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INTRODUCTION TO INDUSTRIAL ENGINEERING AND MANAGEMENT

TU-A1300
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THE IDEA OF THE COURSE: FROM FUNDAMENTAL PHENOMENA TO MANAGEMENT TECHNOLOGIES

MANAGEMENT TECHNOLOGIES*

Quality Systems, SPC, SixSigma

Production control

Business Model Canvas

Logistics

Customer value

Useful skills

Quality

Delivery precision

Purchasing

Exchange value

MANAGEMENT ISSUES

Cost control

Scheduling

Layout

Pricing

Coordination

Volume

Prospect

Trading

Conrol

Division of labor

Specialization

Standardization

OBJECTIVES

Variability

Decay

Value

Understanding how the world works

TRANSFORMATION

TRANSACTION

PHENOMENA

Chaos - order

Entropy

Time-space

Cooperation

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') Technology here in the broad sense, se fig. #13.

TUOTANTOTALOUS
INDUSTRIAL ENGINEERING AND MANAGEMENT
OPERATIONS MANAGEMENT

Produces knowledge about:

Production systems = Purposeful, value creating socio-techno-economic systems

Methods

- Empirical: mixed method: case, survey, simulation,…
- Theory: models

Results: managerial technologies for planning, management and improvement

Societal mission: Improve productivity: get more with less

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SUB-AREAS

Operations strategy: make or buy, locations, investments

Planning and control of production systems

Logistics: material- and information flows

Purchasing

Networks, partnering, and contracting

Quality and risk management

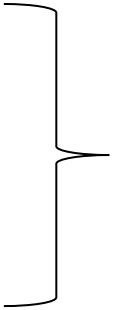
Project management

Continuous improvement

Management accounting

Human resources

Innovations



Supply chain management

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THE NECESSARY INSTITUTIONS FOR ECONOMIC PROGRESS

1. Private ownership
   - Legal and legitimate protection of property and investment
   - Contracting

2. Scientific and technical thinking
   - Rationality: the world works in a way that can be known
   - Empiricism: observations and experimentation

3. Capital markets
   - Connect savers and investors
   - Spread risk

4. Logistics
   - Transport
   - Communication

The world where Industrial Management can operate

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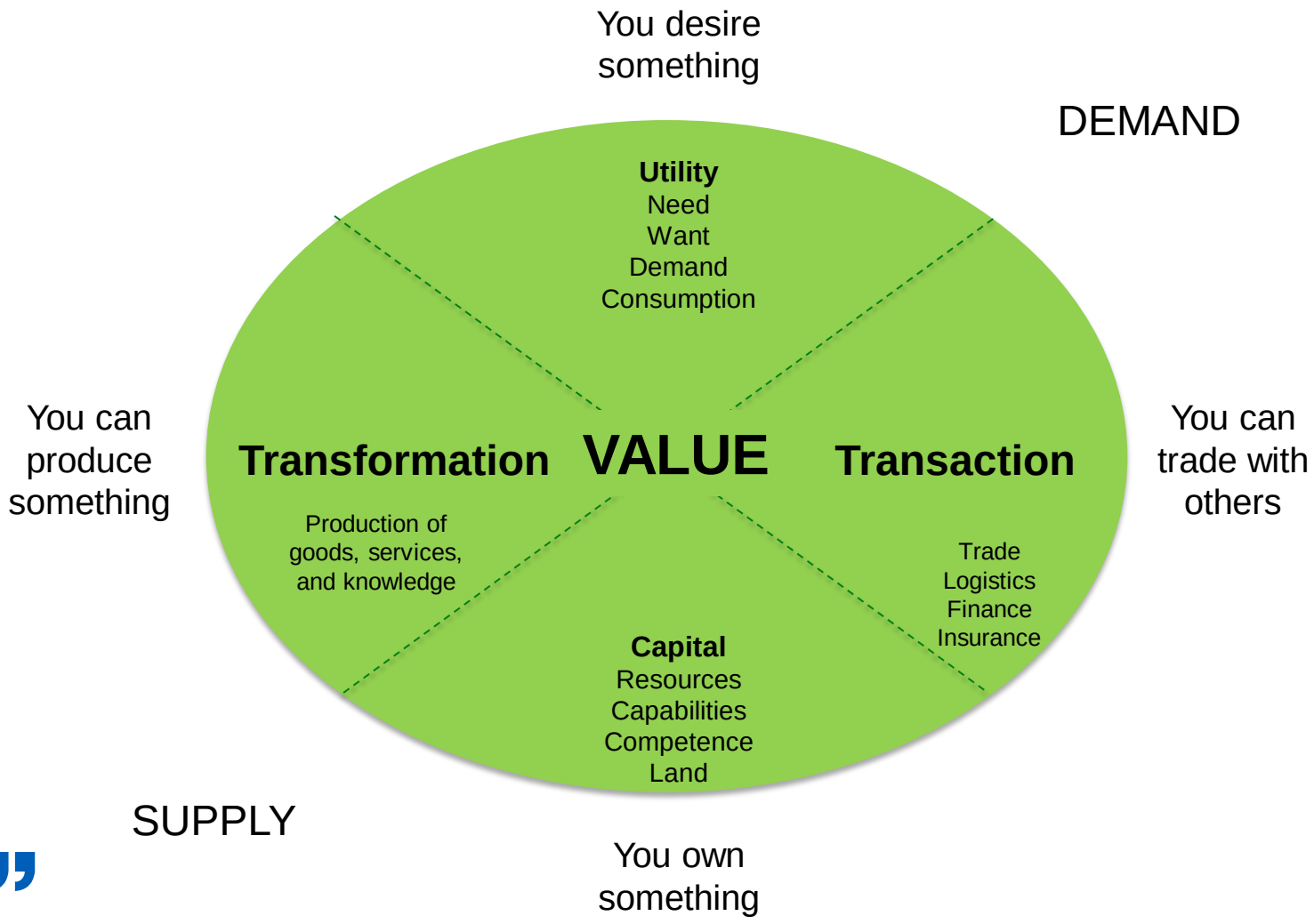
PURPOSEFUL ECONOMIC ACTIVITY



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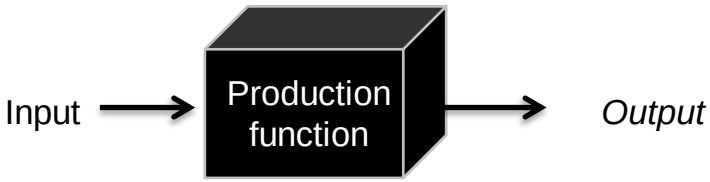
PRODUCTION FUNCTIONS DO THE JOB



Basic production functions

Extraction:	Hunting & gathering, fishery, mining
Cultivation:	Agriculture, animal husbandry, fermentation
Subtraction:	Carving, machining
Forming:	Molding, casting, pottery
Assembly:	Construction, discrete manufacturing
Chemical reaction:	Process industries, petrochemicals
Addition:	Candle-making, 3D-printing

"Manufacturing is to apply controlled energy to matter in order to realize an idea."

