Systems Innovation : Its Properties and Impacts on Society Transformation

Hidenori Kimura
Vice Director of Systems Innovation Center
Prof. Emeritus of the Univ. Tokyo

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- **What is Systems Innovation?**
- **Historical Perspectives**
- **Value Shift from Components to Systems**
- **Problems in Japan**
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What is systems innovation?

- **Systems innovation** is an innovation which is materialized through creation of new excellent systems.

What is Systems Innovation?

- **Systems innovation is a new notion that is contrasted with component innovation which has been regarded as usual innovations.**

The two different categories of innovations

- The innovations are divided into the two different categories, **component innovation** and **systems innovation**.
- All the great inventions belong to component innovation.

home appliances, vehicles, medicine, weapons, battery, LSI, machine tools, cameras, printing machines, materials etc.

But component innovation has been the synonym of innovation.

Clayton, M. Christensen
“The Innovations Dilemma” 1997

- All the examples of innovations taken in this famous book are component innovations.

  Hard Desk, Excavation Machine, Insulin,

  Motorcycle,

What is systems innovation?

- **Systems innovation has been neglected in the wide-spread arguments of innovations, because it is sometimes hard to identify the people who lead the systems innovation.**

Examples of Systems Innovation

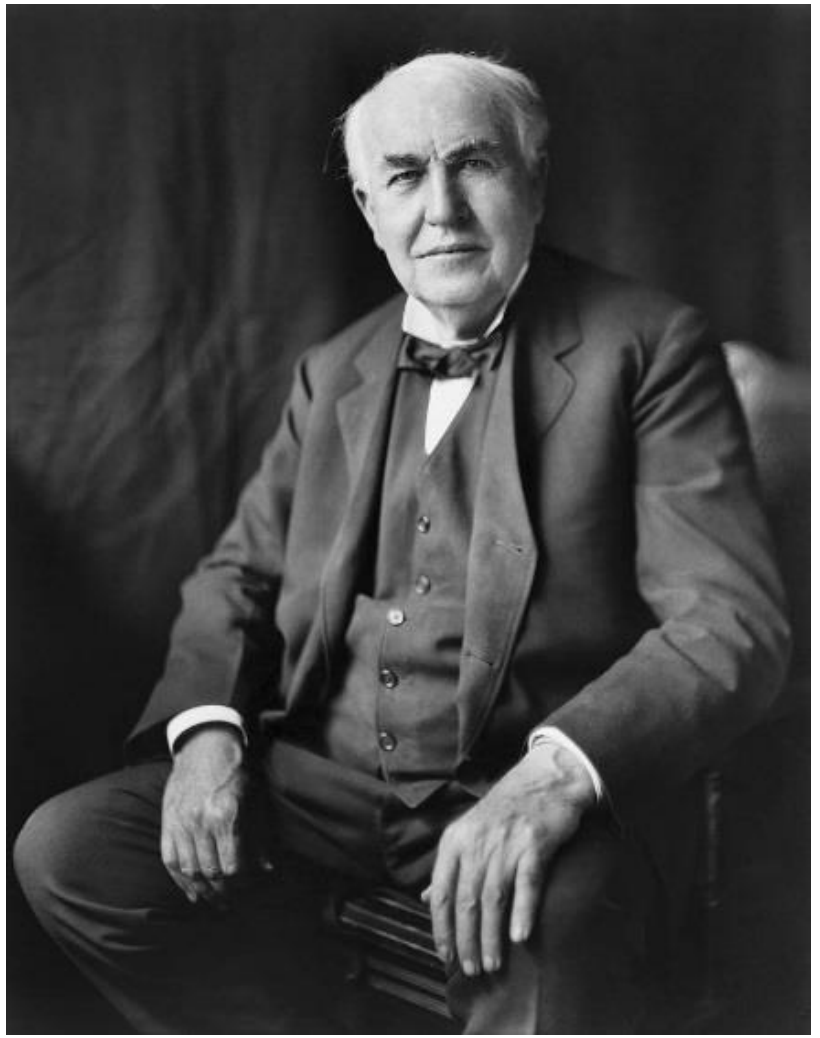
- **Edison's power distribution systems**
- **Ford automobile manufacturing systems**
- **Radar air defense system of UK during World War II.**
- **Apollo Program**
- **Shinkansen by Japanese Railways**
- **Product management system of huge steel making plant in Japan in early 1970's.**
- **Computers**
- **GPS**
- **INTERNET**
- **・ ・ ・ ・ ・**

Historical Remarks on Systems Innovation

- Edison's power distribution systems (1910~1930)
- Ford automobile manufacturing systems (1908~1914)
- Radar air defense system of UK during World War II.
- Apollo Project
- Shinkansen by Japanese Railways
- Product management system of huge steel making plant in Japan in early 1970's.
- Computers
- GPS
- INTERNET
- ・・・・・

Supply Network of Electric Power

The first remarkable example of systems innovation



Thomas Edison (1847~1931)

Edison's Dream

Edison was the only one among those who were competing the invention of incandescent lamp in the end of 19th century, who wished to supply electric power through large scale power distribution network to each user's home.

