



VIII Astana Economic Forum
High-Level Panel of Asian and European
Knowledge Economy Leaders

What's next after information revolution

The sixth revolution of
Science and technology is on the way



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China Center for Modernization Research
Chinese Academy of Sciences
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Good morning

Hon. Mr. Chairman

dear colleagues

and all friends





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it's my great honor and pleasure
to attend this high-level forum.

My name is HE Chuanqi,
Director of China Center for
Modernization Research,
Chinese Academy of Sciences





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First of all,
I would like to thank Kazakhstan
and someones for their good job and invitation

Thank: organizations

Ministry of Economy, NMH Baiterek, etc.

Thank: friends

Chairman of Baiterek **Kuandyk Bishimbayev**

Mr. Daniyal Serikbayev, Mr. Anuarbek Saltangazin, Ms. Anara Alibayeva, etc.



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Today,
my topic of speech is
what is the next after information revolution

My core idea is that
the information revolution is going to end,
the new revolution is on the way, and
the radical innovation is waiting for you.



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Hon. Mr. Chairman, and all friends,

In the past 16 years (since 1998),
We have published more than 40 books on
the modernization, innovation and revolution.

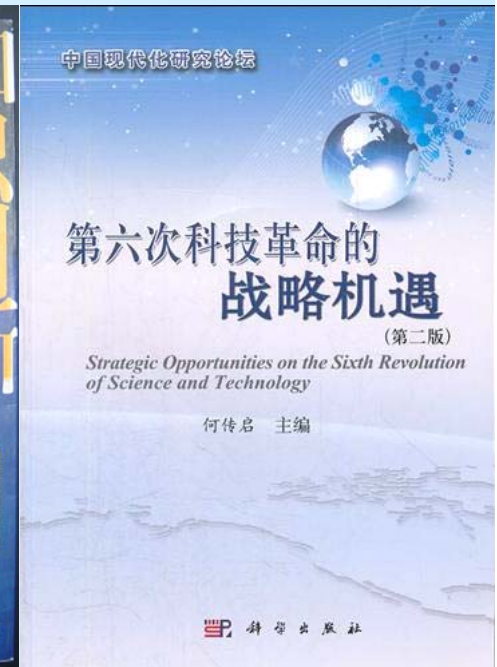
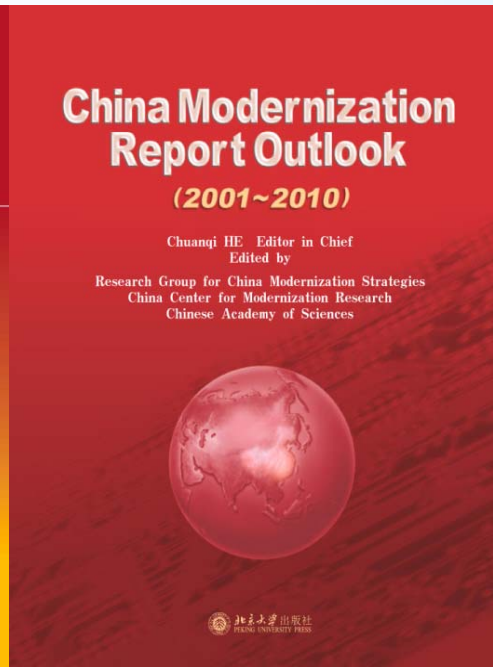
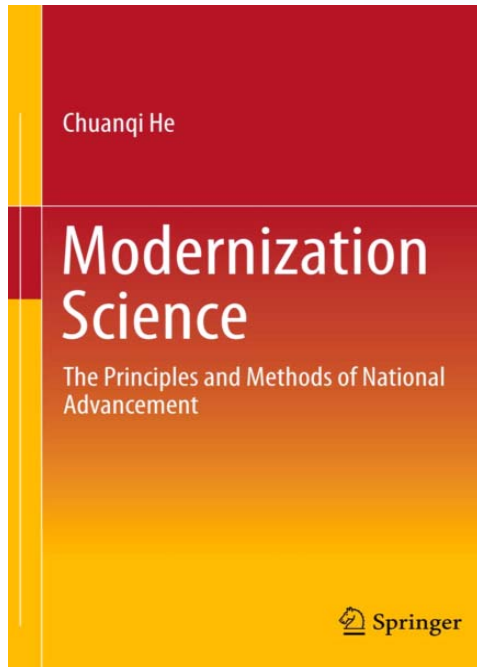
For example,
modernization science,
China modernization report,
knowledge innovation,
Strategic opportunities of sixth revolution
of science and technology, and so on



