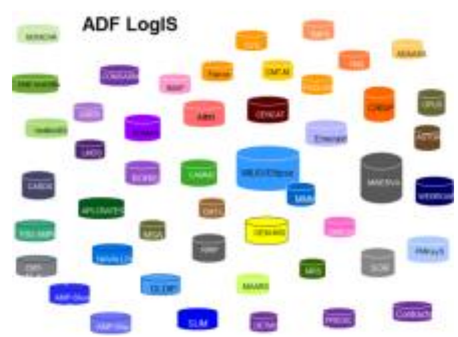


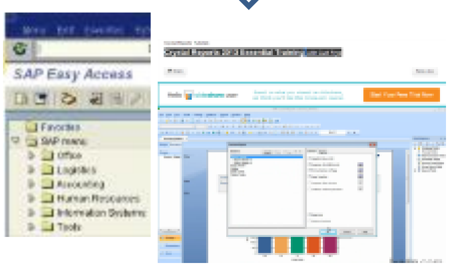
Dynamic Data Ecosystem (DES) – Future 25 years

DW - ERP Back-End



50+ IS





Cloud migration

DDM – Front-end BI

Our-sourcing

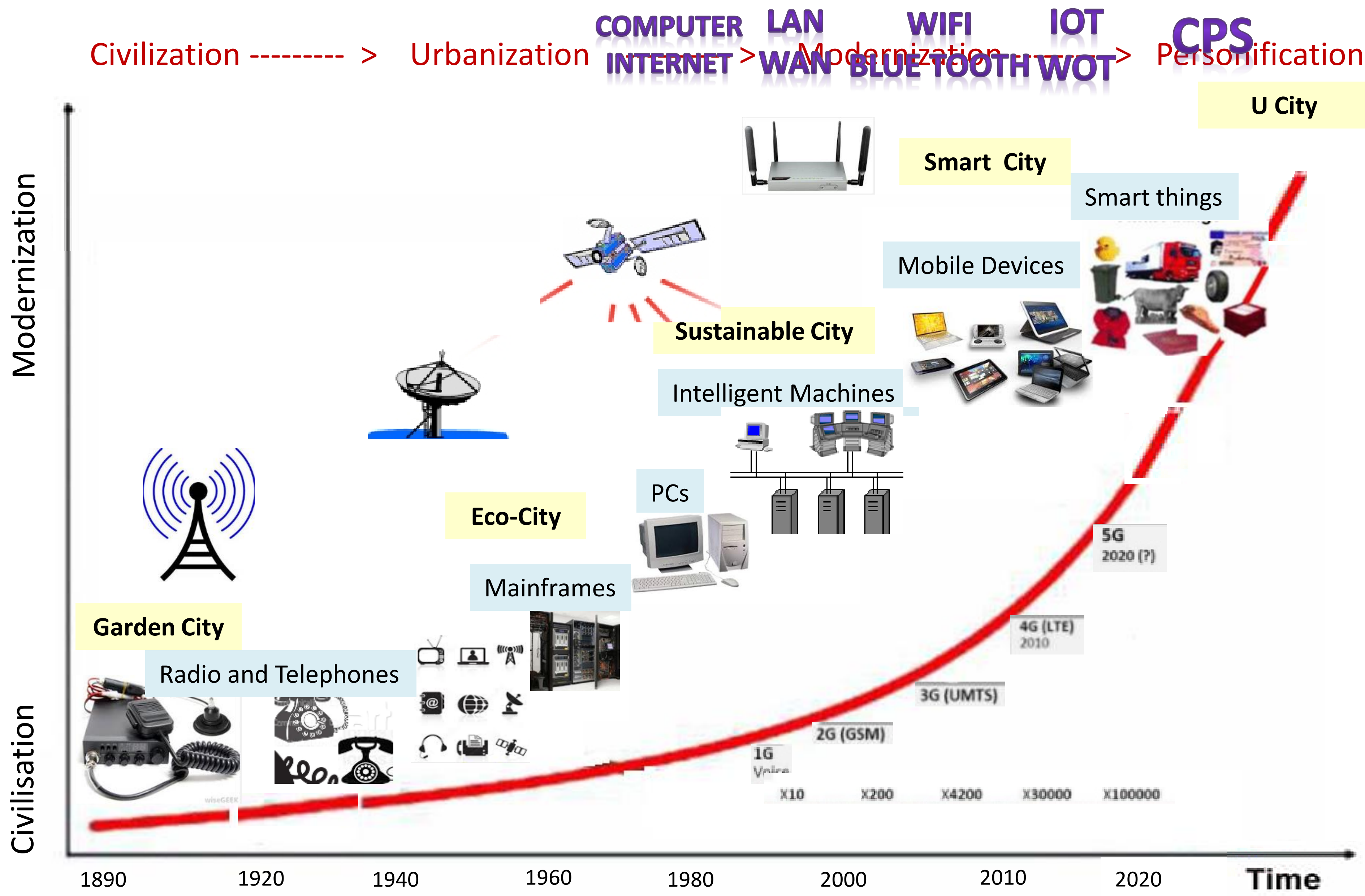
In-House Capability

5. Smart City

– Where we are going