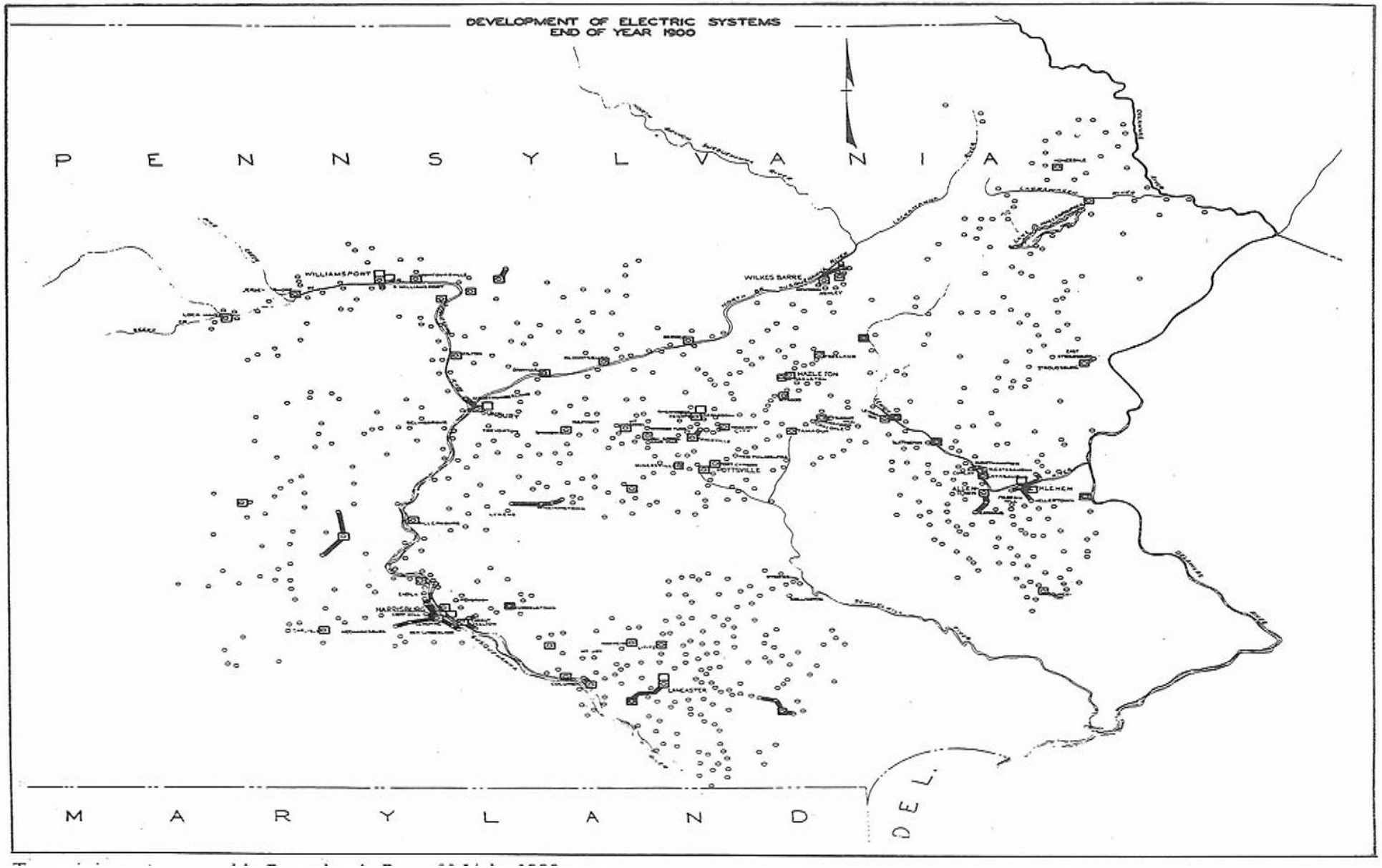
His dream was the creation of systems that enable each user to use electric power at any place and time freely.

“Edison is the first systems engineer in the history of technology.”

