iMDE: international Market-Driven Engineering

Lecture 5: Innovation Climate and Innovation Examples

ZHEJIANG UNIVERSITY

LUND UNIVERSITY

Lectures

The course will take you from “how to generate innovations”, though “the writing of Business Plans, and understanding Product development and Production” to the “how to sell and market a product”.

- Lecture 1: Introduction
- Lecture 2: Innovation-Inspiration
- Lecture 3: Innovation-Ideation
- Lecture 4: Innovation-Implementation
- Lecture 5: Innovation-Innovation climate and Examples
- Lecture 6: Business plan
- Holliday
- Lecture 7: Product Development and Production
- Lecture 8: Marketing and Sales
- Lecture 9: Final presentation
- Lecture 10: Final presentation

ZJU LU 技术管理 Technology Management

Agenda

09.15-10.00 Innovation climate in China (JunJin)

10.00-10.15 break

10.15-11.00 Innovation climate in Sweden (Andreas and Charlotta)

11.00-11.15 break

11.15-12.00 Examples from production (Charlotta and Qinmin)

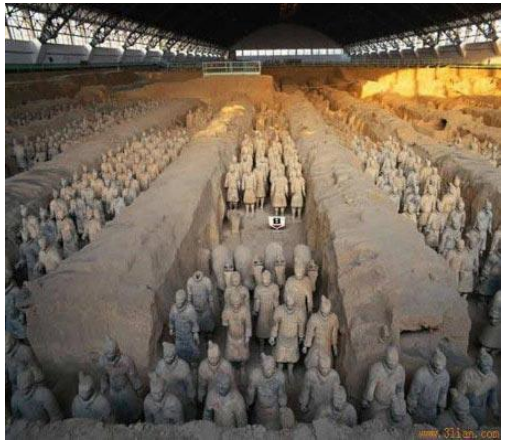
ZJU LU 技术管理 Technology Management

Agenda

- Brief Information of China
- Innovation policies
- Philosophy and culture

Image of China

- **What do you know about China?**
  - **What represent China?**



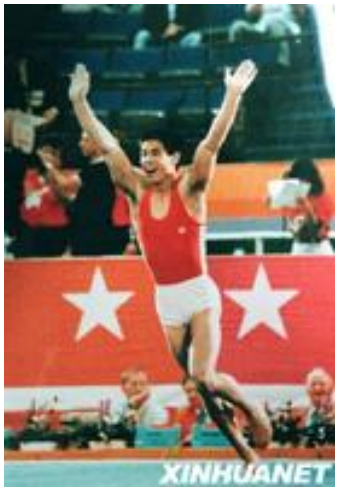
How many Chinese cities do you know?

Do you know these Chinese leaders?

1964年与周恩来、朱德在北京

ZJU LU 技术管理 Technology Management

Do you know these Chinese?



一切皆有可能

ZJU LU 技术管理 Technology Management

Do you know these Chinese Businessmen?

阿里巴巴 Alibaba.com.cn

lenovo 联想

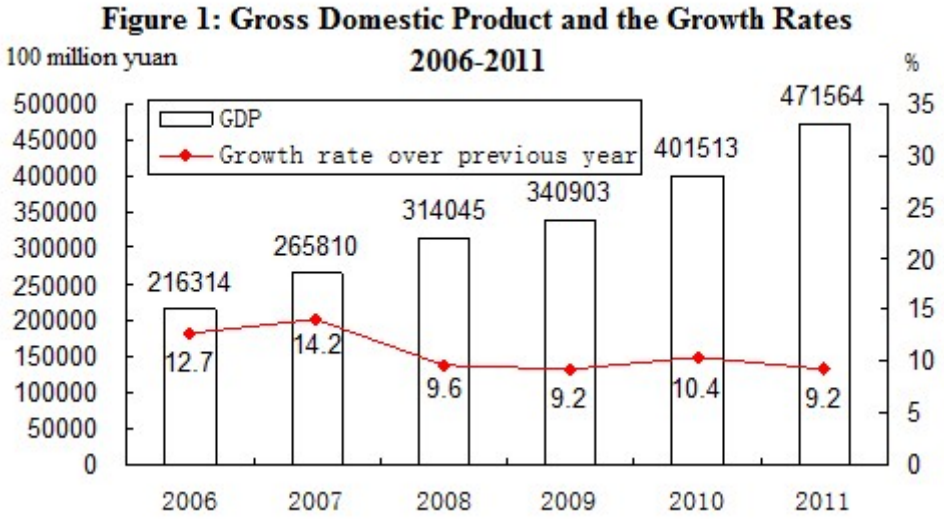
Haier | CHINA

HUAWEI

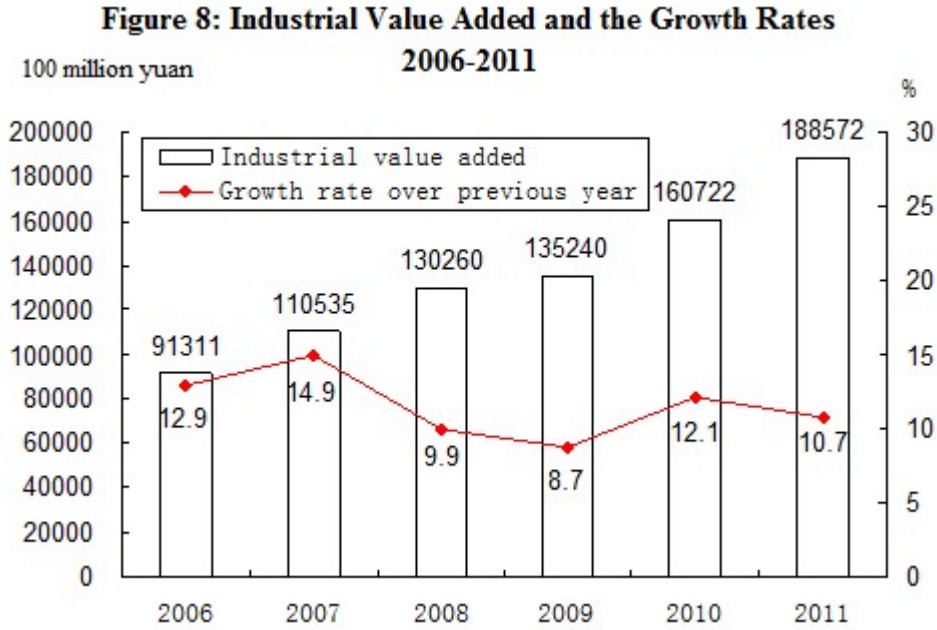
ZJU LU 技术管理 Technology Management


Beijing
Shanghai
Hangzhou
Guangzhou
Hong Kong

Figures of China (I)



Source: Statistics Data, http://www.stats.gov.cn/english/newsandcomingevents/t20120222_402786587.htm



ZJU LU 技术管理 Technology Management

Figures of China (II)

GERD by source of funds and sector of performance

亿元 100 million yuan

执行部门 Performance sectors / 经费来源 Source of funds	合计 Total	企业 Business	研究机构 Research institutes	高等学校 Higher education	其他事业单位 Others
合计 Total	7062.6	5185.5	1186.4	597.3	93.4
企业 Business	5063.1	4809.0	34.2	198.5	21.4
政府 Government	1696.3	236.8	1036.5	358.8	64.2
国外 Abroad	92.1	82.8	3.4	5.4	0.4
其他 Others	211.0	56.9	112.2	34.5	7.4

Source: China Science and Technology Statistics Data Book, http://www.sts.org.cn/sjkl/kjtjdt/data2011/%E7%A7%91%E6%8A%80%E7%BB%9F%E8%AE%A1%E6%95%B0%E6%8D%AE2011.pdf

ZJU LU 技术管理 Technology Management

Figures of China (III)