Varnecke,H.J, The Fractal Company. Springer 1993.

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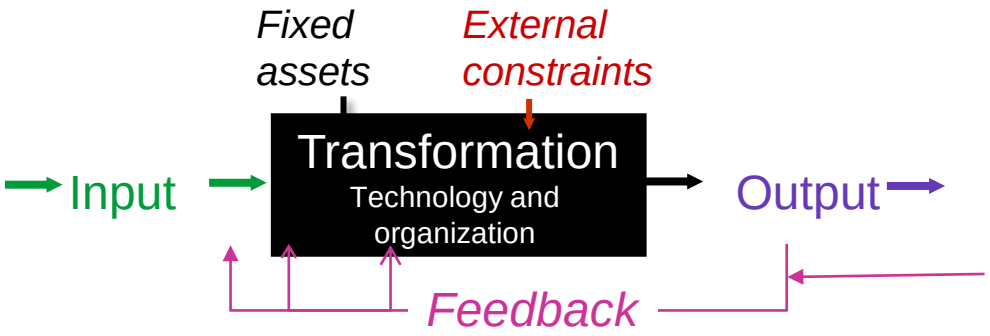
PRODUCTION FUNCTIONS ARE ORGANIZED INTO PROCESSES AND SYSTEMS



Input
- orders
- material, energy, labor

Physical technologies and fixed assets

Cognitive technologies: capabilities and skills

Social technologies: organisation och processes

External constraints
- regulation, trade barriers, availability of resources,…

Output / throughput
- sellable goods

Feedback
- control, learning

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TRANSACTIONS IN MARKETS

Economy: the science of rational management of scarcity

- *Oikonomie* (house) → housekeeping → economy

Self-sufficiency → exchange economy: social exchange, barter, pecuniary economy.

Trade: voluntary exchange of goods and services perceived to be beneficial to both parties

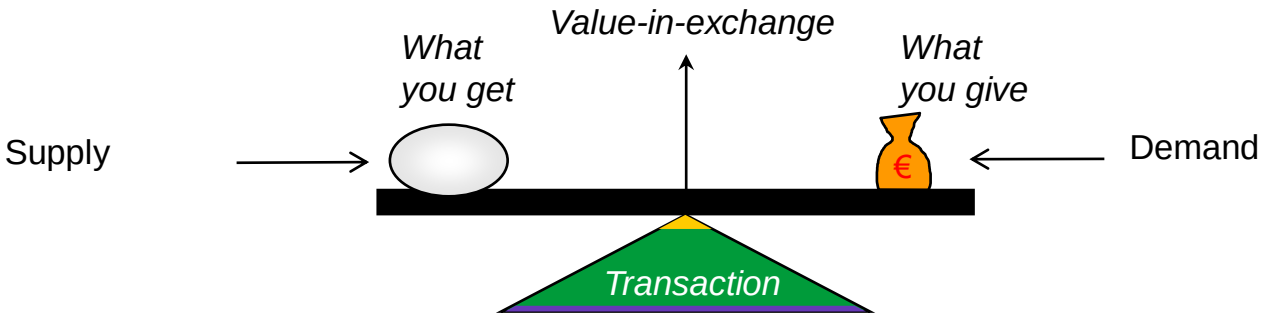
- Opposite: robbery, slavery, exploitation,

Exchange requires a common conception of value

- Value-in-exchange – Market value
- Value-in-use - Utility
- Show-off –value - Status

Value is a property of transaction and use (not product)

Product attributes: functionality, grade, style, quality



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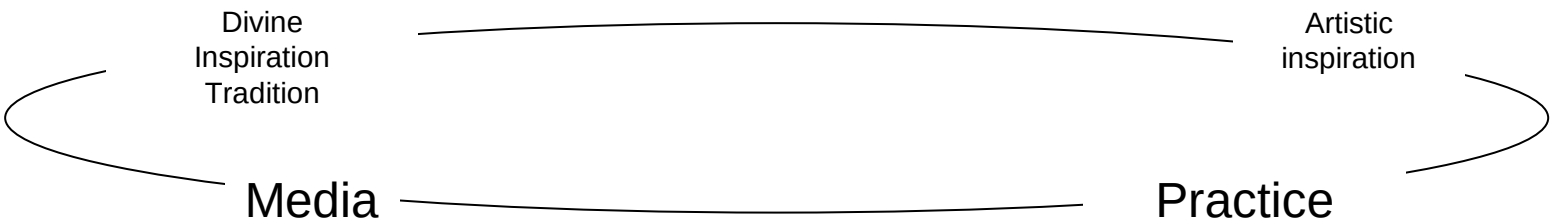
RESEARCH UNIVERSITIES PRODUCE KNOWLEDGE