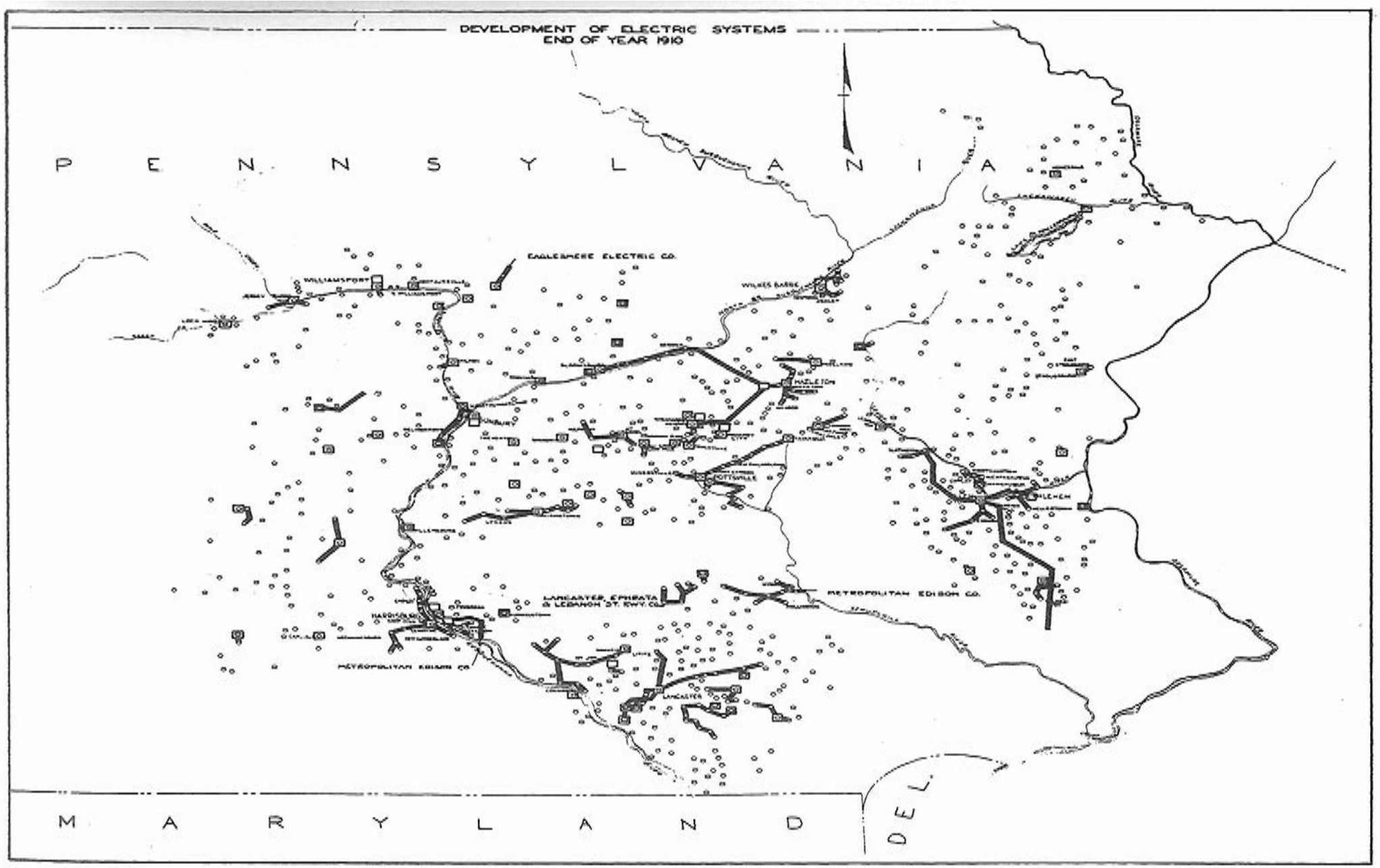
（Thomas Hugh）

- **「Networks of Power」**

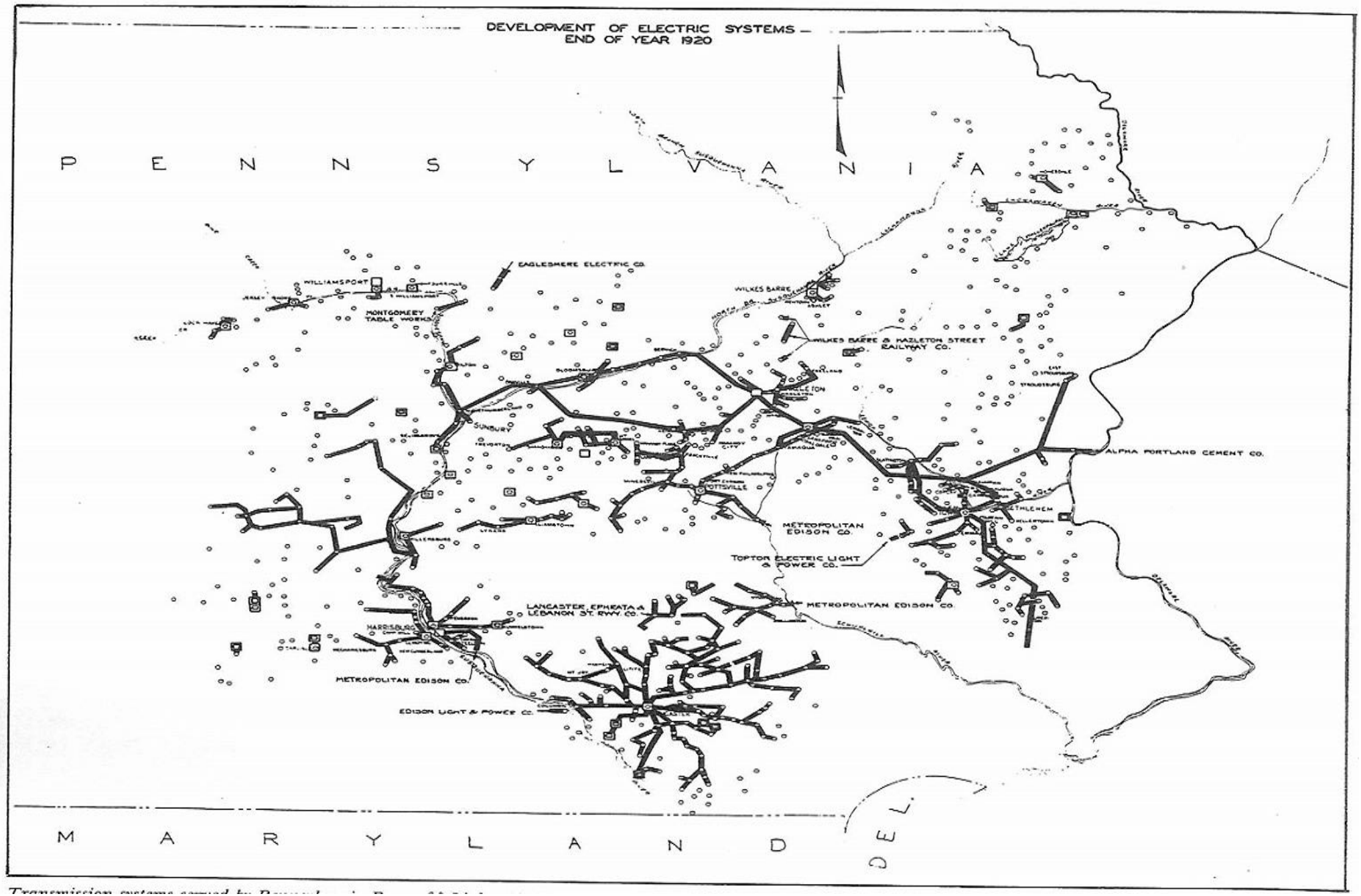
「Growth of an Electric Light and Power System in Pennsylvania」
from “NETWORKS OF POWER” by Thomas P. Hughes



