

05  
MAY

17:00 – 19:30

TECHNOPARK LIECHTENSTEIN

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**EmTech 2022**

**Summit Liechtenstein**

FREE ENTRY

Professor Dr. Leo Brecht | Institute for Entrepreneurship  
Chair in Entrepreneurship & Technology  
University of Liechtenstein | Fürst-Franz-Josef-Strasse  
FL-9490 Vaduz | leo.brecht@uni.li | uni.li

## Summit on Emerging Technologies

In several booths we present most innovative companies, learn about emerging technologies, understand why innovation is relevant for investors and discuss latest findings from innovation research. And finally get inspired by our special guest speaker from Inficon.

Time	Agenda	Speaker
17:00	<b>Come together</b>	
17:30	<b>Welcome and Topics</b>	<i>Prof. Dr. Brecht</i>
17:40	Outlook 2022+: <b>Emerging Technologies</b>	<i>Dr. Kauffeldt</i>
18:00	<b>Why Innovation really Matters:</b> Some Insights from Research	<i>Prof. Dr. Brecht, Dr. Bayrle</i>
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19:00	<b>Inficon – Innovation Champion</b> from the Rhine Valley	<i>Dr. Wälchli</i>
19:20	<b>Summary and Closing</b>	<i>Prof. Dr. Brecht</i>
> 19:30	<b>Networking and Aperòche</b>	

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## Welcome and Topics

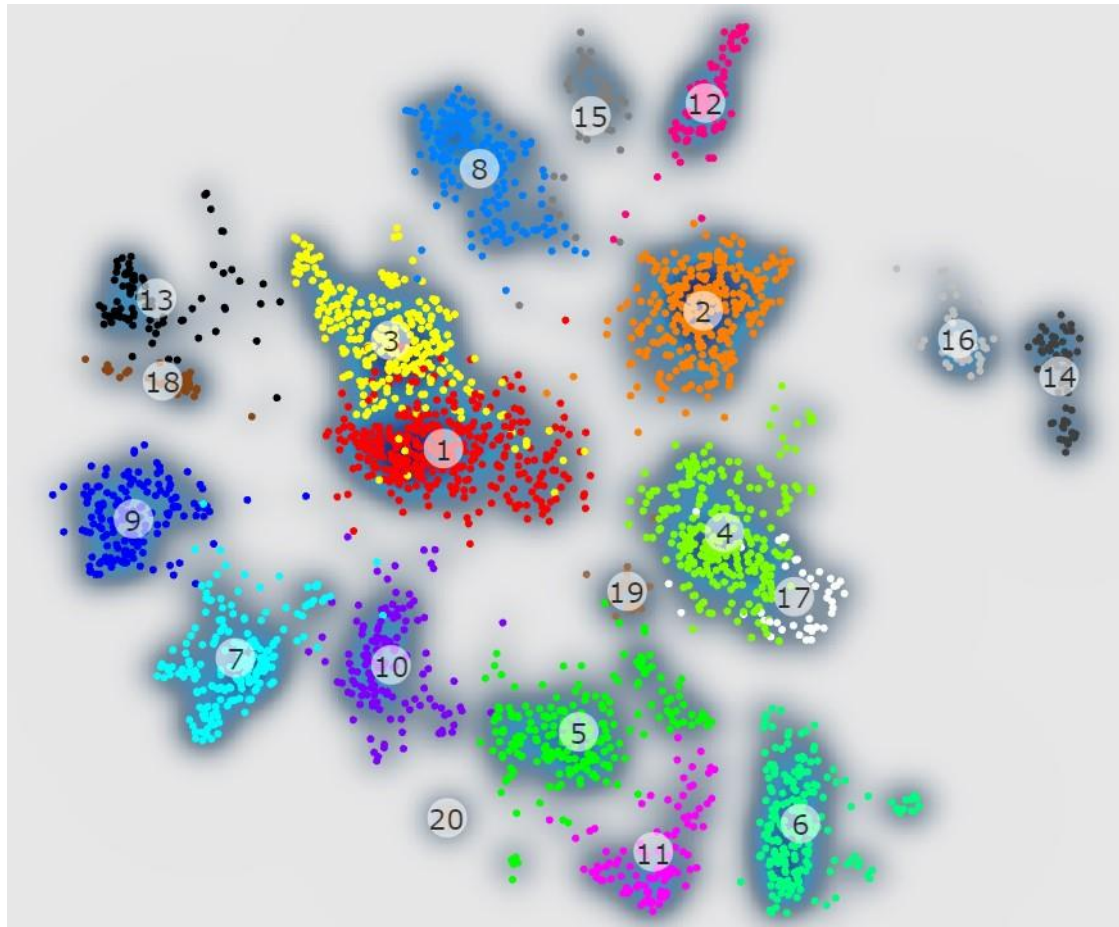
- Erstes 3 D gedruckte Implantant für den Unterkiefer eines Kindes



**4 D Druck**

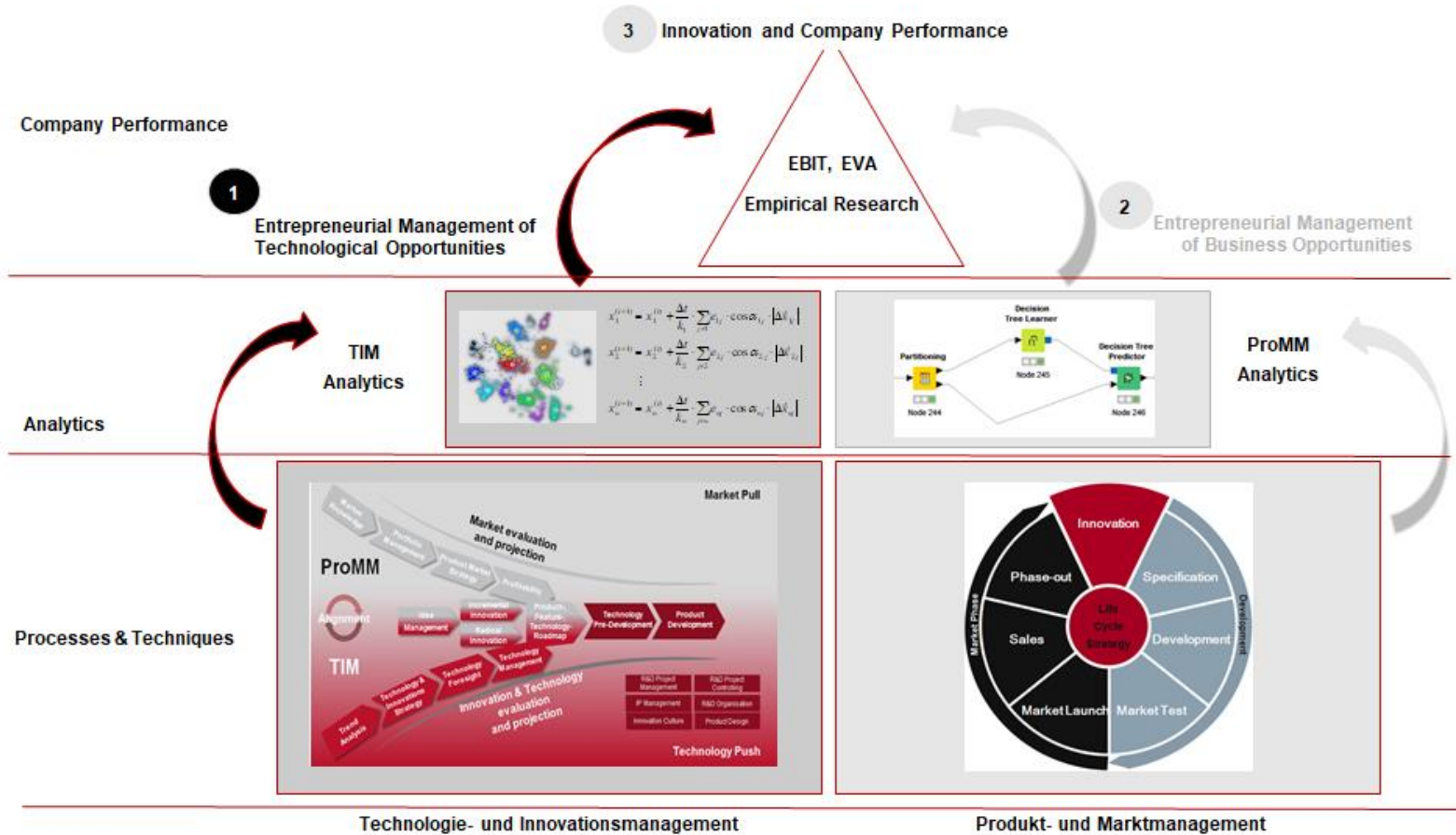
# Welcome and Topics

- Who we are and what we do ...