Gather,
Choose
Copy
Edit…

Learn-by-doing
Experience

Science

Observations: data

Reasoning

Experimentation

Replication

Theory building

Accumulation of knowledge

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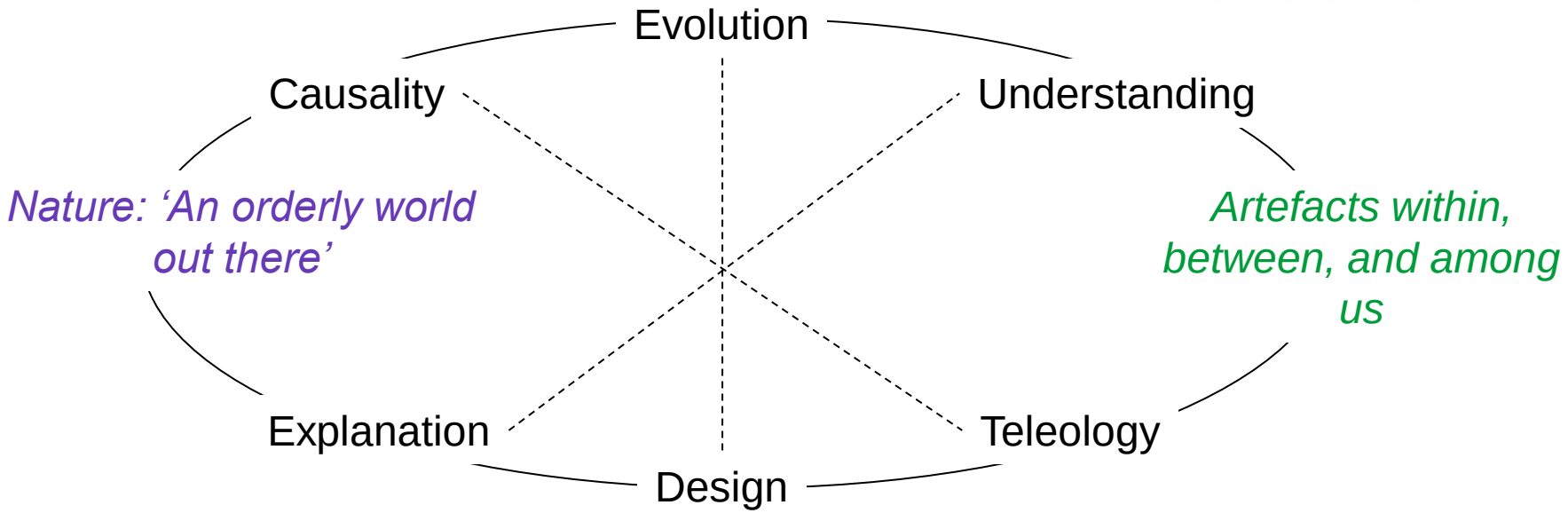
THE WORLDS OF SCIENCE

Sciences of the natural world

Sciences of the artificial world: Behavioral science



Sciences of the mind: Mathematics, Logic

Art and commentary: Humanities

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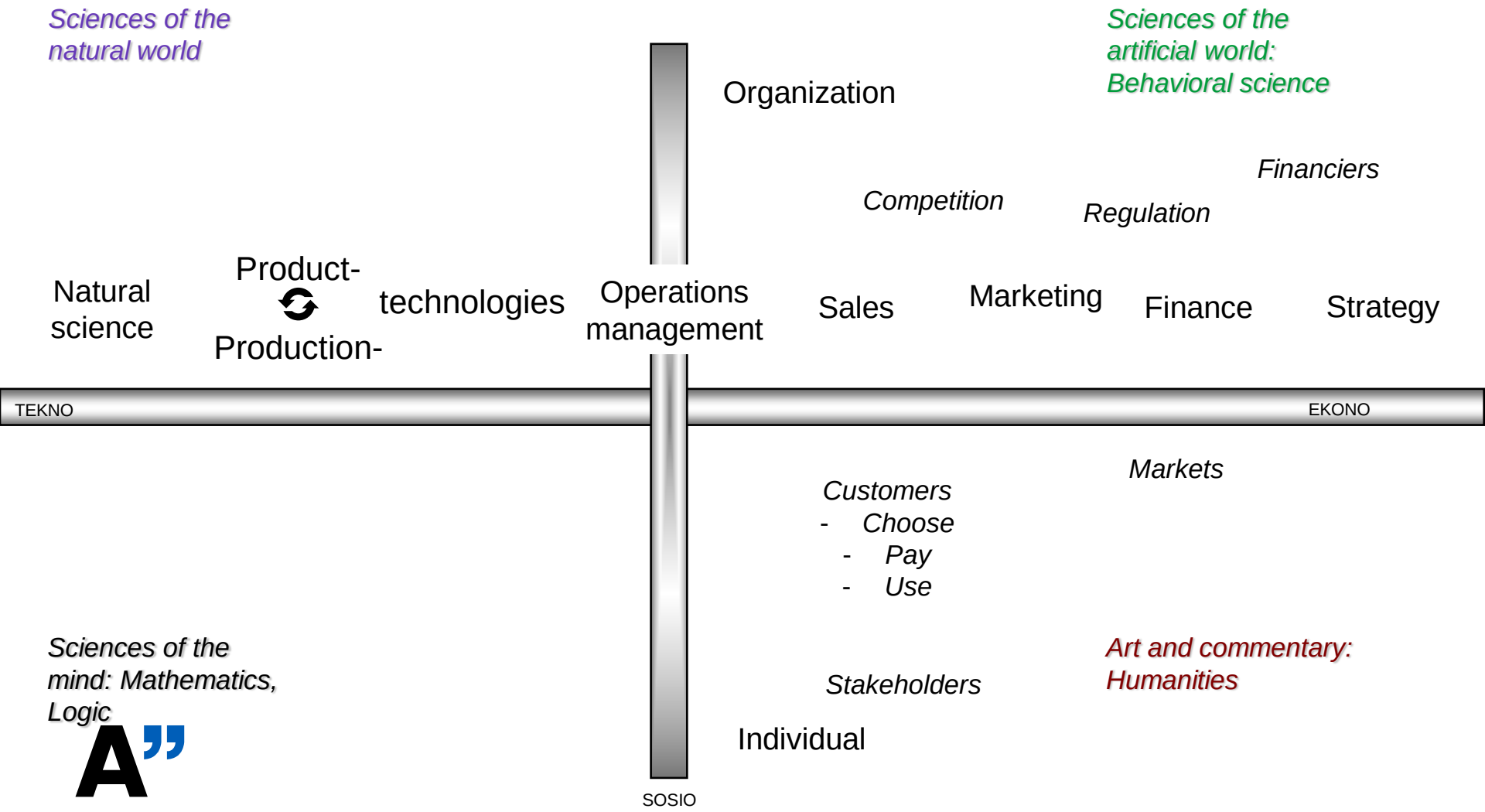
THE OPERATIONS MANAGEMENT PLAYING FIELD



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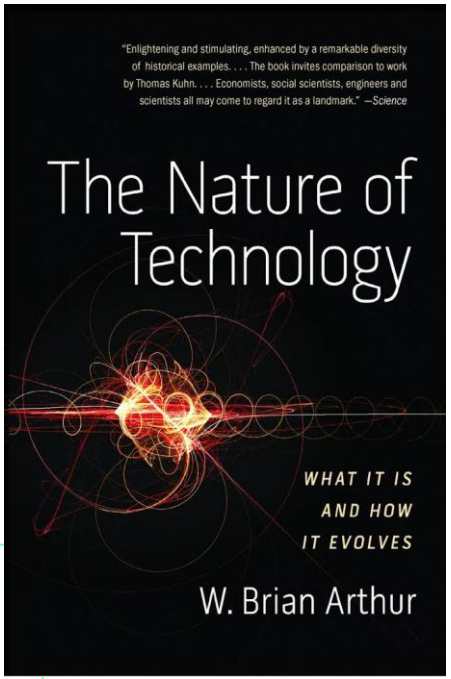
TECHNOLOGY IS TO MANIPULATE A PHENOMENON FOR A PURPOSE

A technology is built upon some principle, "some method of the thing", that constitutes the base of idea of its working.

