CHAPTER 1: BUSINESS ECOSYSTEMS
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<th>topic</th>
<th>Starter Seminars</th>
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<tbody>
<tr>
<td>business ecosystems</td>
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<td>18/10/22</td>
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<td>finance II</td>
<td>6/12/22</td>
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<td>marketing</td>
<td>13/12/22</td>
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<tr>
<td>team aspects</td>
<td>20/12/22</td>
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Reintroduction of the Wolf in Yellowstone

- hunts for deer
- deer concentrate in areas that provide cover from wolf
- areas that were previously heavily grazed can now recover
- more and more diverse set of plants and trees
- more insects
- more insect eaters (birds, small mammals)
- More trees
- more beavers
- change of waterways (banks, more swamps, pools... so landscape changed)
- better habitat for fish, birds...

Conclusion: Everything is connected, no individual, species... is an island
A business ecosystem is a community of interacting organizations and individuals that affect each other. (…)

J. Moore
1993
“(...) The community produces goods and services of value to customers, who are themselves members of the ecosystem. The community includes suppliers, producers, distributors, government, competitors, and other stakeholders. (...)”

J. Moore
1993
“(...) Over time, they co-evolve their assets and roles and tend to align themselves with the directions set by one or more central companies.”

J. Moore
1993
WHY SHOULD WE LEARN THIS?

- Because this is what the (economic) world is made of
- Because it is the world in which every entrepreneur and enterprise functions
- Because entrepreneurs need this knowledge -applied to their market- to start, survive, thrive
Business ecosystems

Sectors, industries, & markets
Supply chains & value chains
Standards
Network effects & economies of scale
Business ecosystem actors
Regional clusters
Sectors, industries, & markets
Supply chains & value chains
Standards
Network effects & economies of scale
Business ecosystem actors
Regional clusters
What is it again that you do?

Classifying your venture
### Primary Sector
- Extracts or harvests products from the earth: production of **raw material and basic foods**.
- Activities: agriculture, mining, forestry, farming, grazing, hunting and gathering, fishing, and quarrying. + the packaging and processing of the raw material associated with this sector
- About 3% of the U.S. labor force is engaged in primary sector activity today, while more than two-thirds of the labor force were primary sector workers in the mid-nineteenth century.

### Secondary Sector
- Manufactures finished goods
- All of **manufacturing, processing, and construction** lies within the secondary sector.
- Activities: metal working and smelting, automobile production, textile production, chemical and engineering industries, aerospace manufacturing, energy utilities, engineering, breweries and bottlers, construction, and shipbuilding.

### Tertiary Sector
- **Service industry**
- Provides services to the general population and to businesses
- Activities: retail and wholesale sales, transportation and distribution, entertainment, restaurants, clerical services, media, tourism, insurance, banking, healthcare, and law.
- In the U.S., more than 80% of the labor force are tertiary workers.

### (Quaternary Sector)
- The quaternary sector consists of intellectual activities. Activities associated with this sector include **government, culture, libraries**, scientific research, education, and information technology.
- Others limit quaternary sector it to **not-for-profit sector**
Distribution of different sectors over time and over degree of economic development.
- An **industry** is a collection of similar companies or companies conducting similar activities.

- **Top-down** classification: large sectors, split into smaller subsegments
  - sometimes quite arbitrary
  - in 2021 ‘Oil and Gas’ was renamed to ‘Energy’

- Newcomers to economics can use it to grasp the scope of business activities

- **Industry Classification (benchmark)**
  - 10 industries
  - 20 supersectors
  - 41 sectors
  - 114 subsectors

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<table>
<thead>
<tr>
<th>Industry</th>
<th>Supersector</th>
<th>Sector</th>
<th>Subsector</th>
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<tr>
<td>0001 Oil &amp; Gas</td>
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<td>0530 Oil &amp; Gas Producers</td>
<td>0533 Exploration &amp; Production</td>
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<tr>
<td></td>
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<td>0570 Oil Equipment, Services &amp; Distribution</td>
<td>0537 Integrated Oil &amp; Gas</td>
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<td>0573 Oil Equipment &amp; Services</td>
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<td>0577 Pipelines</td>
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<td>0580 Alternative Energy</td>
<td>0583 Renewable Energy Equipment</td>
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<td>0587 Alternative Fuels</td>
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</table>
# Industries

## Apple’s Industry Classification

<table>
<thead>
<tr>
<th>Industry</th>
<th>Supersector</th>
<th>Sector</th>
<th>Subsector</th>
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</thead>
<tbody>
<tr>
<td>3000 Consumer Goods</td>
<td>3700 Personal &amp; Household Goods</td>
<td>3740 Leisure Goods</td>
<td>3743 Consumer Electronics</td>
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<td>3745 Recreational Products</td>
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<td>3747 Toys</td>
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<td>5000 Consumer Services</td>
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<td>5553 Broadcasting &amp; Entertainment</td>
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<td>5555 Media Agencies</td>
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<td>9535 Internet</td>
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<td>9537 Software</td>
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<td>9572 Computer Hardware</td>
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<td></td>
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<td>9578 Telecommunications Equipment</td>
</tr>
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</table>
Markets are those meeting places where products and services are **traded**. They are the **interfaces** between customers and suppliers.