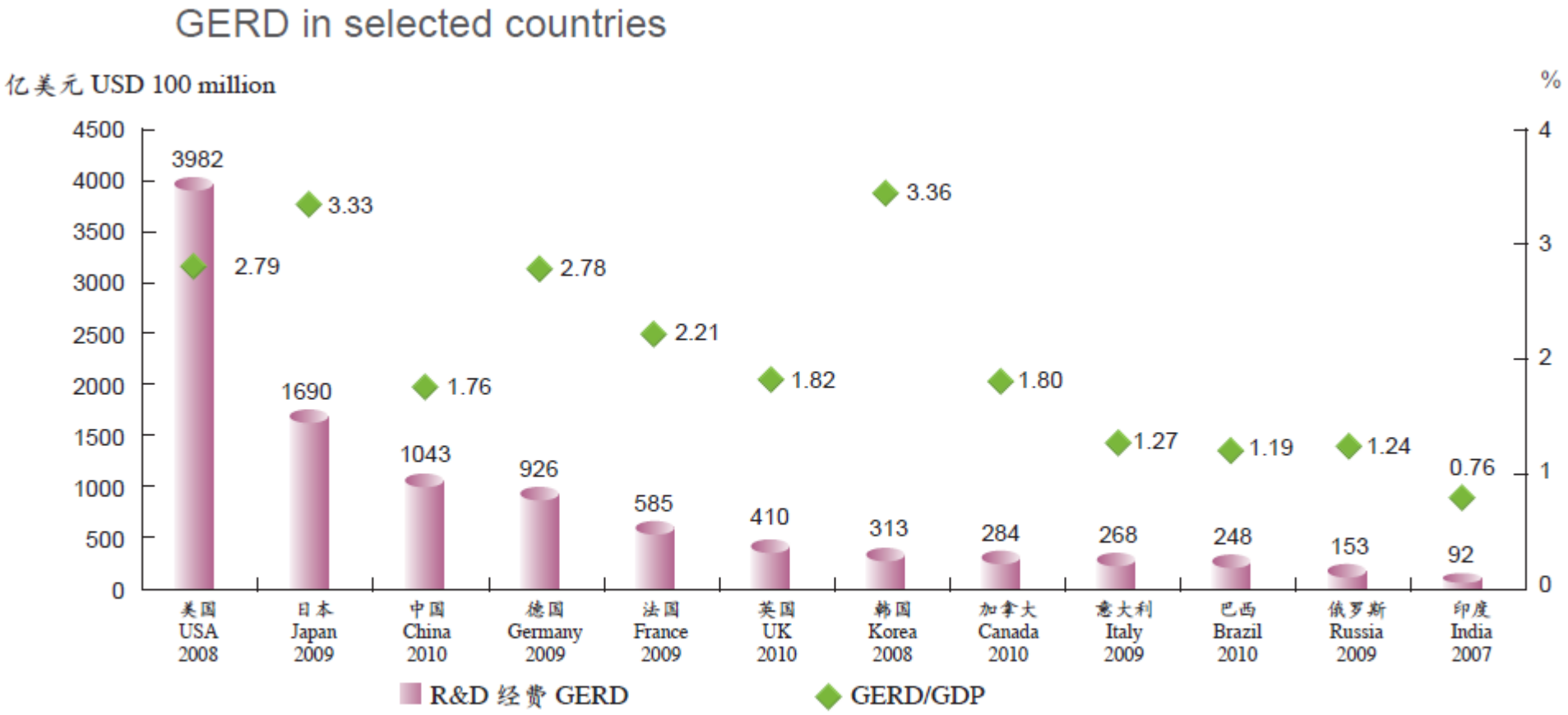
Science and technology

Year	2000	2001	2002	2003	2004	2005	2006
GERD (Billion RMB)	89.57	104.3	128.8	153. 96	196.6	245	300.3
GERD/GDP(%)	0.9	0.95	1.07	1.13	1.23	1.34	1.42
Patent (Thousand)	105	114	132	182	190	214	268
Invention Patent (Thousand)	13	16	21	37	49	53	58
SCI、EI、ISTP papers (Thousand)	50	65	77	93	111	153	172

Source: Statistics Data, STS website

ZJU LU 技术管理 Technology Management

Figures of China (IV)



数据来源：中国科技部；OECD《主要科学技术指标2011/1》；巴西科技部；联合国教科文组织。
Source: MOST; Main Science and Technology Indicators 2011/1 (OECD); Ministry of S&T of Brazil; UNESCO.

ZJU LU 技术管理 Technology Management

Innovation policies

Reform & Open since 1978

Reasons

- Economic backward after the culture revolution
- Planned economy system sapped the vitality and limited the growth

Reform in China (I)

- 1978, 1979
- Encouraging certain lead groups and areas to become rich first, enabling them to help others towards prosperity too
- Planned economy → Socialist market economy
  - Market driven
  - Morden enterprise system
  - Open policy:
    - FDI: JV

ZJU LU 技术管理 Technology Management

Reform in China (III)

Mao's theories

- Rural area → urban → rural
  - The household contract responsibility system in rural area 1978
  - 1984 to Cities, individual
  - Morden agriculture
- Eastern → western & North-eastern

ZJU LU 技术管理 Technology Management

Chinese new innovation policies

- In early 2006, China's new median and long term S&T plan (2006-2020)
- Objective: making China an innovation-based country in 2020
  - Increasing R&D spending to 2.5 percent of GDP
  - Increasing the contribution of S&T to the economic growth
  - Reducing over-dependency on foreign technology
  - Stepping up the output of publications and patents in major fields
- Approach: promoting indigenous innovation;
  - Acquisition, assimilation, and innovation;
  - Integrative innovation
  - Original innovation

ZJU LU 技术管理 Technology Management

Priority Areas

- Applied research based on the societal needs:
  - Energy, water resources, environmental protection, health, agriculture, manufacturing, service, and etc ;
- Mega Projects:
  - Semiconductor manufacturing, broadband wireless mobile communication, nuclear power water pollution treatment, power, AIDS and Hepatitis, aircraft manufacturing, space exploration and etc.
- Frontier Technologies:
  - Bio-tech, IT, new materials, new energy, space…
- Important basic research
  - In broad areas and interdisciplinary areas.

ZJU LU 技术管理 Technology Management

Some issues:

Chinese philosophy and culture

Confucianism

- The core of traditional culture
- Emphasize: regulation, moral, and personality
- People-oriented
- Influence over the history, social structure and the people of China and Asia
- The role of Confucius: especially on education
  - Impact on the Chinese intellect
  - e.g. Studying without thinking leads to confusion; thinking without studying leads to laziness

Temple of Confucius

ZJU LU 技术管理 Technology Management

Laos: Tao Te Ching

- Work: Tao Te Ching
- About the nature rules, and methodologies to do things
- Some theories:
  - **Wu Wei: non action**
    - **Without intention, It manifests all things**
  - The tangible is manifested from the intangible

Religion: Taoism

ZJU LU 技术管理 Technology Management

Laos: Taoism

- About 2000 years
- Emphasize the link between human and nature
- Peaceful

Ancient Architectural Complex in Wudangshan Mountain

Yin and Yang

- Moon and Sun
- Female and male
- Dark and bright
- Food

➔**Harmony, balance**

➔Usage example: mostly, danger is not on the opposite of safety, it hides in the safety *who drowned?*

ZJU LU 技术管理 Technology Management

Arts of War

- Sun Tzu:
  - an ancient Chinese military strategist at the Spring and Autumn Period (around 2500 years ago)
  - 36 strategies: widely used in Chinese and Japanese business

36 Strategies

- Examples:
  - No. 7, Creating something out of nothing
    - The role of media
    - Rumor
  - No.31, using beauty to corrupt the enemy
  - No. 36, running away as the best choice
    - Keep life and leave as early as possible

ZJU LU 技术管理 Technology Management

Agenda

09.15-10.00 Innovation climate in China (JunJin)

10.00-10.15 break

10.15-11.00 Innovation climate in Sweden (Andreas and Charlotta)

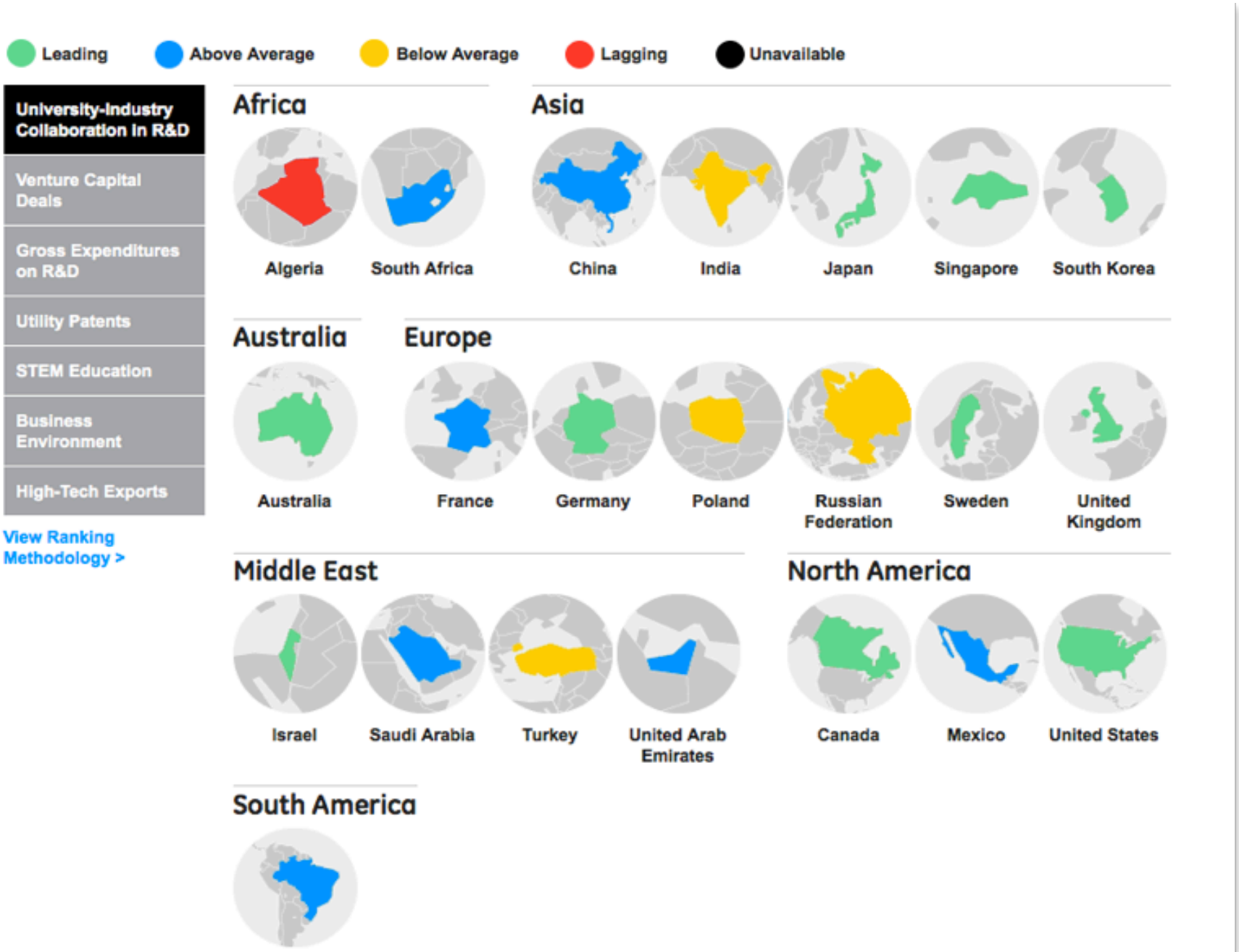
11.00-11.15 break

11.15-12.00 Examples from production (Charlotta and Qinmin)