# Welcome and Topics

- Who we are and what we do ...

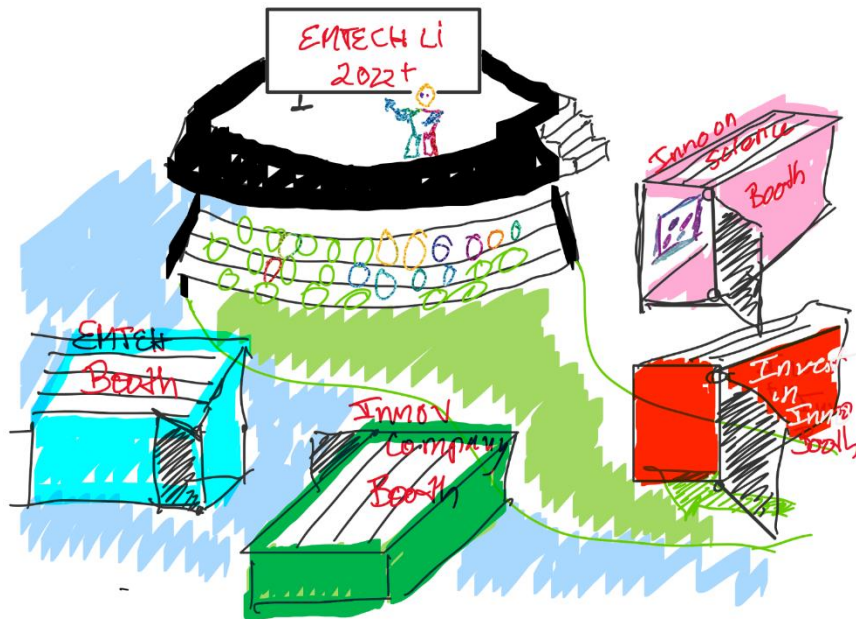


Technologie- und Innovationsmanagement

Produkt- und Marktmanagement

# Welcome and Topics

- Our Concept – a different kind of a Summit





# Welcome and Topics



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# Emerging Technologies 2022+: Methodology

- The emerging technology fields 2022\* have been identified based on Big Data Analytics using 2.795 scientific publications.

## 1. Scientific Database



## 2. Search Strategy

Only Reviewed Articles

TITLE: (emerg\* OR innovat\* OR new OR disrupt\* OR develop\* OR unfold OR reveal OR unique OR improv\* OR revol\* OR latest OR ground\$breaking OR state-of-the-art OR "state of the art" OR recent OR advanc\* OR experimental OR modern OR cutting\$edge OR novel OR non\$traditional OR unconventional OR evolv\* OR evolut\*) AND technolog\*

2795 publications

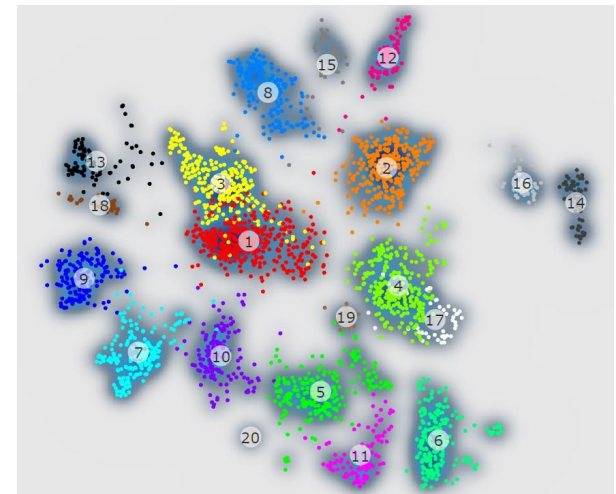
## 3. Bibliometrics



Calculation of similarity based on cited references and lexical measures

4.

## Visualization of 20 Research Frontiers

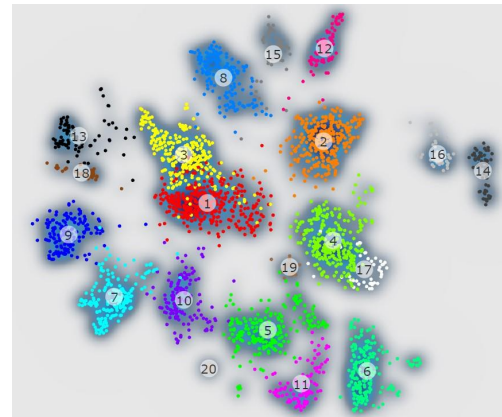


NETCULATOR

# Emerging Technologies 2022+: Overview

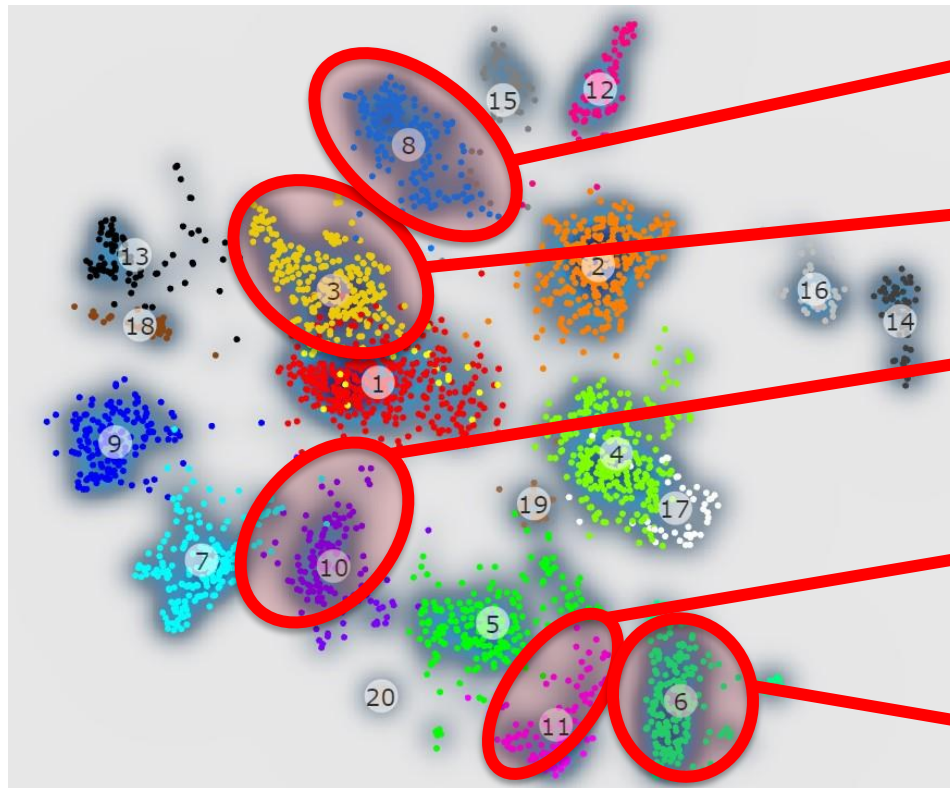
- 20 different and highly relevant emerging technology fields for the upcoming years have been revealed.