A technology is a phenomenon captured and put to use.

A technology is a programming of phenomena to our purposes.



Physics, Chemistry	→	Engineering
Biology	→	Clinical medicine
Psychology	→	Behavioral technologies
Social science	→	Management

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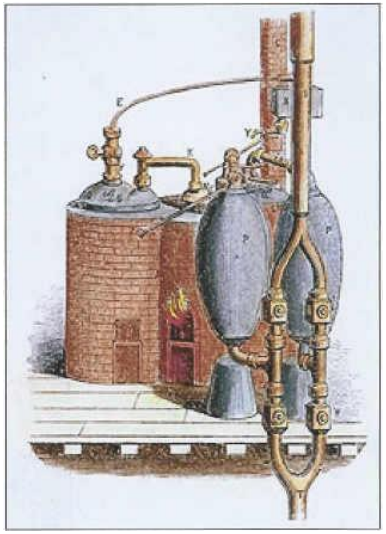
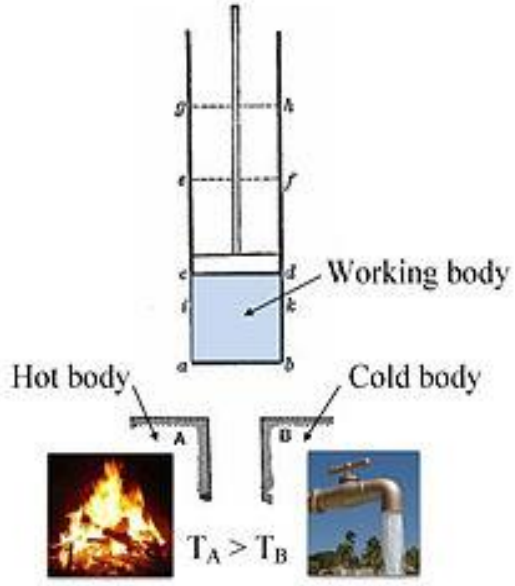
FIRST THERE WAS TECHNOLOGY

Steam engine



Thomas Savery 1678
Thomas Newcomen 1711
James Watts 1765

Thermodynamics



Sadi Carnot 1824
Lord Kelvin 1854

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FIRST IT WORKED IN PRACTICE, THEN IN THEORY

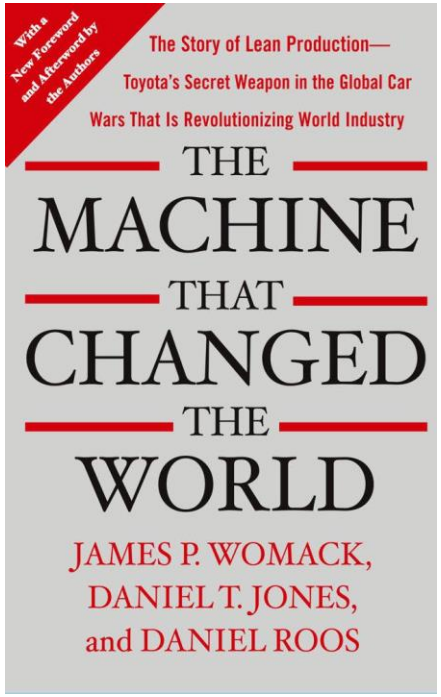
Toyota production system, 1955→

Export-success 1975→

Theoretical explanation: Lean Production 1990

Successful application in different nations and industries

Lean healthcare



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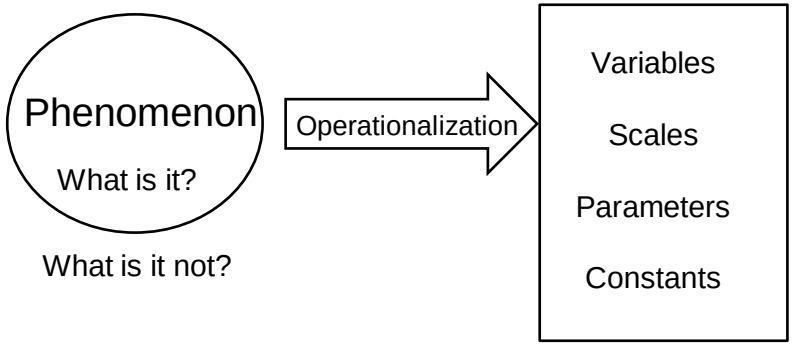
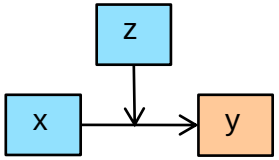
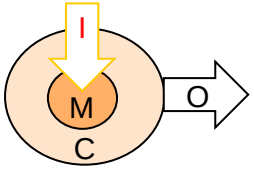
DEVELOP TECHNOLOGIES

What is it? *Ontology*	**What can be known?** *Epistemology*	**How does it work?** *Dynamics*	**What can be done?** *Technology*
Conceptual model	**Measures**	**Dynamic model**	**Interventions**





Deterministic
Stochastic
Enabling
Necessary / sufficient conditions
Simulations
Experimentation



