Summer term 2023

Master Course:

Prof. em. Dr. Reinhard Doleschal

Innovation and Development Strategies (IDS)

International Master Information Technology /

Master Electrical Engineering / Master Mechatronische Systeme

The topics:

I. From Knowledge towards Knowledge society and Knowledge economy
II. Strategic Knowledge and Innovation Management

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Innovation and Development Strategies (IDS) SS 2023

International Master Information Technology /

Master Mechatronische Systeme

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I. Knowlegde and Knowledge based economy
Introduction and Overview

Part 1

Global and local risks of knowledge creation and innovation

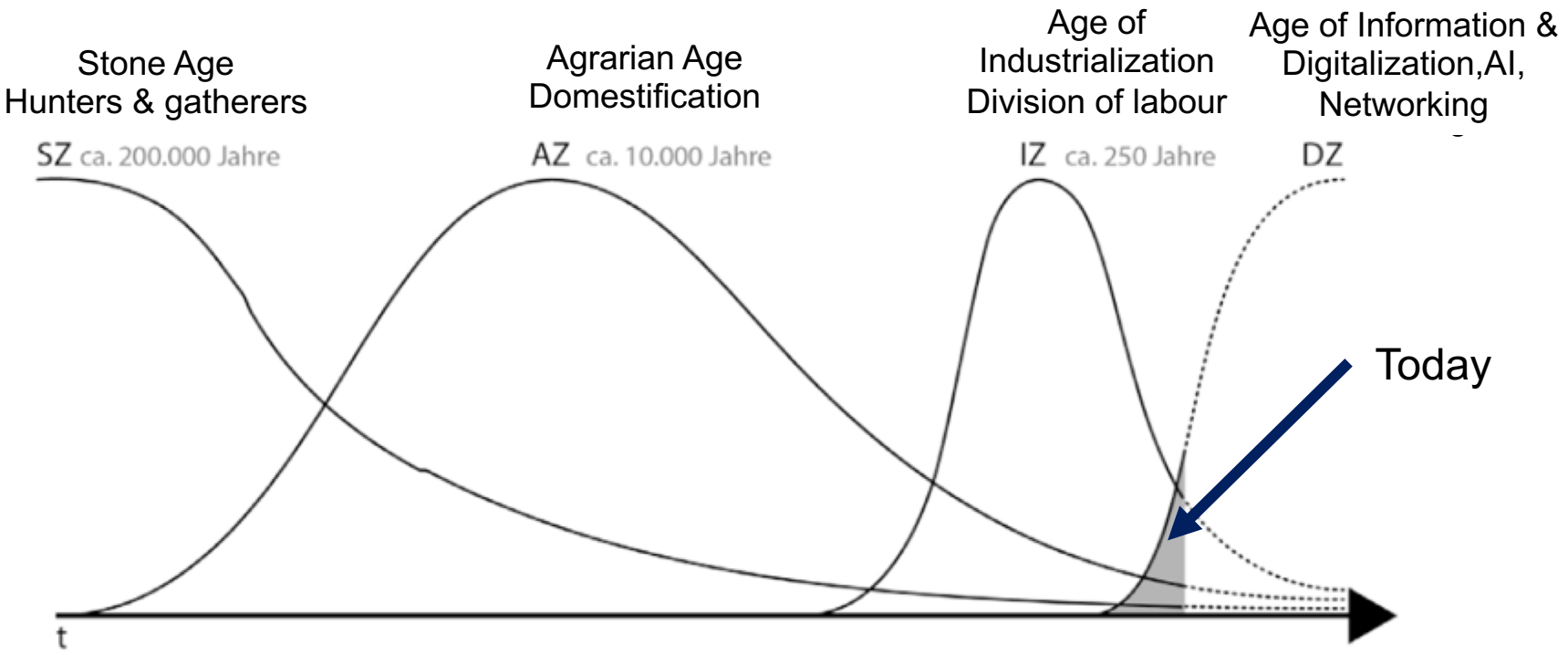
What are the most important influences that prevent new innovation?

- Political framework / Political uncertainty / week Government
- Lagging education / lagging R&D (public & privat)
- Inflexible organizational ecosystem
- Traditional organizational culture
- Lack of Finance / Resources / Venture Capital
- Incongruous legal system / patent rights / Intellectual property (IP)

What kind of risks can occur through innovation?

- Loss of political and economical control
- Turbulences on the Labour or job market
- Conflicts with stakeholders
- Temporary Monopolies / loss of competition
- Commercialization of private data / commercial control
- Cyber attacks / Data fraud /Cyber Crime
- Increasing Uncertainty
- Short-term private benefits and long-term public disadvantages or follow-up costs

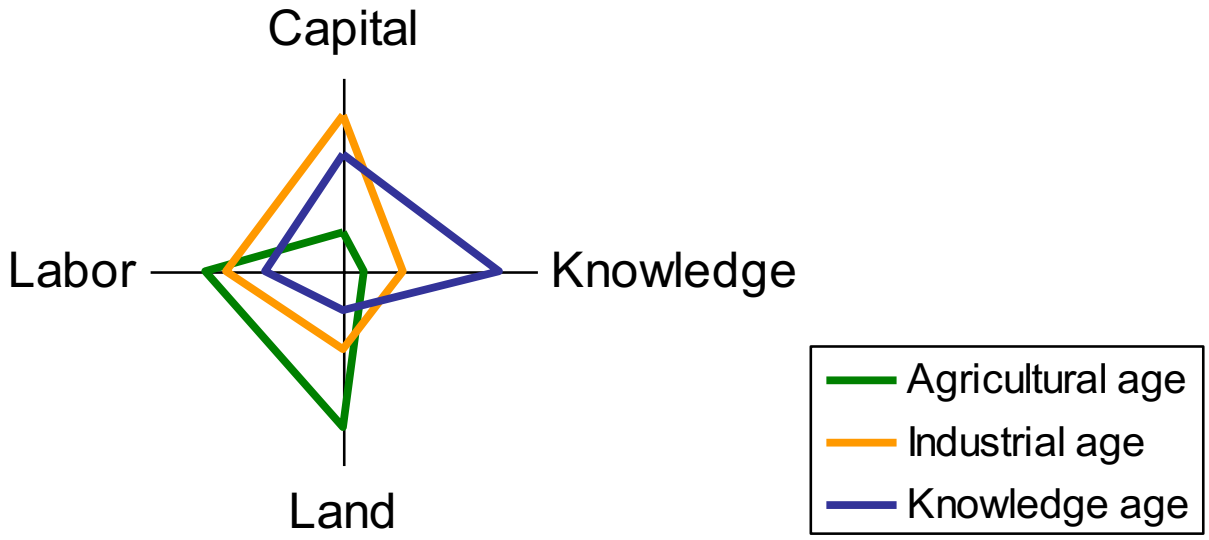
Big waves of living and working



Coast effect: accelerating frequency and increasing amplitude

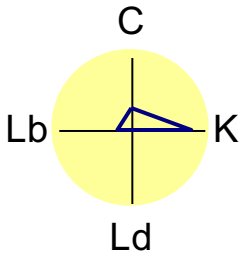
Source: combined with Stengel 2017

The knowledge economy



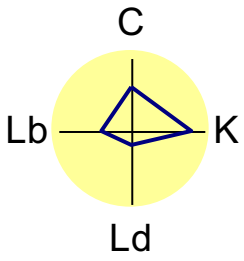
- Knowledge has become the main resource
- The pace of innovation is accelerating
  (not only in products and services, but also in processes, markets, sourcing, business models, etc.)

Growth of knowledge in the economy



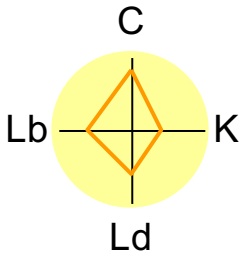
Knowledge industries

Knowledge itself is the product/service
(e.g., software, media, entertainment, consulting)



Knowledge-intensive industries

High level of K embedded in products/services
(e.g., electronics, computer, pharmaceutical)



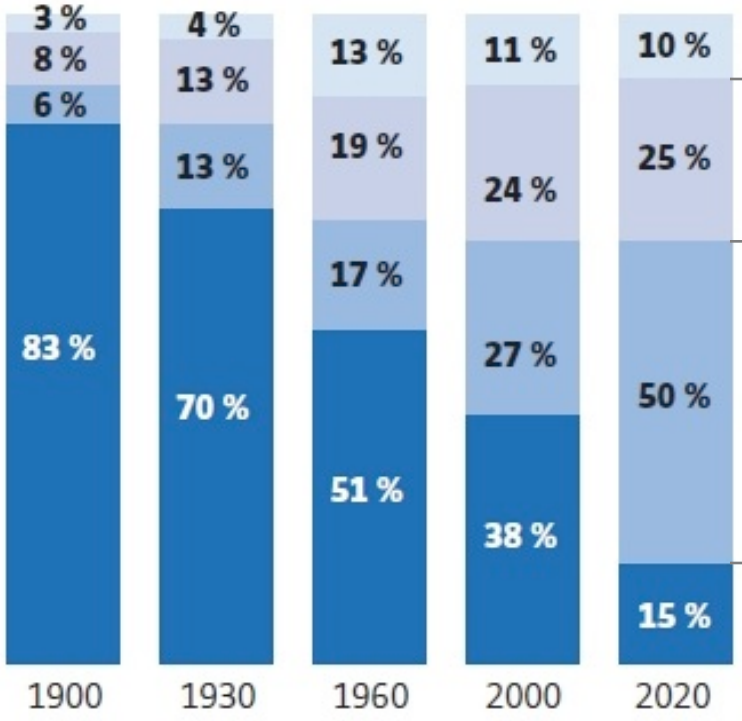
Traditional industries

Capital and labor still largely relevant
(e.g., oil & gas, construction, transportation, retail)

The Knowledge Society

- Primacy of scientific knowledge (Bell 1973; Stehr 1994)
  - K as source of authority and basis of social stratification
  - Scientific research as the ultimate source of knowledge
- Rise of knowledge work (Drucker 1969; Reich 1991)
  - Fastest growing section of the workforce
  - Knowledge workers own their knowledge
- Networked society (Castells 2000; Benkler 2006)
  - Networked economy, work and social relations
  - Enabled by information and communication technology

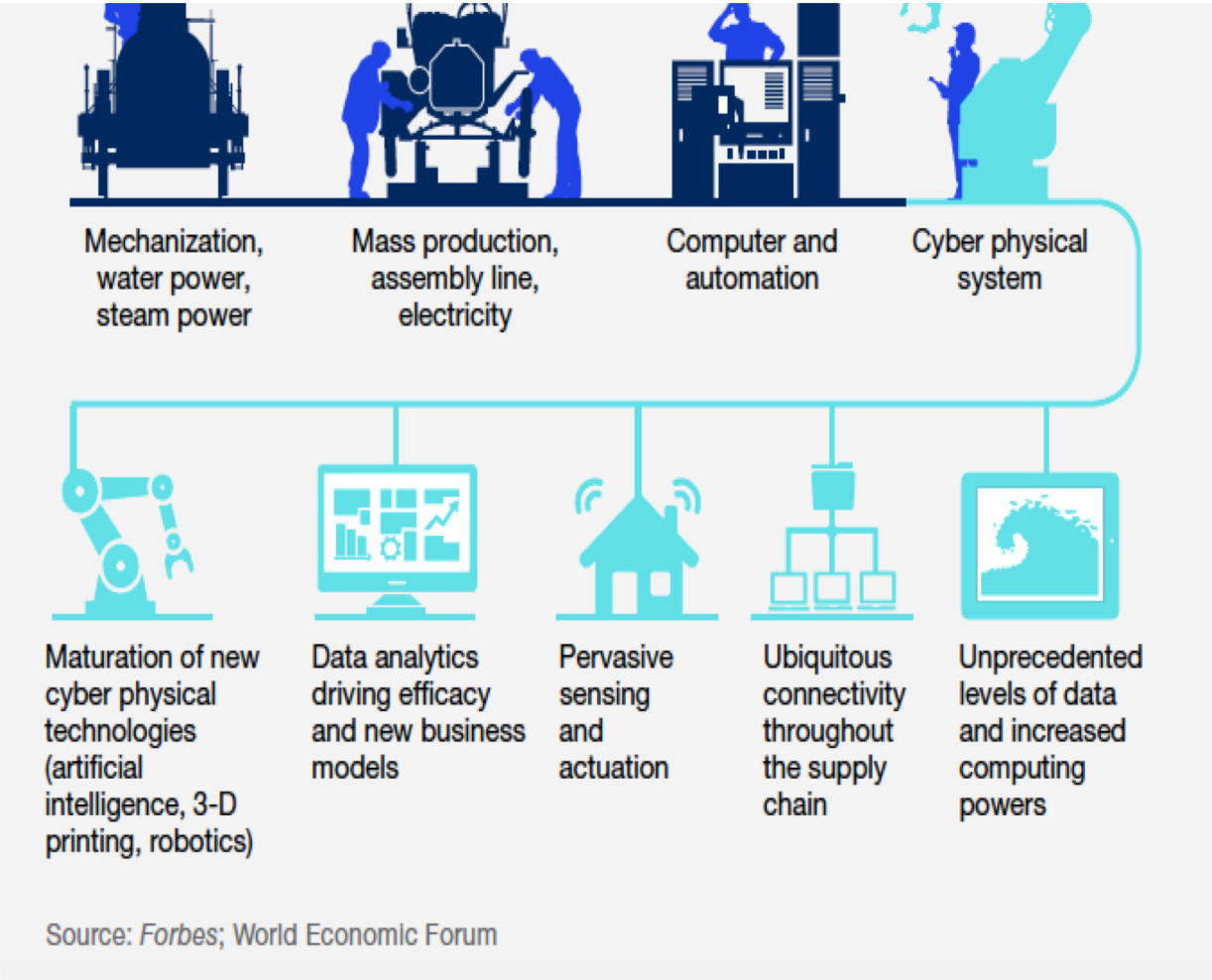
Quantities: Shares of workforce worldwide



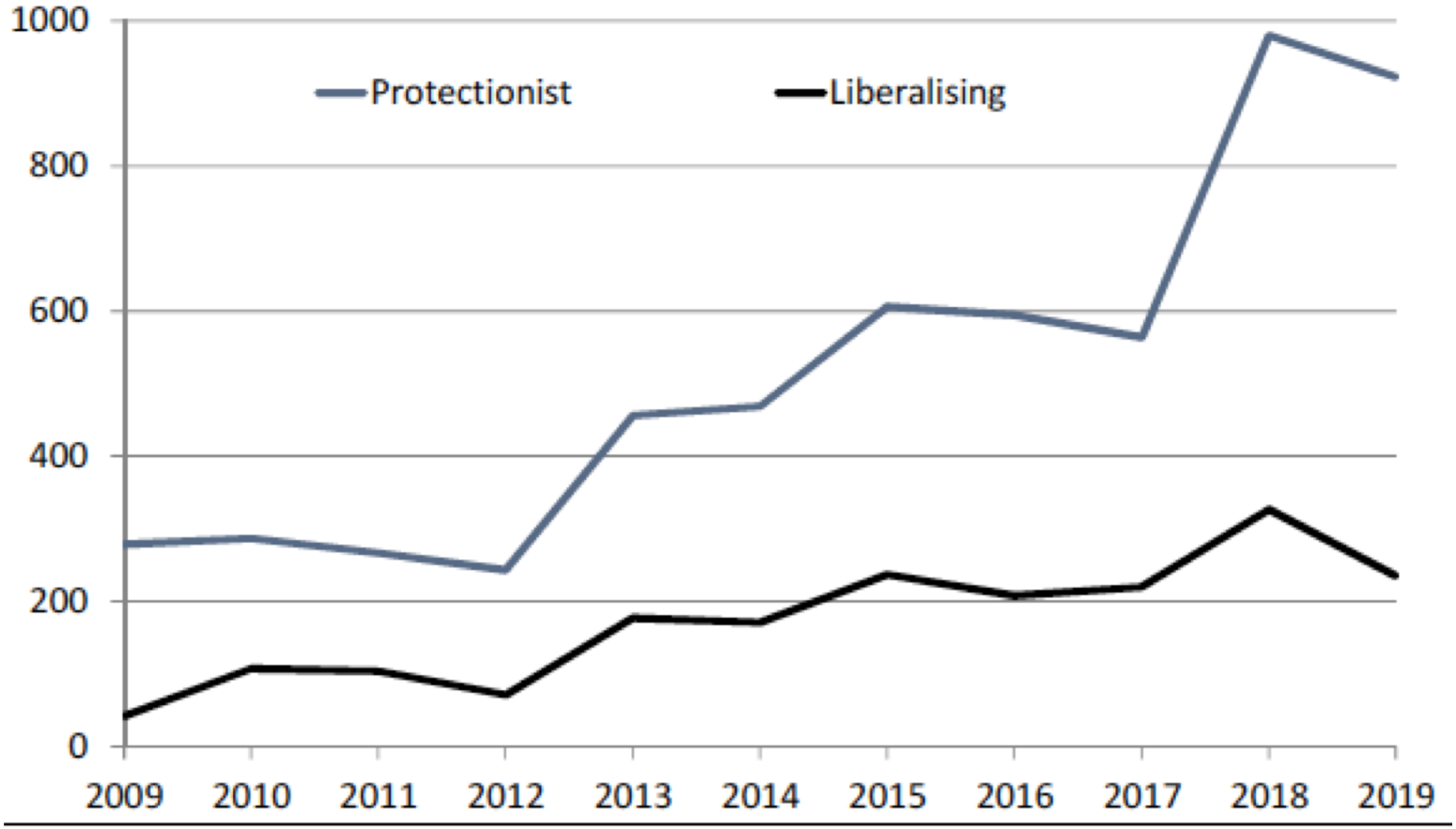
strategic & coordinating workforce	consulting, coaching, management
knowledge worker	organization, R&D, Knowledge transfer
service worker 50% ICT (2020)	clerks, commerce, basic services
blue color worker	raw material sourcing, production, agriculture