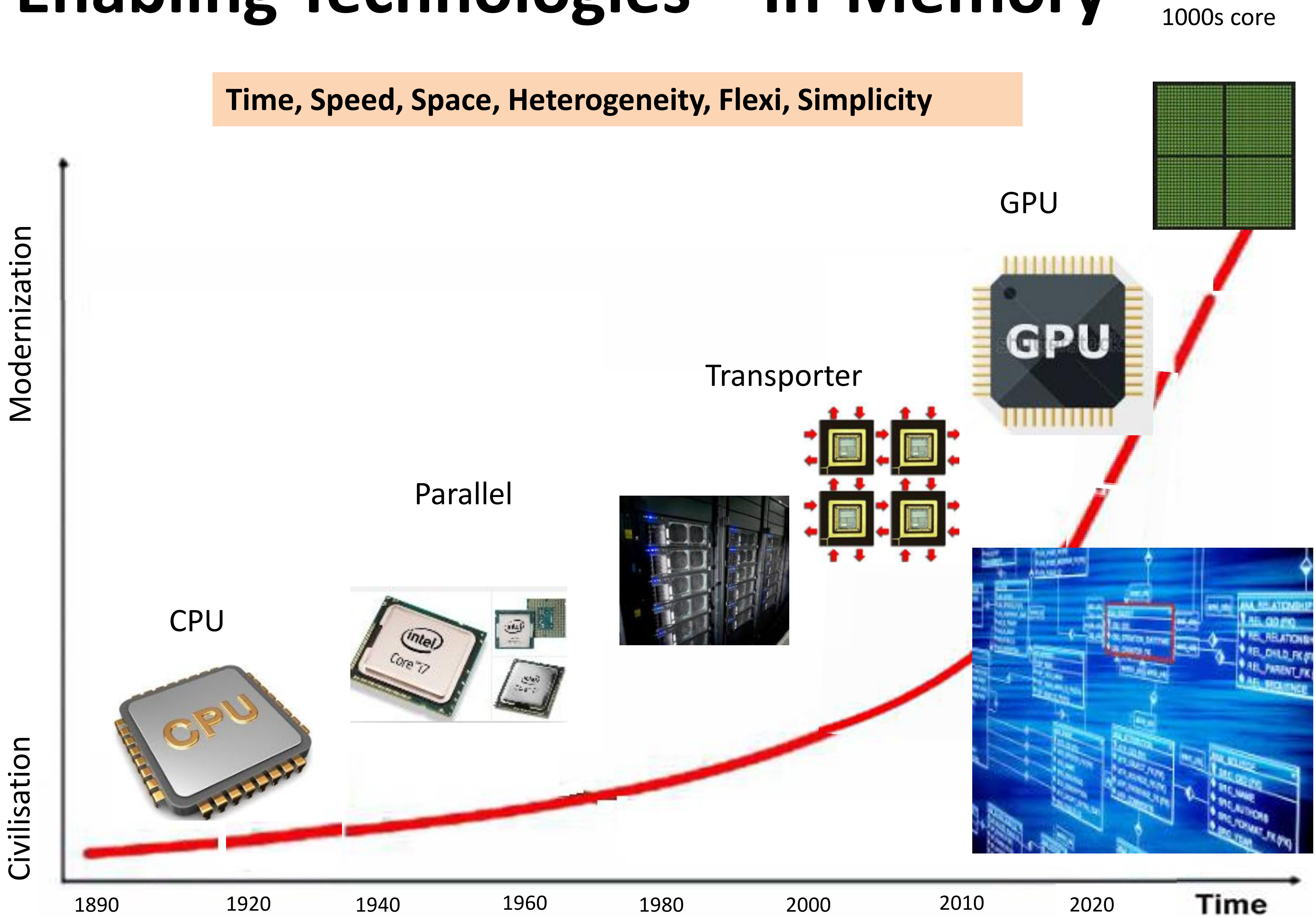
- Hot Research

Enabling Technologies



Enabling Technologies – In-Memory

Time, Speed, Space, Heterogeneity, Flexi, Simplicity



Big Data Management - 2025

Where we are going

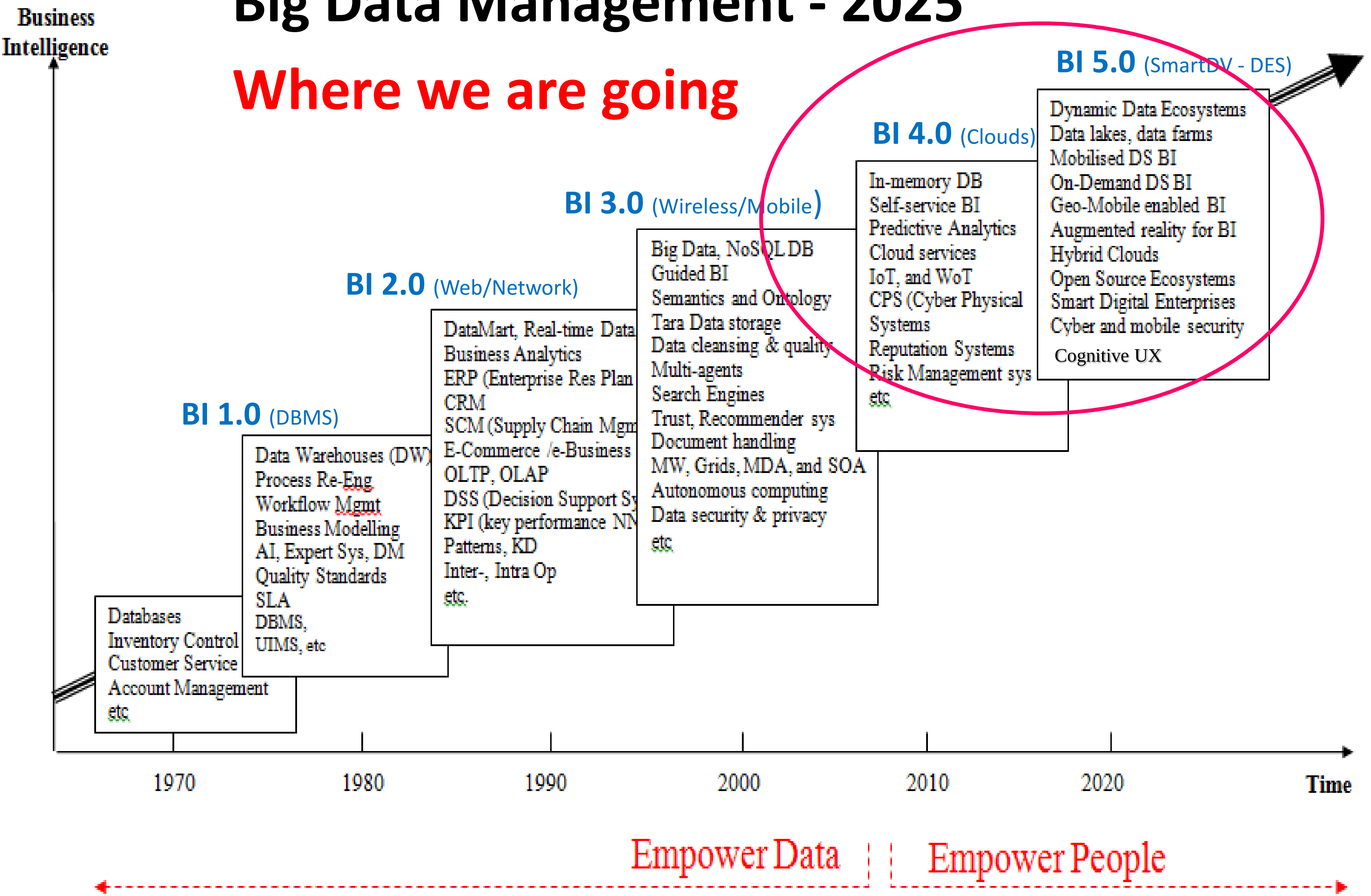


Figure 14.1 50 Years of Business Intelligence Development Paradigm (Chang etal 2006,2015)