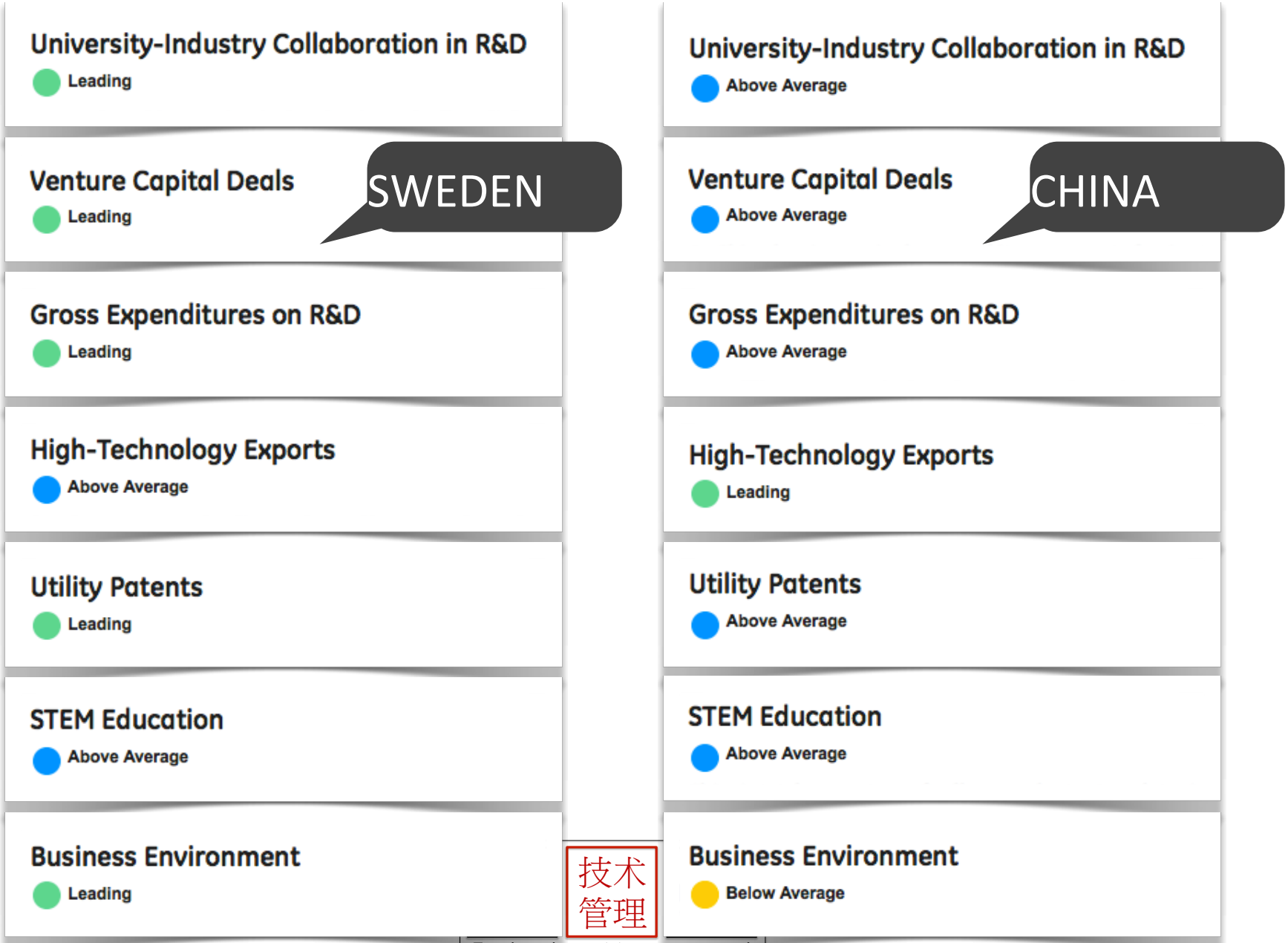
ZJU LU 技术管理 Technology Management

Technology Management

http://www.ge.com/innovationbarometer/



http://www.ge.com/innovationbarometer



技术管理

Technology Management

http://www.ge.com/innovationbarometer/

SWEDEN

Conclusion

Sweden is clearly a global innovation leader, with one of the highest levels of levels of R&D investment in the world. Venture capital is readily available, and its high concentration of researchers is notably productive in generating new patents. The thriving nature of this 54 ecosystem is reflected in the optimism and approval expressed by Swedish respondents in the GE Innovation Survey.

CHINA

Conclusion

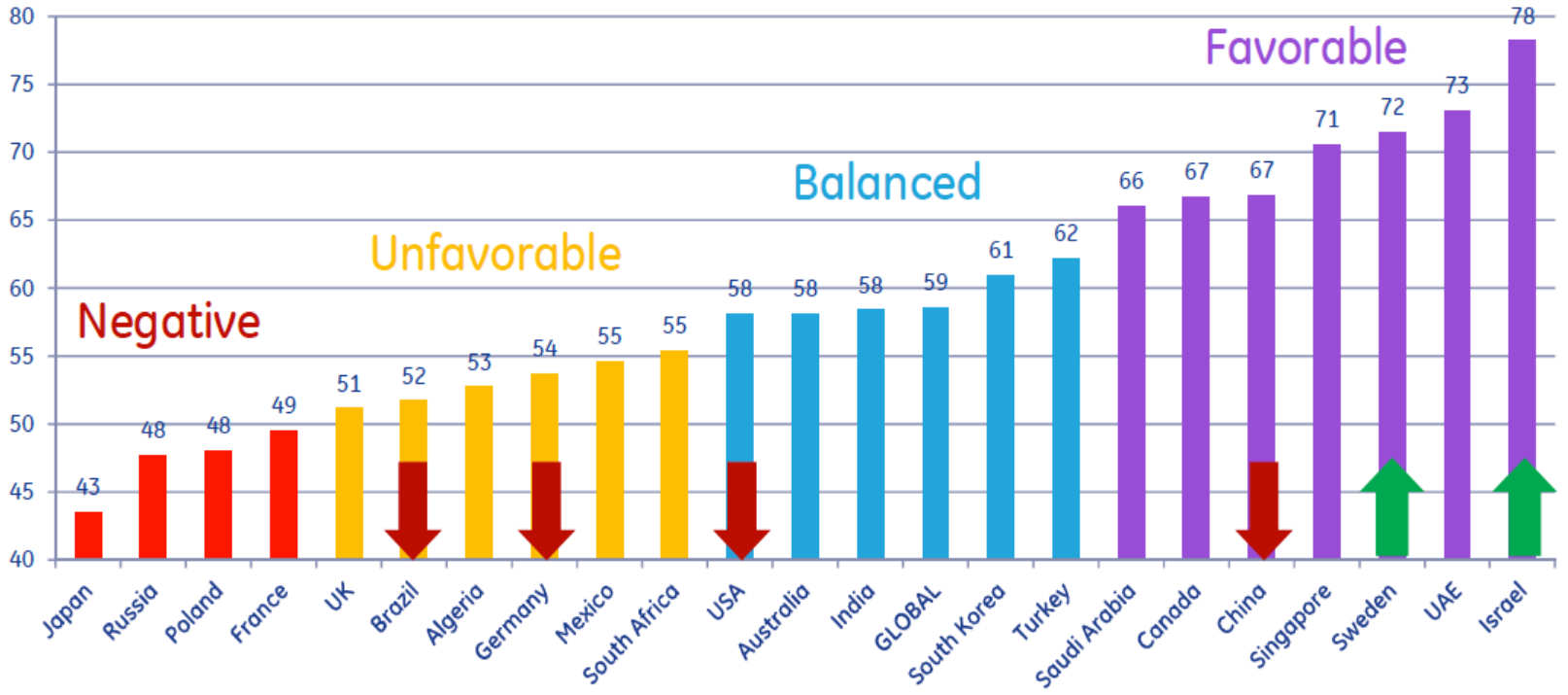
Although the indicator results place China in the second quartile of innovative countries, the world can see that the country is catching up rapidly. While only 7 percent of Chinese 18 respondents in the GE Innovation Survey ranked China as the leading innovator, the country finished first among respondents from two other countries, and second among respondents from three others. Further, individual Chinese firms are now asserting themselves on the world stage:Four Chinese businesses made Boston Consulting's 2010 list of the 50 most innovative companies in the world. The one Chinese company in the top 10 (battery and car maker BYD) has attracted significant investment from Warren Buffett.