Adapted from: Zukunftsinstitut (4)

In the fourth industrial revolution, digital analytics enables a new level of operational productivity



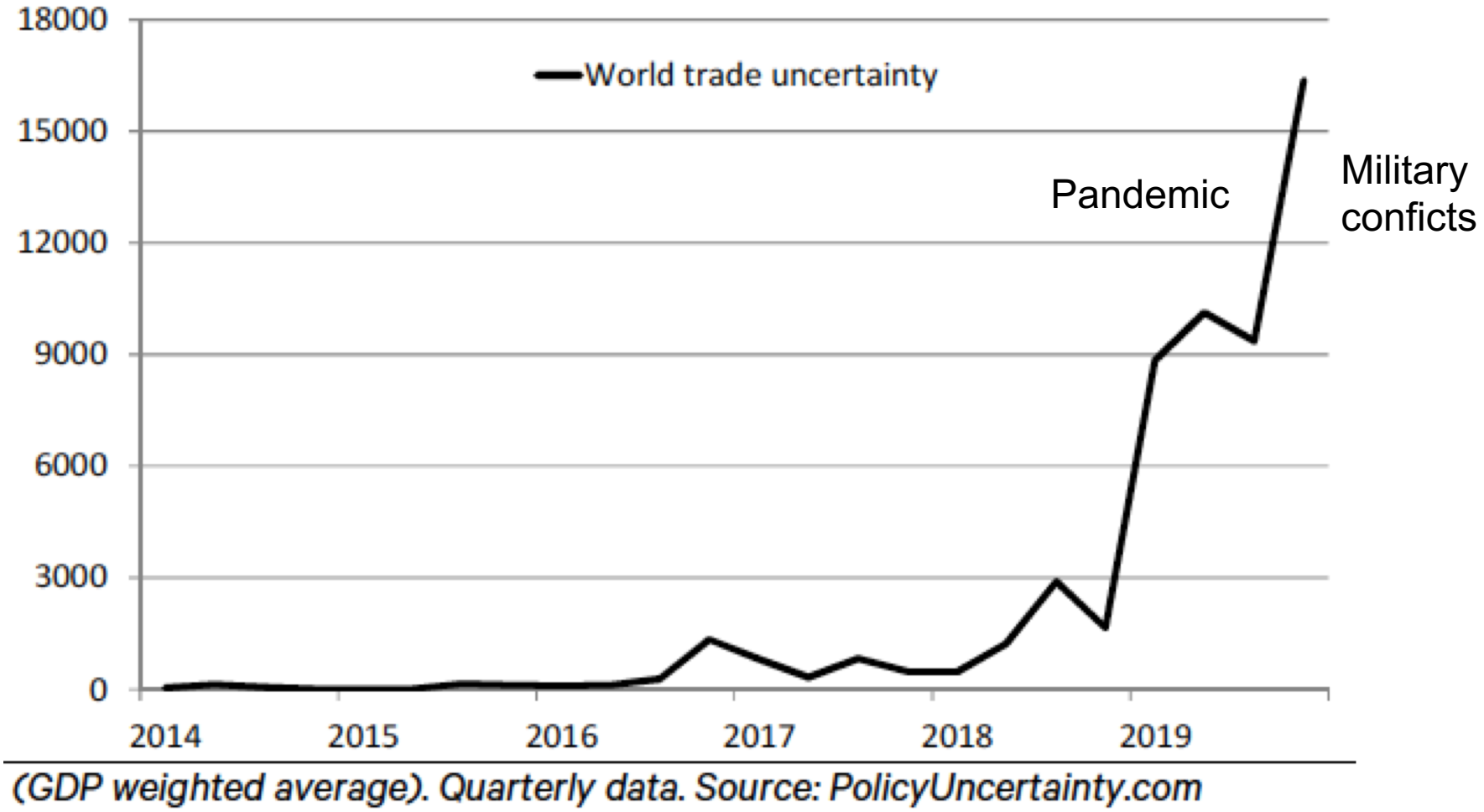
Trade measures introduced globally



Number of trade measures introduced in each year. Source: Global Trade Alert database, Bank of England. Data have been adjusted for reporting lag

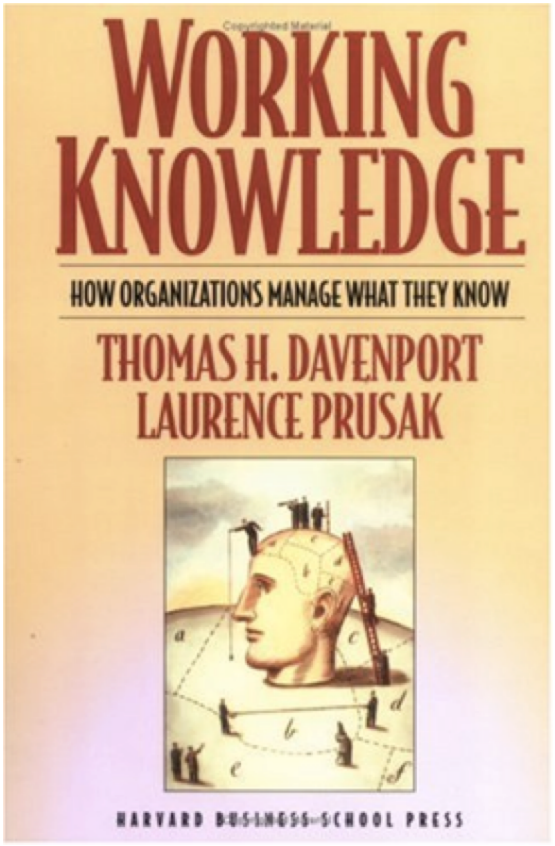
Source: Berenberg 2020

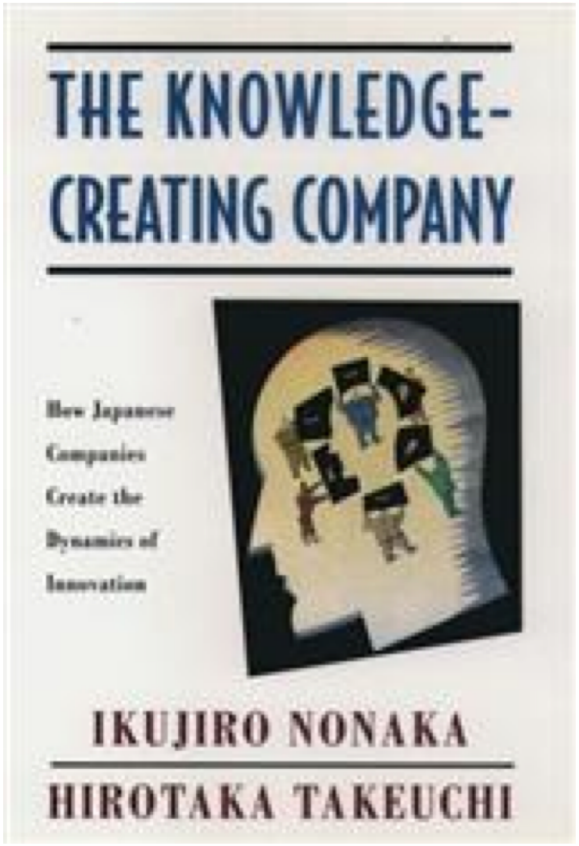
Global risks: World trade uncertainty has surged (Index, Q1 2016=100)

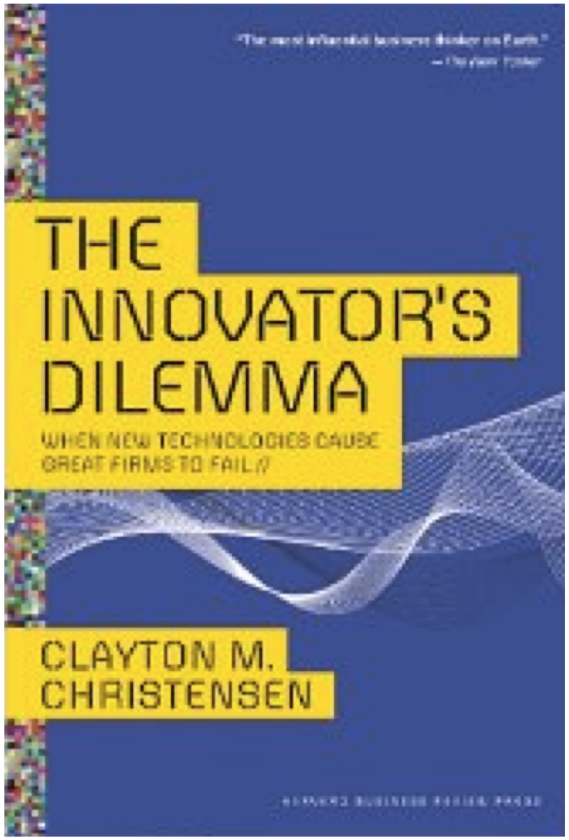


Source: Berenberg 2020

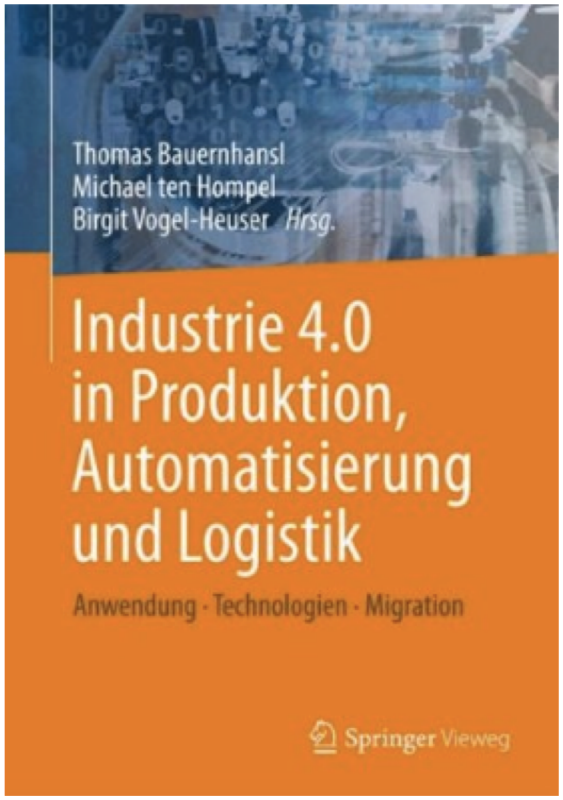
Books:

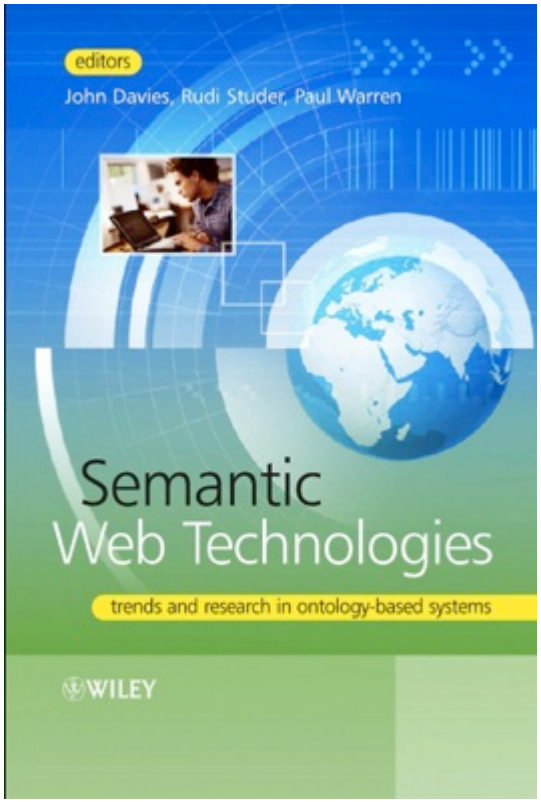

WORKING KNOWLEDGE
HOW ORGANIZATIONS MANAGE WHAT THEY KNOW
THOMAS H. DAVENPORT
LAURENCE PRUSAK
HARVARD BUSINESS SCHOOL PRESS


THE KNOWLEDGE-CREATING COMPANY
How Japanese Companies Create the Dynamics of Innovation
IKUJIRO NONAKA
HIROTAKA TAKEUCHI


THE INNOVATOR'S DILEMMA
WHEN NEW TECHNOLOGIES CAUSE GREAT FIRMS TO FAIL
CLAYTON M. CHRISTENSEN

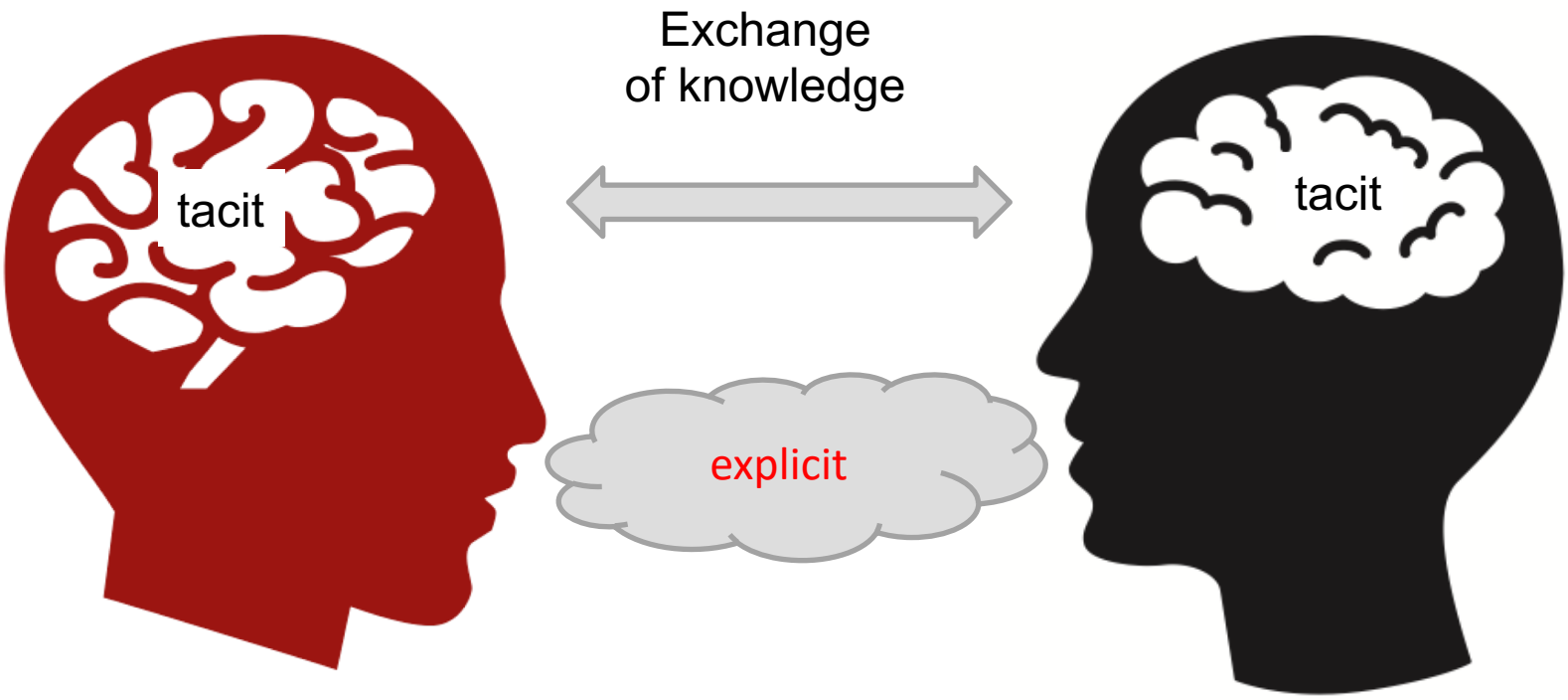
Books and Rerports:





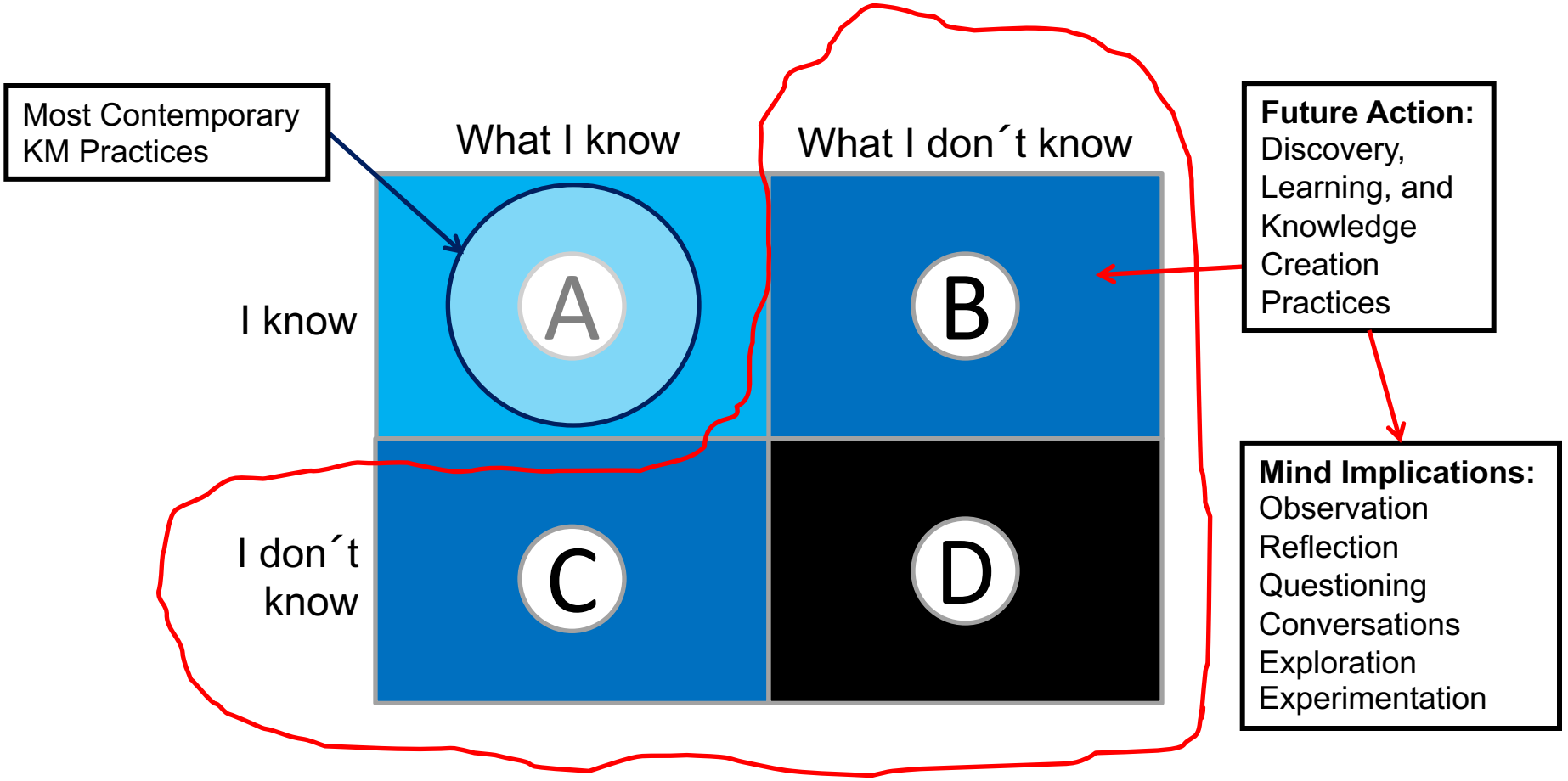
What is ...

Part Two



At the end of the exchange both people have extended their knowledge.

The Knowledge-Window© RD



Ontology

Philosophy / Science of Knowledge (Fundamentals) Many Theories

Philosophy / Science of Reality (Fundamentals) Many Theories

Fundamental understanding:

The nature of Knowledge (Epistemology)
The nature of (virtual) Reality (Ontology)

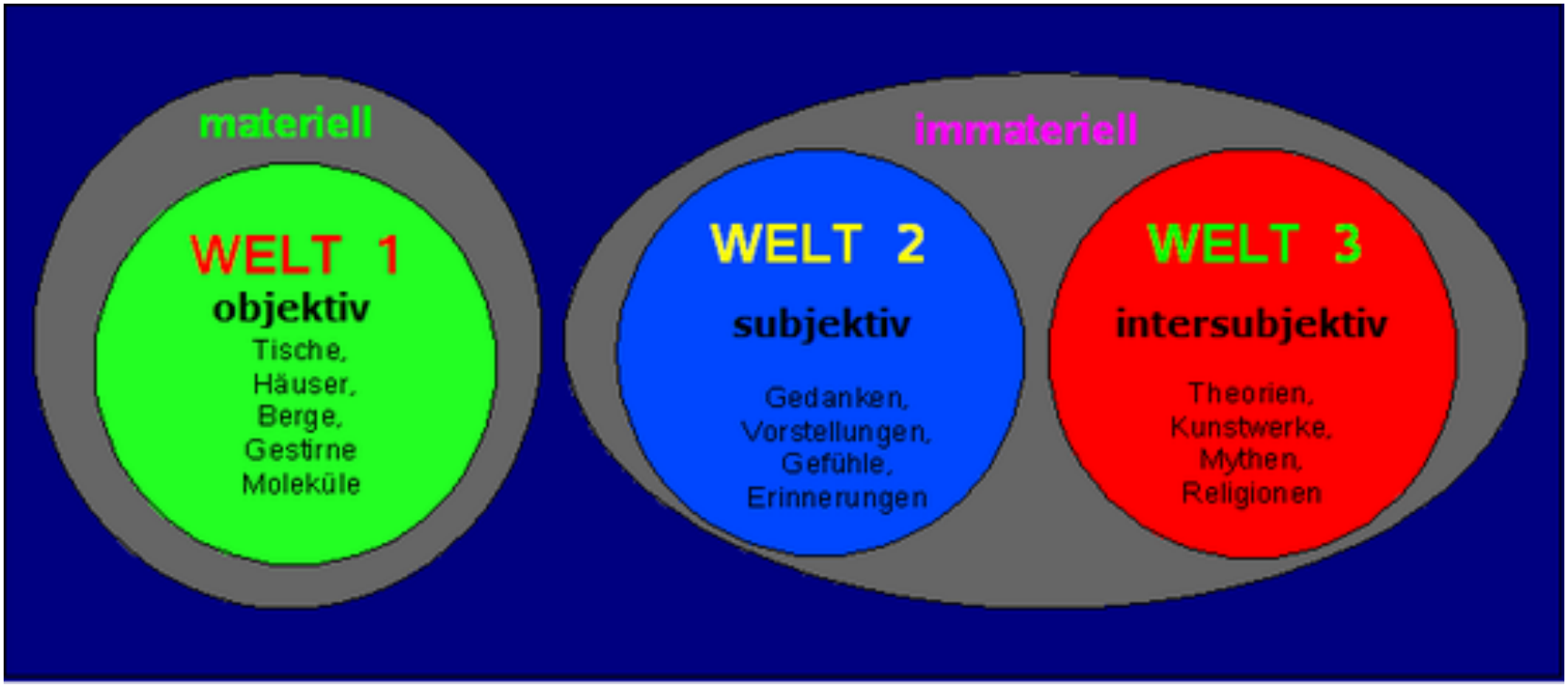
Ontology

Ontology is concerned with what is true or real, and the nature of reality	Epistemology is concerned with the nature of knowledge and different methods of gaining knowledge
Asks questions like *"What is existence?"* and *"What is the nature of existence?"*	Asks questions like *"What do you know?"* and *"How do you know it?"*

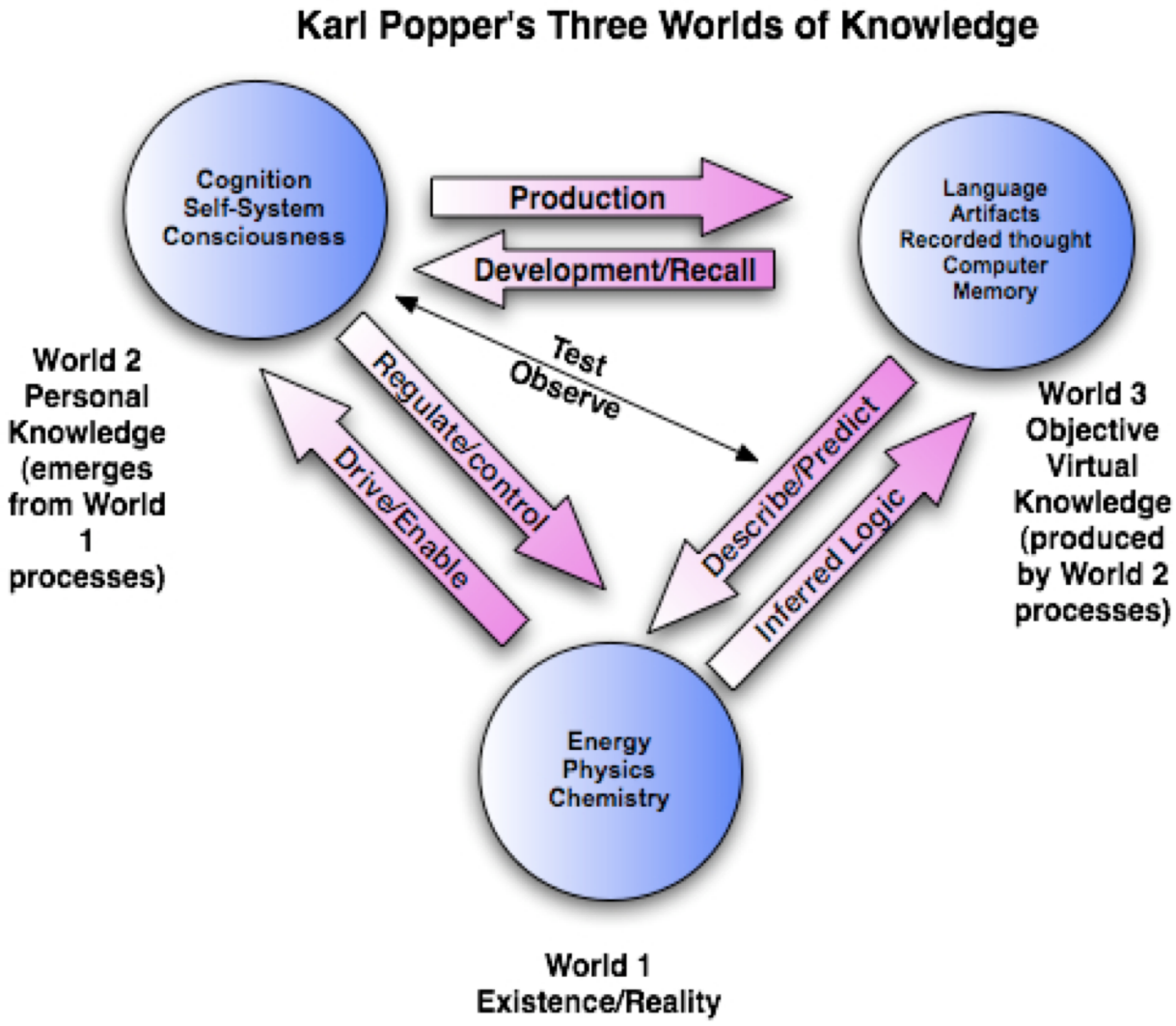
Pediaa.com

Epistemology

Karl Popper three worlds of knowledge (Ontology)



Source: Philoclopedia


Karl Popper's Three Worlds of Knowledge
Cognition
Self-System
Consciousness
Production
Development/Recall
Language
Artifacts
Recorded thought
Computer
Memory
Test
Observe
Regulate/control
Drive/Enable
Describe/Predict
Inferred Logic
World 2
Personal
Knowledge
(emerges
from World
1
processes)
World 3
Objective
Virtual
Knowledge
(produced
by World 2
processes)
Energy
Physics
Chemistry
World 1
Existence/Reality

Karl Popper three worlds of knowledge:

•**World 1** is the physical universe. It consists of the actual truth and reality that we try to represent, such as energy, physics, and chemistry. We may exist in this world, however, we do not always perceive it and then represent it correctly.

•

World 2 is the world of our subjective personal perceptions, experiences, and cognition. It is what we think about the world as we try to map, represent, and anticipate or hypotheses in order to maintain our existence in an every changing place. Personal knowledge and memory form this world, which are based on self-regulation, cognition, consciousness, dispositions, and processes. Note that Polanyi's theory of knowledge is based entirely within this world.

•

World 3 is the sum total of the objective abstract products of the human mind. It consists of such artifacts as books, tools, theories, models, libraries, computers, and networks. It is quite a diverse mixture that ranges from a claw-hammer to Maslow's hierarchy to Godel's proof of the incompleteness of arithmetic. While knowledge may be created and produced by World 2 activities, its artifacts are stored in this world. Popper also includes genetic heredity (if you think about it, genes are really nothing more than a biological artifact of instructions).

Source: Karl R. Popper, Objective Knowledge, Oxford: Clarendon Press, 1972

Source: Karl Popper, "Epistemology Without a Knowing Subject" (1967), published as chapter three in his book *Objective Knowledge: An Evolutionary Approach*, Oxford University Press, 1972.

Source: Popper KR. Das offene Universum. Gesammelte Werke Band 8. Tübingen: Mohr Siebeck; 2001

Epistemology (Theory of cognition)

(from Greek ἐπιστήμη - *epistēmē*, meaning "knowledge, understanding", and λόγος - *logos*, meaning "study of") is the branch of philosophy concerned with the

nature and scope of knowledge/cognition.