Highlight hot areas

1) Big data
2) IoT and CPS
3) Mobile Security

To address top 8 Enterprise issues

1. Inflexible
2. Single source of truth
3. Not Required Expert to operate
4. Not for managers or end-u[illegible] BI)
5. Low RoI
6. Custo[illegible] control
7. [illegible]ecurity, privacy, trust
8. Data Sharing – Ecosystems inspired Data Management

Failure to address these issues in the next 10 years, the history will repeat itself

A Dream World of Data Intelligence

- Not a lot of data, tables, graphs, reports etc => but a Picture worth of 1000 of words
- Not the patterns or discoveries =>

  but a decision support or recommendation(s)
- Not what you have or you do not have =>

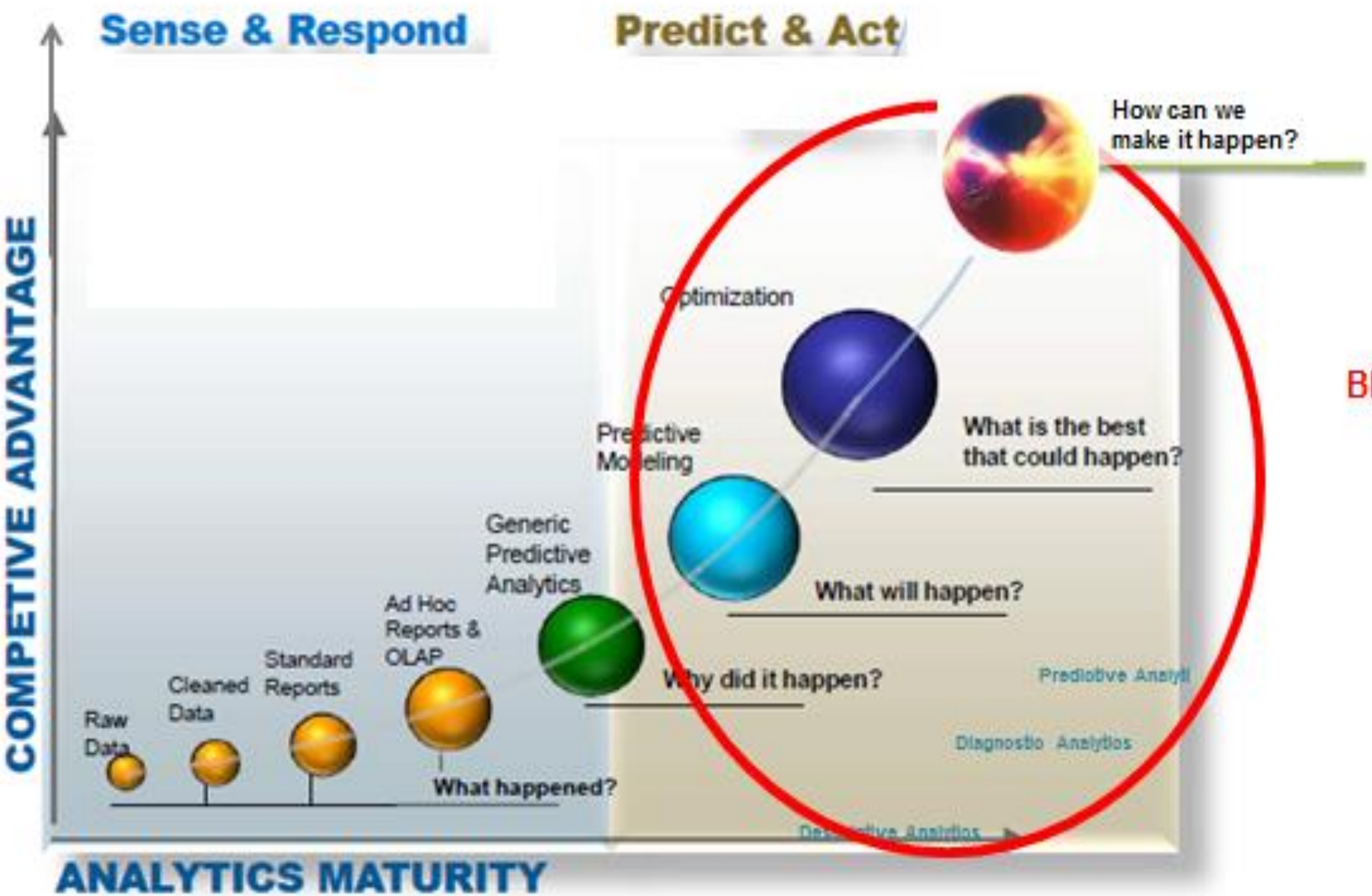
  but what you got to do => such as 1,2,3,4
- Not visualisation of data =>

  but interpretation of data

Big Data, Big Impact

- Mobilised Decision Supported
- Mobile and smart device enabled. No office, no desktop, anytime, anywhere and in real time
- Agile, dynamic, and automated
- On-Demand Decision Support
- Rapid recommendation support
- Sustainable through Self-organization
- Smart Usage capture => capture Knowledge or knowledge discovery => have data and knowledge = enables rapid decisions and decision support

Where Big Data reseach goes?