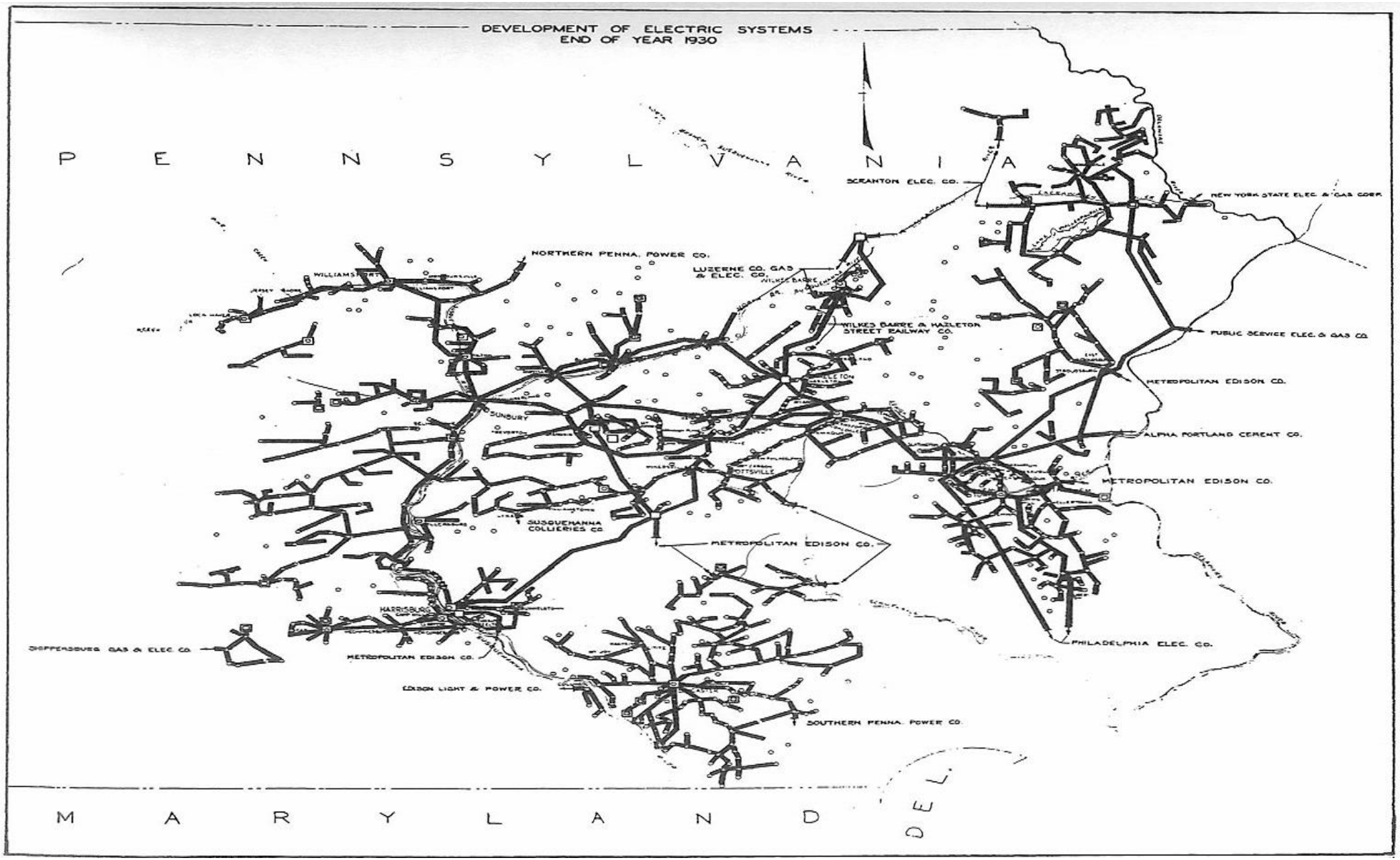
1900


DEVELOPMENT OF ELECTRIC SYSTEMS
END OF YEAR 1910
PENNSYLVANIA
EAGLESMERE ELECTRIC CO.
WILLIAMSPORT
WILKES BARRE
HAZLETON
POTTSVILLE
BETHLEHEM
LANCASTER, EPHRATA & LEBANON ST. RWY. CO.
METROPOLITAN EDISON CO.
METROPOLITAN EDISON CO.
LANCASTER
MARYLAND
DEL.

1910


DEVELOPMENT OF ELECTRIC SYSTEMS —
END OF YEAR 1920
P E N N S Y L V A N I A
M A R Y L A N D
DEL.
EAGLESMERE ELECTRIC CO.
WILLIAMSPORT
MONTGOMERY TABLE WORKS
SUNBURY
WILKES BARRE
WILKES BARRE & HAZLETON STREET RAILWAY CO.
POTTSVILLE
METROPOLITAN EDISON CO.
TOPTON ELECTRIC LIGHT & POWER CO.
ALPHA PORTLAND CEMENT CO.
LANCASTER, EPHRATA & LEBANON ST. RWY. CO.
HARRISBURG
METROPOLITAN EDISON CO.
EDISON LIGHT & POWER CO.

1920

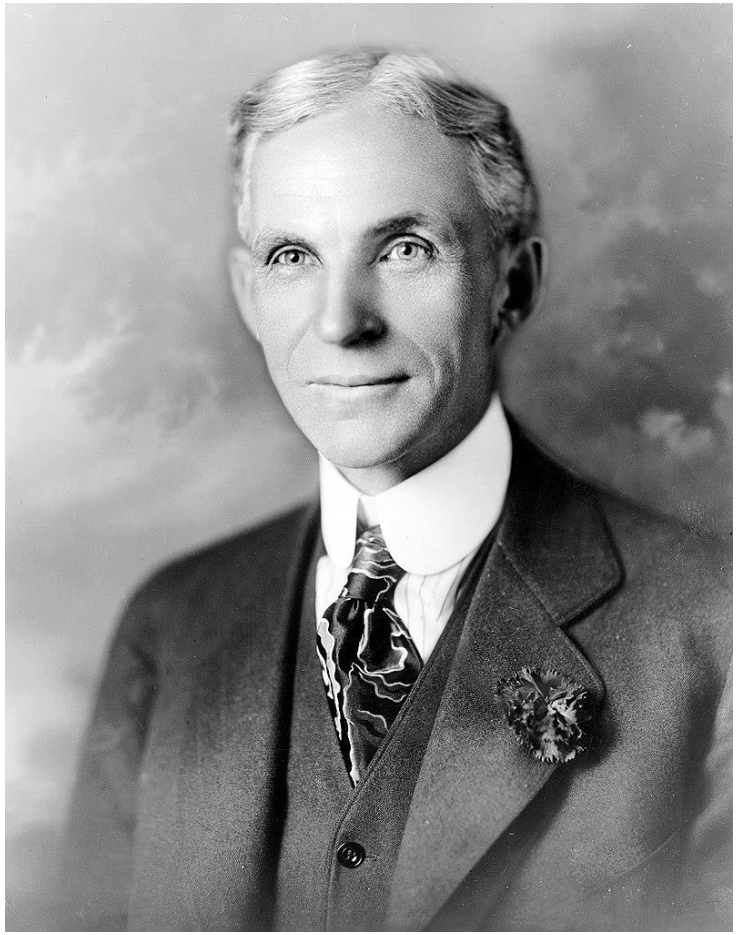

DEVELOPMENT OF ELECTRIC SYSTEMS
END OF YEAR 1930
PENNSYLVANIA
MARYLAND
DELI
SCRANTON ELEC. CO.
NEW YORK STATE ELEC. & GAS CORP.
NORTHERN PENNA. POWER CO.
LUZERNE CO. GAS & ELEC. CO.
WILKES BARRE & HAZLETON STREET RAILWAY CO.
PUBLIC SERVICE ELEC. & GAS CO.
METROPOLITAN EDISON CO.
ALPHA PORTLAND CEMENT CO.
METROPOLITAN EDISON CO.
SUSQUEHANNA COLLIERIES CO.
METROPOLITAN EDISON CO.
PHILADELPHIA ELEC. CO.
METROPOLITAN EDISON CO.
EDISON LIGHT & POWER CO.
SOUTHERN PENNA. POWER CO.

1930

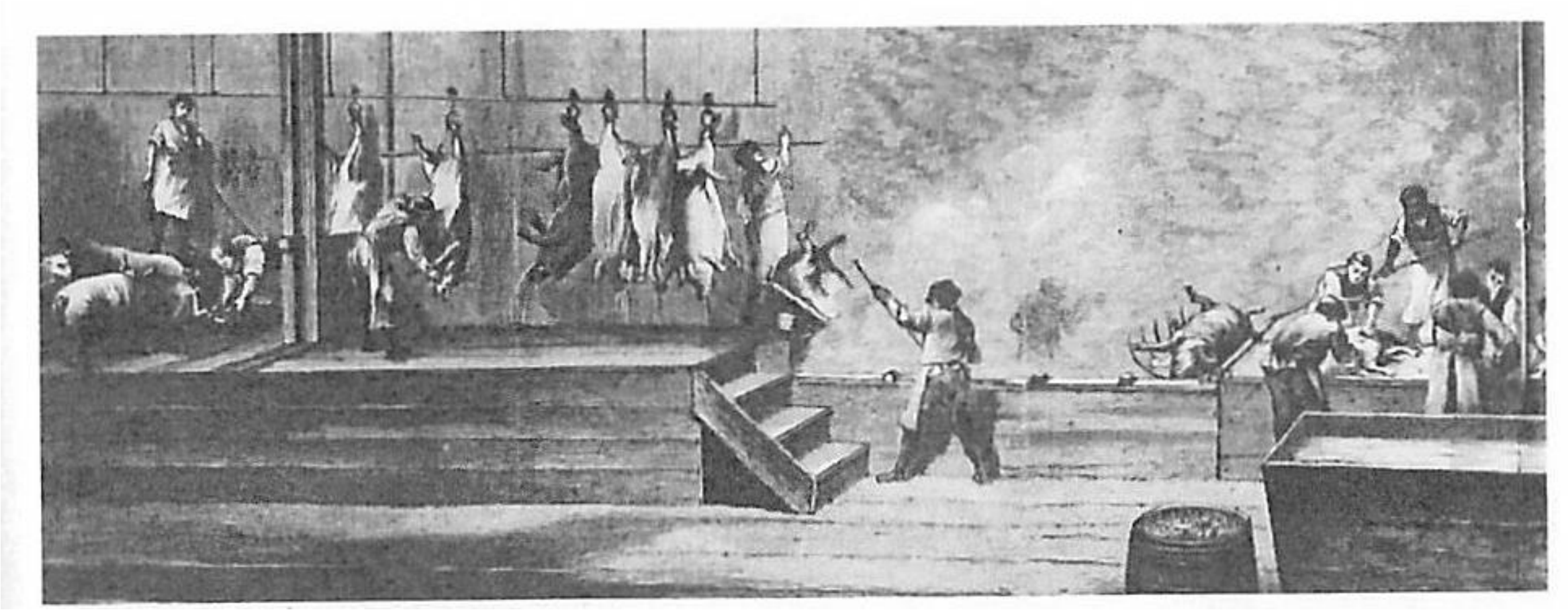
Introduction of conveyer systems in the automobile industry