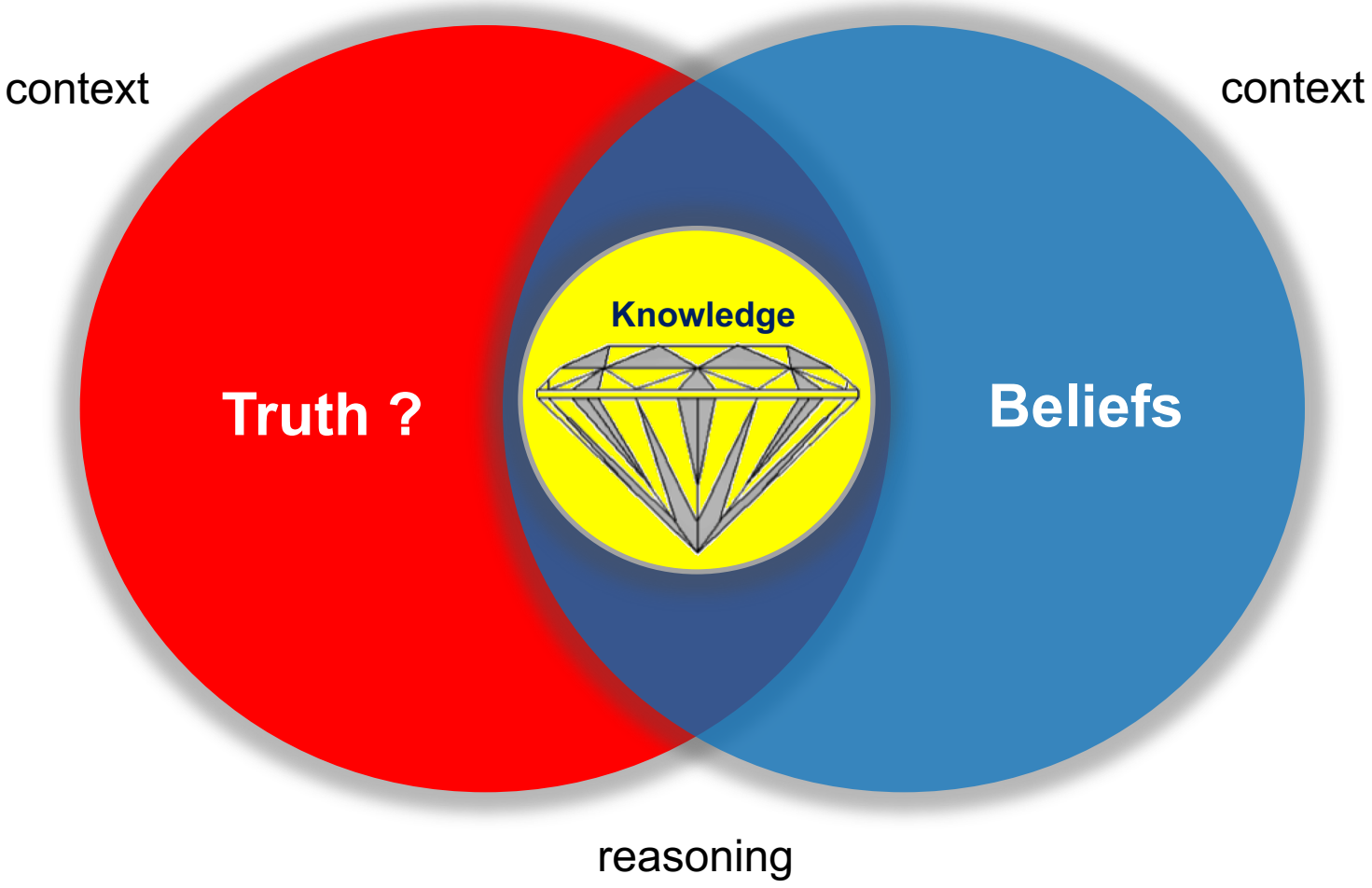
It questions what knowledge is, how it is acquired, and the possible extent to which a given subject or entity can be known.

Much of the debate in this field has focused on analyzing the nature of knowledge and how it relates to connected notions such as truth, beliefs, and justification.

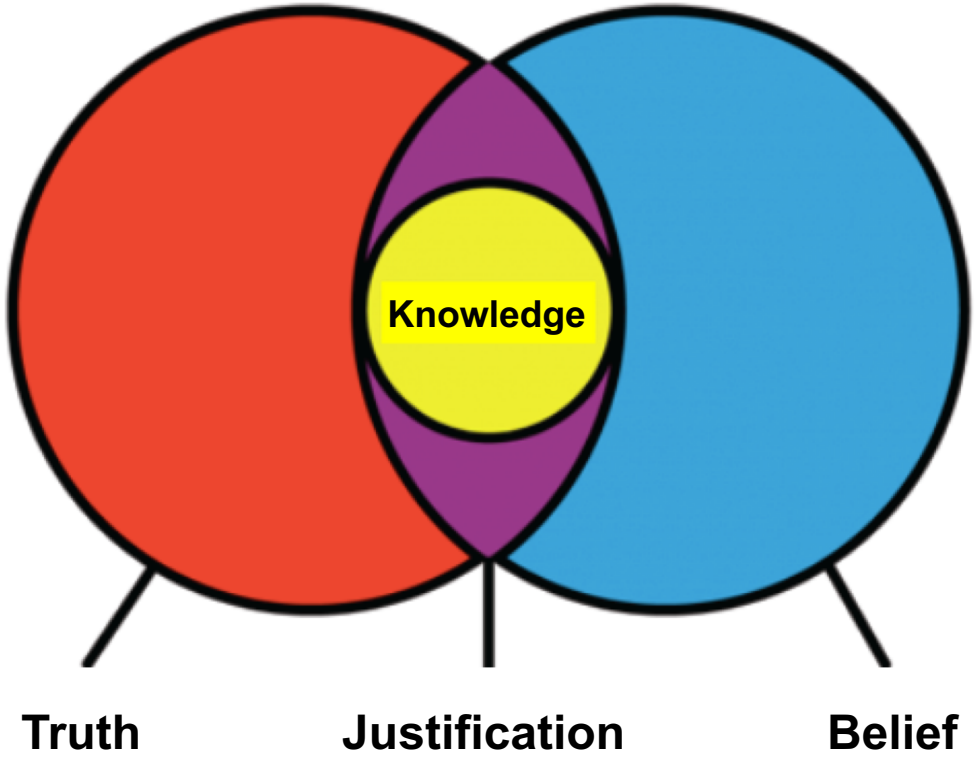
The term was introduced by the Scottish philosopher James Frederick Ferrier (1808–1864). The field is sometimes referred to as the *theory of knowledge*.

Source: adapted from Wikipedia

Nature and scope of knowledge (Epistemology)?



Edmund Gettier: „Knowledge as justified true belief“ (1963)



Source: Gettier, E. (1963). Is justified true belief knowledge?, Analysis, 23, 121-123.

The Gettier Problem

Various attempts have been made in recent years to state necessary and sufficient conditions for someone's knowing a given proposition. The attempts have often been such that they can be stated in a form similar to the following:

(a) S knows that P IFF (i.e., if and only if)

(i) P is true,
(ii) S believes that P, and
(iii) S is justified in believing that P.

For example, Chisholm has held that the following gives the necessary and sufficient conditions for knowledge:2

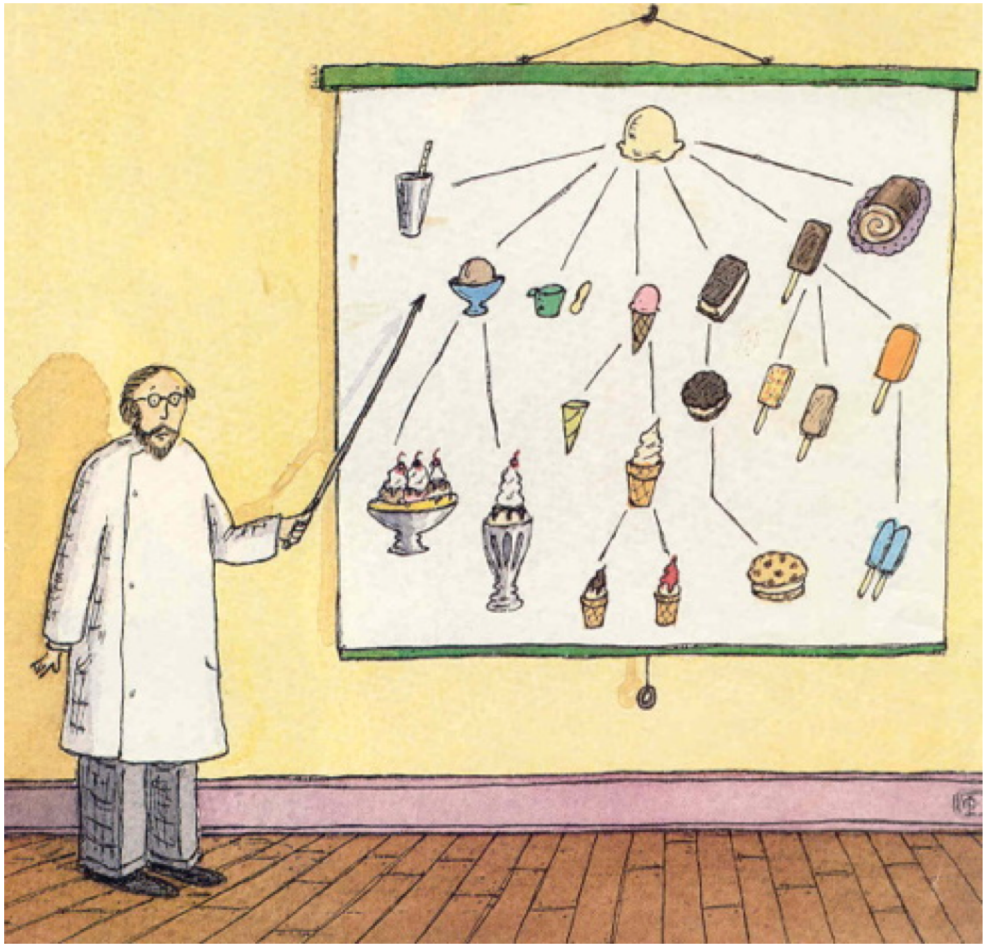
(b) S knows that P IFF (i.e., if and only if)

(i) S accepts P,
(ii) S has adequate evidence for P, and
(iii) P is true.

Source: Edmund L. Gettier: Is Justified True Belief Knowledge? Analysis, Vol. 23, No. 6. (Jun., 1963), pp. 121-123.

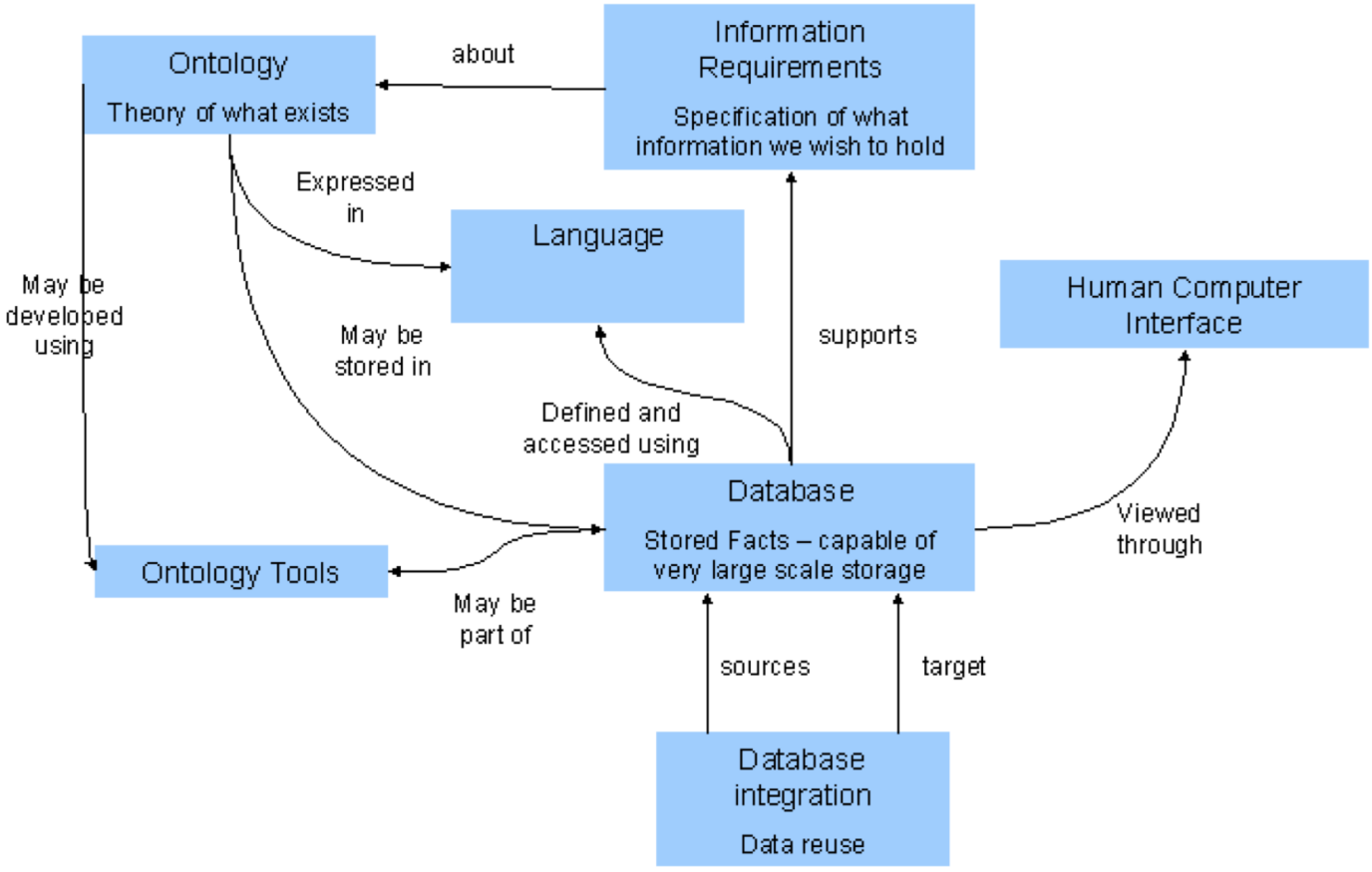
Source: insilico

Exloring the structure of the world and the semantics of data



Source: insilico

Ontology and Databases



DEFINITION OF ONTOLOGY (computer and information sciences)

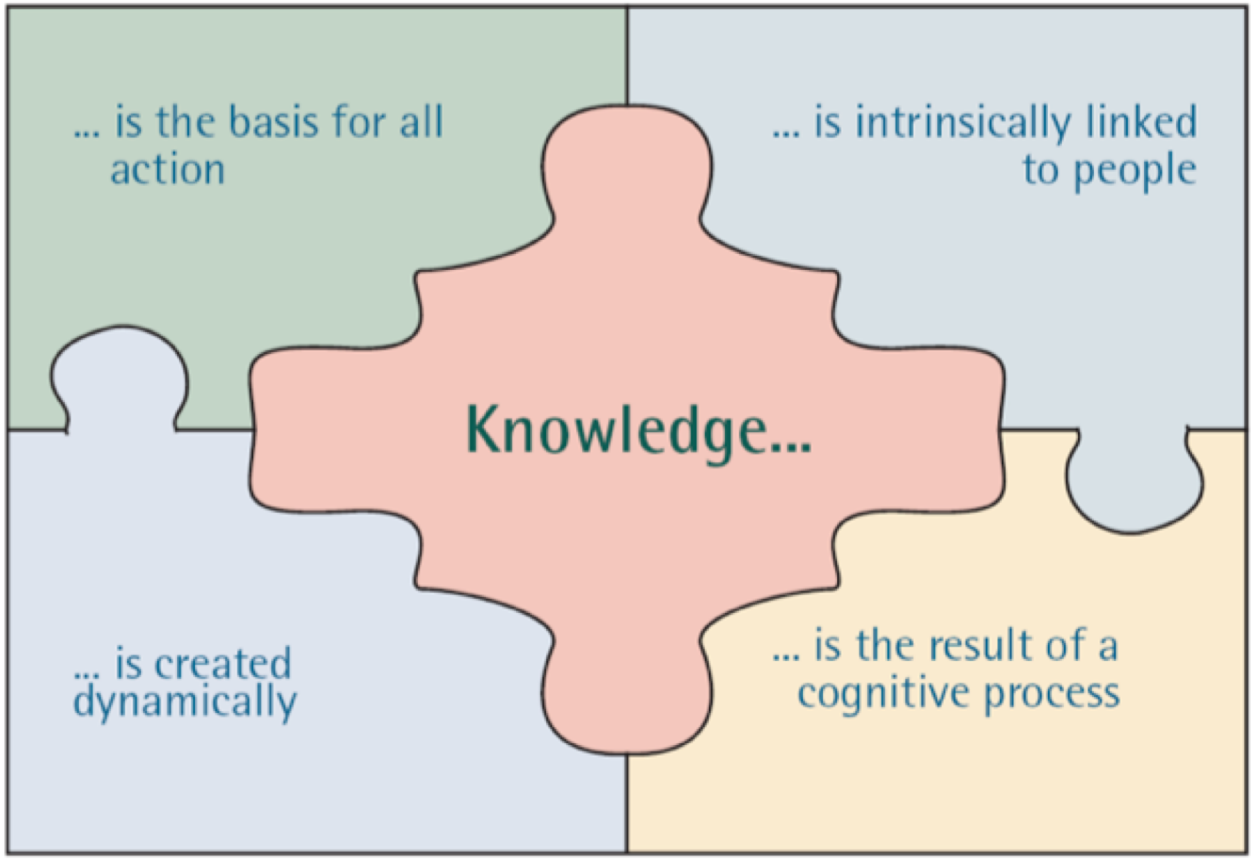
In the context of computer and information sciences, an ontology defines a **set of representational primitives with which to model a domain of knowledge or discourse**.