BI Vendor cannot do BI for Enterprise

Conjoint DM and In real time

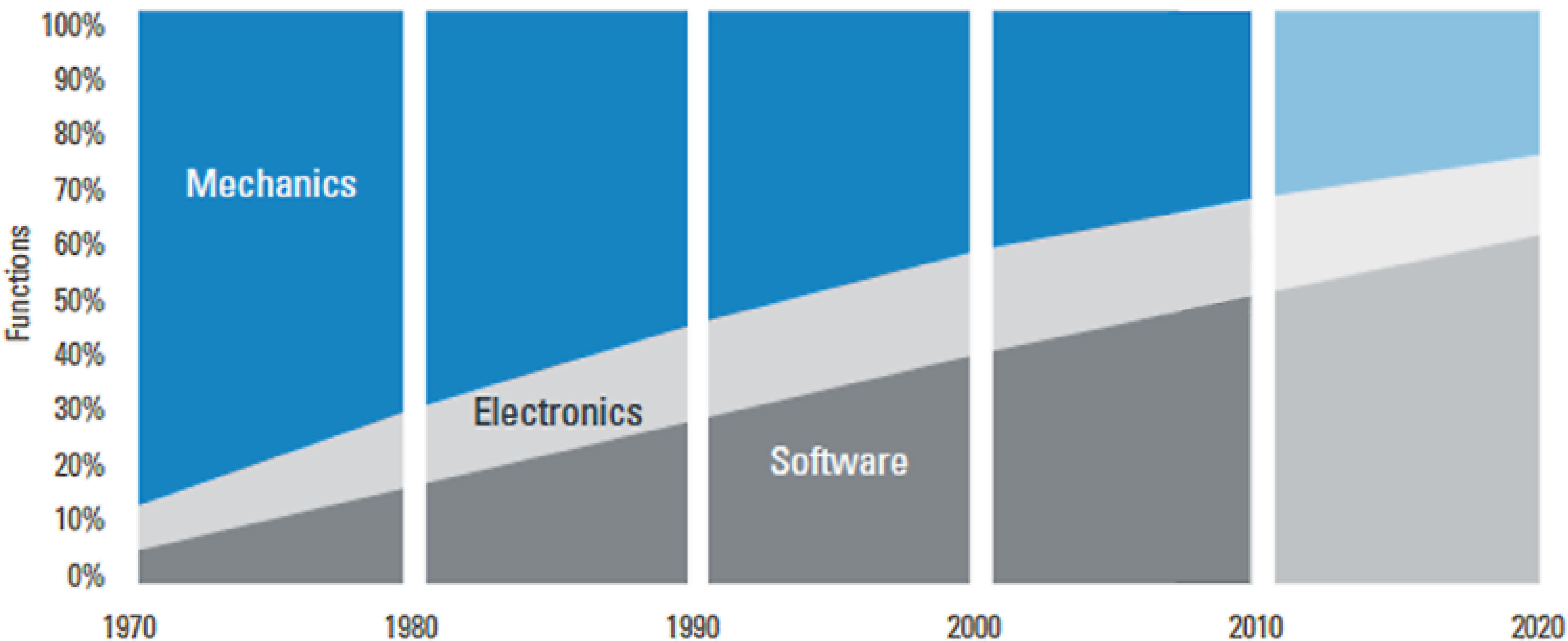
- The co-joint data and content mining on Big Data including the combined RFID and wireless sensors data on the goods and assets handling, warehousing and transportation, GPS, GPRS and position location system for transport vehicle and shipment tracking, Surveillance Systems for Operator Performance and situation awareness, provenance of Goods and Asset tracking.
- The conjoint data and content mining are also needed for Inter- and intra-ship, on-shore and off-shore transactions; data monitoring,
- Black-box (on ships vessels) communication and auto and semi-automated physical flow and information flow

Where the World is going?

What Machine can do ⟷ What Human can do

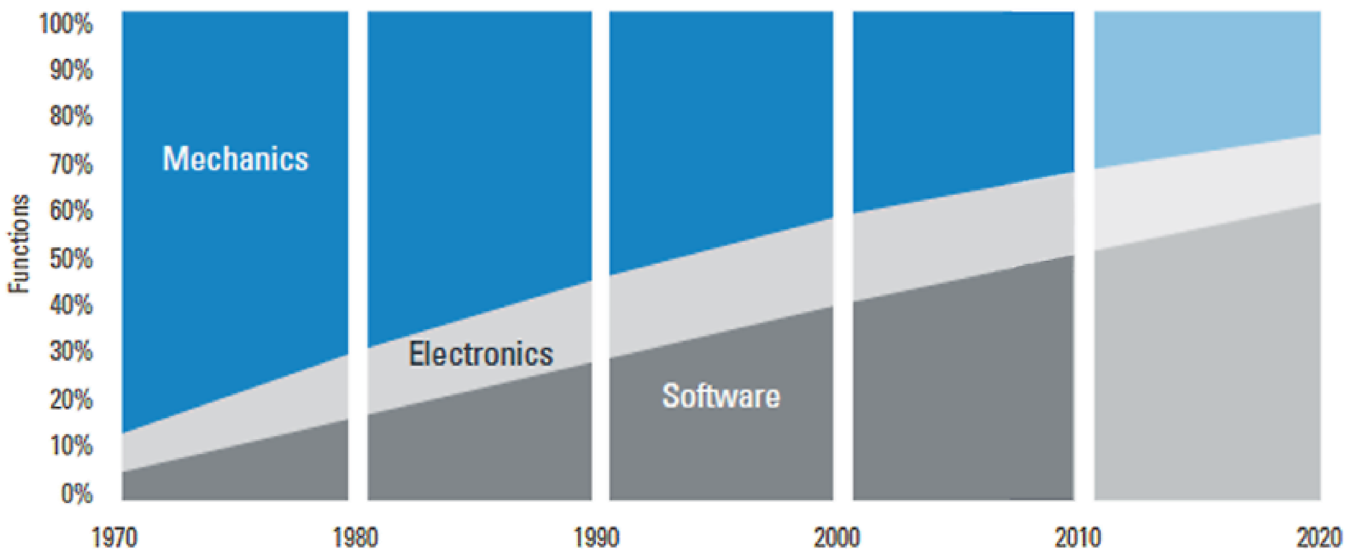
	1970s	1980s	1990s	2000s	2010s	2020s
Economic world	Products	Tools	Platforms	Services	Resources	Environments
Cyber world	Database	Information Systems	Knowledge Base Systems	Web Repositories	Digital Resources	Big Data on Cloud
Social World	Network	Internet	Wireless & Mobile	Sensors actuators	Cyber-Physical Systems	Digital Ecosystems