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More than 40 books on modernization & revolution





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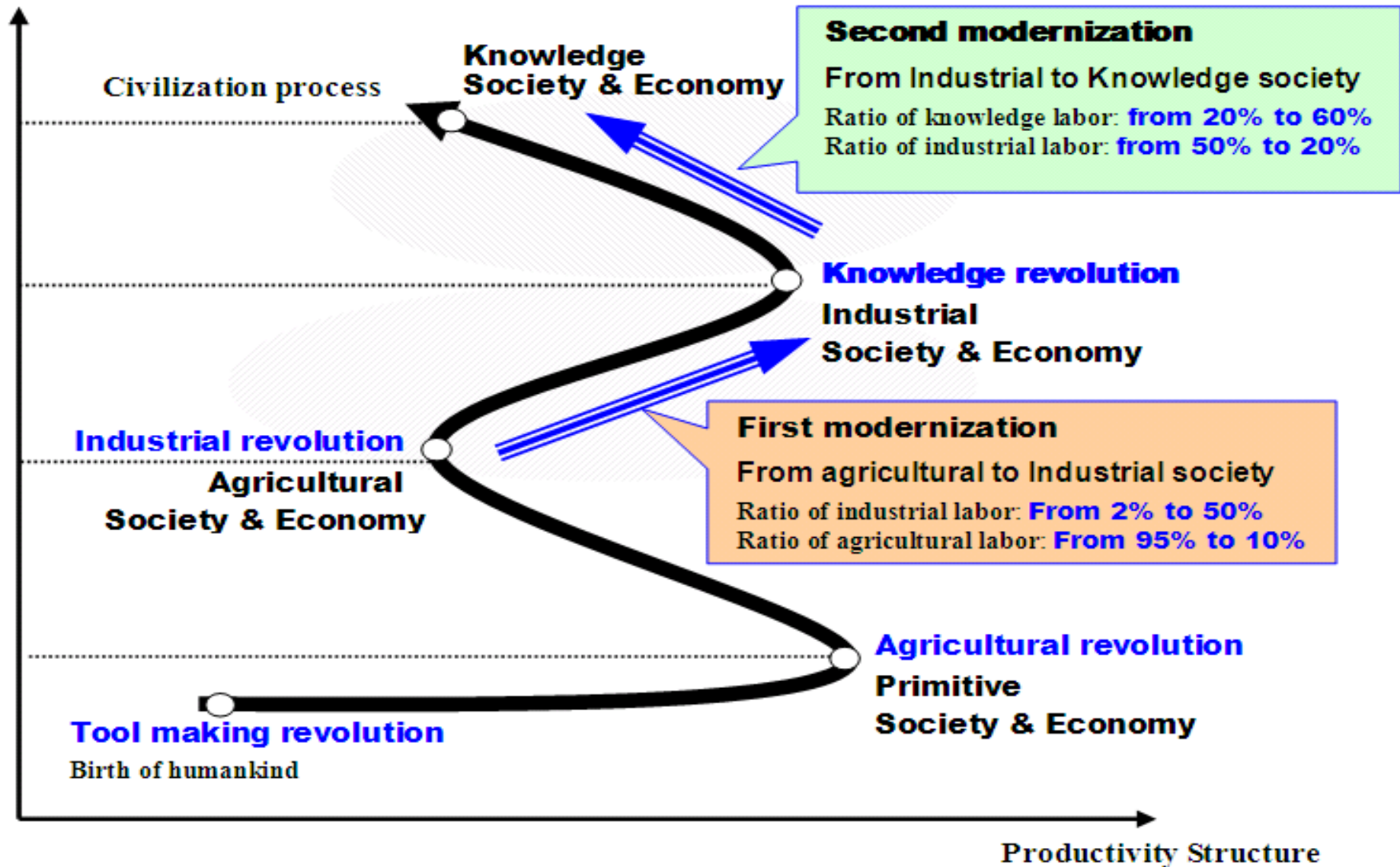
We believe that,
modernization can be divided into two stages
from 18th century to the end of 21st century