Cluster	Research Frontier
1	Digital Scan, Sensor & Analytics Technologies
2	Advanced Healthcare Applications
3	Novel Material Technologies
4	Research & Knowledge Management
5	Energy Transition Technologies
6	Green Innovation & Eco-efficient Technologies
7	Food Process- & Persavation Approaches
8	Bioengineering & Cell Treatments
9	Clean Water Technologies
10	Alternative Fuel & Energy Technologies



Cluster	Research Frontier
11	Climate & Zero Emission Studies
12	eLearning Approaches
13	Next Gen Sequencing & Genome Editing
14	Novel Material Printing Applications
15	Agriculture 4.0
16	New Robotic Surgery Technologies
17	Patent Analytics
18	Mining Technologies
19	Data Security Technologies
20	Diabetes Technologies

# Emerging Technologies 2022+: Deep Dive



**8. Bioengineering & Cell Treatments**

**3. Novel Material Technologies**

**10. Alternative Fuel & Energy Techn.**

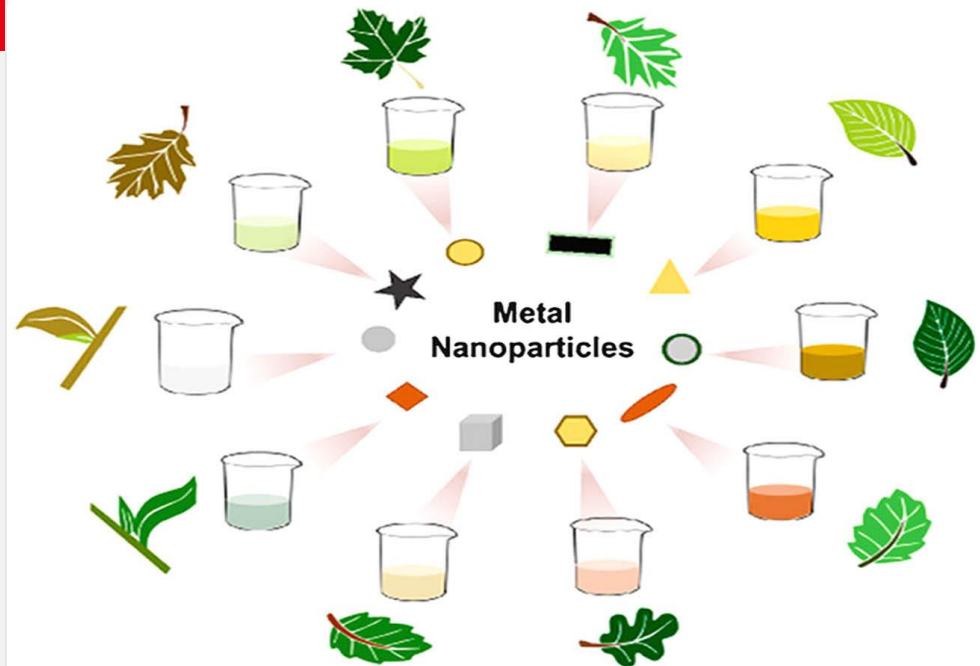
**11. Climate & Zero Emission Technologies**

**6. Eco-Efficient Technologies**

# Selected Emerging Technologies 2022+: 3. Novel Material Technologies

## Research Topics

- ◇ **Precision Manufacturing**  
e.g. laser material processing;
- ◇ **Magnetic Energy Metals (MEMs)**  
e.g. recovering magnetic micro particles from spent lithium-ion batteries
- ◇ **Green Synthesis**  
e.g. synthesis of silver-nanoparticles (AgNPs) for unique properties and potential applications in medicine

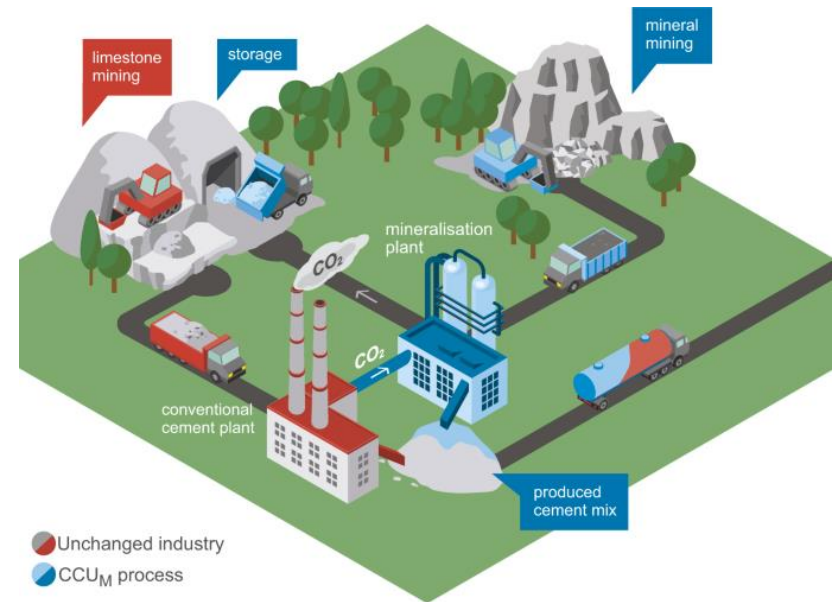


El Shafey, A. M. (2020). Green synthesis of metal and metal oxide nanoparticles from plant leaf extracts and their applications: A review. *Green Processing and Synthesis*, 9(1), 304-339.

# Selected Emerging Technologies 2022+: 6. Eco-Efficient Technologies

## Research Topics

- ◇ **Green Innovation – Impact Ratings**  
e.g. eco-efficiency (EE), eco-technology innovation (ETI) and eco-well-being performance (EWP)
- ◇ **Clean Tech – Inter City Network**  
e.g. green supply chain (management)  
**Emerging CO<sub>2</sub>-Mineralization Technologies**  
e.g. coal fly ash, steel slag or cement

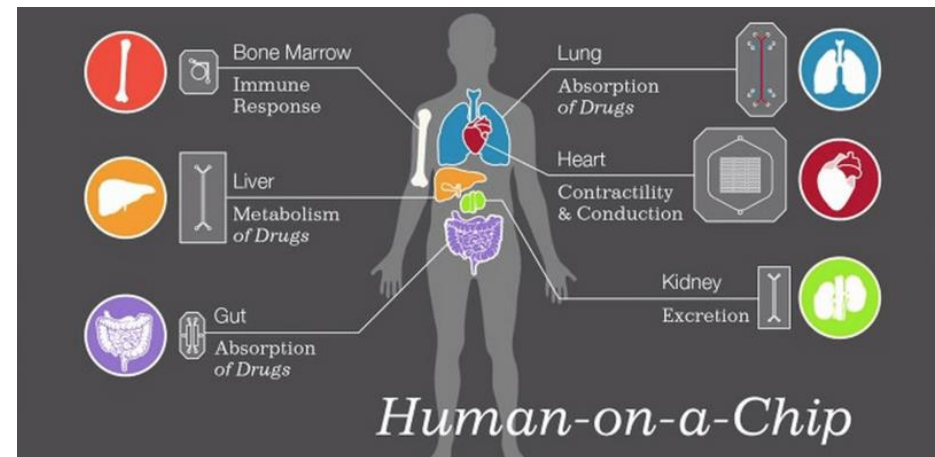


Strunge, T., Renforth, P., & Van der Spek, M. (2022). Towards a business case for CO<sub>2</sub> mineralisation in the cement industry. *Communications earth & environment*, 3(1), 1-14.

# Selected Emerging Technologies 2022+: 8. Bioengineering & Cell Treatments

## Research Topics

- ◊ **Nanomedicine-based technologies**  
e.g. novel biomarkers for the diagnosis and treatment of Alzheimer's disease
- ◊ **Single-cell sequencing (SCS)**  
e.g. unprecedented high resolution for early detection
- ◊ **Organ-On-Chip / Tumor-On-Chip**  
e.g. in vitro organ/tumor models are rapidly advancing cancer research



<https://www.etvflow.com/microfluidic-reviews/organs-on-chip-3d-cell-culture/organs-chip-review/>