ZJU LU 技术管理 Technology Management

http://www.ge.com/innovationbarometer/

How business perceives their home country's innovation environment

Innovation Environment Index: This 100-point index illustrates how satisfied businesses in each market are about the combined 13 elements that make up the innovation environment. Arrows indicate year over year trends.

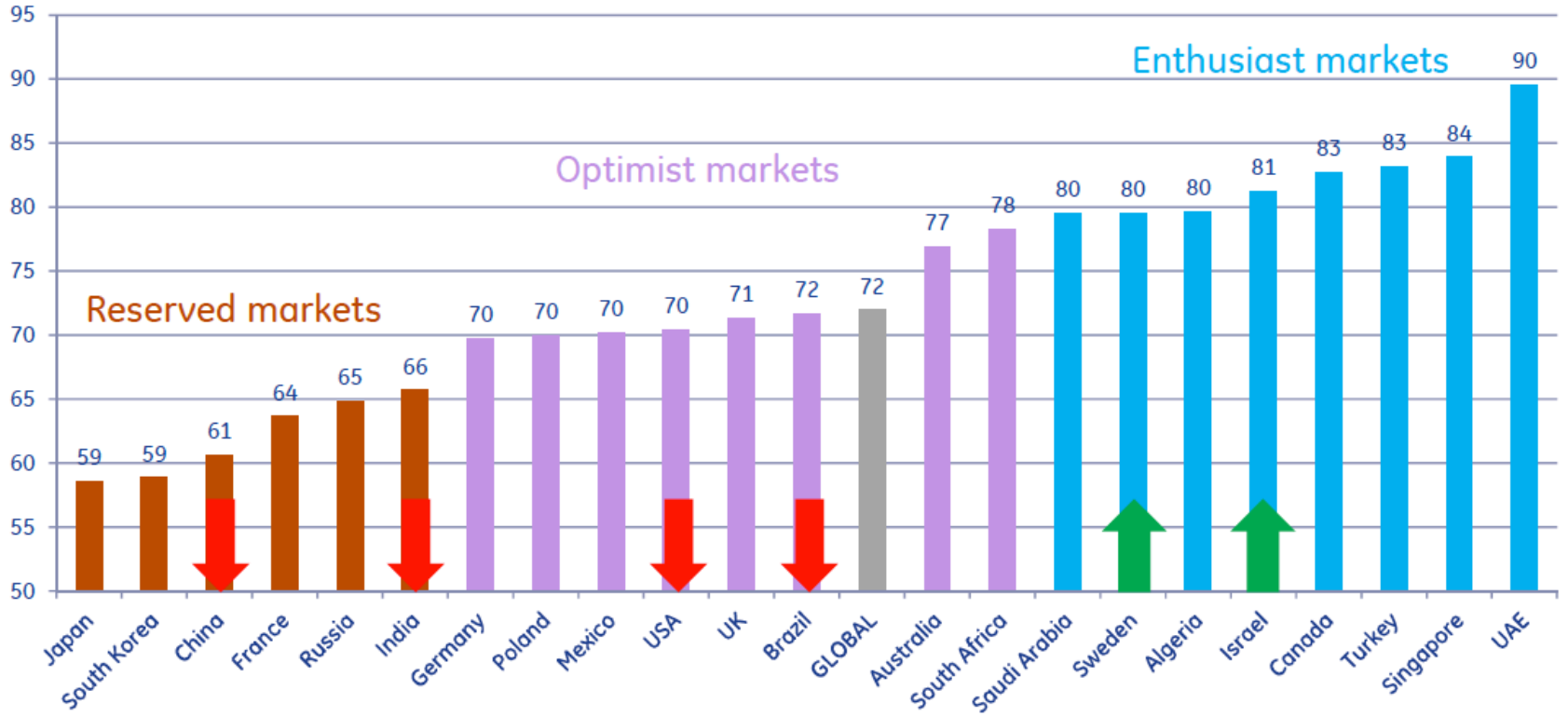


ZJU LU 技术管理 Technology Management

http://www.ge.com/innovationbarometer/

How optimistic business feels that innovation will result in better life (by market)

Innovation Optimism Index: Hundred-point index illustrates how optimistic business is that innovation will successfully convert into improved quality of life for citizens. Arrows indicate year-over-year trends

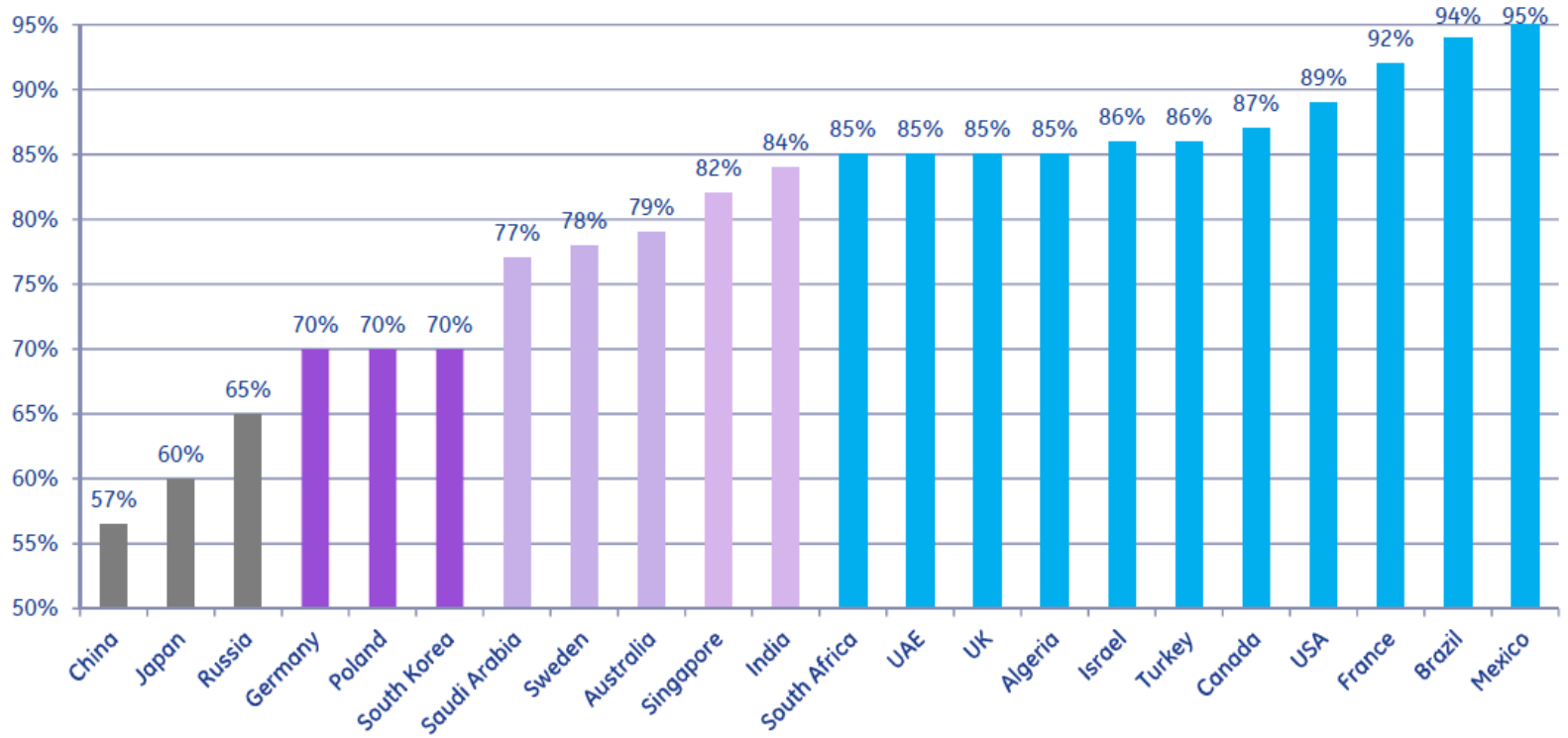


ZJU LU 技术管理 Technology Management

http://www.ge.com/innovationbarometer/

Harnessing the innovative potential of SMEs and individuals (by country)

More than ever before, SMEs and individuals can be as innovative as large companies (% Agree)