First modernization
(1760-1970)
transformation and
change from
agricultural to industrial
economy and society.

Second modernization
(1970-2100)
transformation and
change from
industrial to knowledge
economy and society.



Productivity Level





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We have witnessed that,
the revolution of science, technology and industry
is the driving force of the modernization (Figure 1).

First modernization
(industrial economy)
promoted by three times
revolutions, such as
machinery revolution,
electricity revolution and
automation revolution.

Second modernization
(knowledge economy)
promoted by three times
revolution, such as
information revolution,
new biological and
new physical revolution.



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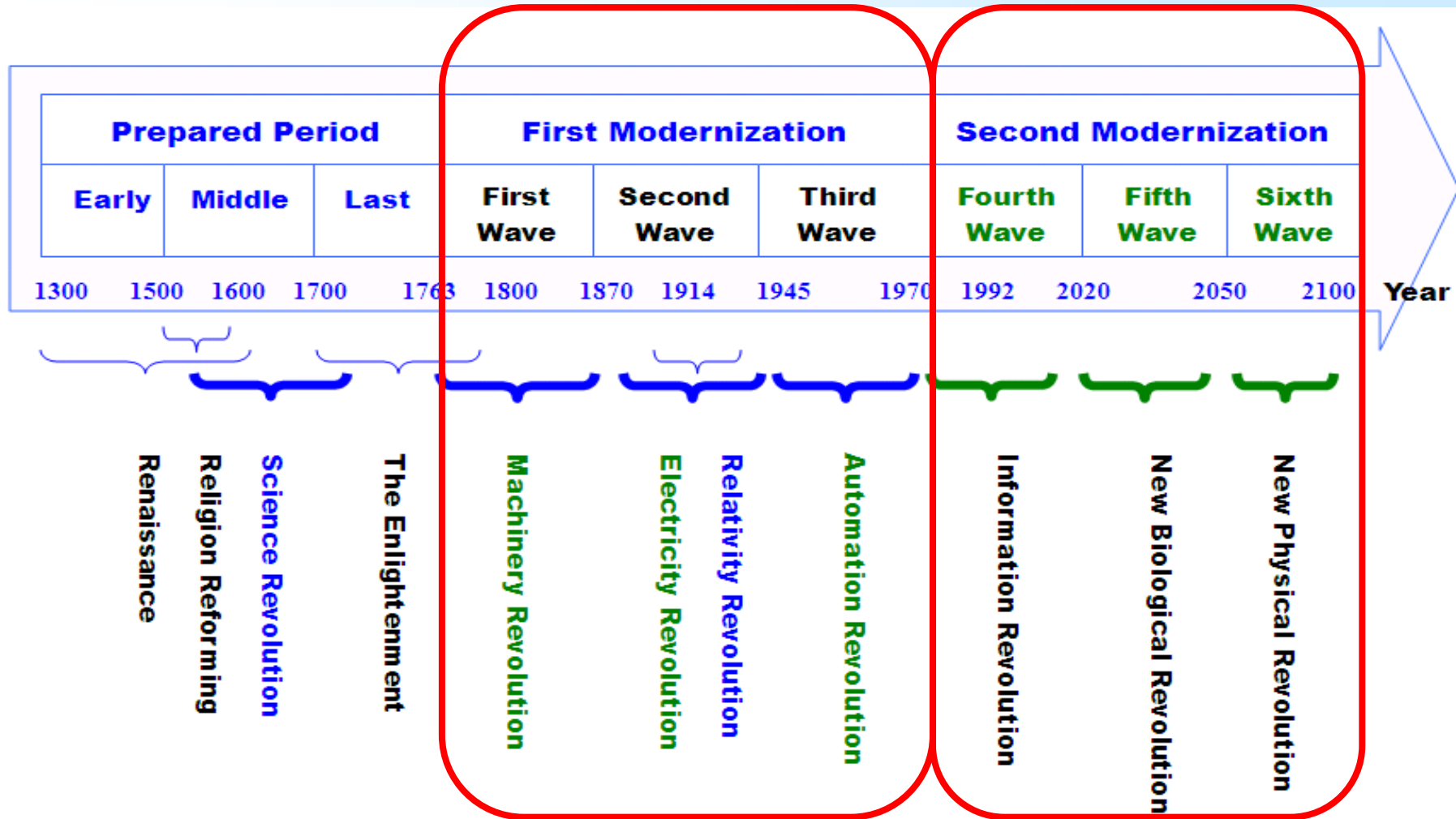