Second remarkable example of systems innovation.

Revolution of automobile manufacturing through assemble lines that enabled the era of world motorization.



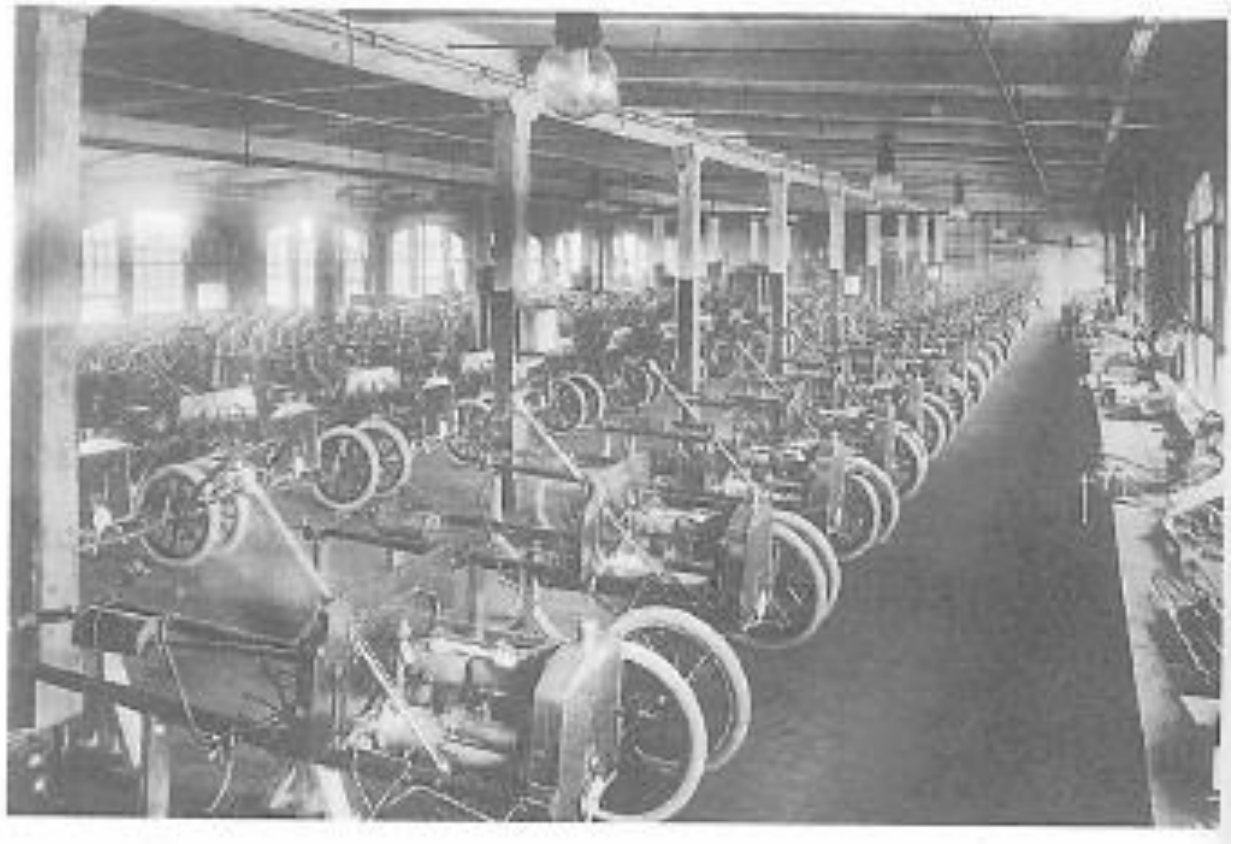
Henry Ford (1863~1931)



Conveyer production systems were used in the light industry like productions of foods, sewing machine etc, but it was believed to be impossible to use this systems to automobile that was heavy and complex.

Ford Highland Park Plant（１９１３）

Conveyer Line Production (New)



Assemble Box Production (old)

What the introduction of assemble line brought to the automobile industry and the society?

- The price was reduced to almost 1 /3 of the previous Price. The production scale was increased to 45 times.
- Heading of the article reporting the assemble line
  “Systems・Systems・Systems !”
- Many changes and improvements of the components, processes and architectures were required to meet the assemble production.
- Variation of quality and reliability were unavoidable → The quality control became necessary.
- Suddenly, the sales of model T became drastically slow after 30 years dominance of the market. → Necessity of market research

年(暦年)	小売価格(ツーリングカー)	T型車生産台数の合計	T型車販売台数の合計
1908	$850	n. a.	5,986
1909	950	13,840	12,292
1910	780	20,727	19,293
1911	690	53,488	40,402
1912	600	82,388	78,611
1913	550	189,088	182,809
1914	490	230,788	260,720
1915	440	394,788	355,276
1916	360	585,388	577,036

Ford Model T： price and production

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Current Tendency of Technology, Society, and Business

- The success of Google, Amazon, Uber etc. are supported by new excellent and huge systems behind their business models.
- Now, it is time to achieve innovations by creation of new excellent systems, rather than new excellent components.
- As the system becomes more and more complex, large and heterogeneous, the difficulty of creating, managing and evolving systems increases enormously.
- System emerges as one of the central concept of contemporary technology and management in a broad sense.