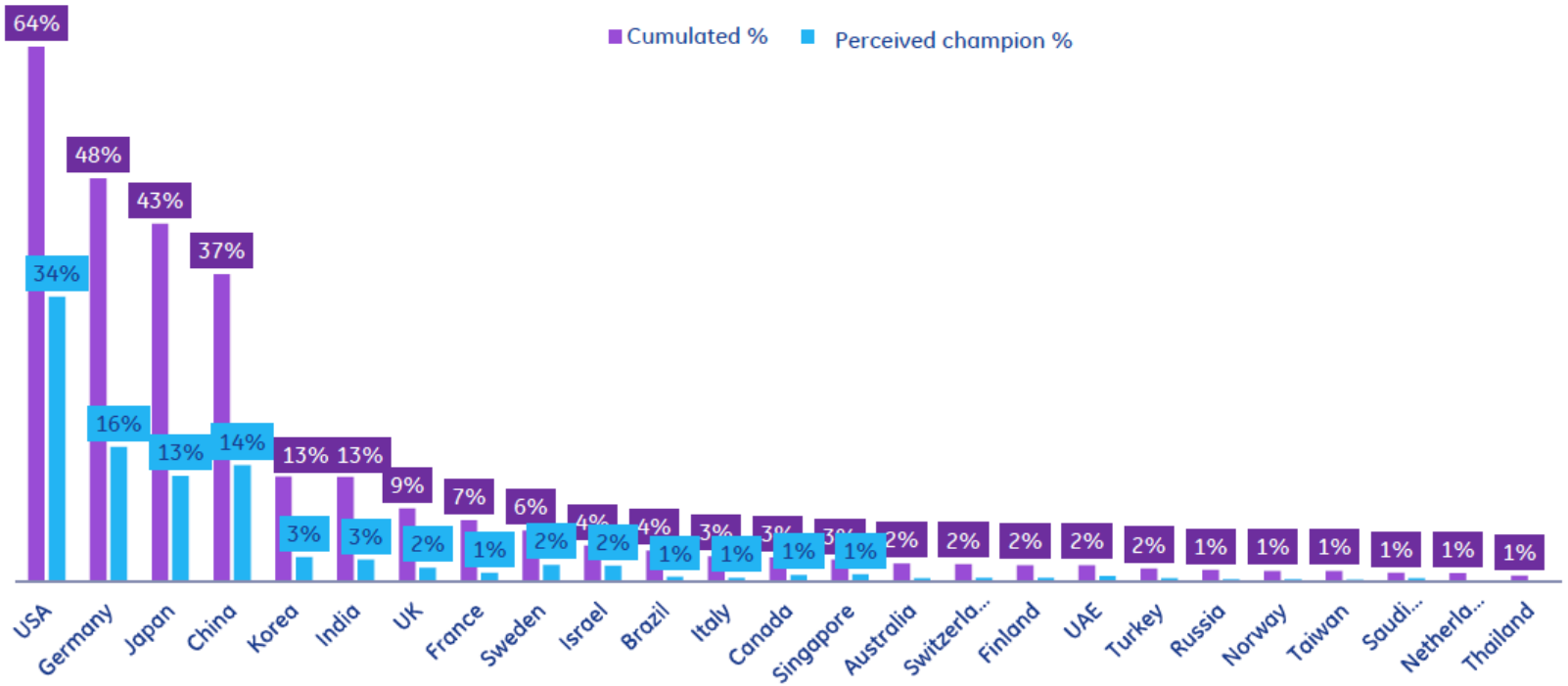


ZJU LU 技术管理 Technology Management

http://www.ge.com/innovationbarometer/

The countries with the best innovation reputation (Respondents asked to identify and rank top 3 leaders)

What are the 3 countries that you see as leading innovation champions? Respondents asked to identify one country they regarded as the clear champion. Respondents allowed to name their own country.



ZJU LU 技术管理 Technology Management

http://www.ge.com/innovationbarometer/

SWEDEN

national innovation strategy

*meet global social challenges

* continue to strengthen the competitiveness of Sweden-based companies in international markets

* provide good quality welfare and social services

ZJU LU 技术管理 Technology Management

EUROPEAN UNION

THE INNOVATION UNION

* Improved access to finance

* Innovation-friendly rules and regulations

* Accelerated interoperable standard-setting

* Cheaper patenting

* Innovation supported by the public sector

* Innovation Partnerships

* Easier participation in EU research/innovation programmes

EUROPEAN UNION

horizon 2020

* 2014-2020, €80 billion budget

* Strengthen the EU's position in science with a dedicated budget of € 24 598 million.

* Strengthen industrial leadership in innovation € 17 938 million.

* Provide € 31 748 million to help address major concerns shared by all Europeans (climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population.)

ZJU LU 技术管理 Technology Management

Rank	Company	Country	Sales	Profits	Assets	Market Value
1	Exxon Mobil	United States	$433.5 B	$41.1 B	$331.1 B	$407.4 B
2	JPMorgan Chase	United States	$110.8 B	$19 B	$2,265.8 B	$170.1 B
3	General Electric	United States	$147.3 B	$14.2 B	$717.2 B	$213.7 B
4	Royal Dutch Shell	Netherlands	$470.2 B	$30.9 B	$340.5 B	$227.6 B
5	ICBC	China	$82.6 B	$25.1 B	$2,039.1 B	$237.4 B
6	HSBC Holdings	United Kingdom	$102 B	$16.2 B	$2,550 B	$164.3 B
7	PetroChina	China	$310.1 B	$20.6 B	$304.7 B	$294.7 B
8	Berkshire Hathaway	United States	$143.7 B	$10.3 B	$392.6 B	$202.2 B
9	Wells Fargo	United States	$87.6 B	$15.9 B	$1,313.9 B	$178.7 B
10	Petrobras-Petróleo Brasil	Brazil	$145.9 B	$20.1 B	$319.4 B	$180 B

http://www.forbes.com/global2000/

Rank ▲	Company	Country	Sales	Profits	Assets	Market Value
5	ICBC	China	$82.6 B	$25.1 B	$2,039.1 B	$237.4 B
7	PetroChina	China	$310.1 B	$20.6 B	$304.7 B	$294.7 B
13	China Construction Bank	China	$68.7 B	$20.5 B	$1,637.8 B	$201.9 B
19	Agricultural Bank of China	China	$62.4 B	$14.4 B	$1,563.9 B	$154.8 B
21	Bank of China	China	$60.8 B	$15.8 B	$1,583.7 B	$129.1 B
24	Sinopec-China Petroleum	China	$391.4 B	$11.6 B	$179.8 B	$104.2 B
65	China Life Insurance	China	$56 B	$5.1 B	$214.1 B	$76.5 B
100	Ping An Insurance Group	China	$42.2 B	$3 B	$362.8 B	$55 B
108	Bank of Communications	China	$24.9 B	$5.9 B	$598.5 B	$48.8 B
126	China Shenhua Energy	China	$33.1 B	$7.3 B	$63.6 B	$84.2 B

Rank ▲	Company	Country	Sales	Profits	Assets	Market Value
135	Nordea Bank	Sweden	$21.7 B	$3.4 B	$933.3 B	$39.7 B
183	Volvo Group	Sweden	$45 B	$2.6 B	$49.7 B	$31.5 B
239	Ericsson	Sweden	$32.9 B	$1.8 B	$39 B	$32.4 B
280	SEB	Sweden	$13.5 B	$1.6 B	$344.5 B	$16.5 B
282	Svenska Handelsbanken	Sweden	$10.9 B	$1.8 B	$358 B	$20.9 B
294	TeliaSonera	Sweden	$15.1 B	$2.7 B	$35.9 B	$29.9 B
311	Swedbank	Sweden	$10.3 B	$1.7 B	$270.8 B	$19.5 B
489	H&M	Sweden	$16.3 B	$2.3 B	$8.7 B	$61.6 B
528	Atlas Copco	Sweden	$11.8 B	$1.9 B	$10.8 B	$31.4 B
578	Sandvik	Sweden	$13.6 B	$0.8 B	$14.4 B	$19 B

http://www.forbes.com/global2000/

Europe rank 2012	Europe rank 2011	Company	Country	Sector	Market value $m
1	1	Royal Dutch Shell	UK	Oil & gas producers	222,425.1
2	2	Nestle	Switzerland	Food producers	207,376.0
3	4	HSBC	UK	Banks	160,670.0
4	6	Novartis	Switzerland	Pharmaceuticals & biotechnology	151,760.6
5	9	Roche	Switzerland	Pharmaceuticals & biotechnology	151,496.6
6	3	Gazprom	Russia	Oil & gas producers	145,761.1
7	8	BP	UK	Oil & gas producers	140,270.6
8	5	Vodafone Group	UK	Mobile telecommunications	136,591.9
9	7	Total	France	Oil & gas producers	120,367.8
10	19	Anheuser-Busch Inbev	Belgium	Beverages	117,160.8
11	13	GlaxoSmithKline	UK	Pharmaceuticals & biotechnology	112,519.1
12	17	Sanofi-Aventis	France	Pharmaceuticals & biotechnology	103,977.0
13	26	British American Tobacco	UK	Tobacco	98,888.7
14	22	Unilever	Netherlands/UK	Food producers	94,797.5
15	14	Eni	Italy	Oil & gas producers	93,819.8
16	10	Siemens	Germany	General industrials	92,156.6
17	28	LVMH	France	Personal goods	87,107.2
18	20	StatoilHydro	Norway	Oil & gas producers	86,423.1
19	31	SAP	Germany	Software & computer services	85,703.2
20	27	Basf	Germany	Chemicals	80,246.7
21	24	BG Group	UK	Oil & gas producers	78,569.3
22	12	Rio Tinto	UK	Mining	77,677.5
23	32	Volkswagen	Germany	Automobiles & parts	77,463.5
24	16	Rosneft	Russia	Oil & gas producers	75,652.6
25	11	Telefonica	Spain	Fixed line telecommunications	74,663.5
26	33	L'Oreal	France	Personal goods	74,020.5
27	25	Sberbank of Russia	Russia	Banks	72,185.5
28	15	Banco Santander	Spain	Banks	69,742.8
29	42	Novo Nordisk	Denmark	Pharmaceuticals & biotechnology	65,338.4
30	30	Daimler	Germany	Automobiles & parts	64,541.5
31	23	BHP Billiton	UK	Mining	64,369.7
32	49	SABMiller	UK	Beverages	63,841.2
33	65	Diageo	UK	Beverages	60,153.4

http://www.ft.com/intl/companies/ft500

Agenda

09.15-10.00 Innovation climate in China (JunJin)