Figure 1 Modernization and revolution since 16th century



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We also witnessed that,
there are two kinds of innovation,
one is incremental innovation,
the other is radical innovation.

In the process of modernization and revolution,
both incremental and radical innovation
are very important to the economic growth,
but the radical innovation is the key factor for success.
So we do need to identify radical innovation in the future.



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Today, I would like to discuss

What's next after information revolution

What's the radical innovation in the future

It includes three parts:

1. When is the end of information revolution
2. What's next one after information revolution
3. What's the proposal on the new revolution



1. When is the end of information revolution

- The information revolution, is the great change and transformation of world economy and human society mainly based on the information and computing technology.
- The first electronic digital computer had been invented in 1945, and some scholars believe that is the **first milestone** of the information revolution.



In the past 60 years,
the information revolution
has changed our world in many aspects ,

such as
computer, internet, mobile phone,
e-mail, e-commerce, e-government,
e-science, network-television,
network-game and digital life and so on.





- In 2011, my book Strategic Opportunities on the Sixth Revolution of Science and Technology (C. He, 2011) was published in China.
- We identified five times revolutions of science and technology since 16th century (Table 1).
- two scientific revolutions,
- three technological revolutions,
- three Industrial revolutions.



Table 1 Revolutions of S&T, industrial revolutions since 16th Century

Revolutions of S&T	Duration	Main Contents	Common name	Industrial Revolution
1 st	16 th ~17 th century	Birth of modern physics (Scientific revolution)	1 st scientific revolution	-
2 nd	18 th century	Revolution of steam engine and machine	1 st technological revolution	1 st Mechanization
3 rd	19 th century	Revolution of electricity and transportation	2 nd technological revolution	2 nd Electrification
4 th	First half of the 20 th century	Revolution of relativity and quantum theory	2 nd scientific revolution	
5 th	Second half of the 20 th century	Revolution of Electronic technology and information technology	3 rd technological revolution	3 rd Automation & Information
6 th	First half of the 21 st century	Revolution of new biology and regeneration	-	4 th Bio-industry
7 th	Second half of the 21 st century	Revolution of new physics and new space-time	-	5 th New-transport



We discovered three features of revolutions of S&T

- Firstly,
revolution of S&T is a historical process
- which has its starting and finishing points,
- contents, features,
- landmark events,
- impact on the world, etc. (Table 2).