Its definition is grounded **bottom-up**
- Consumers and suppliers (& consultants, trade show organizers) drive the definition of markets
- Gradual and ad-hoc classifications, overlaps, no top-down classification of markets
- Are there magazines, trade fairs, consultants? **Then there is a market**
- Partly driven by marketing strategies of suppliers and industry specialists (e.g. Gartner)
MARKETS

OVER TIME...

• ... markets merge
  – PDA+GSM+iPod+camera+gaming console = iPhone
  – -> Will these markets disappear as separate entities? On what does it depend?

• ... markets split
  – ‘Computers’ -> hardware, operating system, software, storage, peripherals, internet...

• ... markets (dis-)appear
  – Analog photography
  – Nucleic acid isolation market

• ... markets can be encapsulated in others
  – Changes in one overall markets unavoidably impacts encapsulated markets

• Several types of links between markets are possible for supplier
  – Same core competencies, same customers
Scientific advances (e.g. completion of human genome project, enabling technologies (biochips, sequencing technologies), ...) spurred demand for isolated NA especially for genome DNA

Research and Markets: Nucleic Acid Isolation and Purification Market, 2018: Plasmid DNA Isolation, MIRNA Isolation, Total RNA Isolation

Research and Markets (http://www.researchandmarkets.com/research/dk296p/nucleic_acid) has announced the addition of the "Nucleic Acid Isolation and Purification Market by Technology, Consumables & Instruments, Application & by End Users - Global Forecasts to 2018" report to their offering.

The global market is expected to grow at a CAGR of close to 8.11% between 2013 and 2018, to reach $3,106.28 million by 2018.
Segments = subsets of a wider market (size)
Niches = smaller and more specialized segment (specialization)

Example LCD screens
- Segments: TVs, PCs, mobiles
- Niches: concert stages, medical monitors
Horizontal = offering goods and services to **multiple groups of customers with common needs**; generally broad markets.

Vertical = offering goods and services specific to a **group of customers with specialized needs**. This implies thorough understanding - often a seasoned professional is a must - to succeed in a vertical market (examples of failures, a/o, for this reason: Iridium, WebVan).

**Examples**

- **Horizontal**
  - Washing powder
  - Cars
  - Search engines

- **Vertical**
  - Software for film post-production
  - Biotechnology patent lawyers
  - Vision systems for industrial automation
  - Software for cultural centers
- VUB spin-off
- Core technology: 3D imaging
- Enormous range of application areas
MARKETS

OPTRIMA APPLICATION

### Television
- DepthSense™ and OptriCam™ enables natural interface to TVs based on simple gestures, allowing new and intuitive ways of interacting with your media-centre. A simple hand gesture will change the TV channel, turn up the volume, surf the Internet or flip through the photo or music library.

### Gaming
- You are the controller

### Automobile
- Optrima NV has licensed its DepthSense™ 3D CMOS Sensor technology to Melexis NV for adaption of the technology to the automotive market.

### Health-Lifestyle
- New applications that can help elderly people or less valid patients home, in hospitals or in care centers benefit from “gaming alike rehabilitation and revalidation programs”.

### Automation
- Optrima’s DepthSense™ and OptriCam™ systems provide reliable 3D data for autonomously guided vehicles, with improved obstacle identification and avoidance, service robots in industrial and in assembly, quality control monitoring, material handling and automation.

### Security
- By using the OptriCam™ 3D Time-of-Flight camera a reliable set of depth data becomes available. This increases the robustness and flexibility of many surveillance, inspection, and logistics systems: camera based factory automation, person-counting applications at airports, elevator and door/gate security detection systems.

### The engineers know nothing of these (end) user markets...
MARKETS

OPTRIMA CASE: VERTICAL MARKET

- The automated milking market.
  - Selling “2757 Industrial Machinery”
  - To “3573 Farming & Fishing”
- Magnitude comparison

| Table 4.1: Annual expenses, Automatic milking robot - Manual milking installation |
|--------------------------------------|-----------------|-----------------|
| **Investment**                      | 1 milking-robot | milking shed technique |
| Price (in €)                        | 110,000,-       | 70,000,-         |
| Depreciation                        | 6.5%            | 6.5%             |
| Interest                            | 5%              | 5%              |
| Maintenance                         | 4%              | 4%              |
| Electricity/Water                   | 2%              | 3%              |
| **Total per year (in €)**           | 16,500,-        | 16,500,-        |
OPTRIMA CASE: VERTICAL MARKETS

- The automated milking market.
  - Selling “2757 Industrial Machinery”
  - To “3573 Farming & Fishing”
- Magnitude comparison
B2B & B2C

- **B2B far larger than B2C market**
  - Several layers and dimensions of B2B behind each consumer product (see supply chain)
  - Most companies are business to business

- Comparing B2B and B2C: three main differences with implications on marketing strategies and tactics
  1. Market segmentation
  2. Market structure and demand
  3. Decision making process
MARKETS

B2B & B2C: MARKET SEGMENTATION

In B2C
- Psychological, demographical, sociological criteria...
- E.g. ‘TV for those who actively look for added value’ vs de ‘family TV station’

In B2B
- More ‘sober’ criteria
- Can be linked to clear, concrete, understandable performance criteria
- E.g. (Optrima Case) industrial use of 3D camera’s: resistance to dust, water... Vs. use in consumer equipment: cost, ease of use, mass manufacturing...