10.00-10.15 break

10.15-11.00 Innovation climate in Sweden (Andreas and Charlotta)

11.00-11.15 break

11.15-12.00 Examples from production (Charlotta and Qinmin)

ZJU LU 技术管理 Technology Management

Examples from Production

From: manual production

To: automated production

⇒A journey of 100+ years

⇒ A journey filled with many innovations

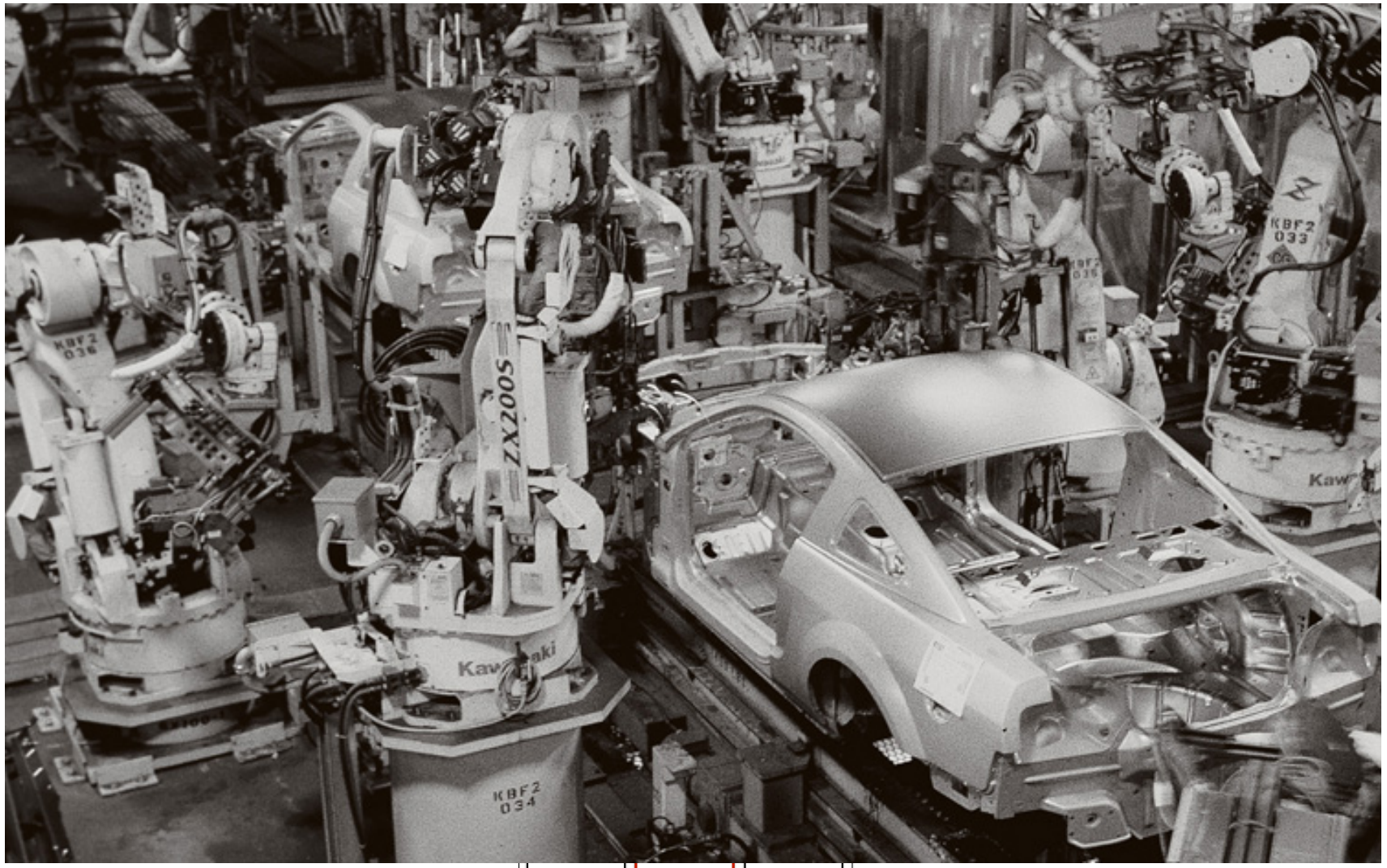
ZJU LU 技术管理 Technology Management

Manual production

A flywheel assembly line at the Ford Motor Company's Highland Park, Mich., plant in 1913.

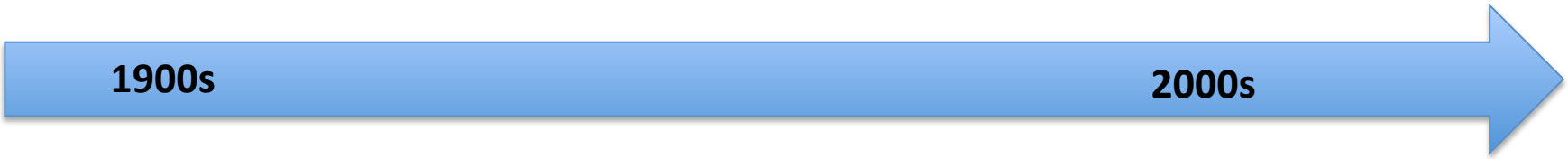
ZJU LU 技术管理 Technology Management

Automated production



Automated production

Timeline

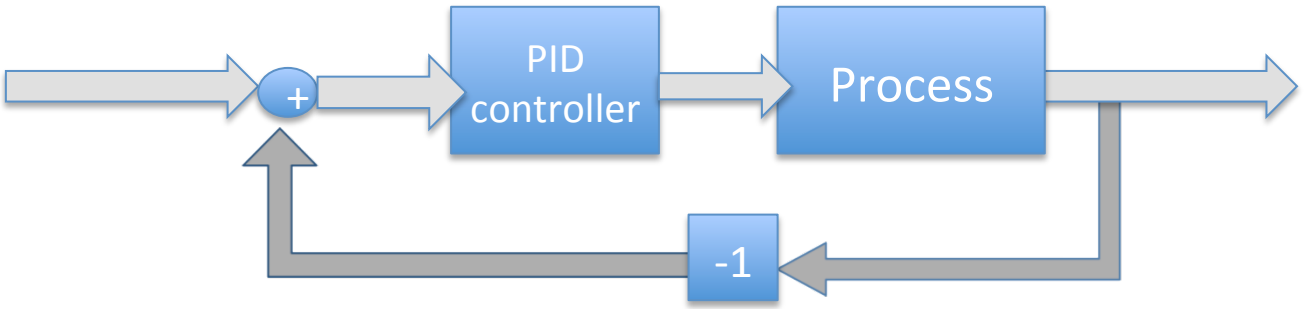


Systems	Mostly manual		**PLC & DCS**	ERP	MES	**BI**
Calculation Methods		**PID Control**		**Adaptive Control**		**Model Predictive Control**
Equipment	Instruments		Mechanical, Pneumatic, Hydralic		IT	**Robots**

ZJU LU 技术管理 Technology Management

PID control

What is it: PID is a feedback mechanism used in industrial control systems.



PID is the most commonly used feedabck controller today.

A PID controller calculates an "error" value as the difference between a measured process variable and desired setpoint. The controller attempts to minimize the error by adjusting the process control inputs.

ZJU
LU
技术
管理
Technology Management

PID control

Inspiration:

First PID controller was launched in 1890 where it was developed for automatic ship steering.

One of the earliest examples of PID controller was done by the American inventor Elmer Sperry in 1911. Sperry was active in the ship industry (inventor of gyrocompass).

PID control

Ideation:

The first trials were made in USS New Mexico. It was used to control the angular velocity of a rudder. The PID controller was performing better than a helmsmen.

The navy did ultimately not adopt the controller due to resistance by personnel.

One of the first academic papers about PID controller was published in 1922 by the Russian American engineer Nicolas Minorsky.

ZJU LU 技术管理 Technology Management

PID control

Implementation:

The PID controller later had success within the process industry.

Today the PID controller is the most frequently used industrial controller.