The representational primitives are typically classes (or sets), attributes (or properties), and relationships (or relations among class members).

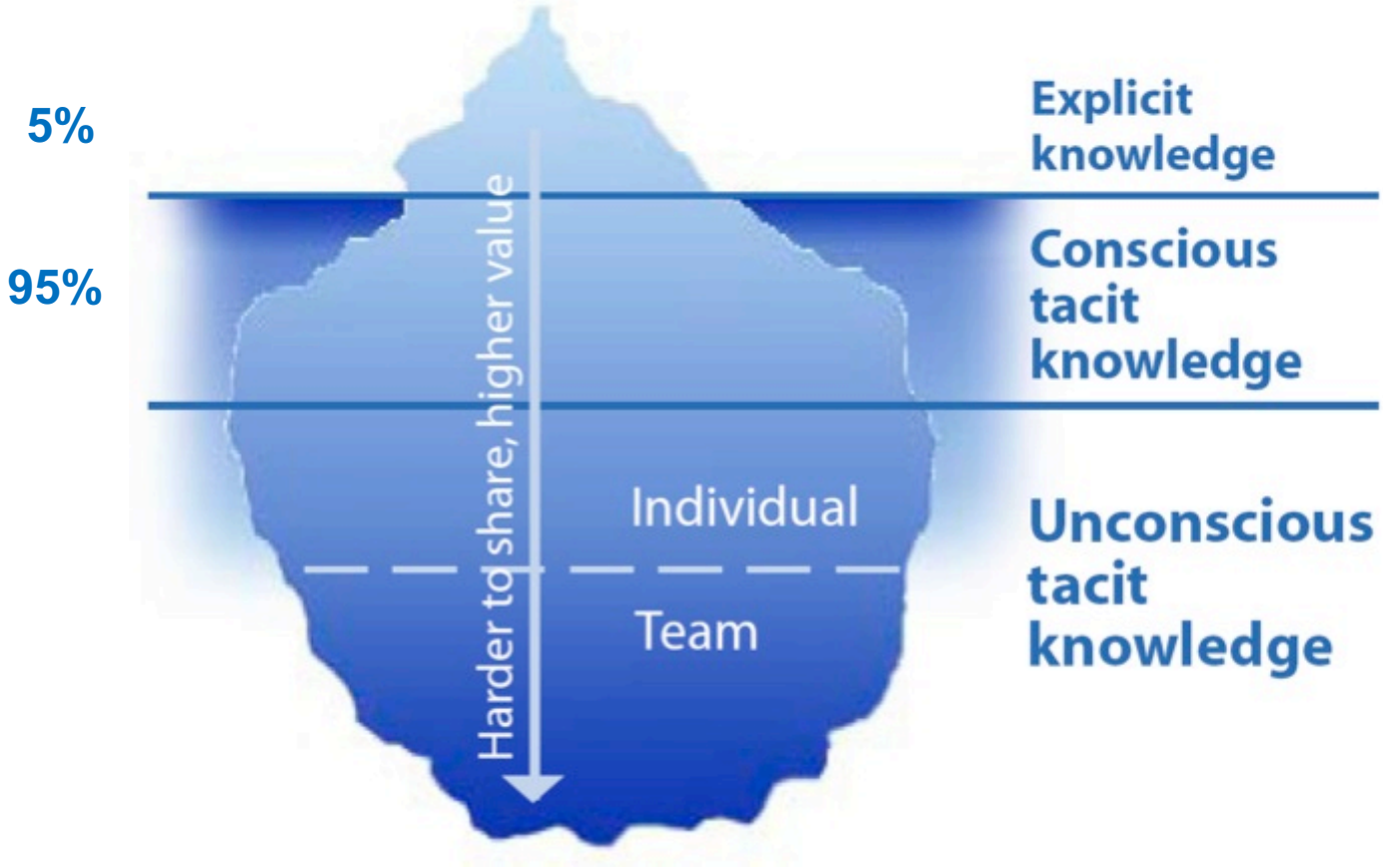
The definitions of the representational primitives include information about their meaning and constraints on their logically consistent application. In the context of database systems, ontology can be viewed as a level of abstraction of data models, analogous to hierarchical and relational models, but intended for modeling knowledge about individuals, their attributes, and their relationships to other individuals. Ontologies are typically specified in languages that allow abstraction away from data structures and implementation strategies; in practice, the languages of ontologies are closer in expressive power to first-order logic than languages used to model databases. For this reason, ontologies are said to be at the "semantic" level, whereas database schema are models of data at the "logical" or "physical" level. Due to their independence from lower level data models, ontologies are used for integrating heterogeneous databases, enabling interoperability among disparate systems, and specifying interfaces to independent, knowledge-based services. In the technology stack of the Semantic Web standards, ontologies are called out as an explicit layer. There are now standard languages and a variety of commercial and open source tools for creating and working with ontologies.

Source: *Encyclopedia of Database Systems*, Ling Liu and M. Tamer Özsu (Eds.), Springer-Verlag, 2009