Major Emphasis Shift

past

- Producing things with excellent performance
- Optimization of each section leads to happy ends.
- Competition is good for promoting overall activities.
- Additional values are brought by superiority of components.
- Develop components with higher performance

now

- Producing things fitting to individual value sense
- Local optimizations may not lead to total optimization
- Collaboration gives a better solution than competition.
- Additional values are brought by integration of different functions.
- Construct good systems and evolve them for changing world.

System gives serious problems due to its complexity and hugeness

- Nobody understands the whole system. One person can understand only a very small fraction of the whole system. Uncertainty is rapidly increasing around the system. **How can we manage to operate the system?**
- The world becomes more and more changeable. Today's common sense becomes nonsense tomorrow. **How can we evolve the system to adapt to changing environment?**
- As the system grows, the number of stakeholders increases. **How to achieve a compromise, in face of different individual value senses relating the system.**

Three Viewpoints of Systems

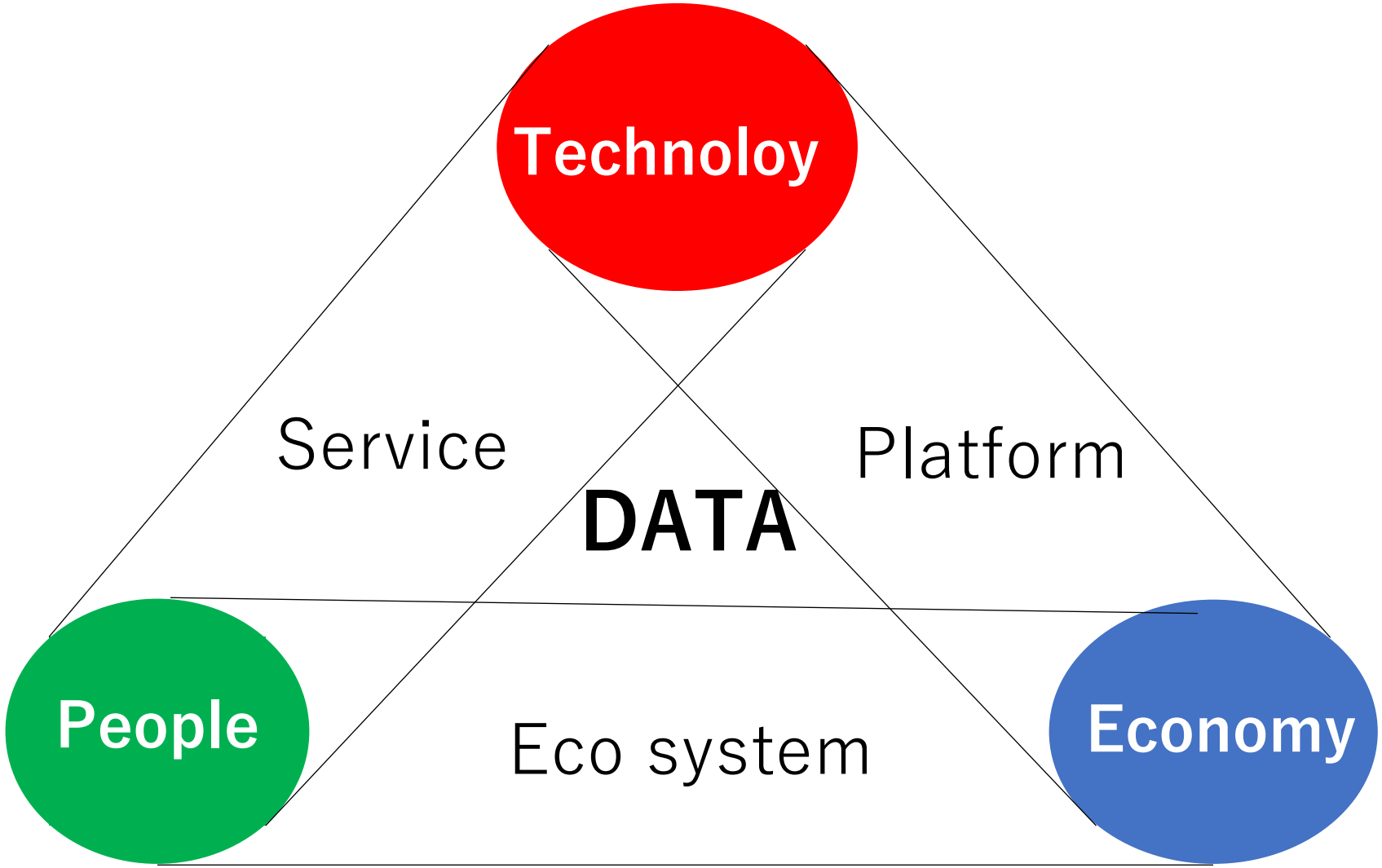
Technology (Enablers)
People (Value Chain)
Economy (Business)

An excellent system must be excellent from all of the above three viewpoints.

Current Trends of Industrial Digitalization

People (society) receives satisfactory **service** through a deployed **ecosystem** implemented on the **platform**.

Service is a connection of people and technology.
Ecosystems are combination of people and economy.
Platform is formed based on economy supported by technology.


Technoloy
Service
Platform
DATA
People
Eco system
Economy

Japan's problem

(1) Japanese people traditionally like craftsmen who devote their whole life promoting his skills, rather than craftsmen with wider skills and views.

(2) Japanese technology culture inclines to emphasize component technology, rather than wide systemic view.

Japan's Problem(continued)

(3) **The success of Japanese manufacturing in 1970's and 1980's due to superior component technology made big inertia to keep component technology at the top priority.**

(4) **Japanese society is vertically divided in many social sector, which makes the systemization difficult.**

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https://www.sysic.org

SIC Web : Top Page (2)

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SIC Web : Top Page (3)

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SIC Web : Top Page (4)