PID control

Implementation:

An medium-sized average production plant in the process industry

- has about 50-500 control loops
- has about 200-5000 variables that are measured
- Is measuring the variables with a scan interval of 1-15 seconds.
- Is generating about 1 GB per day (1 GB = 1 000 000 000 bytes)
- Is storing the data forever.

ZJU LU 技术管理 Technology Management

PLC and DCS

What is it: Programmable Logic Controller (PLC) and Distributed Control System (DCS) are systems for industrial automation.

Features safety and reliability

PLC origins from discrete control

DCS origins from analog control

Becoming more and more similar

ZJU LU 技术管理 Technology Management

PLC and DCS

Inspiration: Desire to replace cabinets of expensive, inflexible, and work intensive analog equipment with computer programs.

Ideation:

- DCS: Early study by TRW (aerospace and automotive company) and Texaco (oil company) to use computers for analog control. Started in 1956, running in 1959.
- PLC: Proposed replacement for relay cabinets by General Motors in 1968. Modicon, the first PLC, was released in 1969.

PLC and DCS

Implementation: PLC and DCS are today typically implemented using:

- Microcomputers for execution in realtime
- IO modules for interaction with the reality
- Fieldbuses, e.g. PROFIBUS, for IO communication
- Ordinary PC servers for non-realtime features, e.g., data logging and interaction with business systems
- Ordinary PC for development and maintenance
- Ordinary PC for operator interfaces

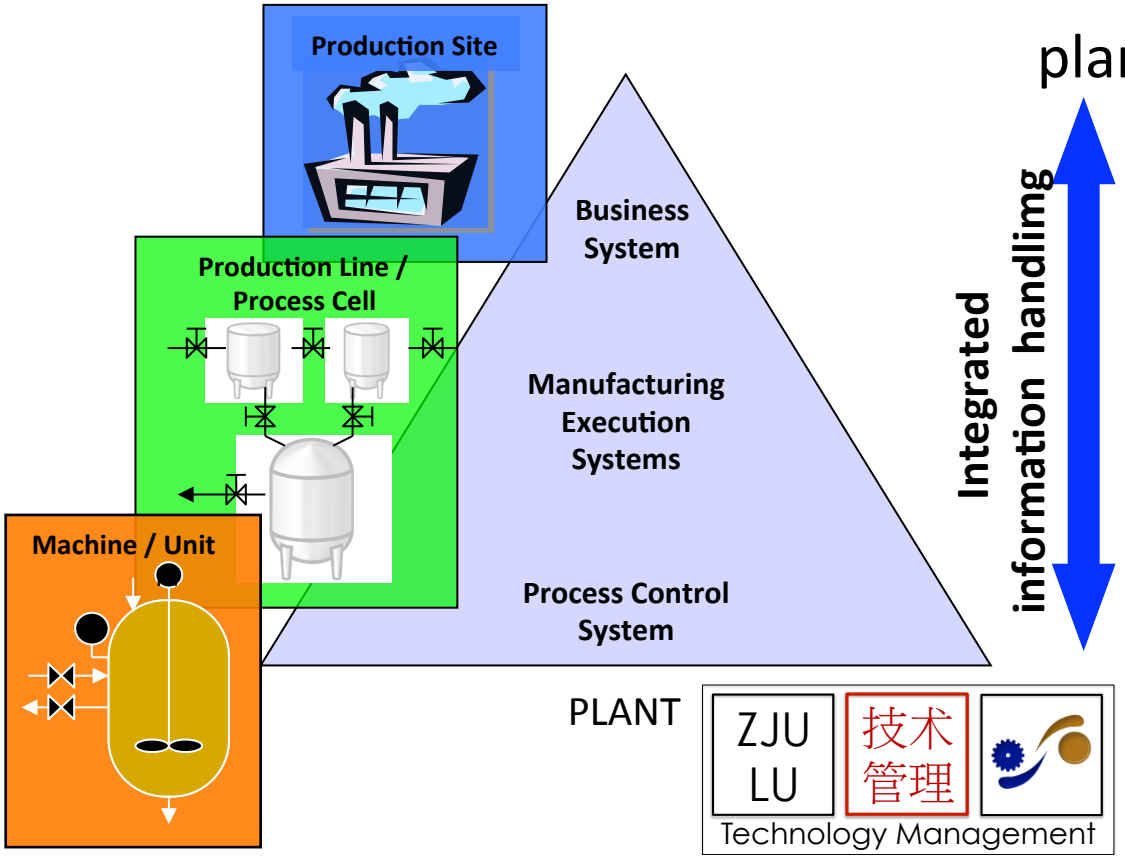
Custom components for improved safety, reliability, and availability:

- Safety classification
- Hardware redundancy. Can continue executing if a component breaks. The broken component can be replaced during execution.

Business Intelligence

What is it: Business intelligence is about using, organizing, and interpreting data to secure competitive advantage within acompany.

To transform data from the production plant into knowledge valuable when making strategic decisions.



Business Intelligence

Inspiration: With todays technology it is easy to collect a lot of data from the production plants and to store them in historical databases. Knowledge about the production performance could be obtained by analyzing all this data.

- For an average site with about 1000-10 000 variables and about 100-1000 control loops (PID controllers), it would be reasonable to calculate a few important performance indicators.

- This will partly be an answer to the industry-wide problem of having ”poor visibility into plant operations” and to start utilizing ”the hidden resource that data is known to be”.

ZJU LU 技术管理 Technology Management

Business Intelligence

Ideation: Analytics applications with prebuilt data models can be a catalyst for shortening the learning curve and speeding up the adoption of an analytics culture in your organization.

- Research has showed that organizations with outstanding performance levels are more likely to have an analytics culture. And now, more than ever before, executives regard business analytics to be a critical component in competitiveness.

Business Intelligence

Implementation: The company has 10 production plants. They share utilities such as electricity, heating system, cooling water, etc. If a utility fails the production has to stop.

They know exactly how to control the temperature in the heating system and the flow of the cooling water.

… but do they know which utility that fails most often? Or that utility that generates the biggest economical loss?

ZJU LU 技术管理 Technology Management

Business Intelligence

Implementation: BI is a growing trend within production.

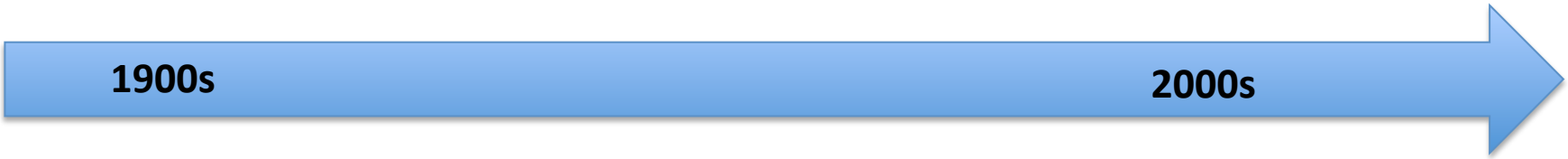
- Typical for Business movers (> 10% improvement in one or several financial metrics) is that they:
  1) Have well defined KPIs
  2) Have informed employees
  3) use IT systems to get measurements, calculate KPIs and display the results, i.e. BI.

  Reference: MESA and Industry Directions survey ”Metrics that Matter”, Oct 2006.

- A technical and management understanding is important!

ZJU LU 技术管理 Technology Management

Timeline



Systems	Mostly manual		**PLC & DCS**	ERP	MES	**BI**
Calculation Methods		**PID Control**		**Adaptive Control**		**Model Predictive Control**
Equipment	Instruments		Mechanical, Pneumatic, Hydralic		IT	**Robots**

ZJU LU 技术管理 Technology Management

Model Predictive Control

What is it: Model Predictive Control (MPC) is an advanced method of process control strategy that has been widely used in the process industries such as chemical plant, power plants, and oil refineries.

- It was first introduced in 1980s. The most applied advanced control technique in the process industries.
- It has >4600 worldwide installations + unknown number of "in-house" installations (Result of a survey in 1999).

ZJU LU 技术管理 Technology Management

Model Predictive Control

Inspiration: How to build a model of a dynamical system has been investigated since the birth of physics. With a model, the behavior of a complex system can be represented by a math equation (usually a differential or difference equation).

- With great power comes great responsibility.

- "spiderman"

ZJU LU 技术管理 Technology Management

Model Predictive Control

Ideation: MPC predicts the change in the output/response of the system caused by changes in the input/control signal.

- Specifically, MPC uses the current plant measurements, the current dynamic state of the process, the models, and the process variable targets and limits to calculate future changes in the control signal. These changes are calculated to hold the system output close to target.

Model Predictive Control

Implementation:

- Step 1: define the input, output, limit, etc.
- Step 2: build a model of the system.
- Step 3: define the performance index.
- Step 4: configure the MPC controller and enter initial tuning parameters.
- Step 5: test.

Adaptive Control

What is it: Adaptive control is a method which can adjust over time in response to changing conditions and knowledge acquired by the controller to a controlled system with varying or initially uncertain parameters.