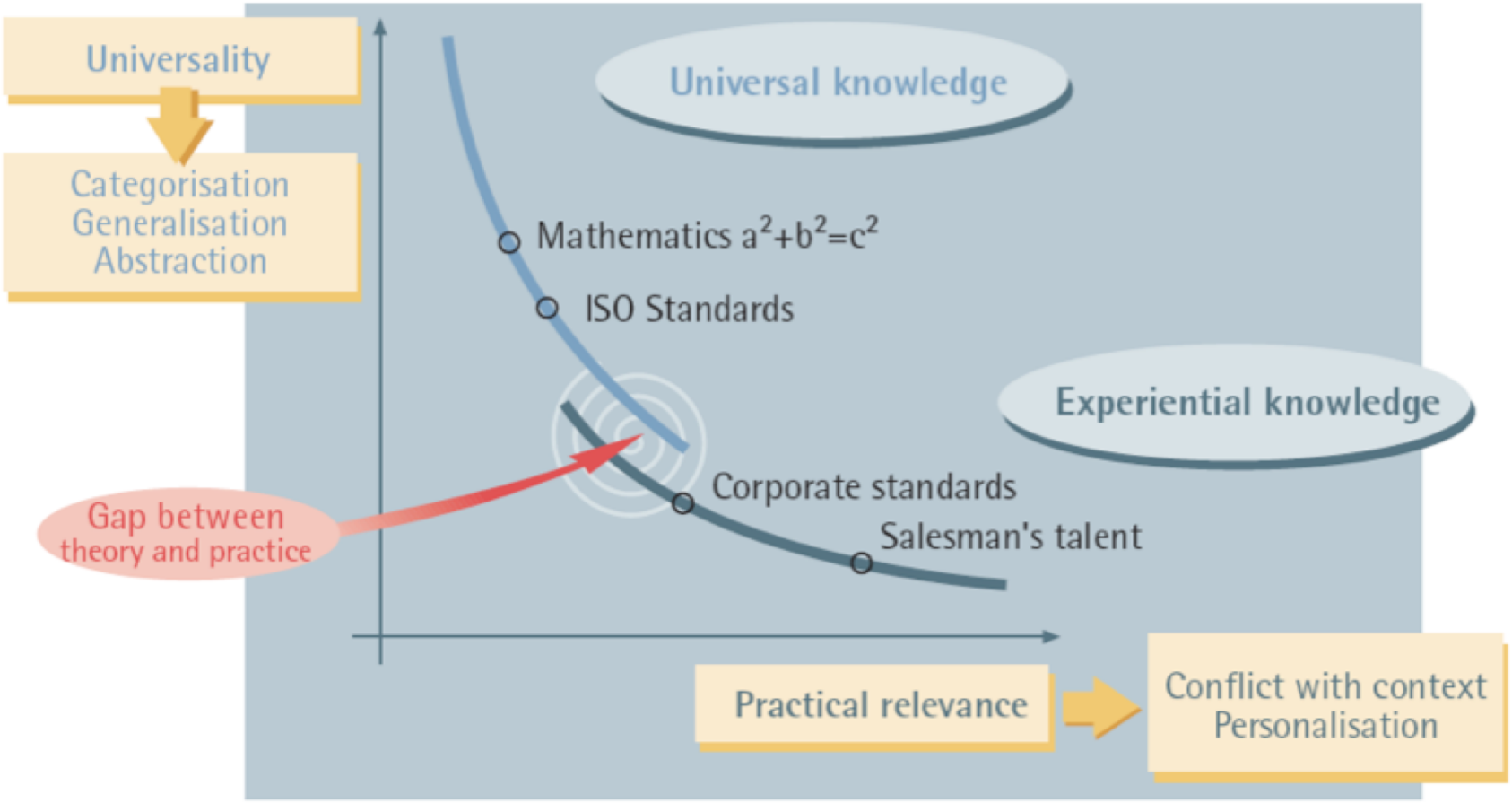
Basic characteristics of knowledge



The Knowledge Iceberg

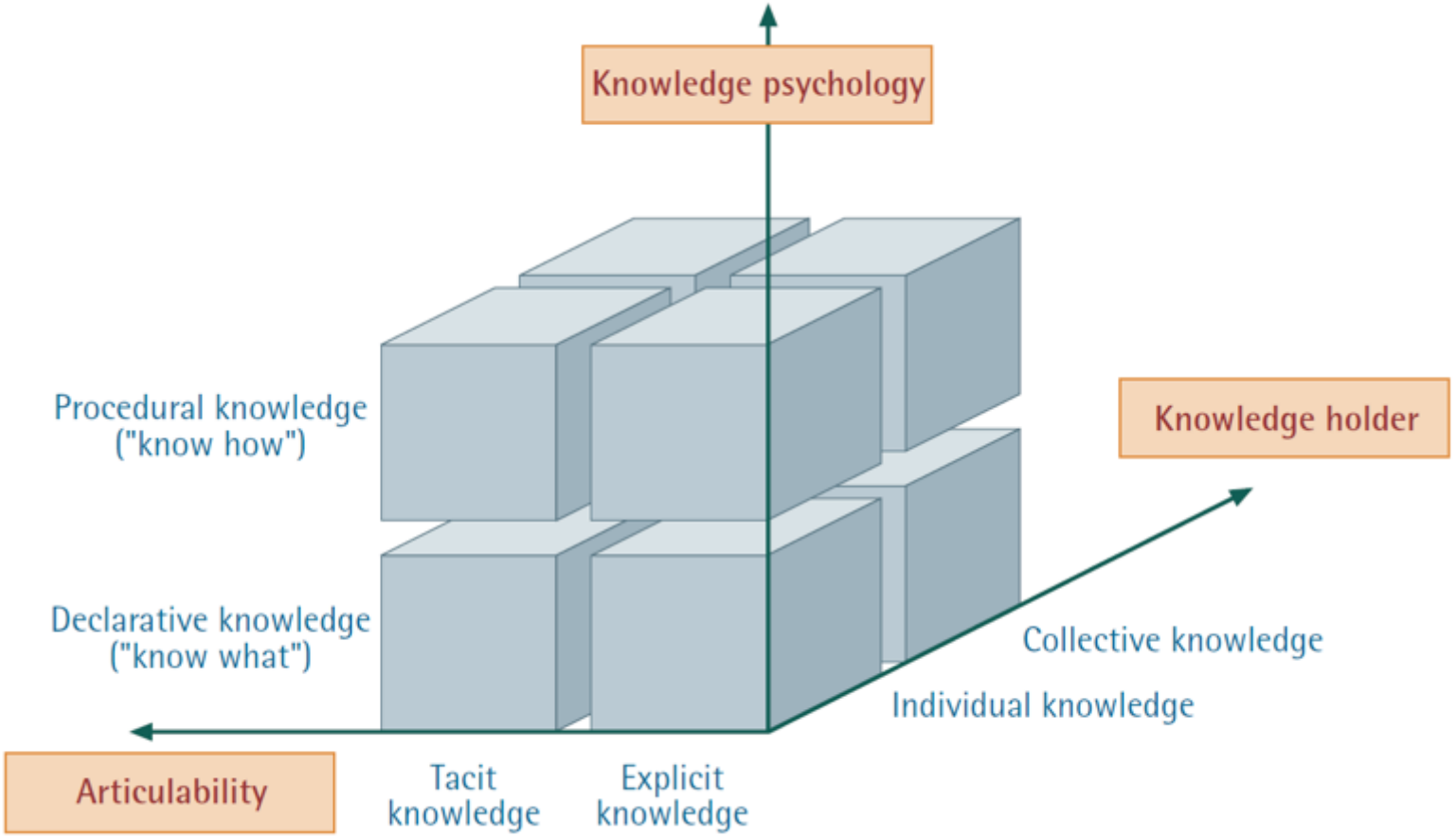


No product applications result from universal knowledge



Source: http://www.wm-forum.org

Knowledge Cube: Dimensions and Generic Types of Knowledge



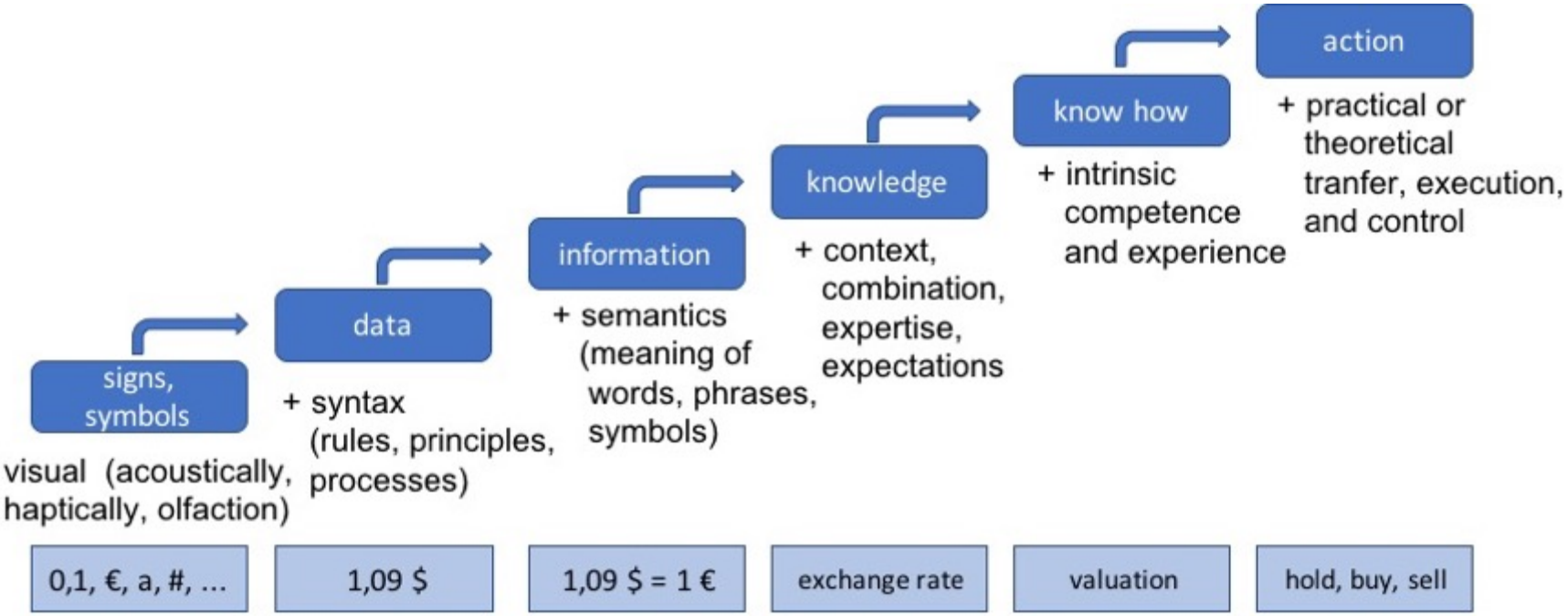
Source: http://www.wm-forum.at

Contrast between the Eastern and Western approaches to knowledge

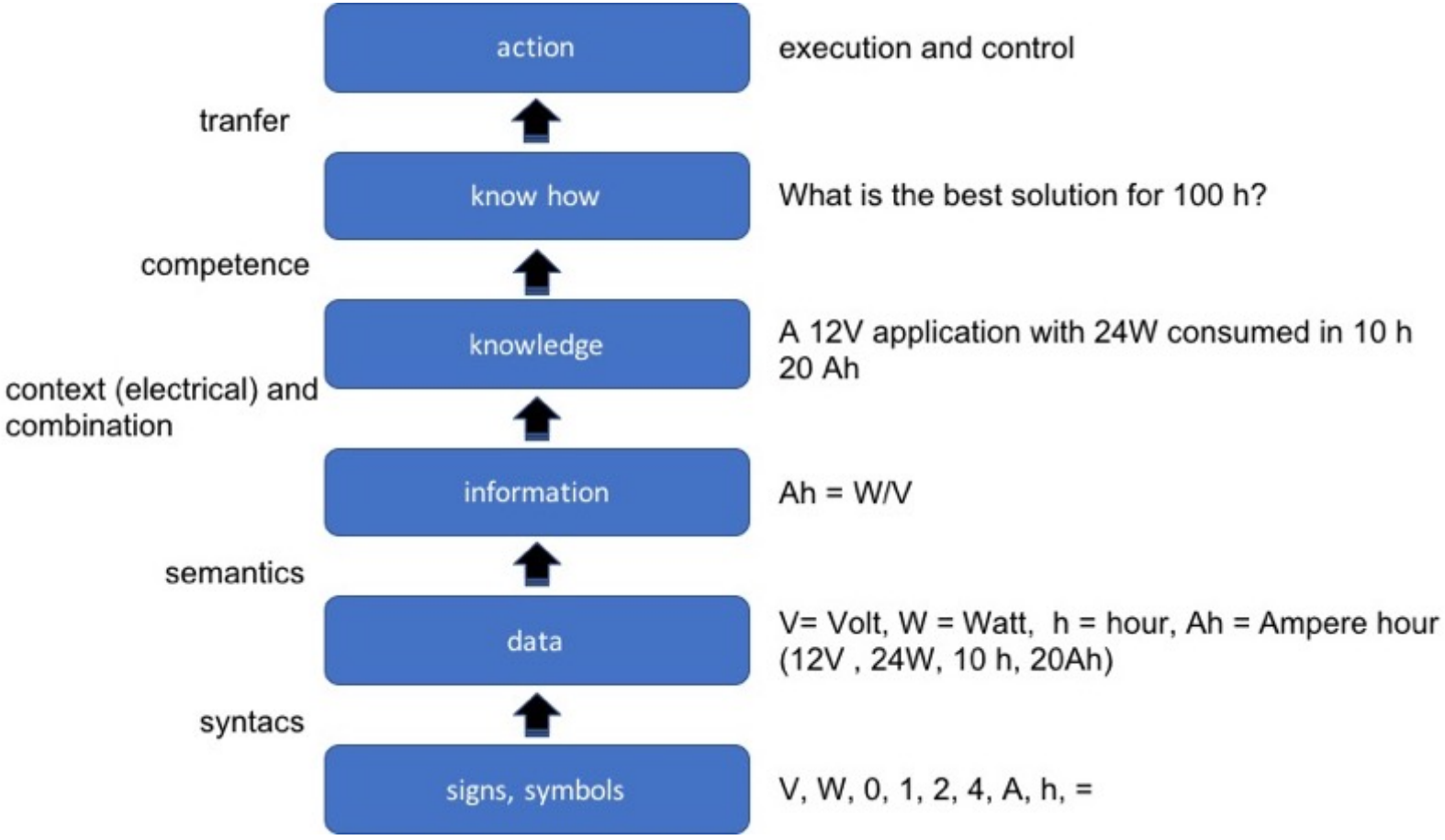
West	East
Focus on Explicit Knowledge	Focus on Tacit Knowledge
Re-Use	Creation
Knowledge Projects	Knowledge Cultures
Knowledge Markets	Knowledge Communities
Management and Measurement	Nurturing and Love
Near-Term Gains	Long-Term Advantage

Don Cohen, 1998

Process from Data to Knowledge with example

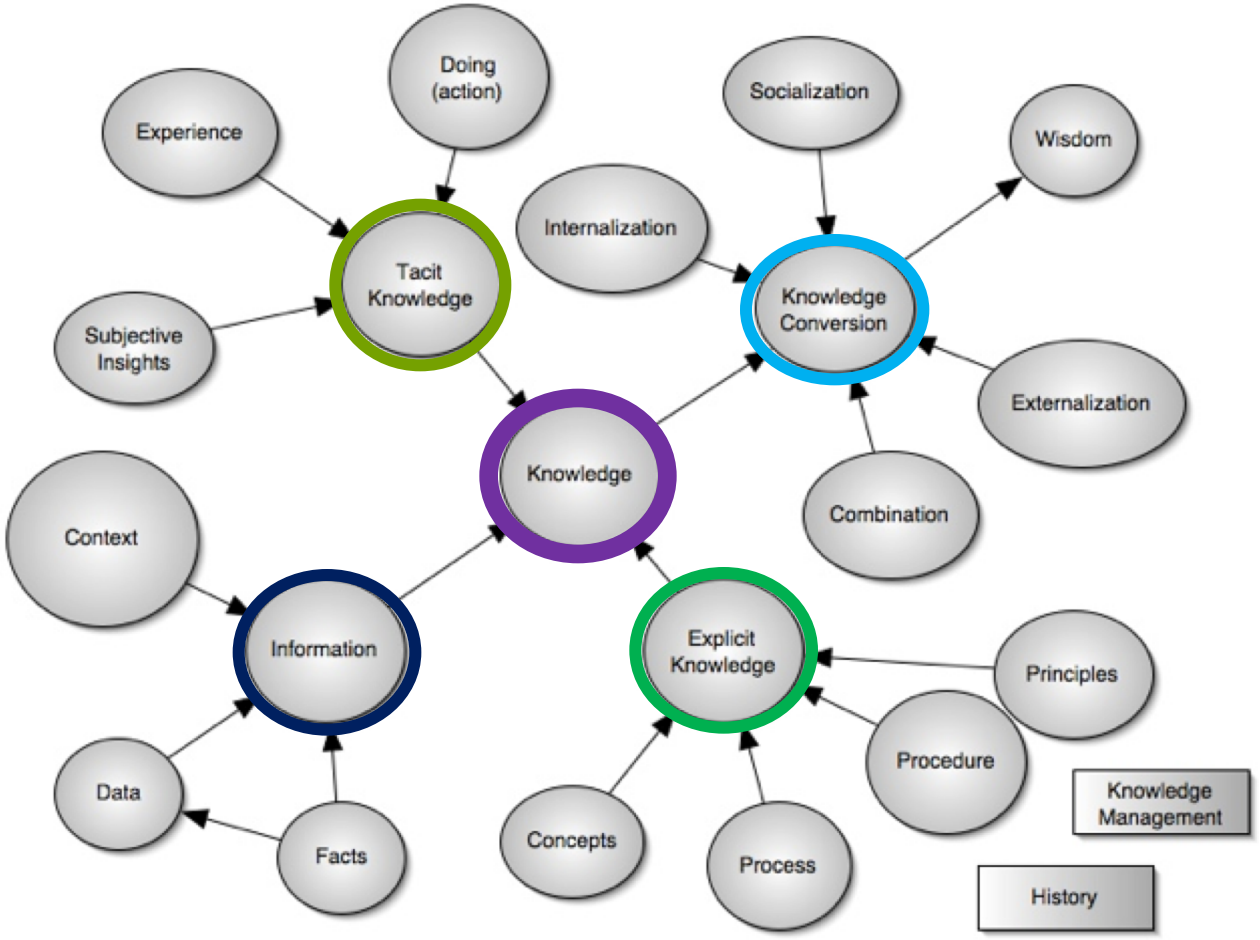


Process from Data to Knowledge with example



Knowledge Typology Map

Emotions control either directly or indirectly these parts of our knowledge base:



Source: http://www.nwlink.com/~donclark/knowledge/knowledge_typology.html

Definitions of Knowledge

Knowledge is defined by the Oxford English Dictionary (OED) as

(i) expertise, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject;

(ii) what is known in a particular field or in total; facts and information; or

(iii) awareness or familiarity gained by experience of a fact or situation.

Philosophical debates in general start with Plato's formulation of knowledge as "justified true belief."

The Dilemma:

There is however no single agreed definition of knowledge presently, nor any prospect of one, and there remain numerous competing theories.

Some other Knowledge Definitions

1.
General: Human faculty resulting from interpreted information; understanding that germinates from combination of data, information, experience, and individual interpretation.

Variously defined as, "Things that are held to be true in a given context and that drive us to action if there were no impediments" (Andre Boudreau).

"Capacity to act" (Karl Sweiby)

"Justified true belief that increases an entity's capacity for effective action" (Nonaka and Takeuchi).

"The perception of the agreement or disagreement of two ideas" (John Locke).

In an organizational context, knowledge is the sum of what is known and resides in the intelligence and the competence of people. In recent years, knowledge has come to be recognized as a factor of production (see knowledge capital) in its own right, and distinct from labor.

2.
Law: Awareness or understanding of a circumstance or fact, gained through association or experience.

Source: http://www.businessdictionary.com/definition/knowledge.html#ixzz2O6eFB6l6

Case study: NASA

DEFINITION

KNOWLEDGE MANAGEMENT **is getting the right information to the right people at the right time, and helping people create knowledge and share and *act* upon information in ways that will measurably improve the performance of NASA and its partners.**

Source: NASA 2002, p. 6

Work definition:

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

"**Knowledge** is the combination of data and information, to which is added expert opinion, skills and experience, to result in a valuable asset which can be used to aid decision making. Knowledge may be explicit and/or tacit, individual and/or collective." [3]

"**Knowledge Management** is the management of activities and processes for leveraging knowledge to enhance competitiveness through better use and creation of individual and collective knowledge resources."

Types of Knowledge

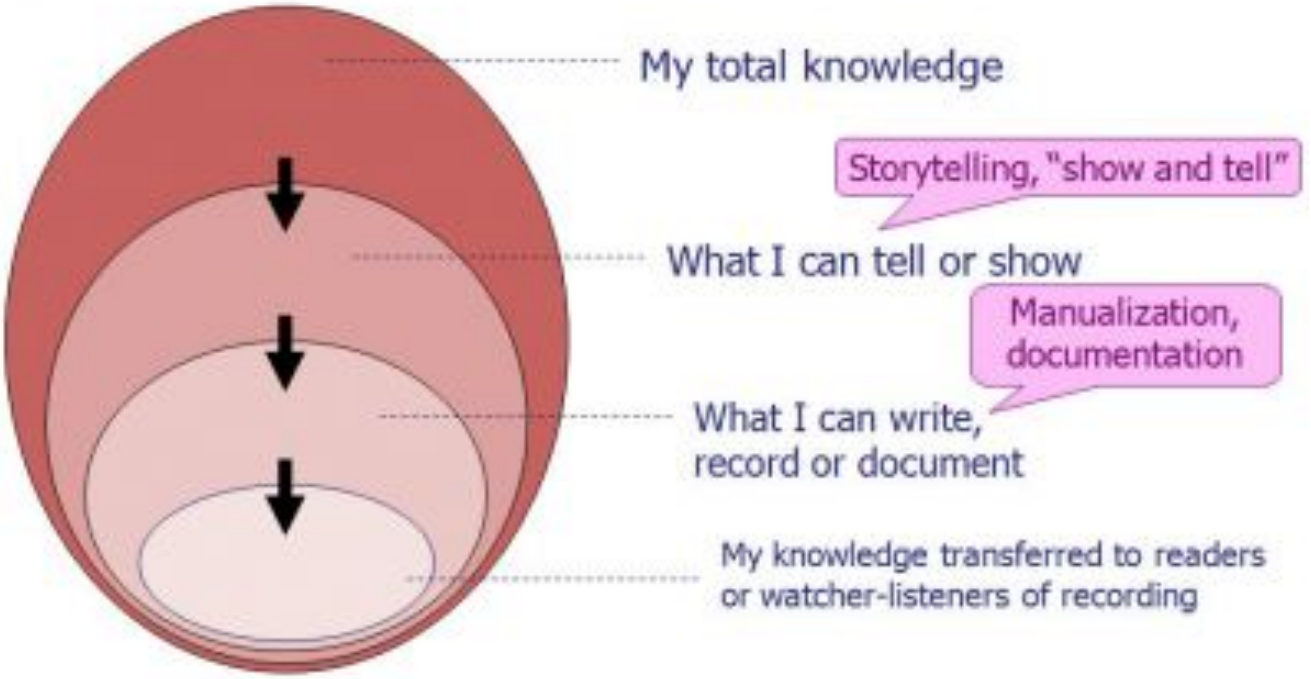
Explicit knowledge can be articulated into formal language, including grammatical statements (words and numbers), mathematical expressions, specifications, manuals, etc. Explicit knowledge can be readily transmitted others. Also, it can easily be processed by a computer, transmitted electronically, or stored in databases.
Tacit knowledge is personal knowledge embedded in individual experience and involves intangible factors, such as personal beliefs, perspective, and the value system. Tacit knowledge is hard to articulate with formal language (hard, but not impossible). It contains subjective insights, intuitions, and hunches. Before tacit knowledge can be communicated, it must be converted into words, models, or numbers that can be understand. In addition, there are two dimensions to tacit knowledge:
Technical Dimension (procedural): This encompasses the kind of informal and skills often captured in the term *know-how*. For example, a craftsperson develops a wealth of expertise after years of experience. But a craftsperson often has difficulty articulating the technical or scientific principles of his or her craft. Highly subjective and personal insights, intuitions, hunches and inspirations derived from bodily experience fall into this dimension.
Cognitive Dimension: This consists of beliefs, perceptions, ideals, values, emotions and mental models so ingrained in us that we take them for granted. Though they cannot be articulated very easily, this dimension of tacit knowledge shapes the way we perceive the world around us.

Velocity and Viscosity

Velocity — the speed with which knowledge moves through an organization.
Viscosity — the richness or thickness of the knowledge transferred.

Davenport and Prusak's book, *Working Knowledge* (1998), describes how knowledge is affected by the speed it moves through the organization (velocity) and the richness of how much context it has (viscosity).

From Tacit to Explicit Knowledge



I know more than I can tell; I can tell more than I can write.