Context
Intervention
Mechanism
Outcome

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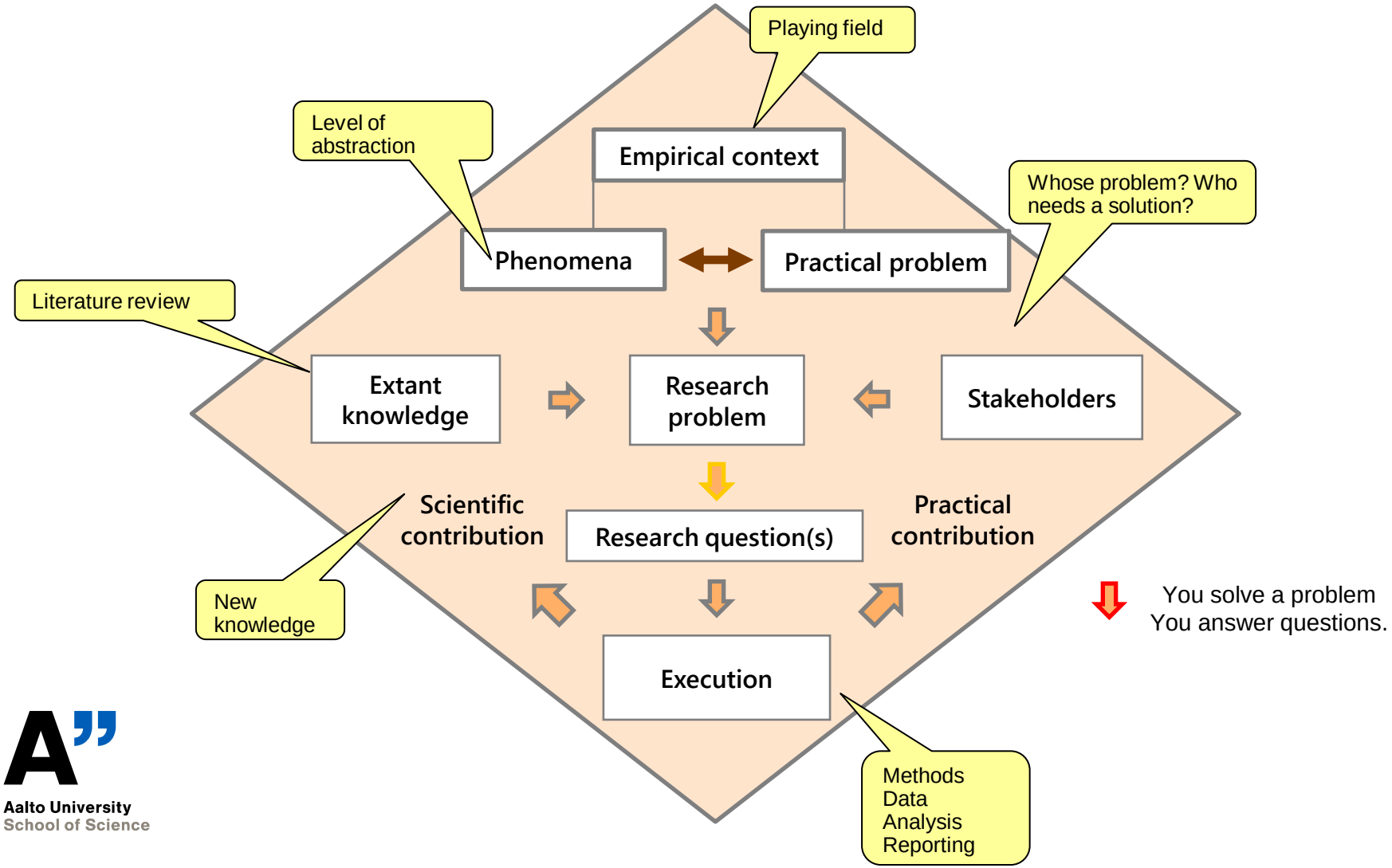
THE STRUCTURE OF A DISSERTATION



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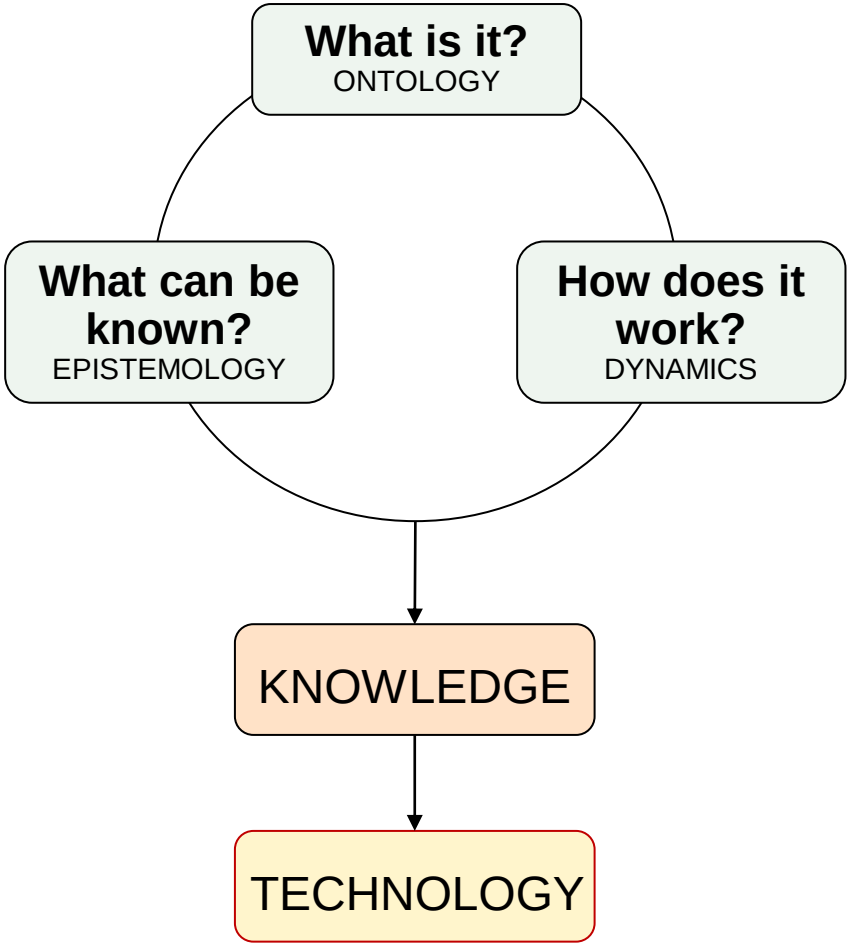
HOW TO CREATE KNOWLEDGE?