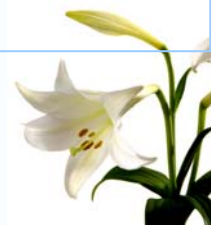


Table 2 Structure of revolutions of S&T since the 16th Century

Revolutions	Landmark	Main Areas	Extended Areas
1 st scientific revolution	Copernicus's astronomy, Newton's mechanics	Modern astronomy and physics etc.	Overall development of modern science
2 nd scientific revolution	Theory of Relativity, Quantum	Physics, theory of Relativity, Quantum mechanics, etc.	Astronomy, genetics, geography, etc.
1 st technological revolution	Steam engine and machinery	Spinner, steam engine, machine tool	Metallurgy, steamship, train, coal etc.
2 nd technological revolution	Electricity and internal combustion engine	Electric generator, internal combustion engine, telecom. technology	Petrochemical, steel, transportation, etc.
3 rd technological revolution (stage one & stage two)	Electron and computer, Information and the Internet	Electronics, computer, control and automation; Microcomputer, information technology, database	Nuclear energy, aerospace, automation; Biology, materials, manufacturing, etc.



- Secondly,
 - The technological revolution and the industrial revolution are the two side of one coin, to some content.
-
- Three times technological revolutions with three times industrial revolutions (Table 1)
 - The third technological revolution (industrial revolution) can be divided into two stages:
automation revolution and information revolution.





- Thirdly,
S&T revolutions follow a pattern.
- Each revolution has its specific landmarks, similar structure and different socioeconomic impacts.
- There are differences between a scientific revolution and a technological one.
- The time span tends to be shorter (Table 3).



Table 3 The terms of the five Revolutions of S&T

Revolutions of S&T	Landmarks	The term/ year	Span/ years
1 st scientific revolution	Copernicus's astronomy, Newton's mechanics	1543-1687	144
2 nd scientific revolution	Theory of Relativity, Quantum theory	1900-1926	26
1 st technological revolution	Steam engine and machinery	1698-1825	127
2 nd technological revolution	Electricity and internal combustion engine	1832-1906	74
3 rd technological revolution	Stage one, Computer & automation; Stage two, Internet & Information	1945-1970 1970-2020	75



We considered that,
the Automation and Information Revolution
(the fifth revolution of S&T, third technical revolution)
maybe see the end at 2020 (Table 3),
which last about 70 years

just like Electricity and Transportation Revolution
(the third revolution of S&T, second technical revolution)
Which also lasted about 70 years.



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2. What's the next after information revolution

According to our study,
the 21st century will see about
three times revolutions of S&T.
The sixth one will be discussed below.

- (1) late stage of the information revolution
(second half of the fifth revolution),
- (2) the sixth revolution of S&T
- (3) the seventh revolution of S&T.



2-1 The direction of sixth revolution of S&T

- All the messages indicate that
- the sixth revolution of S&T will probably take place in the field of biology;
- it maybe a revolution of new biology (Table 4).



Table 4 Main fields of revolutions of S&T since 16th Century

Revolutions	The term	Science or technology	Main Fields
1 st	1543-1687	Scientific revolution	Astronomy, physics, etc.
2 nd	1698-1825	Technological revolution	Power (steam engine), machines, etc.
3 rd	1832-1906	Technological revolution	Electricity, transportation, chemical industry, telecommunications, etc.
4 th	1900-1926	Scientific revolution	Physics, etc.
5 th	1945-2020	Technological revolution	Electronics, computer, automation, internet, information, etc.
6 th	2020-2050	Revolution of S&T	New biology, new information tech, Nanotechnology, etc.
7 th	2050-2100	Revolution of S&T	New physics, new energy, space-technology, etc.



2-1 The direction of sixth revolution of S&T

- Sixth revolution of S&T will be a “revolution of new biology and regeneration”,
 - which will take place mainly in the overlap of life science, information technology and nanotechnology (Figure 2.)
-
- From the perspective of scientific revolution, it will be probably one about new biology revolution.
 - From the perspective of technological revolution, it is likely to be regeneration revolution covering bionics, creation and regeneration technologies.