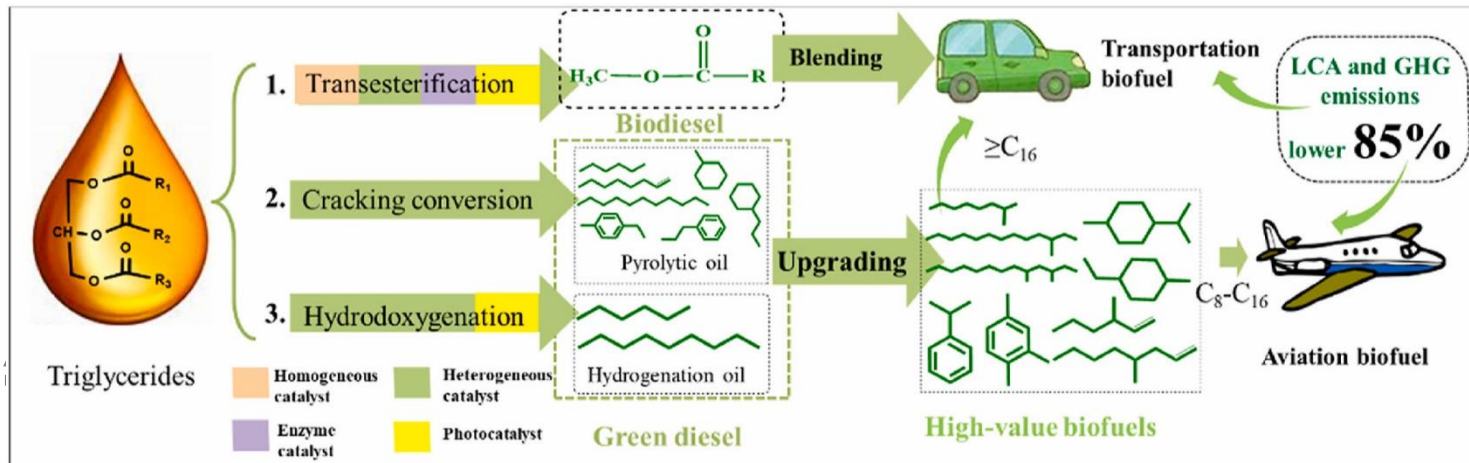
# Selected Emerging Technologies 2022+: 10. Alternative Fuel & Energy Techn.

## Research Topics

- ◊ **State-of-the-art review for biofuel production**  
e.g. triglycerides

## Other Research Topics

- ◊ **Advancements of combustion technologies**  
e.g. ammonia-fuelled engine or gas turbine
- ◊ **New frontiers in gas storage technology**  
e.g. gas hydrates > methane

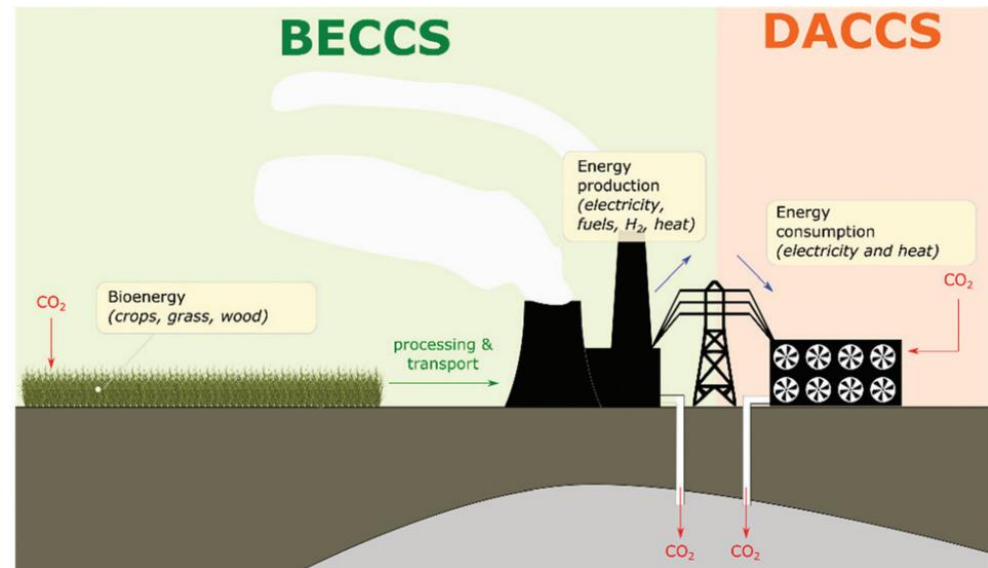


Long, F., Liu, W., Jiang, X., Zhai, Q., Cao, X., Jiang, J., & Xu, J. (2021). State-of-the-art technologies for biofuel production from triglycerides: A review. *Renewable and Sustainable Energy Reviews*, 148, 111269.

# Selected Emerging Technologies 2022+: 11. Climate & Zero Emission Techn.

## Research Topics

- ◊ **Industry Transformation - Reduction of environmental pollution**  
e.g. heavy industry (aluminum in china)
- ◊ **CO2 emission capturing technologies**  
e.g. bioenergy with carbon capture and storage (BECCS) and direct air carbon capture and storage (DACCS) > CO2-Mineralization
- ◊ **CO2 emission reduction technologies**  
e.g. sustainable aviation fuels (SAF)



Creutzig, F., Breyer, C., Hilaire, J., Minx, J., Peters, G. P., & Socolow, R. (2019). The mutual dependence of negative emission technologies and energy systems. *Energy & Environmental Science*, 12(6), 1805-1817.



# Selected Emerging Technologies 2022+: Conclusion

## Emerging Technologies

- ◊ **20 different emerging technologies frontiers were identified in 2022**
- ◊ **Bibliometric Big-Data-Analytics are suitable for discovering new groundbreaking technology trends**
- ◊ **Research frontiers provide clues to emerging technologies and upcoming innovations**

## Deep Dive

- ◊ **Synthesis by Green Methods can replace pure chemical synthesis, reduce costs and, impact the environment positively**
- ◊ **Thermal energy storage (TES) technology is playing an increasingly important role in solving the energy crisis**
- ◊ **Bioengineered microdevices (Tumor-On-Chip) enhance and will become powerful enablers for medical research**

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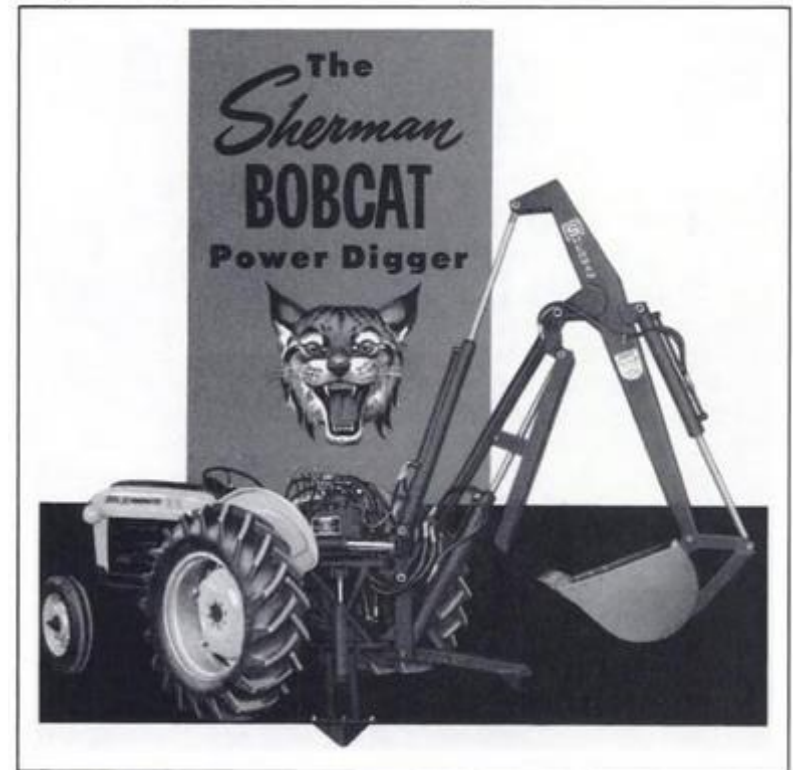


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# Why Innovation Really Matters Innovative?