Innovation in Information Technology



Source: VDMA Future Trend Analysis

Innovation in Information Technology



Steadily increasing complexity of automation software

New techniques are needed for mastering growing complexity

1) Big data

2) IoT and CPS

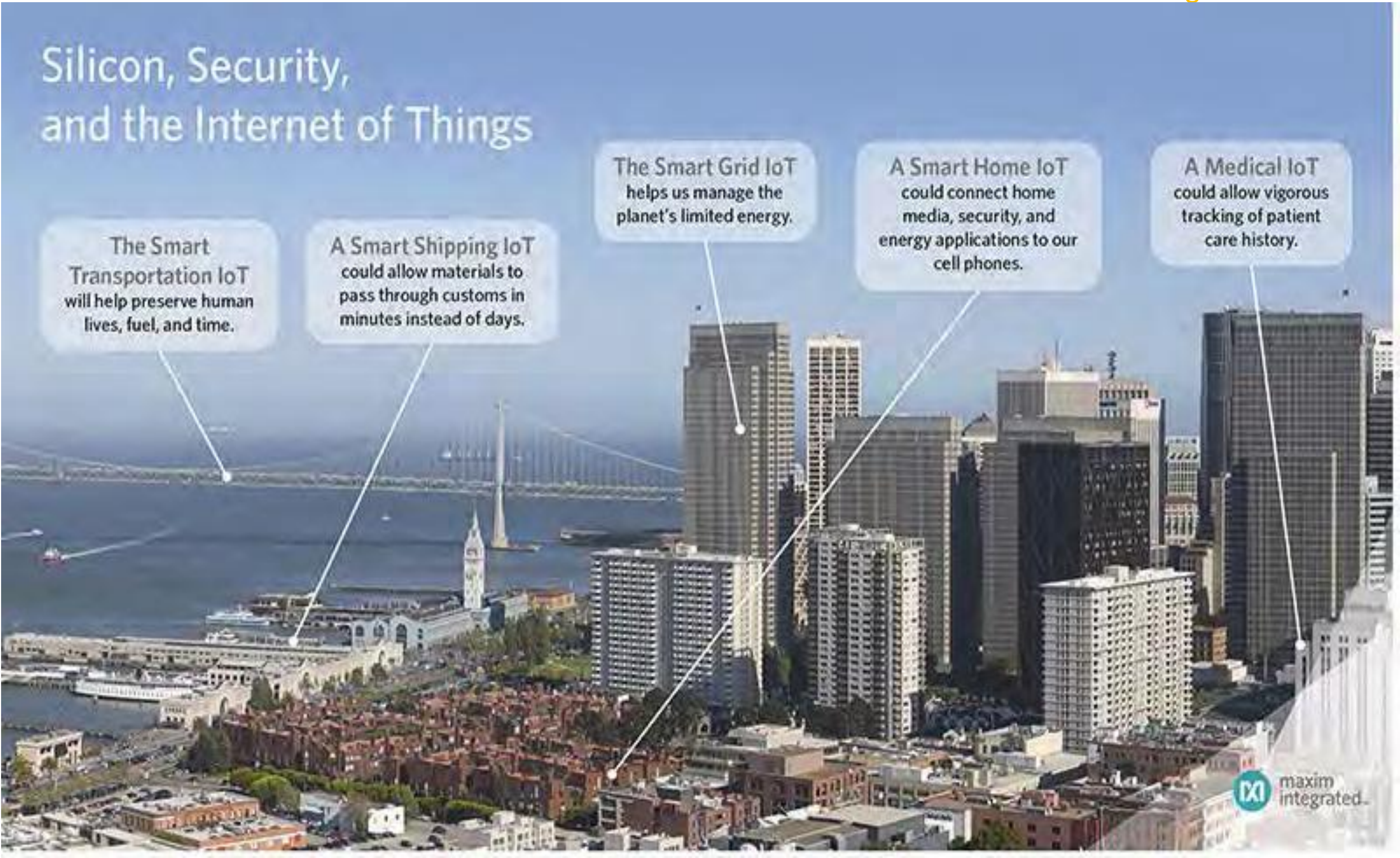
3) Mobile Security

IoT – tightly coupled systems

- The **Internet of Things** (**IoT**, also **Cloud of Things** or **CoT**) refers to the interconnection of uniquely identifiable embedded computing like devices within the existing Internet infrastructure.
  Example: Smart Grid
- Networks of functional tightly coupled system
- the Internet of Things is primarily focusing on using various technologies such as RFID, Zigbee, Bluetooth or 6LoWPAN.
- Things, in the IoT, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, automobiles with built-in sensors, or field operation devices.

IoT - example

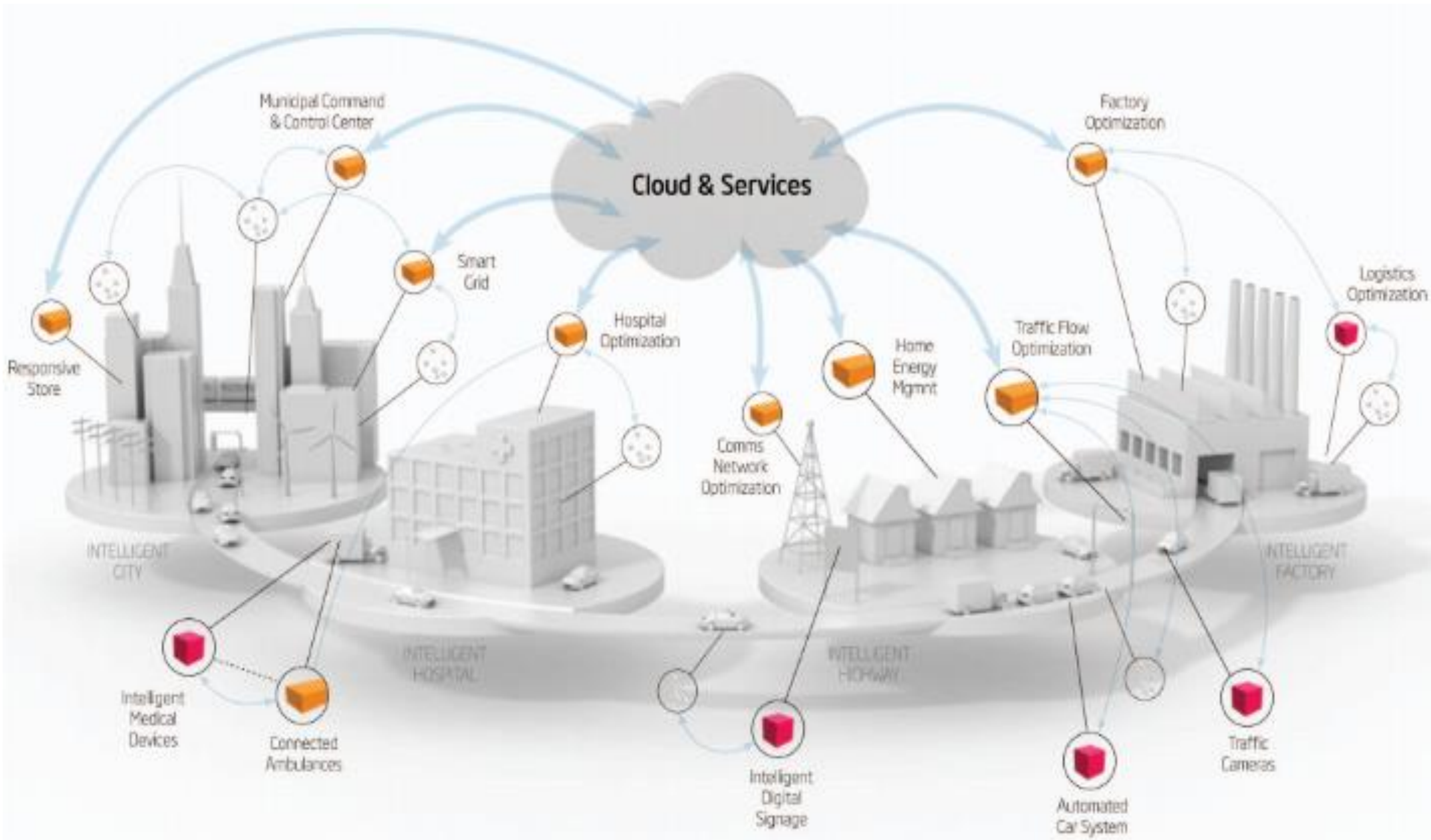
Maxim Integrated 2014



WoT - Systems of systems

- The **Web of Things** (or **WoT**) is a concept and plan to fully incorporate every-day physical objects into the World Wide Web.
- The Web of Things is primarily an evolution of the Internet of Things.
- On the other hand, just like what the Web is to the Internet, allow building an application layer for physical objects, or use 3rd party applications.
- The use of embedded devices.