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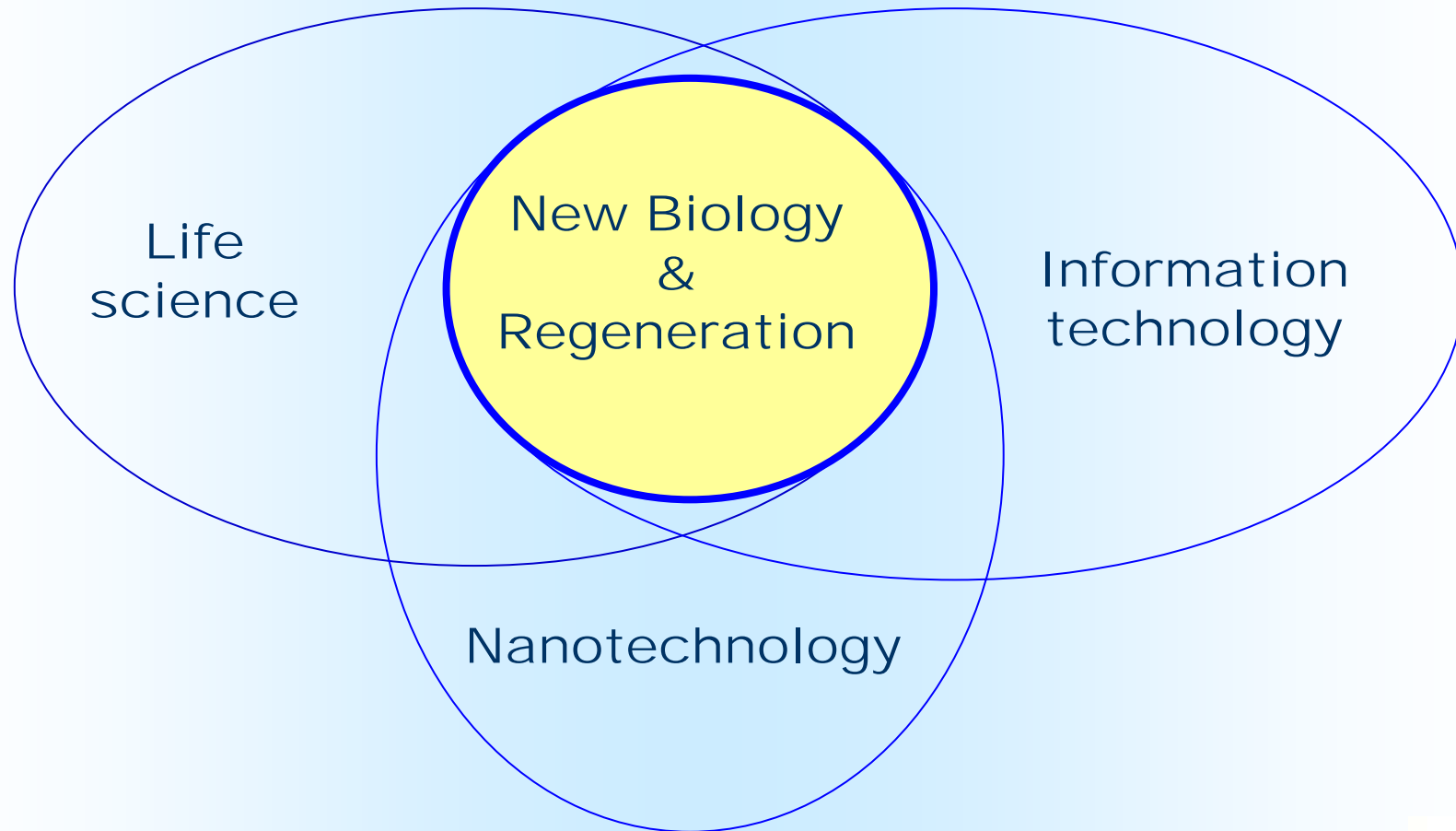