# Why Innovation Really Matters Innovative?



# Why Innovation Really Matters Innovative?



# Why Innovation Really Matters Innovative?

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Search:

Rank	Country	Score	Income Group
1	Switzerland	66.1	High
2	Sweden	62.5	High
3	United States of America	60.6	High
4	United Kingdom	59.8	High
5	Netherlands	58.8	High
6	Denmark		
7	Finland		
8	Singapore		
9	Germany		
10	South Korea		
11	Hong Kong, China	54.2	High

- **Switzerland:** First in Knowledge Creation, second in Global Brand Value
- **U.S.:** First in Entertainment and Media, Computer Software Spending, Intellectual Property Receipts
- **China:** First in Patents Registered
- **Vietnam:** Second in High-Technology Net Exports
- **India:** First in Information and Communication Technology Services Exports
- **Tanzania:** 23rd in Printing and Other Media

# Why Innovation Really Matters Empirical Research

- Research in technology and innovation management



## Why Innovation matters?

Particularly innovative companies with efficient innovation processes are more successful and have much better share price development



# Why Innovation Really Matters



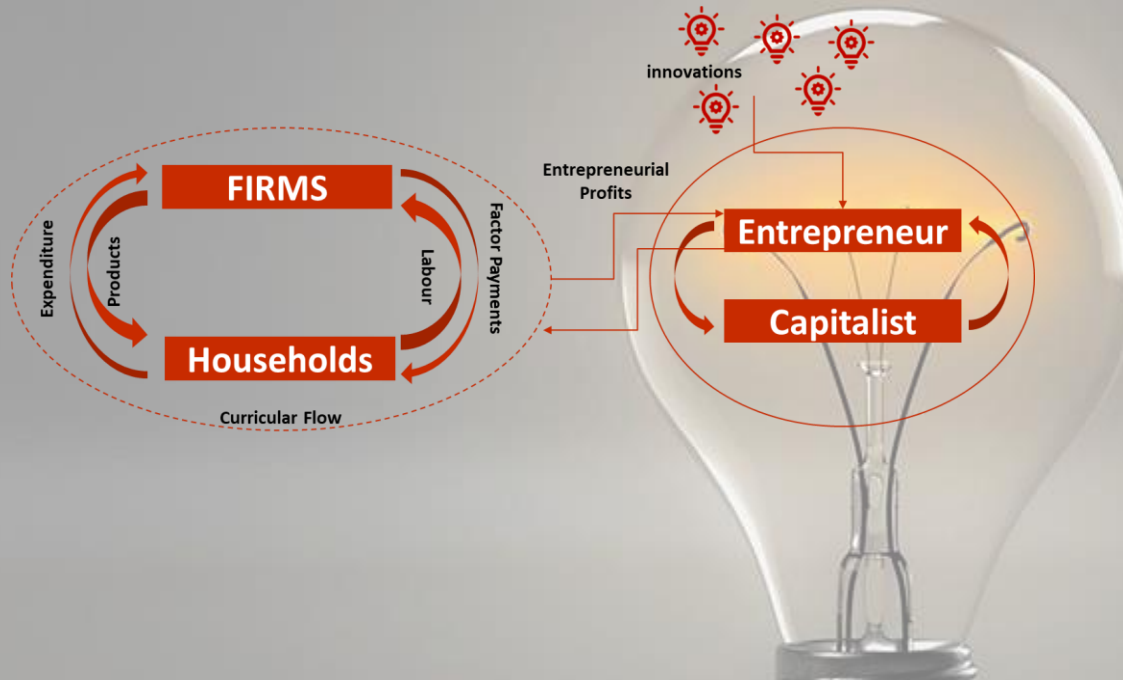


# Why Innovation Really Matters



# Innovation and Growth

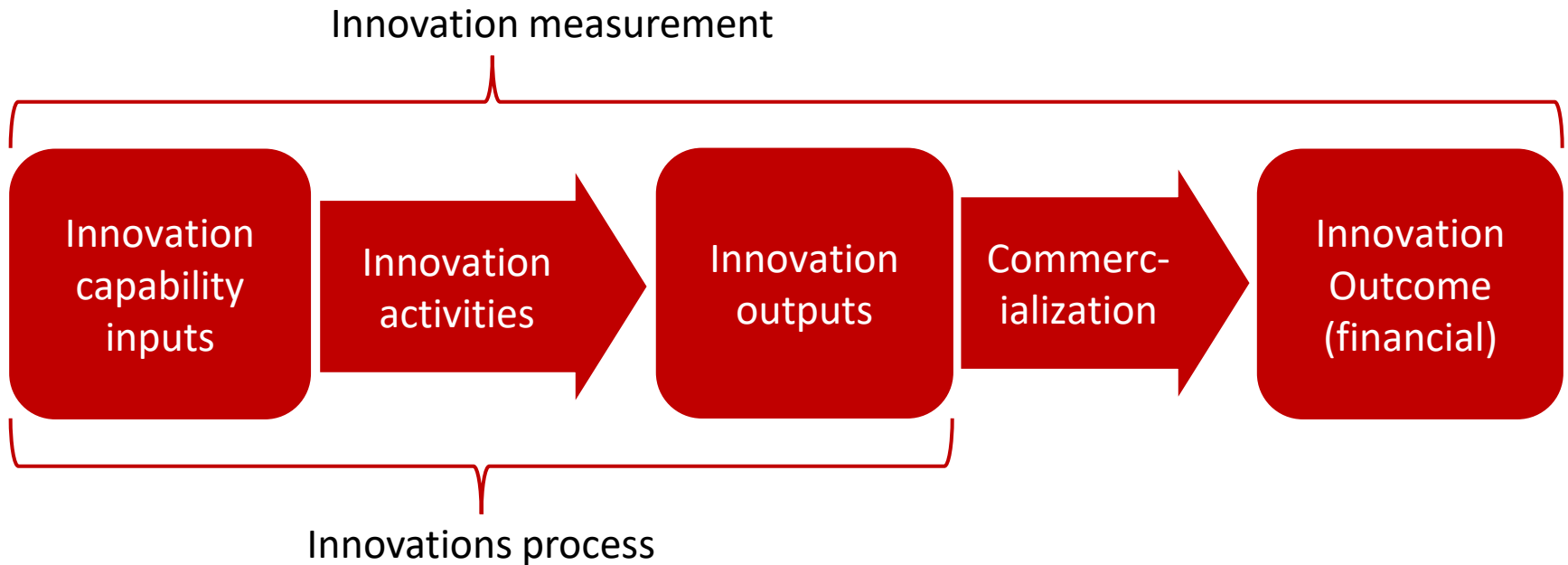
Why do innovations exist at all?



Since Schumpeter (1912; 1942) introduced his theories about creative destruction and innovation, there has been a common understanding that innovation is a significant driver of growth and prosperity (Kogan et al., 2017; Schubert and Simar, 2011).

# Innovation Efficiency

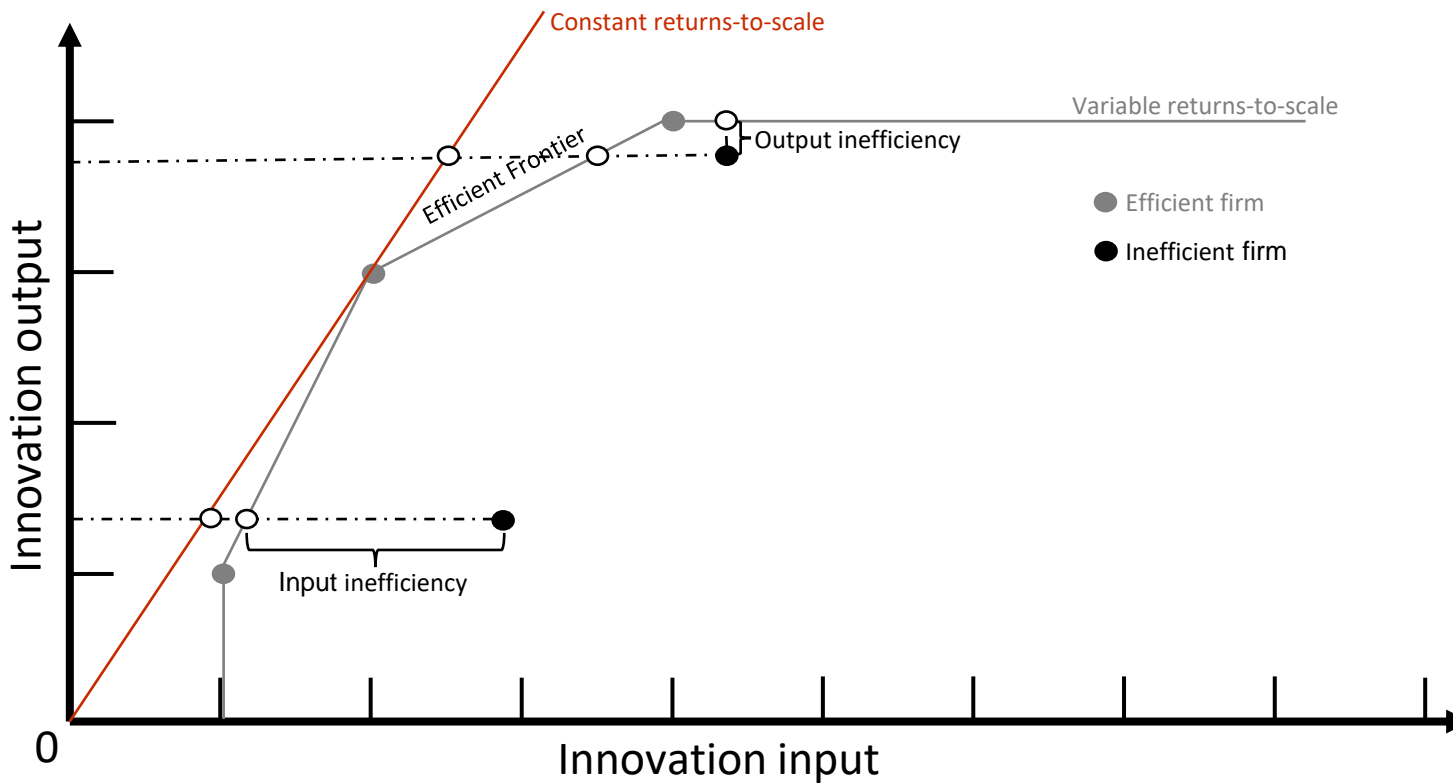
How can innovation capability be measured in the first place?