WoT - Examples



CPS - Globally connected systems of systems

- A **cyber-physical system** (**CPS**) is a globally connected WoT.
- Bring embedded systems to the Web. ie: aerospace, automotive, chemical processes, civil infrastructure, energy, healthcare, manufacturing, transportation, entertainment, and consumer appliances.
- Adaptations: collision avoidance; precision (e.g., robotic surgery and nano-level manufacturing); operation in dangerous or inaccessible environments (e.g., search and rescue, firefighting, and deep-sea exploration); coordination (e.g., air traffic control, war fighting);
- The US National Science Foundation (NSF) has identified cyber-physical systems as a key area of research. Starting in late 2006.

CPS - Examples

Ongoing advances in science and engineering will improve the link between computational and physical elements, dramatically increasing the adaptability, autonomy, efficiency, functionality, reliability, safety, and usability of cyber-physical systems.

Underlying Technologies

– Wireless Communications

- Wireless Sensor Networks (WSN)
- Embedded devices, with tiny computers, sensors, actuators and network interfaces,
- Ability to deploy sensors with flexibility and mobility, on the Web
- Allows to retrieve data about objects and interact with them
- New global networks, enabling new applications and providing new opportunities for humanities and business

Smarter World, Smart Planet, Smart City

– Smart starts here

- Today, the world has 340 trillion trillion trillion unique IP addresses [Maxim Integrated 2014]
- Each Person could have zillions of sensors with unique address [Maxim Integrated 2014]
- 60 billions RFID Tags embedded across entire ecosystems
- many manufactured items, goods or assets today utilizing the Internet of Things are already Internet enabled, they have capability to talk to Internet, talk to each other, talk to service providers and talk to infrastructure and environment

Smart Things – are here to stay

Support for CPS - 2010

- $30,000,000 over 5 years in CPS research programs (40 awards) by the US NSF.
- £5,000,000 initiative for development of CPS applications by UK's Technology Strategy Board.
- $5,5000,000 to transform future electricity grid using CPS by the US Power Systems Energy Research Centre (PSERC).

IoT for Smart Ship

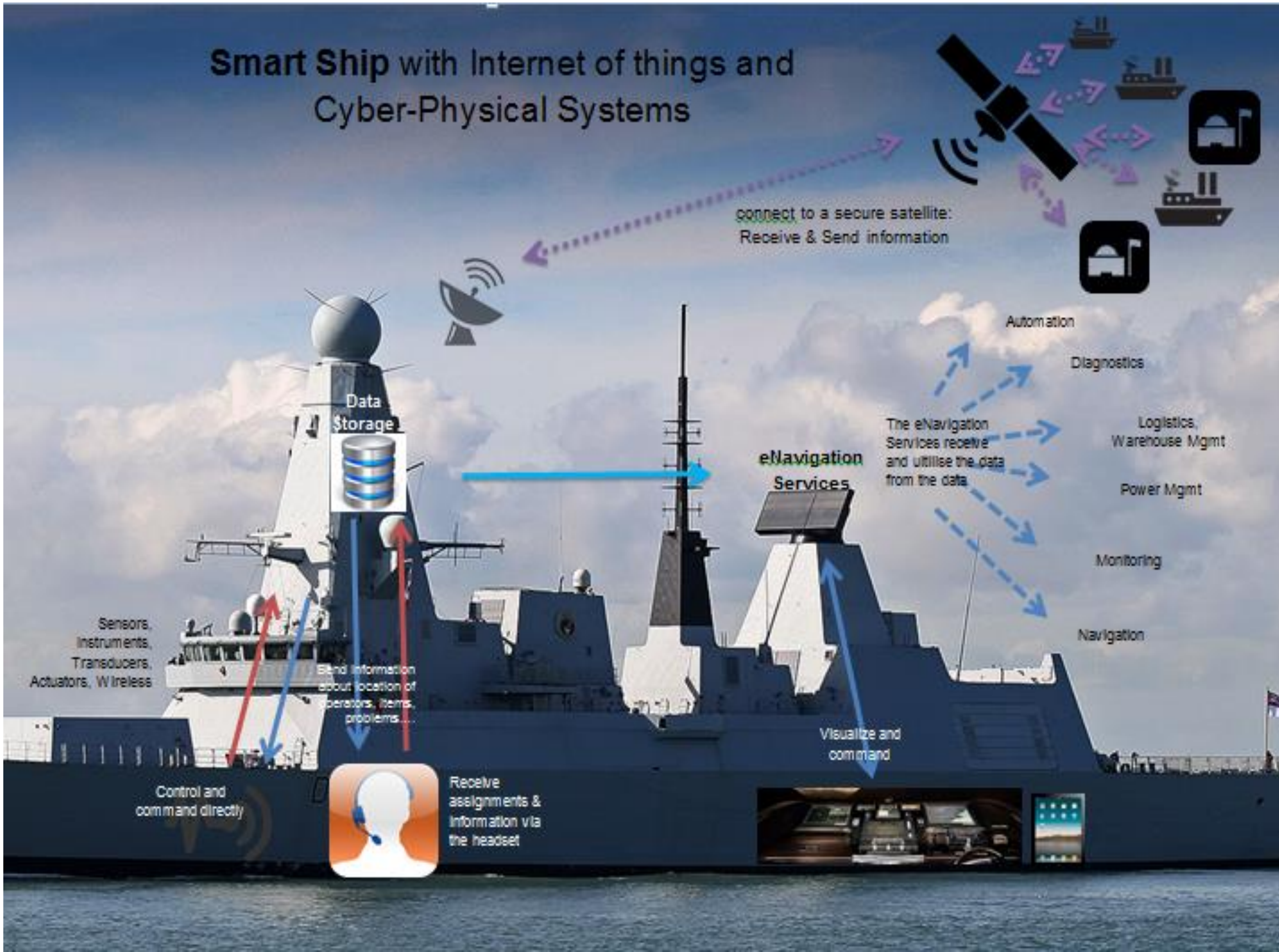
Our solution (IoT, Voice, RFID, MobApp)

Tightly coupled and controlled system

Ship Top Issues
Security and Safety
Communication issues
On-Shore and Off-Shore Asset Visibility
Manual Data Entry System on-board ship
Engineering Reliability and Maintenance