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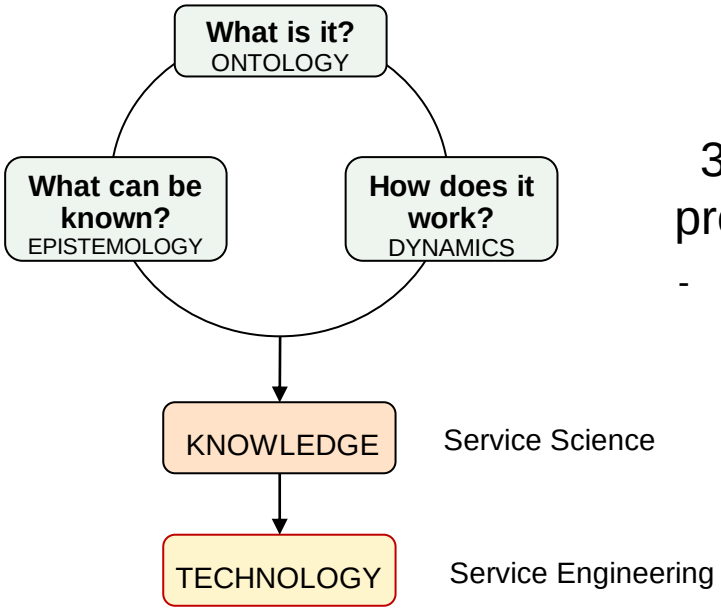
SERVICE DEFINITIONS

1. Immaterial but tradable good

- Immaterial, Heterogeneous, Inseparable, Perishable (IHIP)

2. State change



3. Customers participate: production in open systems

- Co-creation of value; Service –dominant logic (SDL)
- Resource Integration (RI)

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THE IHIP -DEFINITION OF SERVICES

Intangible: Services provide value in forms that are intangible and can't be owned
- → agreement about delivery criteria prior to service production;
  a *promise* of service is marketed

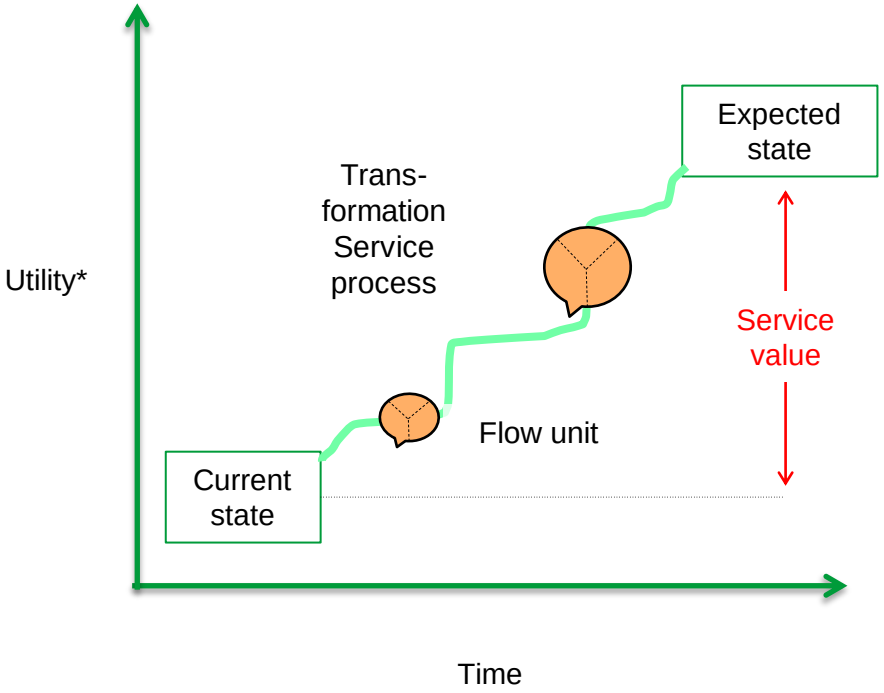
Heterogeneous: Services are complex bundles of activities

Inseparable: Services exist only the moment they are produced and consumed
- → customer affects the service process to varying degree
- → services cannot be owned

Perishable: services cannot be stored
- → capacity management, demand management

Source: mainstream service literature; e.g. Parasuraman et al. 1985, Grönroos 2000

SERVICES APPEAR AS STATE CHANGES



Flow unit is:

Flow unit is:	Material	Immaterial
New (Unique or copy)	*Goods*	*Intellectual property Content*
Existing	*Maintenance Repair Upgrade*	*Knowledge Experience Behavior Location*

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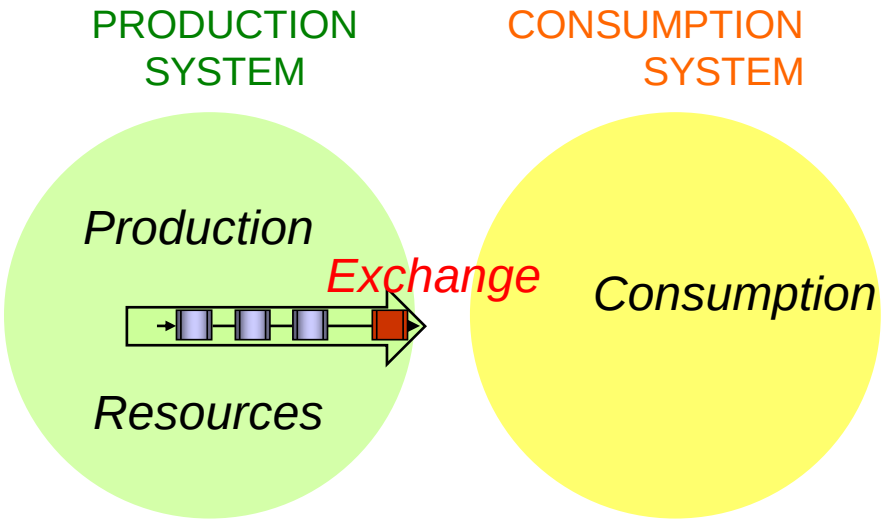
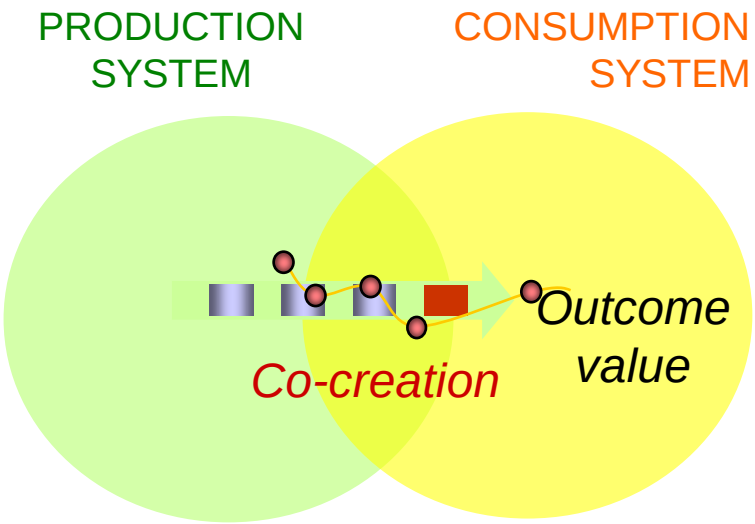
*) In economics 'utility' means whatever a person or a market perceives as valuable. Utilities are revealed in preferences, i.e. what people choose when they have a chance.