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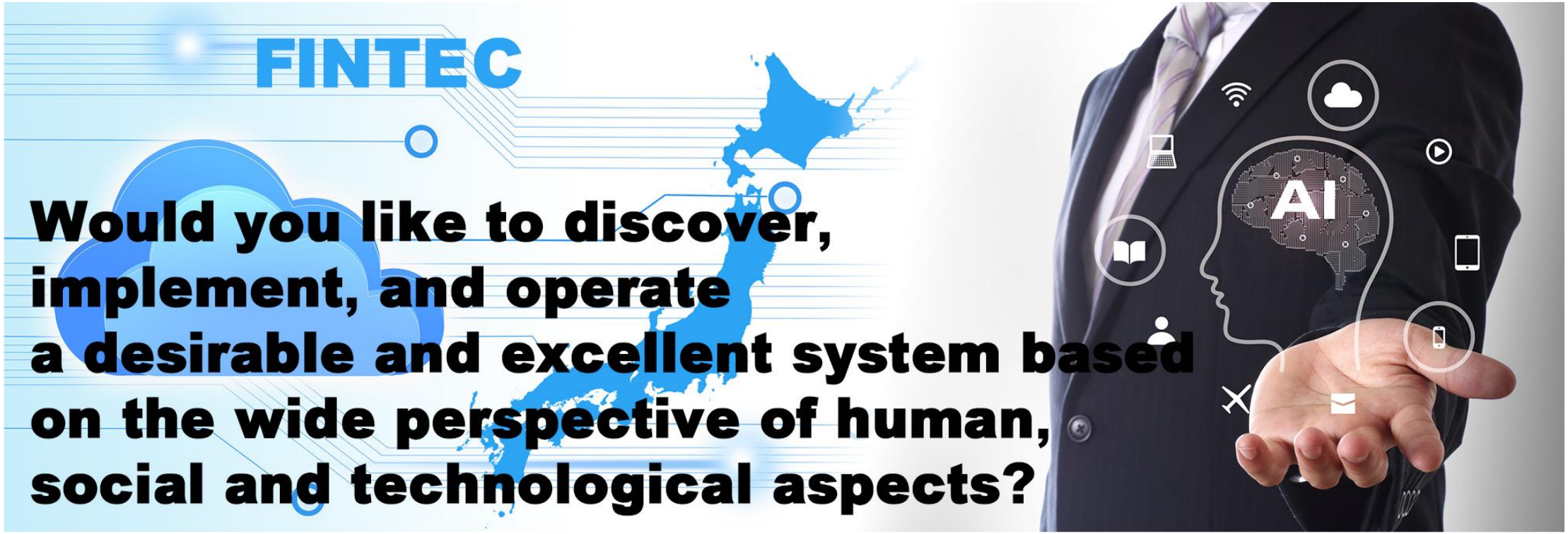


What is our systems innovation center?

- It is an organization supported by companies that are aware of the importance of systemization.
- It has three main missions:

  ① Promoting systemization inside the member companies.

  ② Collaboration among companies to achieve social systemization.

  ③ Education of systemization for engineers and executives.
- It has a big pool of university professors who are ready to help the center activities ①～③. Now 35 professors from 11 universities have joined us.