Our proposed work

- Voice headset, locations of each item…
- share this information inside a single ship
- use voice for managing the ship and sending information.
- monitoring, navigation, asset movement
- Location of operators , assets and via a sensor or the headset
- Managers to assign orders



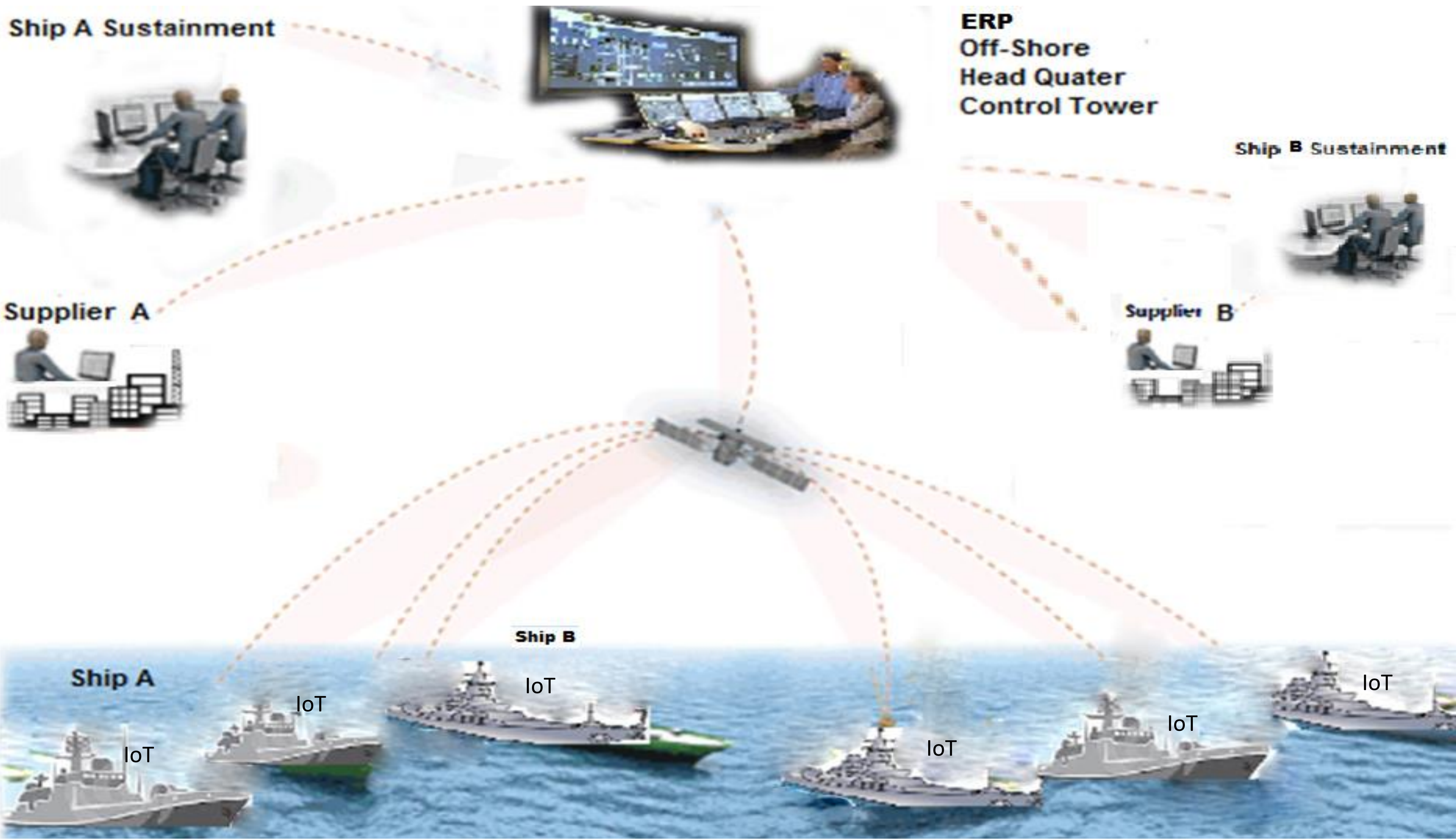
Smart Ship with CPS

Our solution (on-shore+ Off-shore, Sys Integration, E-to-E Visibility)