Figure 2 Academic structure of sixth revolution of S&T



2-2 Main contents of sixth revolution of S&T

- First, ten landmarks (Table 5).
- Second, five knowledge innovations.
- Third, five technical innovations
- Forth, two challenges: ethical challenges and side effects

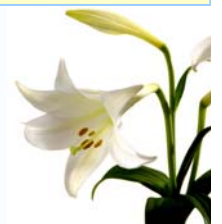


Table 5 Ten landmarks of the sixth revolution of S&T

Landmarks	Contents
Information Exchange Machine (IEM)	Directly exchange information between human brain and computer, bringing about the revolution in learning and education
Information Packet of Personality (IPP)	Contains self-awareness, mind, independent personality and life information of the natural person
Sexual (male or female) Smart Bionic Body (SBB)	Meeting human need for a sex life, leading to the revolution in family and mode of sex life
Regeneration of human body	Achieving the eternity of human body through virtual, bionics and regeneration technologies
Nerve regeneration	Nerve regeneration in human brain
Uterus in vitro	Realizing reproduction in vitro and liberating women, causing the revolution in the mode of reproduction and women's status
Synthetic life	Create new life and living organization
The coupling theory	The couple between cell and cell, life and machine
The integration theory	The integration of organization, life and machine
The theory of eternal life	The principles and methods of eternal life

Table 5 Ten landmarks of the sixth revolution of S&T

Landmarks	Contents
Information Exchange Machine (IEM)	Directly exchange information between human brain and computer, bringing about the revolution in learning and education.
Brain-computer interface (BCI)	Integrated electronic information and brain information into a single knowledge system

August 2013,
 scientists of University of
 Washington, USA,
 “Brain control brain”

Use my brain to control
 your hand by IEM or BCI

More than 200 lab. do it.