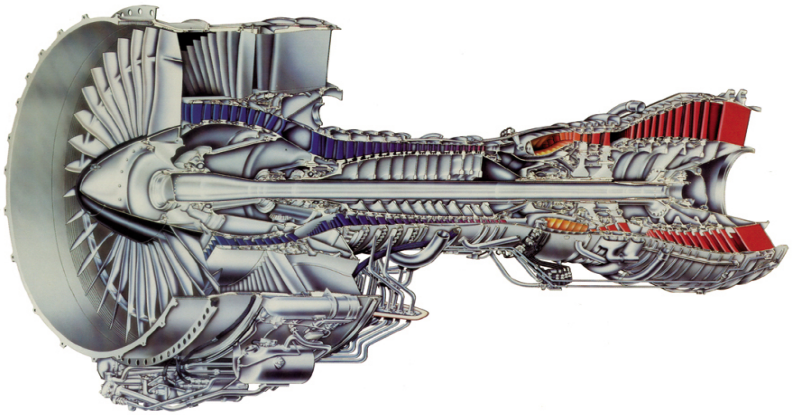
Rather than remaining static or attempting to cope with minor deviations, adaptive control actively responds to changes in the system to improve control performance. This approach is usually needed with dynamic systems in unstable environments, ranging from aircraft to robots.

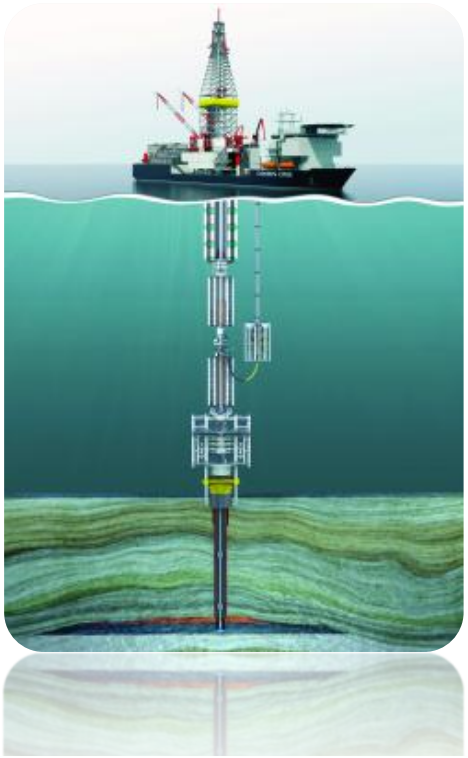
- K. J. Astrom and B. Wittenmark, Adaptive Control, Addison-Wesley, 1989, 2d ed. 1994.

ZJU LU 技术管理 Technology Management

Adaptive Control

Inspiration: An accurate and explicit model of a system to be controlled is sometimes hard or even impossible to obtain. Even worse, some systems change over time.





ZJU LU 技术管理 Technology Management

Adaptive Control

Ideation: With adaptive control, the controller collects data about the environment the system is operating in and uses this information to make adjustments to how the system is controlled.

- Examples of adaptive control can be seen in some vehicles with the ability to adjust automatic braking systems for wet and icy conditions. In these cases, the system responds to the conditions to improve accuracy, effectiveness, and efficiency to make driving safer and easier in a wide variety of settings.

Adaptive Control

Implementation: Designing adaptive control requires a number of skills. In addition to developing a control system, the developer also has to integrate some level of artificial intelligence along with data analysis abilities, allowing the system to gather data and interpret it in meaningful ways. Since changes can happen very rapidly, high processing speed is also required. Systems need to be able to respond to changes in fractions of a second, and ideally to take a proactive rather than retroactive approach to managing changing conditions.

Robotics

What is it: Robotics is the branch of technology that deals with the design, construction, operation, and application of robots and computer systems for their control, sensory feedback, and information processing.

Inspiration: Automated machines/robots are desired to take the place of humans, in hazardous or manufacturing processes.

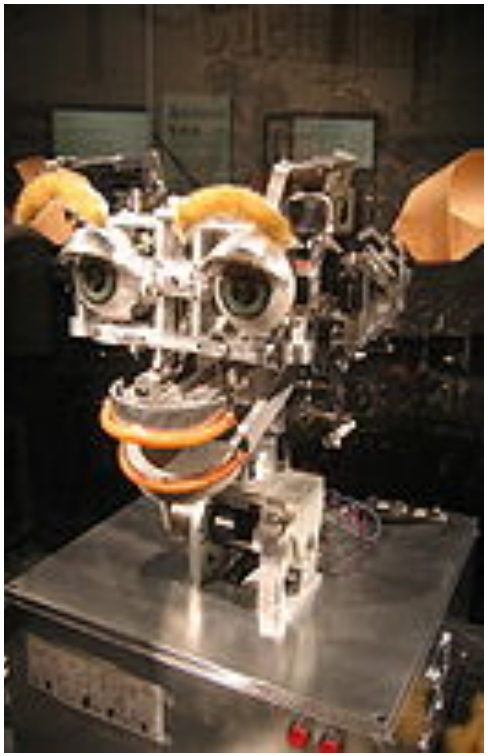
ZJU LU 技术管理 Technology Management

Robotics

Ideation: In 1956, first commercial robot is born, in the Unimation company founded by **George Devol** and **Joseph Engelberger**, based on Devol's patents.

- In 1961, first installed industrial robot appears – Unimation.
- Most popular produces available on market: iRobot, Segway, and etc.

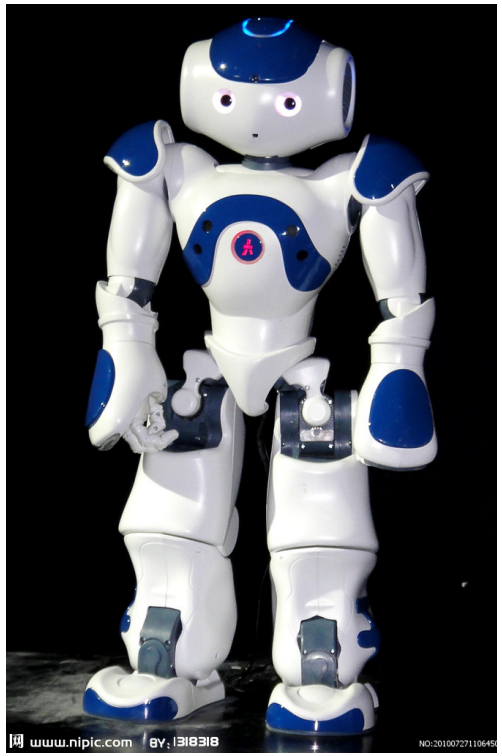
Robotics



Kismet, MIT, USA

iCub, RobotCub Consortium, EU

Terminator



Nao, Aldebaran Robotics, France

ZJU LU 技术管理 Technology Management

Robotics

Implementation: Major components

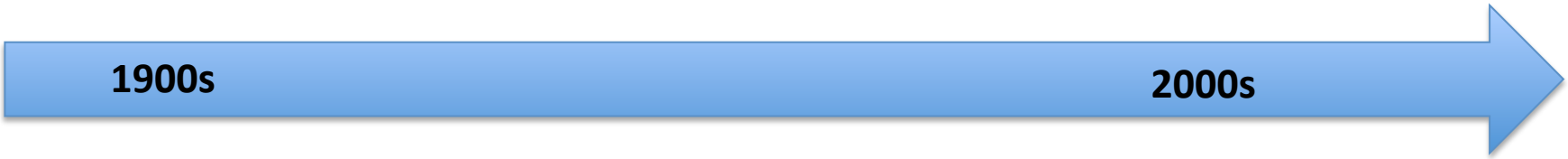
- Power source: Batteries
- Actuation: Motors, artificial muscles, piezo, ...
- Sensing: Vision, lazer, ultrosonic, infrared, ...
- Control: Artificial intelligence, human-robot interaction, environment cognition and navigation, …

Robotics

Implementation:

ZJU
LU
技术
管理
Technology Management

Timeline



Systems	Mostly manual		**PLC & DCS**	ERP	MES	**BI**
Calculation Methods		**PID Control**		**Adaptive Control**		**Model Predictive Control**
Equipment	Instruments		Mechanical, Pneumatic, Hydralic		IT	**Robots**

ZJU LU 技术管理 Technology Management

References
Innovation Climate in Sweden

- Ekvall, Organizational Climate for Creativity and Innovation:
  - http://tinyurl.com/9da29yp (restricted access)
- Isaksen et al, Creating More Innovative Workplaces:
- http://tinyurl.com/8dsago2
- GE Innovation Barometer:
- http://www.ge.com/innovationbarometer/
- Forbes Global 2000:
- http://www.forbes.com/global2000/
- Financial Times 500:
- http://www.ft.com/intl/companies/ft500

ZJU LU 技术管理 Technology Management

References
Examples from Production

- Åström and Murray
  - Feedback Systems
- Alfred Theorin and Vanessa Romero
  - PLC and DCS systems

Agenda

09.15-10.00 Innovation climate in China (JunJin)

10.00-10.15 break

10.15-11.00 Innovation climate in Sweden (Andreas and Charlotta)

11.00-11.15 break

11.15-12.00 Examples from production (Charlotta and Qinmin)

**** Thank you for your attention ****

ZJU
LU
技术
管理
Technology Management