THE GOODS AND THE SERVICE DOMINANT LOGICS

GOODS –DOMINANT LOGIC
GDL



SERVICE –DOMINANT LOGIC
SDL



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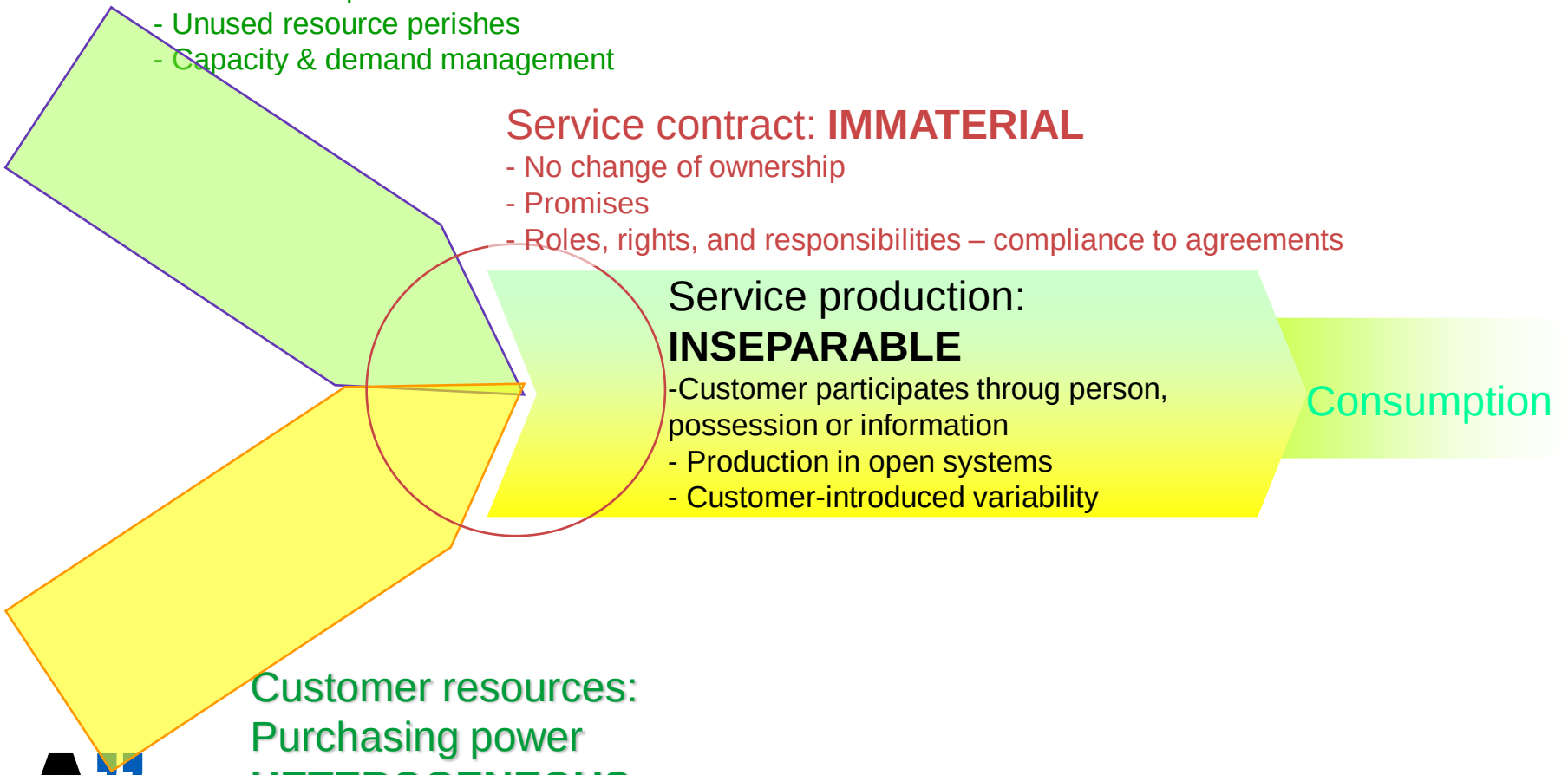
"With service processes, the customer provides significant inputs into the production process." (Sampson and Froehle 2006).
"The customer is always a co-producer." (Vargo and Lush 2004)

RESOURCE INTEGRATION AND IHIP

Producer resources & capabilities: **PERISHABLE**
- Customer requests activate resources
- Unused resource perishes
- Capacity & demand management

Service contract: **IMMATERIAL**
- No change of ownership
- Promises
- Roles, rights, and responsibilities – compliance to agreements



Service production:
INSEPARABLE
-Customer participates throug person, possession or information
- Production in open systems
- Customer-introduced variability

Consumption

Customer resources:
Purchasing power
HETEROGENEOUS
- Individual and situational preferences