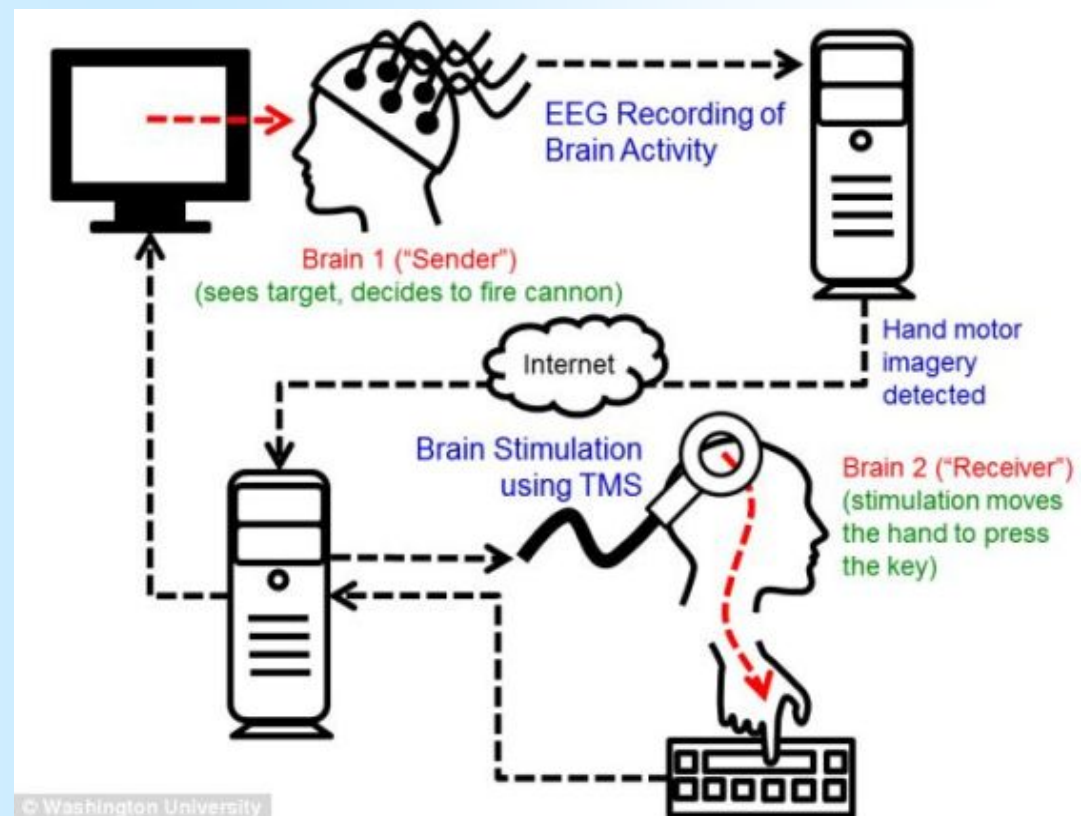


Table 5 Ten landmarks of the sixth revolution of S&T

Landmarks	Contents
Information Packet of Personality (IPP)	Contains self-awareness, mind, independent personality and life information of the natural person

Scholar from Britain forecast that copy the brain into the computer in 2026

American movie *Avatar* give the image of the transfer of human mind from one to other in 2009





Second, five knowledge innovations.

- Integration and creation biology
- Thinking and neurobiology
- Life and bio-regeneration engineering
- Information and bionic engineering
- Nanotechnology and bionic engineering





Third, five technical innovations

- information exchange machine,
- information packet of personality,
- bionic technology,
- bio-creation technology,
- bio-regeneration technology





2-3 Main results of sixth revolution of S&T

Regeneration and Eternity of Human Body

- With the integration of life sciences, information science, nano-science, bionic engineering and robotics as well as the combination of information exchange machine, information packet of personality, sexual smart bionic body, regeneration of human body and the Internet,
- humans will have three new forms of being,
- namely network-based person, bionic person and regenerated person (Table 6),
- By then, every human being will have “four forms of the living”.

Table 6 Roadmap of Regeneration and Eternity of Human Body

Start	Path (a conjecture)	End	Effect
Human body (Natural person)	Information Packet of Personality + Information Exchange Machine + Internet	Networked person	Network-based eternity
	Information Packet of Personality + Information Exchange Machine + Smart Bionic Body	Bionic person	Bionics-based eternity
	Information Packet of Personality + Information Exchange Machine + Regeneration of Human Body	Regenerated person	Replication-based eternity

- The “Information Packet of Personality” refers to the “digital person” that contains “self-awareness, independent personality and life information of the natural person”.
- “Smart Bionic Body” refers to the smart bionic robot with male or female function.
- The “regeneration of human body” refers to the reproduction of human body through the culturing of human somatic cells in vitro.



Four forms of the living

Network-based person is the online image of natural person who obtains needed knowledge and information;

Bionic person is the physical substitute of natural person who does major manual and mental work;

Regenerated person is the new life of natural person who can keep learning and growing;

natural person will be mainly about innovation and leisure.

Specially-made bionic person can adapt to the space environment and take the natural person to space, thus ushering in the Space Era.



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3. What is the proposal on the next revolution

If agreeing with the forecast above
on the sixth revolution of S&T,
we have to do a lot at present.

Here is some suggestions on
discuss topics of Astana Economic Forum.



- What's the last opportunity for the innovation of the information revolution?
- What we can do to deal with the last innovations of information revolution?
- What are the direction and radical innovation of sixth revolution of S&T?
- What are the new industrial revolution accompanying the sixth revolution of S&T?
- What should we do for the coming of sixth revolution of S&T?



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Thank you !
And God Bless You!

Prof. Director, HE, Chuanqi
China Center for Modernization Research
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