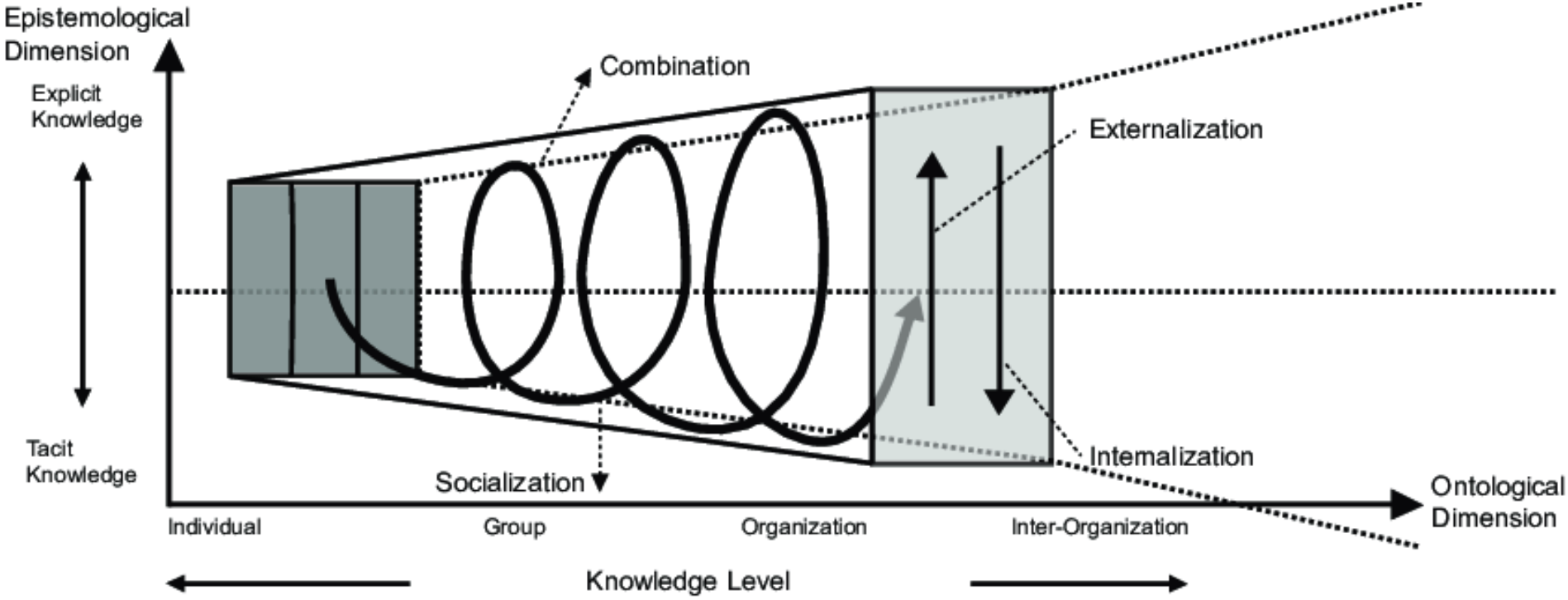
Source:http://ashklytoosi.edublogs.org/week-4/

From Explicit to Tacit Knowledge

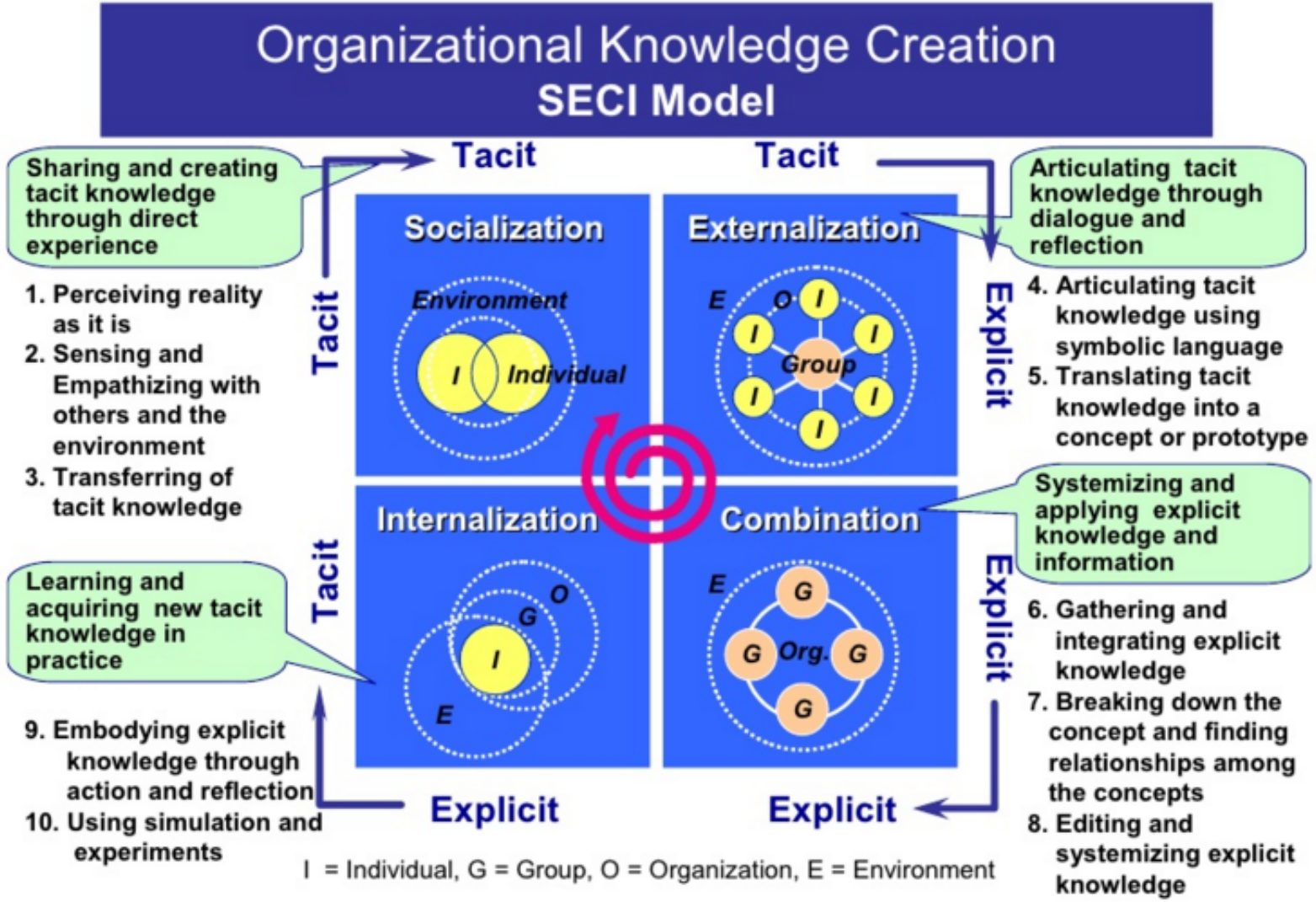
I know more if I practice more; I know even more if I reflect with other practitioners on what we practice.

Source:http://ashklytoosi.edublogs.org/week-4/

The organizational knowledge creation spiral



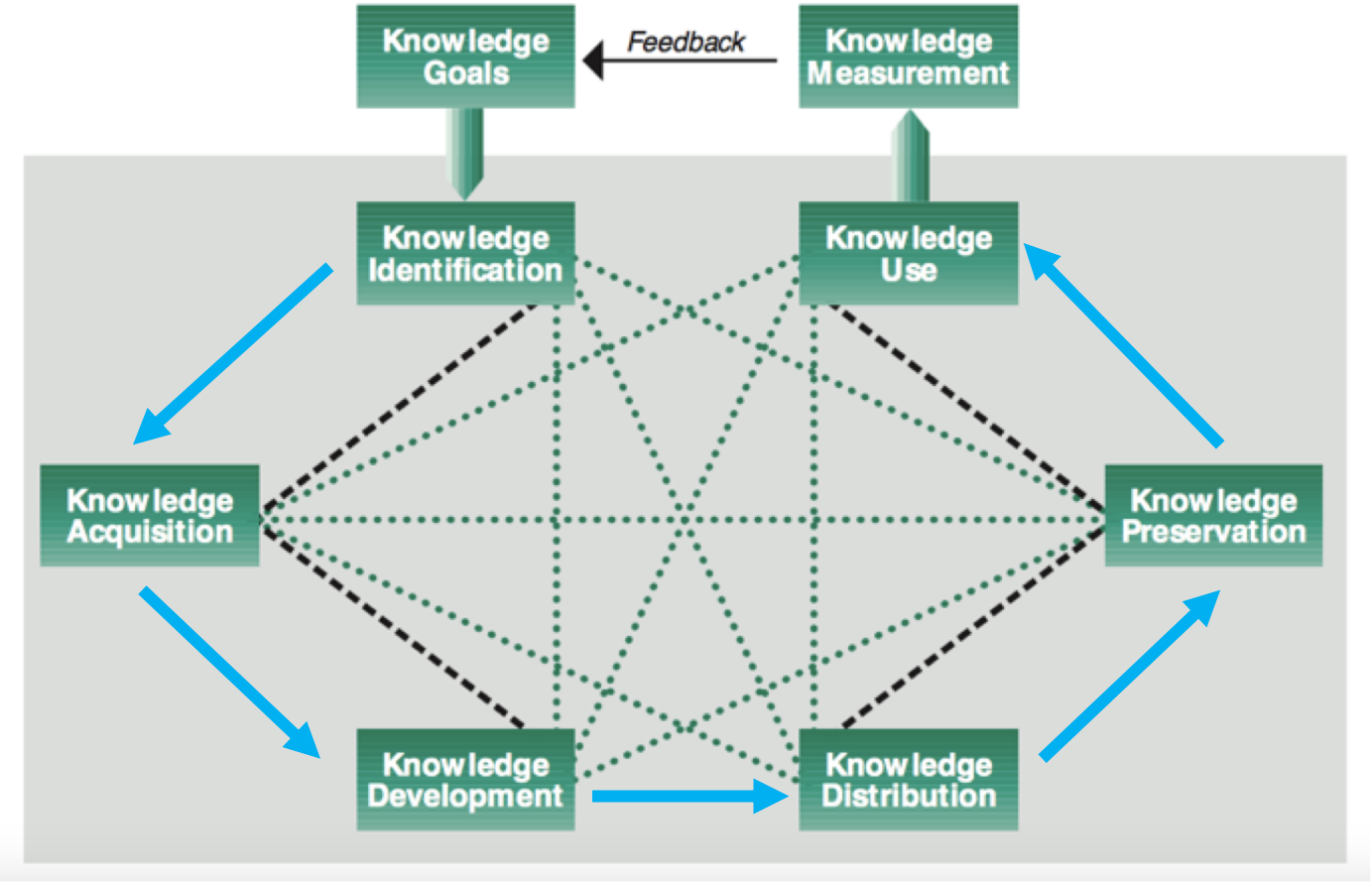
Source: Nonaka / Takeuchi 1995



Source: Nonaka 2010

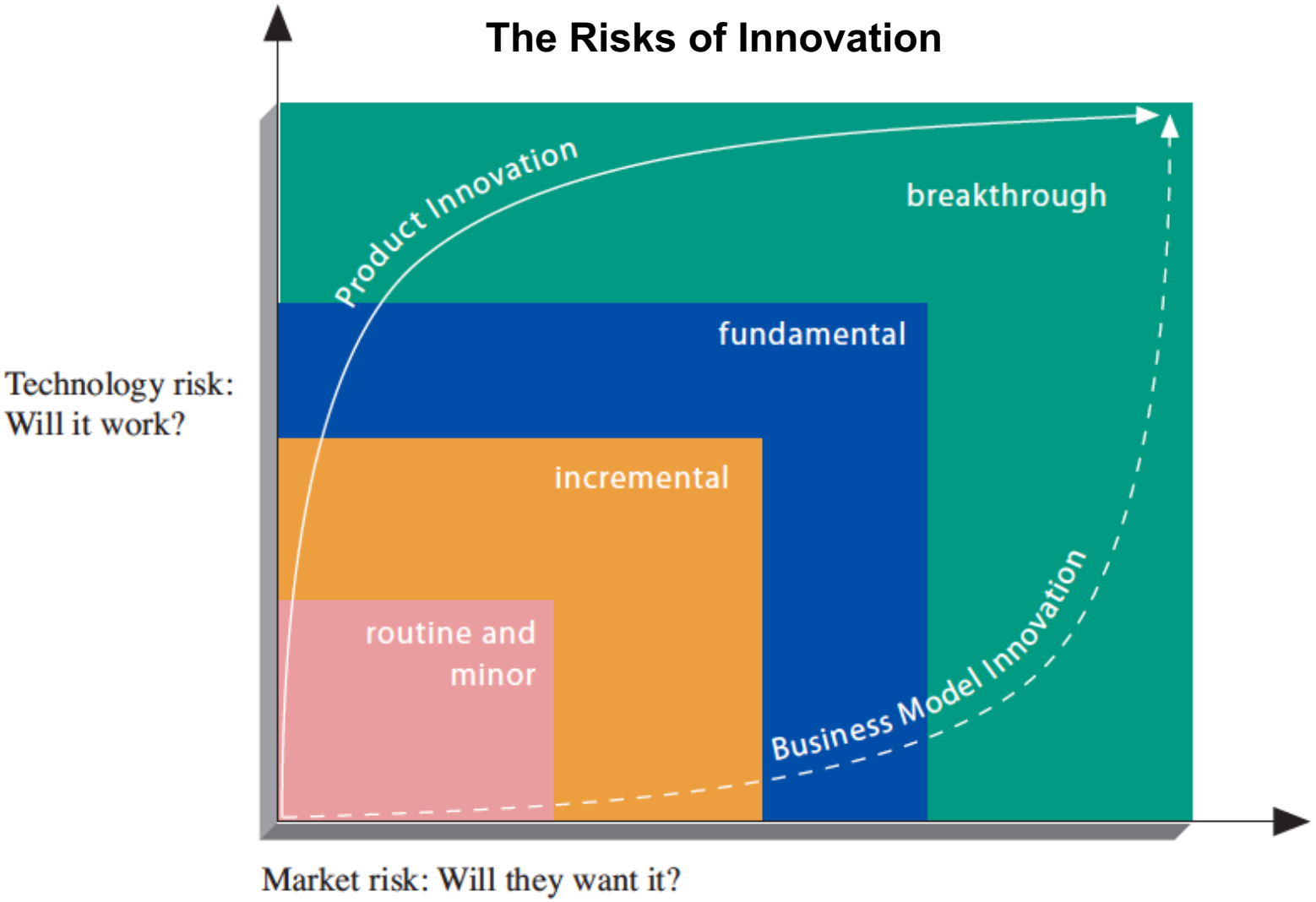
The Building Blocks of Knowledge Management by G. Probst (1997)

Knowledge Management Cycle



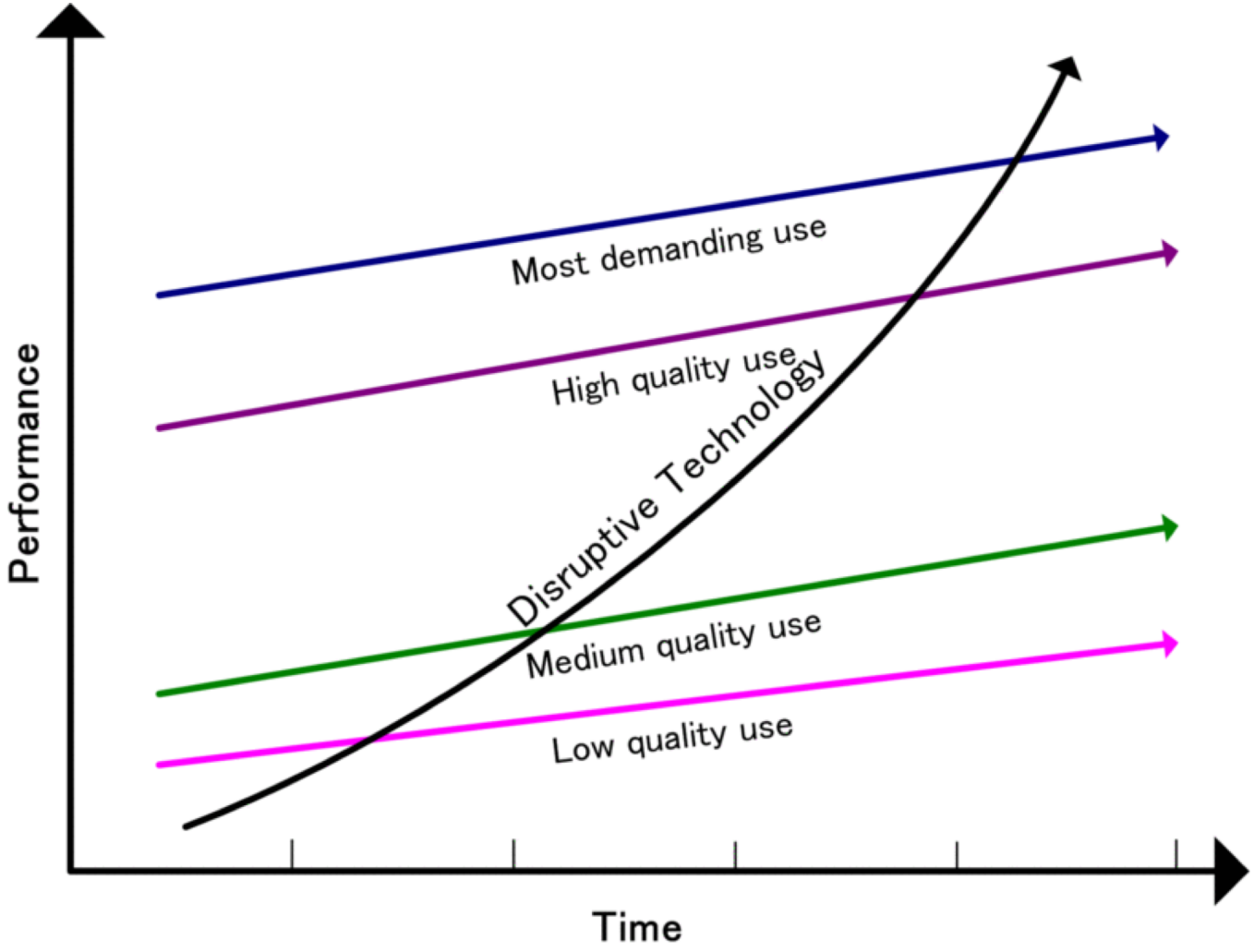
Source: G. Probst, Building Blocks of Knowledge Management - A Practical Approach, Geneva 1997

The Risks of Innovation



Source: VHA 2006

How low-end disruption occurs over time.