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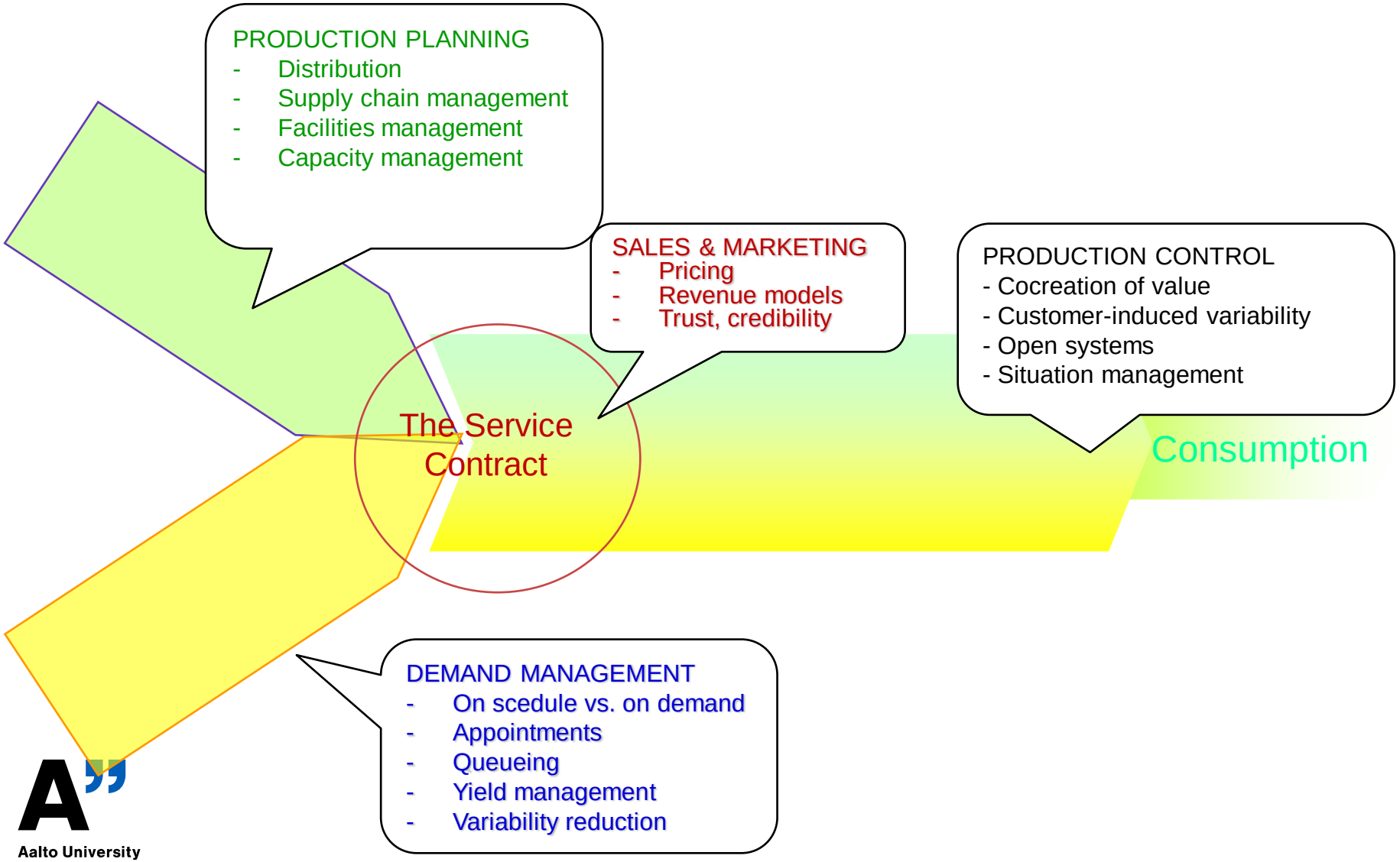
Developed from: Moeller, Sabine: Characteristics of services – a new approach uncovers their value. Journal of Service Marketing 2010, 24/5

THE TASKS OF SERVICE OPERATIONS MANAGEMENT



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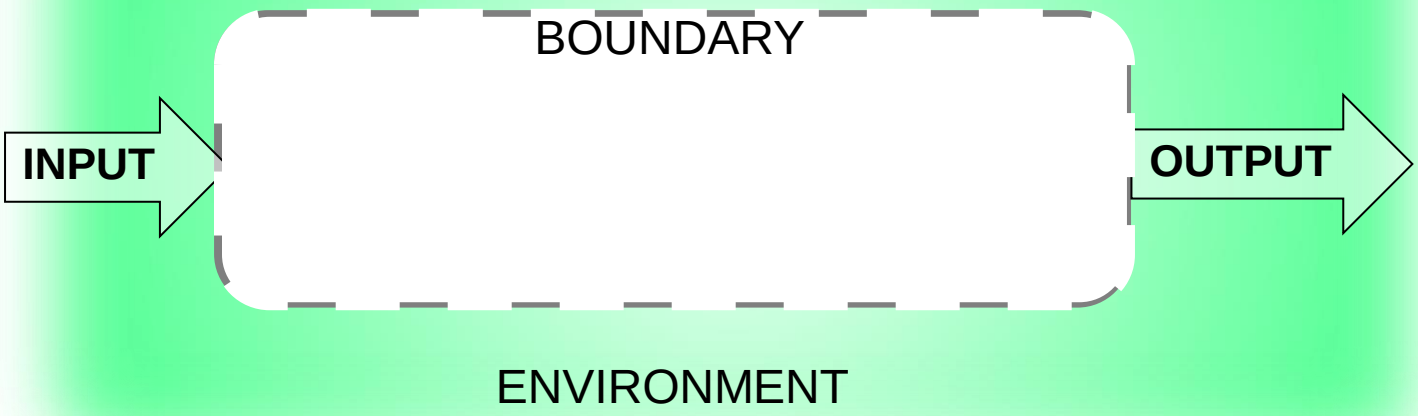
SYSTEMS HAVE BOUNDARIES



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PRODUCTION IN CLOSED OR OPEN SYSTEMS?

CLOSED SYSTEM	OPEN SYSTEM
Goods –dominant logic	Service –dominant logic
Standard / formatted processes	Routine / explorative processes
Identical copies of prototype	Each unit is designed
Inventory management	Capacity management
Value stream additive	Value stream includes multiples
Value resides in product	Value resides in process
Property rights, ownership	Rights and responsibilities
Demand on schedule	Drop-in demand
Variability minimized	Variability absorbed

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INDUSTRIAL MANAGEMENT MILESTONES

Early concepts1776 →
- Division of labor and specialization (*Smith, Babbage*)
- Interchangeable parts, standardization (*Whitney*)

Scientific management 1880 →
- Time & Motion studies (*Gilbreth*)
- One best way (*Taylor*)
- Queuing theory (*Erlang*)

VOLUME

Mass production 1910 →
- Moving assembly line (*Ford*)
- Statistical process control (*Shewhart*)
- Economic order quantity (*Harris*)
- Linear programming PERT (*DuPont*)
- MRP

COST

Lean production 1980→
- JIT, TQM, Six Sigma
- CAD/CAM, EDI
- Cross-functional processes

QUALITY

Mass Customization 1995→
- Globalization & Internet
- Demand-supply chain management
- ERP

FEXIBILITY

Service Engineering and Management 2004 →
- Servitization
- KIBS, PSTS
- SOA, SaS
- Outcome –based business models
- Platforms, P2C

SOLUTIONS

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