Source : Bayrle (2021)

# Innovation Efficiency

## How to find innovation-efficient companies?



$$\max_{v,u} \text{innovation efficiency}_o = \max_{v,u} \frac{\sum_{r=1}^S u_r \text{innovation output}_{r_o}}{\sum_{j=1}^m v_j \text{innovation input}_{j_o}}$$

Source : Cooper et al. (2007)

# Innovation efficiency and firm performance

## What do innovation-efficient companies achieve?



Innovation-efficient companies show higher growth than innovation-inefficient companies.



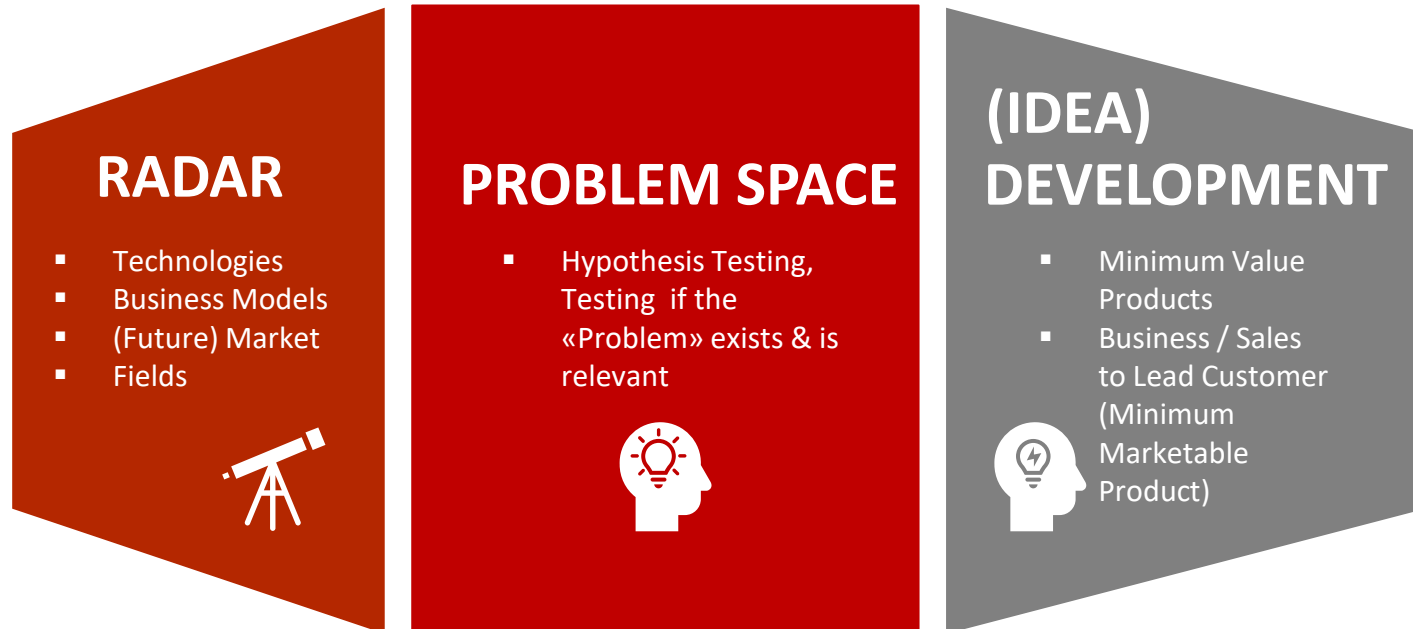
Innovation-efficient firms show higher returns on capital than innovation-inefficient firms.

Source: Bayrle (2021), Cruz-Cázares et al. (2013)

# Innovation Leaders

## What do innovation leaders do differently? Like Inficon, for example?

Current research findings on innovation leaders by Arabella Stock and Prof. Leo Brecht.



- «Timing! (Be ready.)»
- «Rather make a wrong decision than none at all.»
- «Trial and error beats understanding.»

# Why Innovation Really Matters

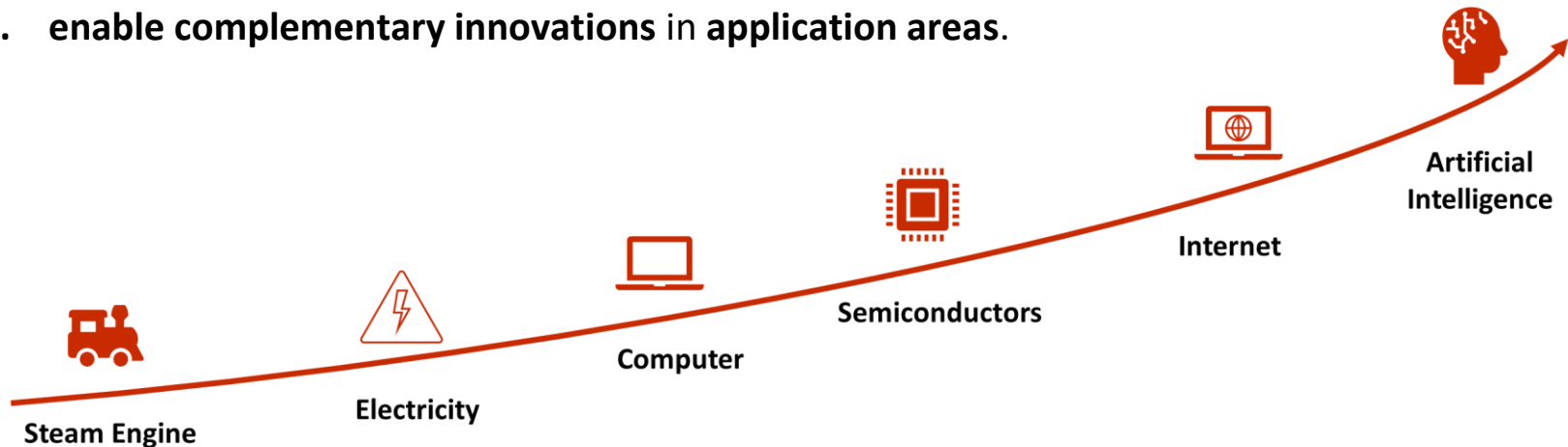


# General Purpose Technologies

## What makes a technology ubiquitous?

Bresnahan and Trajtenberg (1995) introduced the important concept of **general-purpose technologies (GPTs)**, which they characterized by three features (see also Teece, 2018):

1. **GPTs are ubiquitous, i.e., widely used;**
2. can be **continuously improved technically;** and
3. **enable complementary innovations in application areas.**



In other words, GPTs impact the entire economy, **get even better over time**, and **attract further innovation** because the invention triggers discoveries in one area and creates opportunities in others



# General Purpose Technology: Artificial Intelligence



“For more than 250 years the fundamental drivers of economic growth have been technological innovations. [...] The most important **general-purpose technology** of our era is **artificial intelligence**, particularly **machine learning**.” —Erik Brynjolfsson and Andrew McAfee, 2018

# Enabling Technologies in the Digital Age

## What do enabling technologies facilitate?

The threshold for a GPT is very high, but there's a similar category, **enabling technologies**, that can be thought of as junior GPTs, meeting criteria (2) and (3), but not necessarily having measurable economy-wide impacts.