Globally connected Systems of Systems

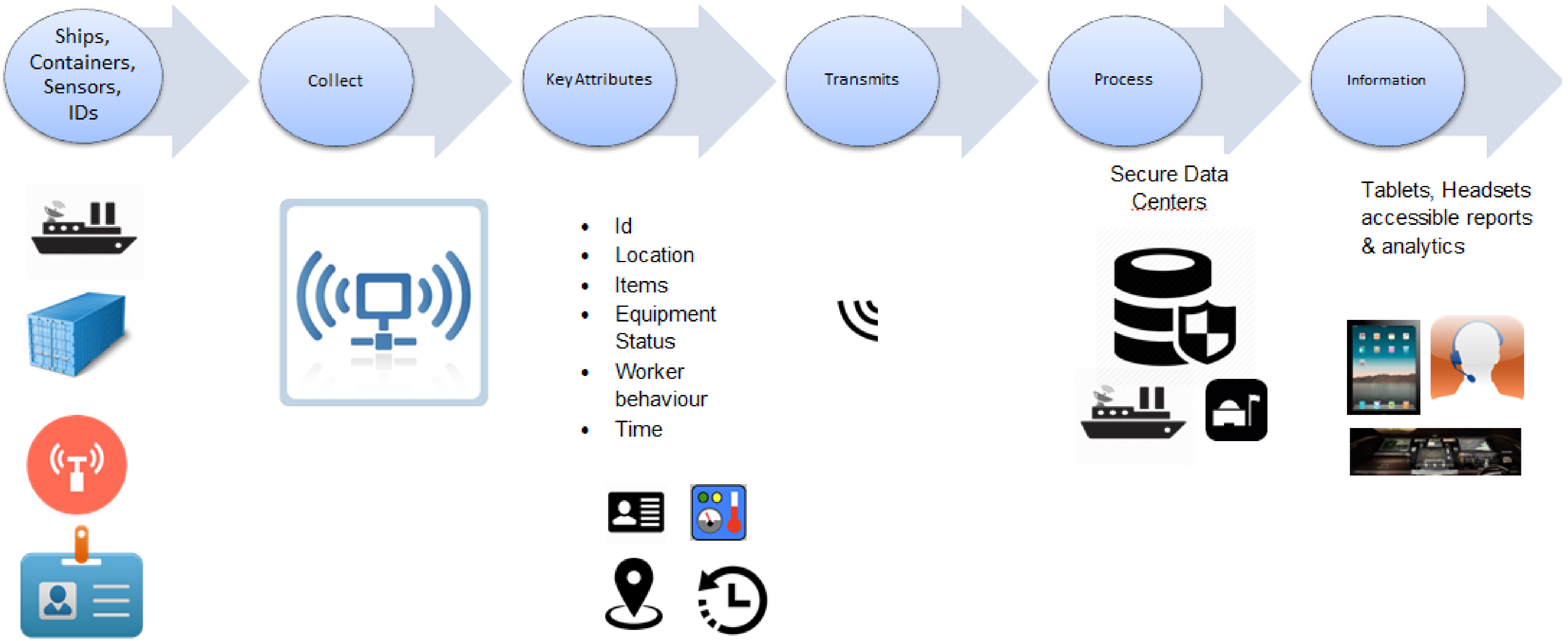
Ship Top Issues

- On-Shore and Off-Shore Asset Visibility
- Engineering Reliability and Maintenance
- Ship Tracking and Sustainment
- Long Lead Time
- Repairs n Overhaul



IoT for Smart Ship

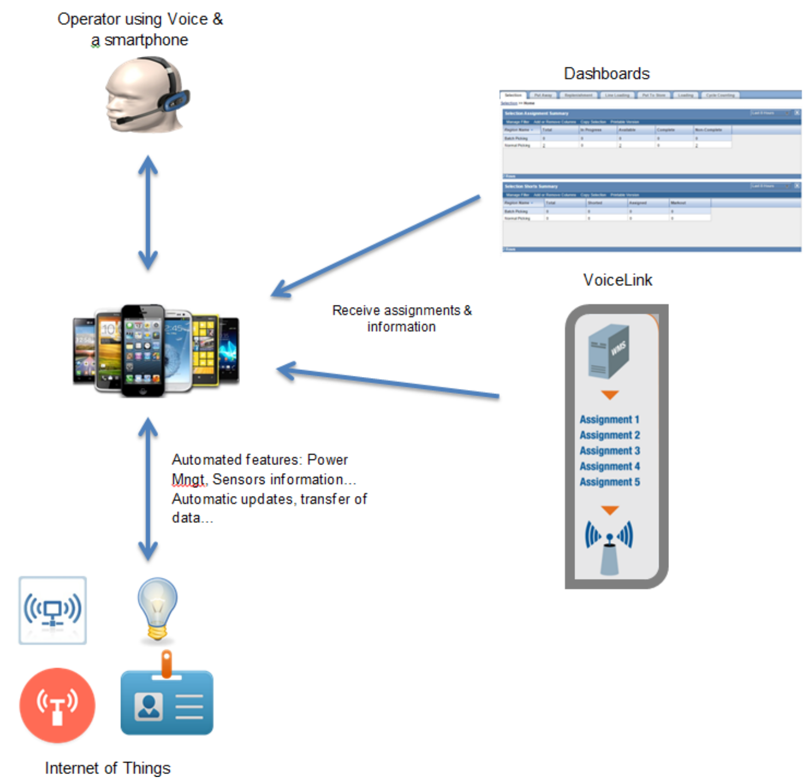
Our Smart Ship Solution Process



Software Integration for Smart Ship

Our Smart Ship Solution integration of RFID, Voice, Data, MobApp,+

Automation	• Controlling equipments by automatic means (gas pump, tank..) • Reduce human intervention&error
Diagnostics	• Receive clear information on dashboards • Reports, analytics...
Logistics	• Improve logistics with tracking devices, and route info of items & ships
Power Mgmt	• Control the power distribution inside the ship
Monitoring	• Vessel positions • Id tracker...
Navigation	• Map updates • Facilitate navigations: recommandations, wheather forecast...

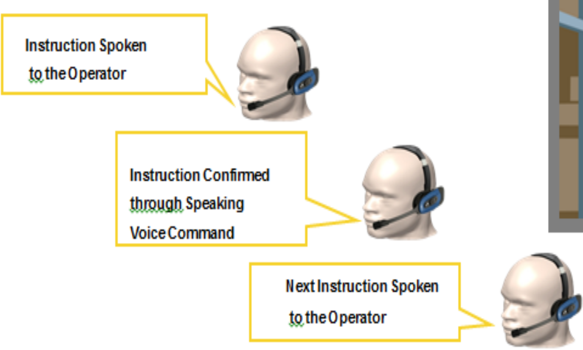


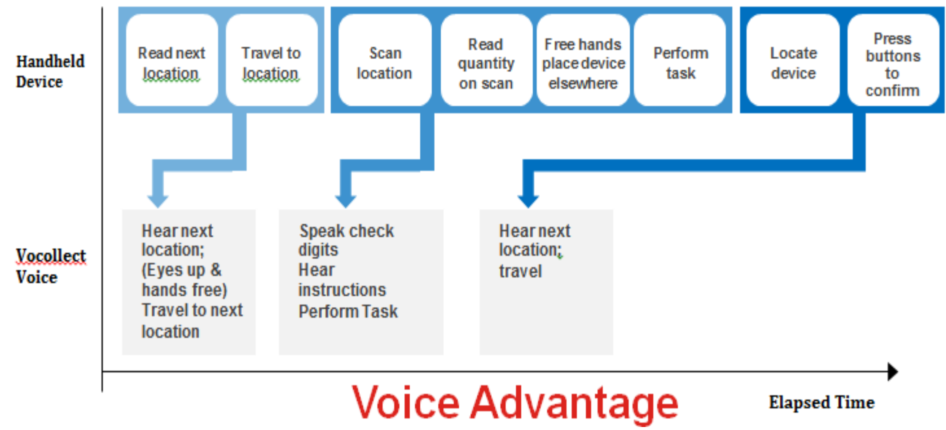
Voice + IoT, Enable Automation

Powered by Honeywell Voice link Technology

a. How does it work

- Assignment from WMS/ERP transmitted to voice-enabled platform via 802.11a/b/g WLAN
- Voice-enabled platform translates assignment data into audible commands
- User provides spoken responses to confirm actions
- Check-digit ensures accuracy
- Translated back to data
- Transmitted from voice-enabled platform via 802.11a/b/g WLAN
- Host data sources updated using enterprise connector





1. Engineering Diagnostics (repair or overhaul)
2. Breakdown scenario outline
3. FastTrack of asset on the on-board ship
4. Urgent demand description
5. Accurate recording of asset usage rate
6. Tracking "Return" of the assets

6. Conclusion

Do Smart Research

Face the issues, embrace technology,

Make our World Smarter

End

Thank you

Acknowledgement:
Google images and CASG at Australian Defence Force

UNSW @ ADFA

Comments and Questions to: E.Chang@adfa.edu.au