一般社団法人
システムイノベーションセンター
Systems Innovation Center（SIC）

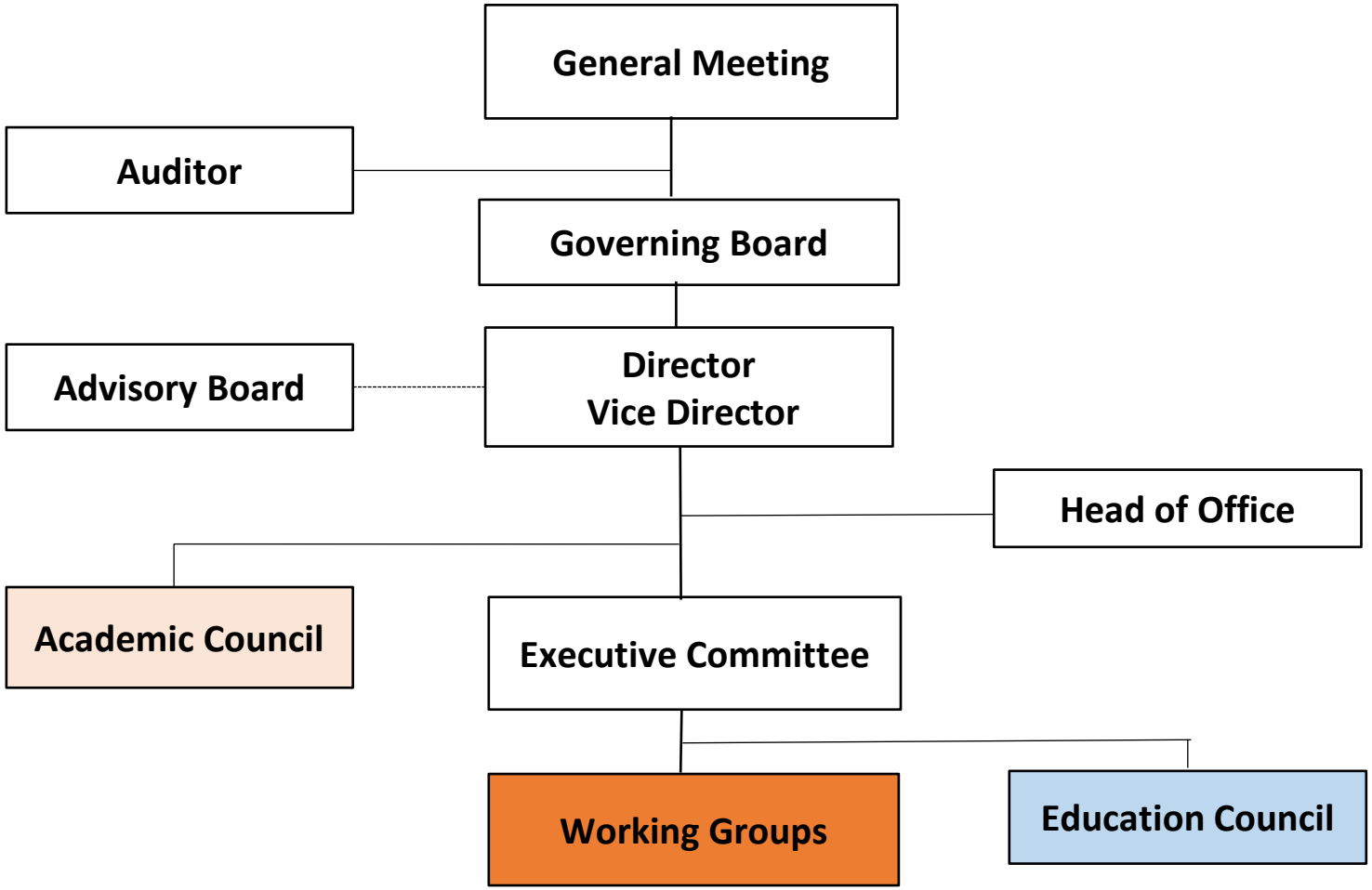
SIC center overview

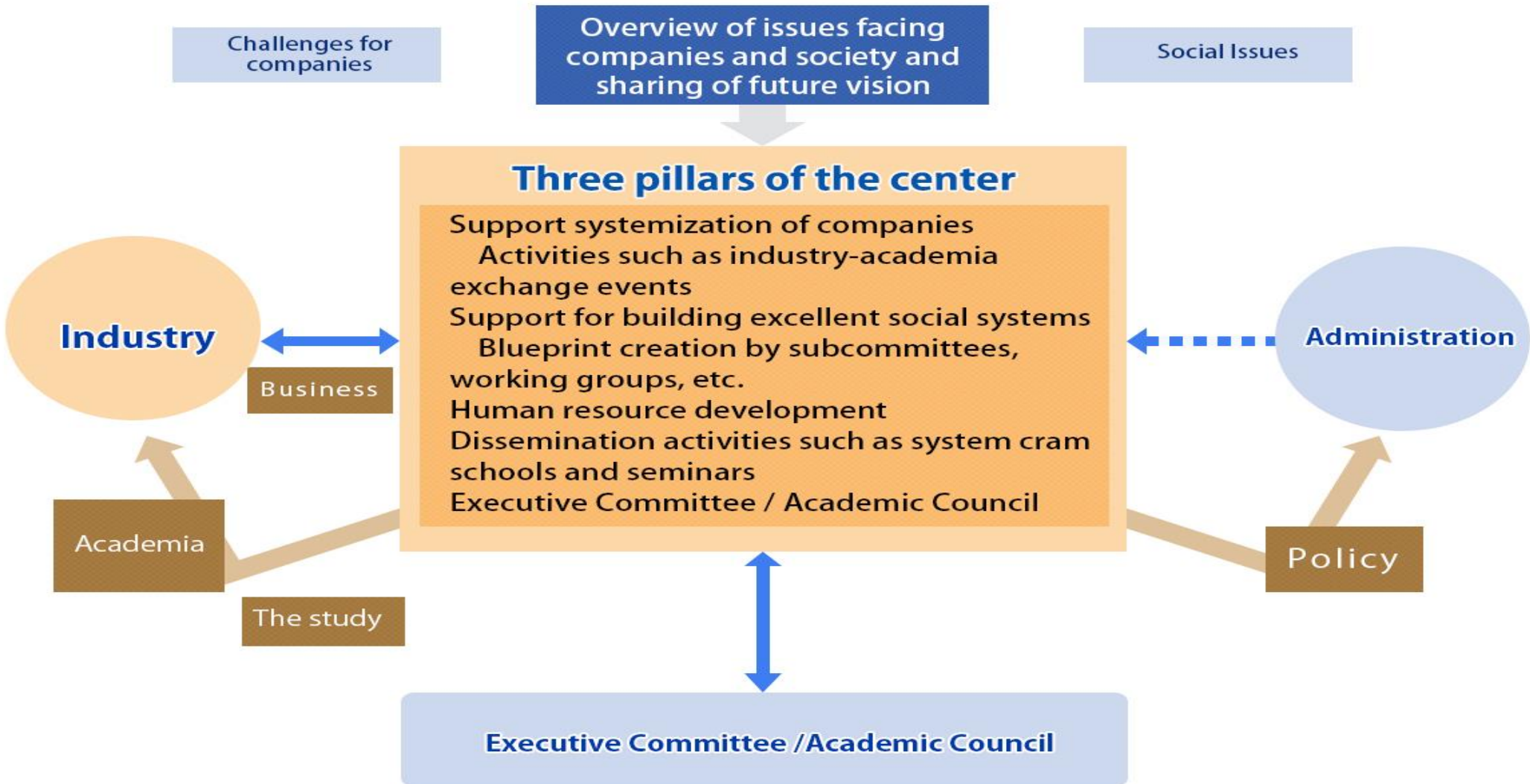
Director

Mr. Yutaka Saito
The Vice President of Fanuc
（The top robot manufacturer in Japan）

SIC Board Member

1	Chairman・Director	Yutaka Saito	Vice President and Executive Officer, Fanuc Corporation
2	Board Member・ Vice Director	Hidenori Kimura	Distinguished Research Professor, Waseda University
3	Board Member・Chair Executive Committee	Takasaki Matsumoto	Information Technology Promotion Agency
4	Board Members	Shinichi Urakawa	Director, Managing Executive Officer, Sompo Japan Nipponkoa Insurance Inc.
5	Board Members	Tsuyoshi Kitani	Director, Managing Executive Officer, CTO, NTT DATA Corporation CTO
6	Board Members	Gil Pratt	CEO Toyota Research Institute, Fellow、Toyota Motor Corporation
7	Board Members	Taro Shimada	Toshiba Corporation Corporate Digital Business Manager
8	Board Members	Katsunori Tanizaki	Director and Senior Managing Executive Officer, Sumitomo Mitsui Banking Corporation
9	Board Members	Shota Hattori	President and CEO, KOZO KEIKAKU ENGINEERING Inc.
10	Board Members	Mitsuo Hitomi	Managing Executive Officer, Senior Technology Development Fellow, Mazda Motor Corporation
11	Board Members	Tetsuo Nakakawaji	Mitsubishi Electric Corporation, Executive Fellow. Corporate R&D Group
12	Board Members	Hidenori Furuta	Representative Director and Corporate Executive Officer SEVP, Technology Solutions Business, Japan Sales, CTO and CIO SEVP, Head of Technology Solutions Business, Fujitsu Limited
13	Board Members	Keiichi Mori	Director, Managing Executive Officer, KDDI Corporation, Deputy General Manager, Solution Business Group and General Manager, Business IoT Promotion Division
14	Board Members	Kazuo Kyuma	President of National Agriculture and Food Research Organization
15	Board Members	Shinobu Yoshimura	Vice President of the University of Tokyo in charge of Industry-University Liaison
16	supervisor	Toshiaki Shirai	> Yokogawa Electric Corporation, Senior Advisor


General Meeting
Auditor
Governing Board
Advisory Board
Director
Vice Director
Head of Office
Academic Council
Executive Committee
Working Groups
Education Council


Challenges for companies
Overview of issues facing companies and society and sharing of future vision
Social Issues
Three pillars of the center
Support systemization of companies
Activities such as industry-academia exchange events
Support for building excellent social systems
Blueprint creation by subcommittees, working groups, etc.
Human resource development
Dissemination activities such as system cram schools and seminars
Executive Committee / Academic Council
Industry
Business
Administration
Academia
The study
Policy
Executive Committee /Academic Council

SIC Working Groups

- (1) Smart Food System Working Group
- The term has completed. The report and the proposal have already been
- publicized and submitted to the Government.
- (2) System Healthcare Working Group
- (3) System Mobility Working Group
- (4) Digital Economy Working Group
- under preparation
- (5) Standardization of Supply Chain Management Working Group
- under preparation

Concluding Remarks

- **Need for creating excellent systems is increasing enormously.**
- **But the difficulty of constructing, managing, evolving systems are getting more and more important.**
- **Old type systems sciences (general systems theory, Santa Fe systems sciences etc.) are no longer effective.**
- **New type of systems science with core on optimization, modeling. Network, learning(AI), signal processing, are necessary.**

一般社団法人
システムイノベーションセンター
Systems Innovation Center（SIC）

谢谢您的聆听!