### Wireless communications

Improvements in the transmission of digital mobile data over the "generations" of the standard - from 2G in the early 1990s to the current 5G - are enabling new types of value creation.

### Cloud Computing

Cloud computing is a form of on-demand and flexible use of IT services. These are provided in real time as a service via the Internet and billed according to use.

### Additive Manufacturing

Additive manufacturing is a process of building complex three-dimensional parts in a layer-by-layer manner from their respective CAD models.

### Blockchain

Blockchain is a decentralized database where there is no central trusted entity that manages and stores the database but is distributed across a network and uses a consensus mechanism to verify transactions.

Source: Teece (2018), Salunkhe und Berglun (2022)

# Innovation and Technology

What innovations are enabled by GPTs like AI?



## Produktinnovation



## Serviceinnovation



## Prozessinnovation



## Organisationsinnovation

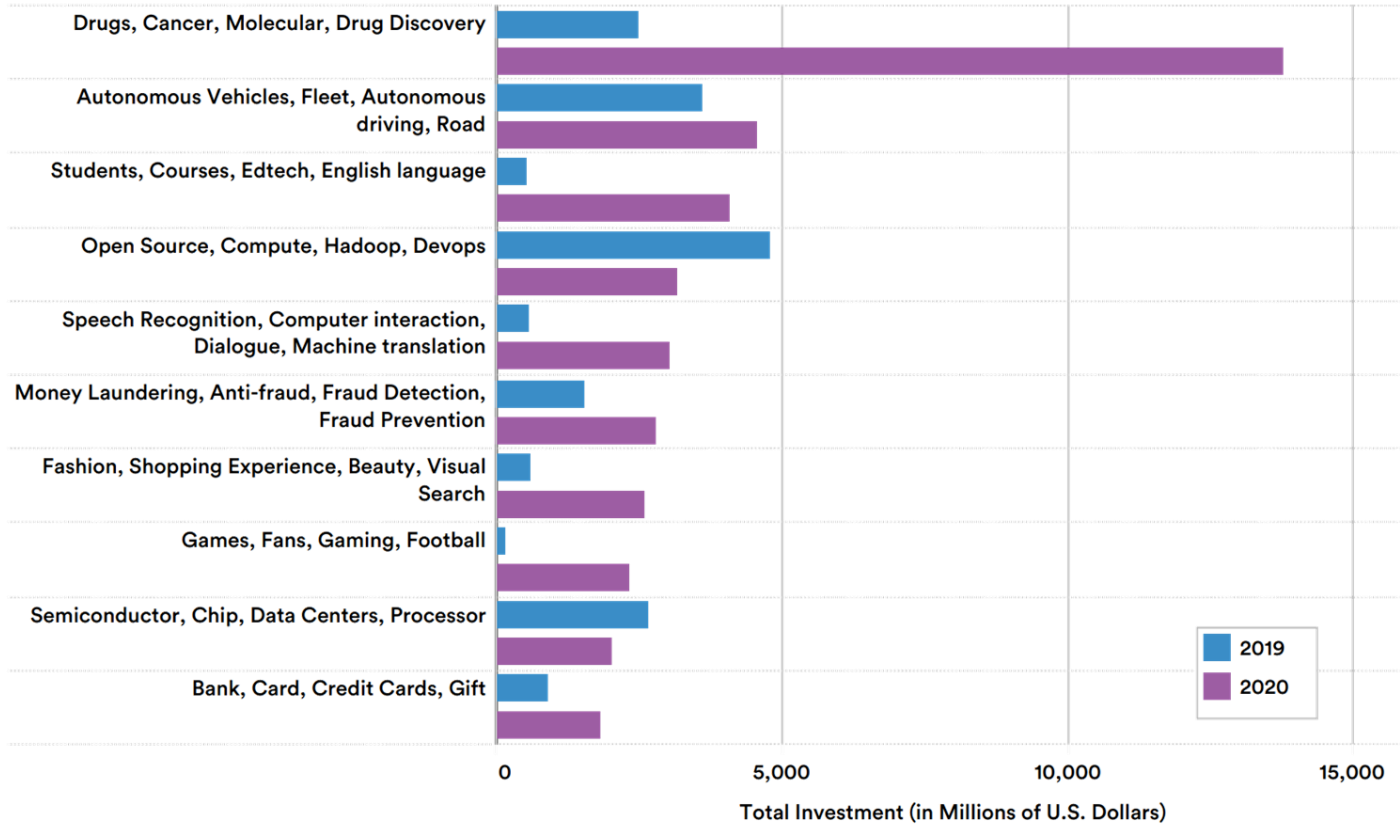


# General Purpose Technology: Artificial Intelligence

## Is AI really a GPT?

GLOBAL PRIVATE INVESTMENT in AI by FOCUS AREA, 2019 vs 2020

Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report



Source: Artificial Intelligence Index Report 2021

# Innovation, Technology, and Inflation

How is innovation related to technology and inflation?

Influencing technological and innovation factors to date:

- **Internet**
- **Communication technology**
- **Automation**
- **Technology**
- **Big Data**
- **Smartphone**

# Innovation, Technology, and Inflation

## How does technology affect productivity and inflation?



### Technological substitution

Human labor is **replaced or supplemented** by **technology**, thus **avoiding price increases**. **Additive manufacturing**, for example, **promises great potential** here.



### Accelerated change

**Unfavorable demographic developments** can be offset by **technological innovations**.



### Artificial intelligence

**Artificial intelligence (AI)** has the characteristics of **general-purpose technologies (GPTs)**. Like other GPTs (e.g., the Internet), AI has the potential to be an important driver of productivity.



### Productivity effects

The experience of the three industrial revolutions suggests that we can expect **productivity effects from new technologies**.

# Technologies that can have a deflationary effect

## Which emergent technologies have a deflationary effect?



### Technology for use in care

- The future potential of technology for care service through telemedicine.
- The use of humanoid robots to care for and entertain elders.
- The increasing sophistication of artificial intelligence and robotics could take some of the work out of doctors



### Developments in the biotech sector

- In the treatment of diseases that become more prevalent as we age, developments in the biotech sector offer new opportunities to reduce future costs and increase treatment efficacy.
- Among novel nucleic acid therapies, messenger RNA (mRNA) technology offers a variety of opportunities to develop therapies beyond vaccines.



### Green energy developments

- Already, demand for electric vehicles is driving up the prices of raw materials such as copper, lithium, nickel and cobalt.
- The key, of course, is the broader time horizon. A rapid transition to a cleaner world will create some inflationary pressures, but in the long run it will dramatically reduce the cost of climate-related disasters.



### Other important areas of innovation

- 3D-printed homes are already on the rise and could soon be built more cost-effectively.
- A variety of innovations, ranging from self-driving tractors to artificially produced meat, promise radically cheaper food supplies.

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# Introduction Innovation Booths



## **INNOVATIVE COMPANIES**

*Examples of Innovative Companies and why they differ*

## **EMERGING TECHNOLOGIES**

*Examples of Emerging Technologies and how they develop*



## **INVEST IN INNOVATION**

*Wall Street does not understand Innovation - yet*

## **SCIENCE ON INNOVATION**

*Findings on Innovation and Performance*



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University of Liechtenstein | Fürst-Franz-Josef-Strasse  
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**Summit on Emerging Technologies**

In several booths we present most innovative companies, learn about emerging technologies, understand why innovation is relevant for investors and discuss latest findings from innovation research. And finally get inspired by our special guest speaker from Inficon.