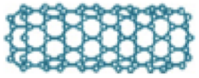
Source: Wikipedia

Twelve potentially disruptive technologies

 **Mobile Internet**	Increasingly inexpensive and capable mobile computing devices and Internet connectivity
 **Automation of knowledge work**	Intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments
 **The Internet of Things**	Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization
 **Cloud technology**	Use of computer hardware and software resources delivered over a network or the Internet, often as a service
 **Advanced robotics**	Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans
 **Autonomous and near-autonomous vehicles**	Vehicles that can navigate and operate with reduced or no human intervention

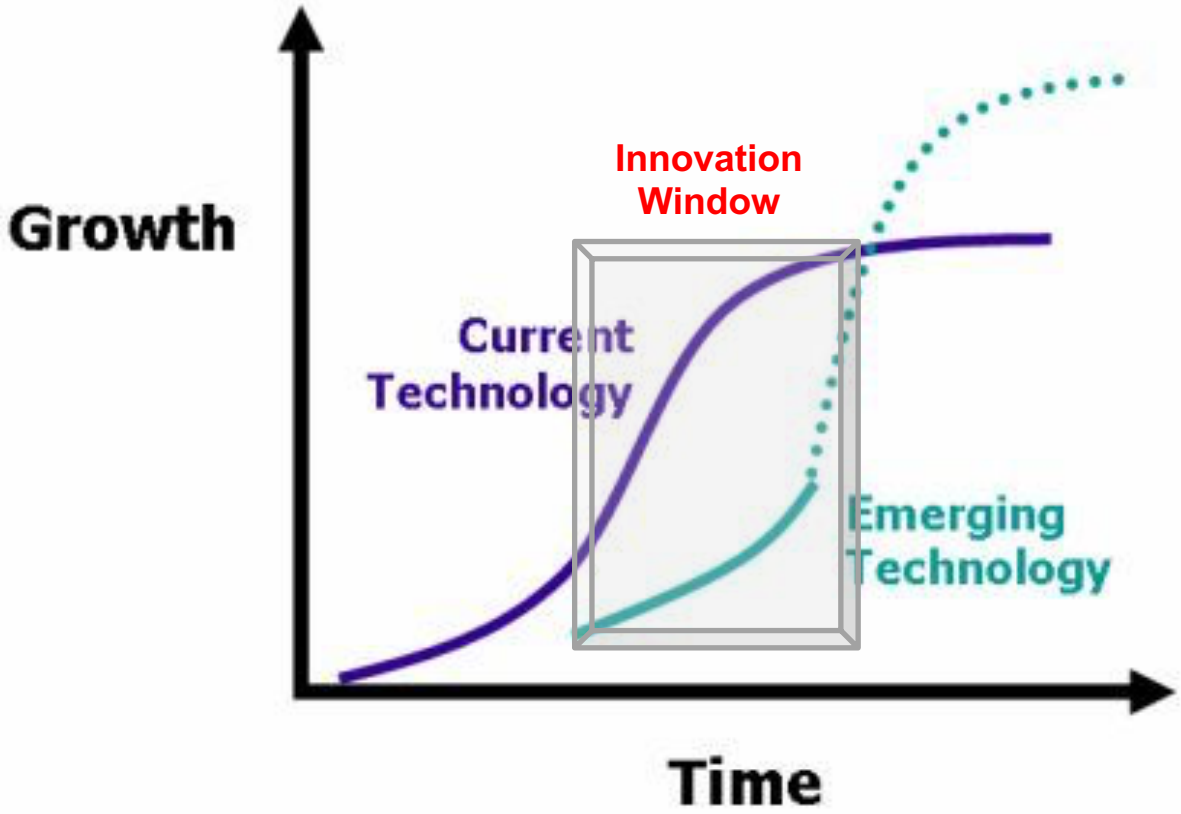
Cont.

Cont. Twelve potentially disruptive technologies

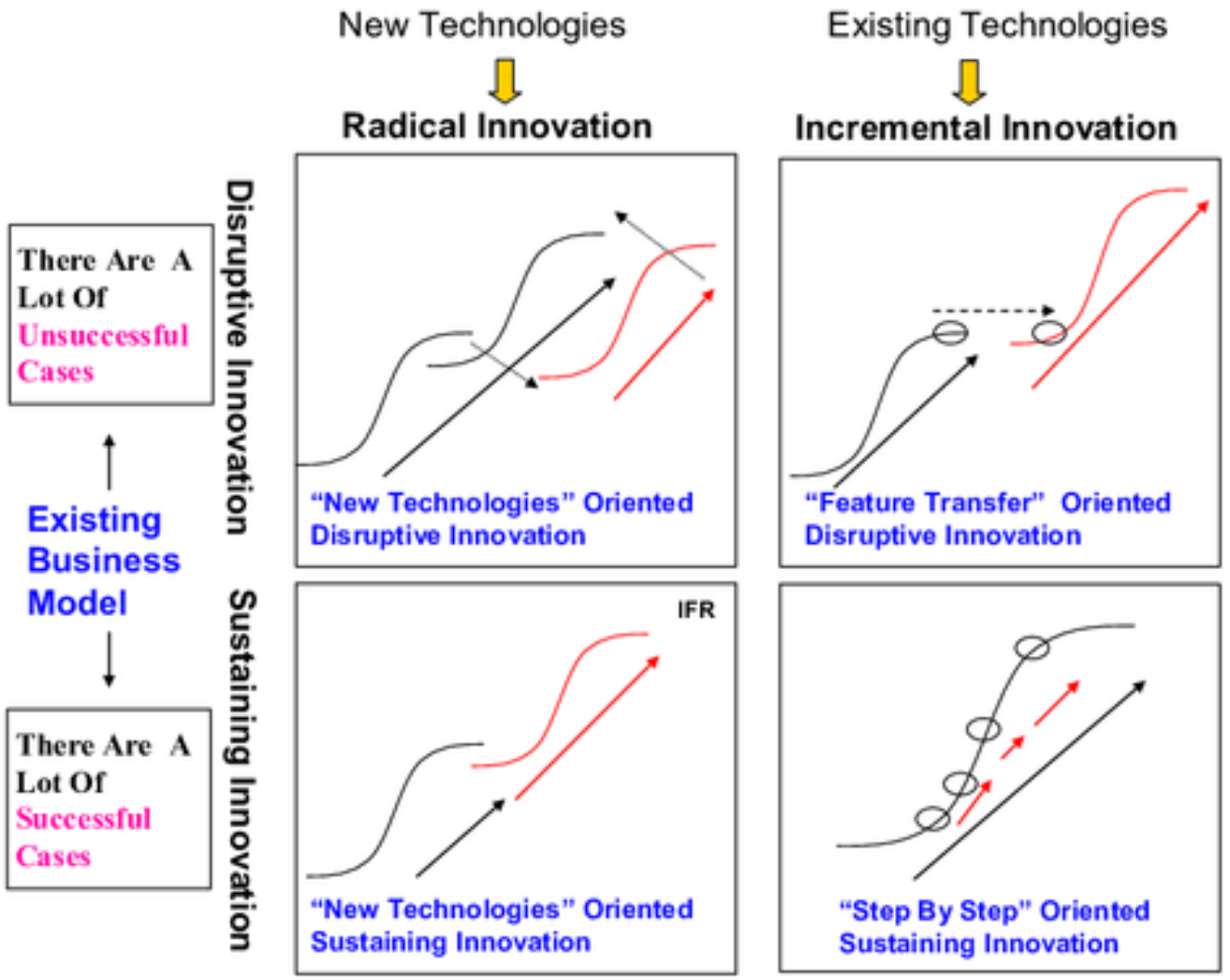
 **Next-generation genomics**	Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology ("writing" DNA)
 **Energy storage**	Devices or systems that store energy for later use, including batteries
 **3D printing**	Additive manufacturing techniques to create objects by printing layers of material based on digital models
 **Advanced materials**	Materials designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality
 **Advanced oil and gas exploration and recovery**	Exploration and recovery techniques that make extraction of unconventional oil and gas economical
 **Renewable energy**	Generation of electricity from renewable sources with reduced harmful climate impact

SOURCE: McKinsey Global Institute analysis

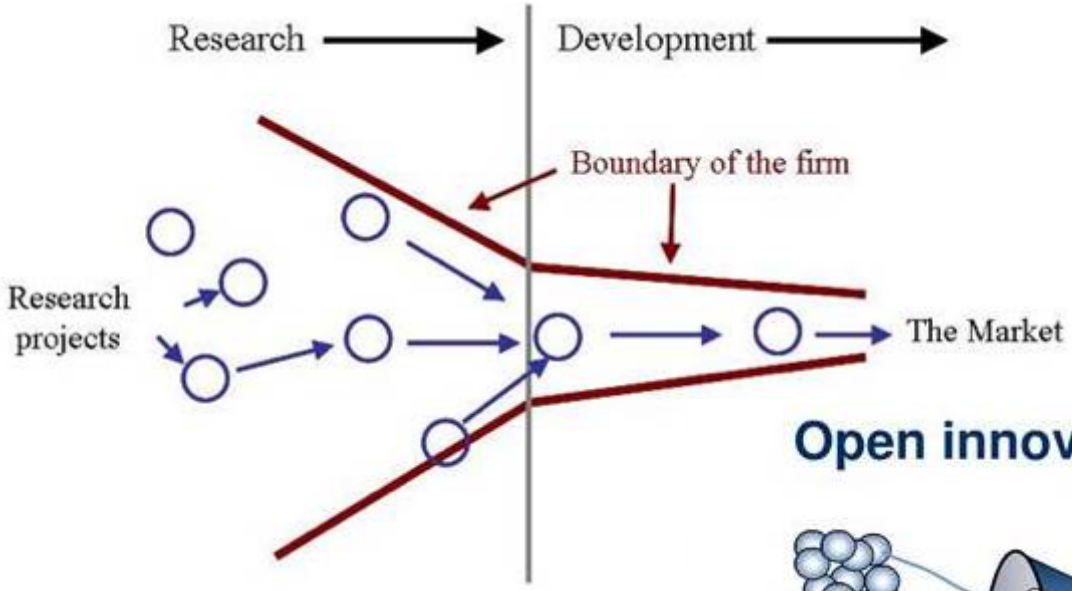
S-curve of innovation

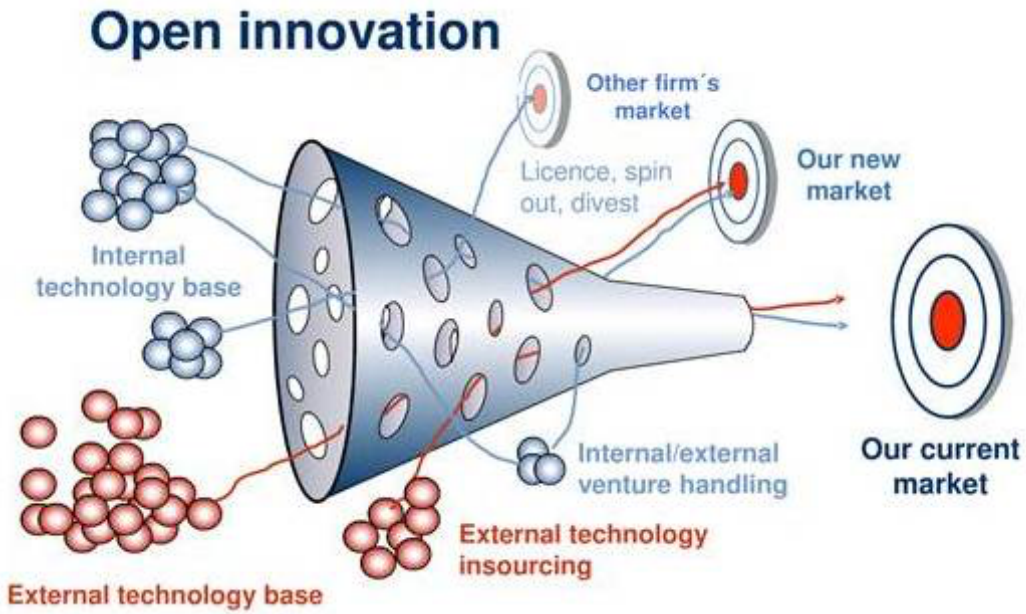


S-curve of innovation



Closed Innovation





Source: Chesbrough 2003

Research → Development →

Closed Innovation vs Open Innovation

Closed Innovation	Open Innovation
Most of the smart people in our field work for us	Not all of the smart people work for us, so we must find and tap into the knowledge and expertise of bright individuals outside our company
To profit from R&D, we must discover, develop and ship ourselves	External R&D can create significant value; internal R&D is needed to claim some portion of that value
If we discover it, we will get it to market first	We don´t have to originate the research in order to profit from it
If we are the first to commercialize we will win	Building a better business model is better than getting to market first
If we create the most and the best ideas in the industry, we will win	If we make the best use of internal and external ideas we will win
We should control our intellectual property (IP) so that our competitors don´t profit from our ideas	We should profit from others´ use of our IP, and we should buy others´ IP whenever it advances our own business model

Source: Chesbrough 2003

Selected KM Tools: But Attention! (see next slide)

capterra.com

Management Software for your organization.

Product	Deployment	Cataloging/Categorization	Collaboration	Content Management	Full Text Search	Knowledge Base Management	Self Service Portal	
Zendesk (2375 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
Intellium Platform (8 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
SABIO Knowledge Management (19 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
elevio (26 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
ComAround Knowledge (13 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
Onna (4 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
elium (6 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
Knowliah		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
Freshdesk (2183 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE
Helpjuice (67 reviews)		✓	✓	✓	✓	✓	✓	VISIT WEBSITE

Check the advantages and disadvantages of standardized KM Tools!

- Are they compatible with the corporate strategy?
- Are they compatible with the organizational KM targets?
- Are they compatible with the organizational culture?
- Are they compatible with the organizational size (SME, Team)?
- Are they compatible with the organizational resources?
- Are they compatible with the organizational environment?
- Are they compatible with the corporate Business model?
- The deepness and scope of the Knowledge base
- The usebility and access to the Knowledge base
- The knowledge sharing procedure and routines
- The protection of intellectual Property