Time	Agenda	Speaker
17:00	<b>Come together</b>	
17:30	<b>Welcome and Topics</b>	<i>Prof. Dr. Brecht</i>
17:40	Outlook 2022+: <b>Emerging Technologies</b>	<i>Dr. Kauffeldt</i>
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19:20	<b>Summary and Closing</b>	<i>Prof. Dr. Brecht</i>
> 19:30	<b>Networking and Aperoriche</b>	

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Inficon



Dr. N. Bayrle  
UniLi



Dr. Urs Wälchli

# INNOVATION CHAMPION FROM THE RHINE VALLEY

05  
MAY

17:00 – 19:30

TECHNOPARK LIECHTENSTEIN

EmTech  
Summit

# EmTech 2022 Summit Liechtenstein

FREE ENTRY

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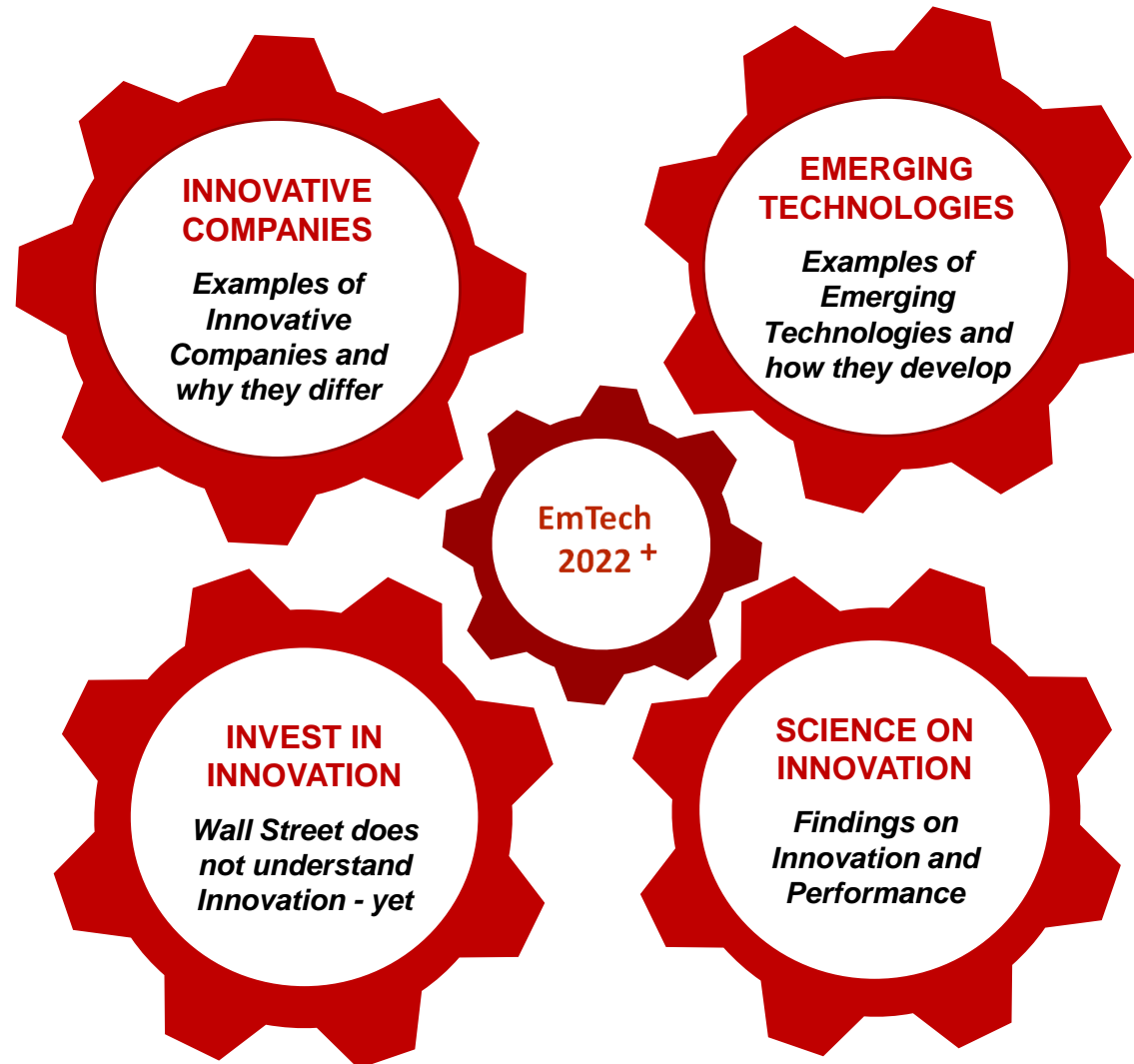
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# Summary and Closing



# Summary and Closing

## *Innovation Efficiency: Case Studies on Alpine Rhine Valley Companies*



### Measured Innovation Efficiency in the Alpine Rhine Valley

Exploitative IE

Exploitative & Explorative IE

«innovation inefficient»

Explorative IE

### Qualitative Insights on Innovation Efficiency Based on European Industrial Companies

#### Examples:

- Long-term orientation
- Problem vs. Solution Space in the Innovation Process
- Role of Communication

### **In-Depth** Knowledge through Case Studies with Companies within the 4 Quadrants:

- ? Interviews with different Levels and Roles (e.g. CTO, Head of R&D or Innovation Manager, Product Manager, Sales/Marketing)
- ? Documentation

## MBA Technologie & Innovation

Liechtenstein und das St. Galler Rheintal sowie die angrenzende Ostschweiz, Vorarlberg, Bayern und Baden-Württemberg sind geprägt durch technologieorientierte Unternehmen mit enormer Innovationskraft und internationaler Ausstrahlung. Knapp 40 % der Wirtschaftsleistung des Fürstentums entfallen auf den Industriesektor – fast doppelt so viel wie in den USA.



### Innovationen erhalten Wettbewerbsfähigkeit

Innovationen spielen in den technologieorientierten Unternehmen unserer Industrieregion eine entscheidende Rolle zur nachhaltigen Sicherung der Wettbewerbsfähigkeit. Dies gilt insbesondere in Zeiten, in denen die Euro-Franken-Parität einen Wettbewerbsnachteil für die durchwegs stark exportabhängige Liechtensteiner und Schweizer Industrie darstellt. Nur durch stetige Effizienzsteigerung in der gesamten Wertschöpfungskette und ein kontinuierliches Bestreben, den Kundennutzen der angebotenen Produkte und Dienstleistungen zu erhöhen, kann die Wettbewerbsfähigkeit erhalten werden. Beides ist nur durch Innovationen möglich. Entsprechend kommt unternehmerischem Umgang mit Innovationen in allen Unternehmen eine Schlüsselrolle zu. "Innovation" umfasst dabei sowohl die technische Erfindung als auch deren Umsetzung im Markt. Dies kann in Form neuer Produkte, neuer Dienstleistungen oder neuer Geschäftsmodelle umgesetzt werden. "Innovatives Unternehmertum" kann demnach als ganzheitliches unternehmerisches Handeln verstanden werden, das die Erhöhung des Kundennutzen in den Fokus stellt.

### Mehr dazu



Inhalte



Durchführung



Zulassung & Bewerbung



Gebühren & Kosten



# Summary and Closing - Virtual Event

UNIVERSITÄT LIECHTENSTEIN

**05 MAY**  
17:00 – 19:30

TECHNOPARK LIECHTENSTEIN

**EmTech 2022**  
**Summit Liechtenstein**

FREE ENTRY

EmTech Summit

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*Dr. Kauffeldt*  
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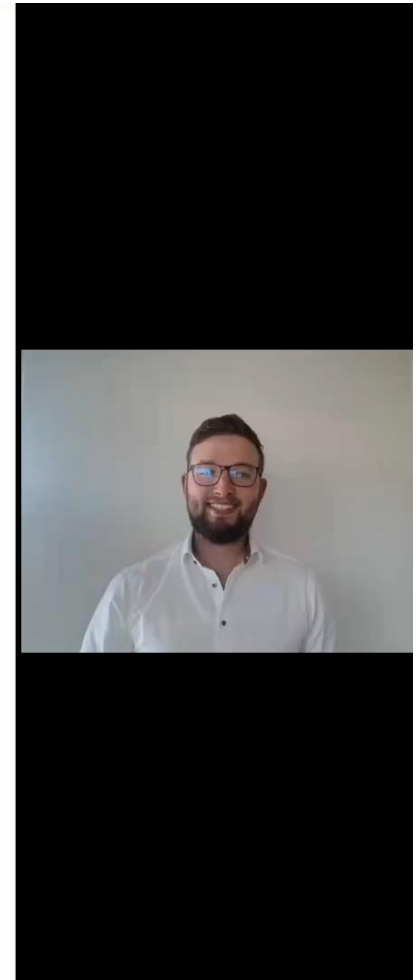
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# Summary and Closing - Virtual Event



**You are cordially invited  
to our virtual event.**

**Event Link:**

[https://etrainplatform.com/event/  
emtech-summit-2022-liechtenstein](https://etrainplatform.com/event/emtech-summit-2022-liechtenstein)

You can find a full  
instructional video here:

[Link](#)

05  
MAY

17:00 – 19:30

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EmTech  
Summit

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# Networking und Apero



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