Example of B2C segmentation criteria
B2B & B2C: STRUCTURE & DEMAND

MARKETS

- Fewer, larger customers
  - # Potential customers for newspaper printing presses, jumbo jets
  - Bulk buying of regular goods

- Scale and strategic importance of contract for all parties
  - Building the Oosterweel connection

- Interdependence between buyer and seller
  - Subcontractors around Ford Genk site

- Long term relationship
  - Close interaction: joint problem analysis, developments; operational integration...
  - Risk of overdependence!

- geographic clustering of activities

- Derived demand
  - If the overall consumer demand for printed media diminishes then so will the demand for ink and plates

- Price inelasticity in short term
  - Size of demand is determined by end-user market

- Fluctuation of demand
  - Especially for investment goods: close link to economic situation

- International scope of sales
  - Most B2B companies act on international scale
    - E.g. Enfocus: <5% of sales in Belgium
  - US (America), Europe (EMEA), Asia: often different markets, market leaders

- It’s a small world...
  - Each market segment is a village
  - Importance of reputation
  - High customer satisfaction required
B2B & B2C: Decision Making

- Much depends on importance of decision

- More professional attitude in B2B
  - The buying process of businesses is one of the most rational business processes around!
  - Major impact on marketing!

- More complex, more people involved
  - Decision process takes longer

- More formalized
  - Product specifications
  - Services, support, maintenance, insurances,
  - -> Contracts!

- The role of the industrial buyer
  - market research, competitor analysis, product evaluations and testing, monitoring purchase orders
  - planning, selecting and buying of merchandise

- Decision making flavored by national cultures
  - US: individualistic decision making
  - Sweden, Netherlands: consensus building within organization

- Who takes the decision? -> Decision making unit
  - Not necessarily a formal group
  - Range of participants
    - Users: often initiate the process, can be anybody in organization
    - Influencers: often technical department (IT...), staff
    - Buyers: in larger organizations: dedicated department
    - Decision makers: depends on importance of decision
    - Gate keepers: protect decision makers from unwarranted influence of sellers
  - -> Multi-level sales!
B2B: IMPLICATIONS ON MARKETING

- Especially in business-to-business clear, rational reasons determine if products are bought
  - B2C adds some other kinds of arguments to the mix
  - ... but rational reasons generally remain applicable

- Especially in innovative entrepreneurship it is essential that the entrepreneur know clearly, explicitly, why a customer should buy

- He must therefore fully understand the logic of the customer

- > One **must** consider things from the **perspective of their customers**

- Tools to formalize this:
  - performance criteria (later)
  - value proposition (later)
Sectors, industries, & markets
Supply chains & value chains
Standards
Network effects & economies of scale
Business ecosystem actors
Regional clusters
the shoe industry supply chain
the shoe industry supply chain
A supply chain is a network between a company and its suppliers to produce and distribute a specific product to the final buyer. This network includes different activities, people, entities, information, and resources. The supply chain also represents the steps it takes to get the product or service from its original state to the customer.
ABOUT SUPPLY CHAINS

- **Many elements** are needed, **many steps** are taken before an end user need is fulfilled
- Your contribution is only a small part of the whole picture
- Supply chains: *'La suite des événements'*
  - How step by step the product is being built and brought to the customers
  - Value increases as value is added by players in every step
- Can be extraordinarily complex or very straightforward
  - E.g. Photovoltech: approximately 10 customers and 10 suppliers; long term contracts
  - vs. Apple iPhone: hardware, music, media, camera, GPS, telecommunications...
- **Different roles** are possible, your role generally impacts many aspects
  - Competitive position
  - Capital needs (e.g. supporting app)
  - Minimum size
  - Scalability (e.g. service company)

Supply chains are crucial to answer: *"What is it exactly that you do as a company?"* Do you see the **whole picture?**
E-INK SUPPLY CHAIN
E-INK SUPPLY CHAIN: STEP 1 – INTELLECTUAL PROPERTY

- MIT media lab 1997
- Ink-based display system
  - Bullets of ink on (potentially flexible) substrate
  - Magnetized in black or white
  - Energy consumption only when changing images, so very long battery life
- But...
  - No color
  - Long image switching time (no video)

SUPPLY CHAIN
1 upper layer. 2 transparent electrode layer. 3 transparent micro-capsules. 4 positively charged white pigments. 5 negatively charged black pigments. 6 transparent oil. 7 electrode pixel layer. 8 bottom supporting layer. 9 light. 10 white. 11 black.
E-INK SUPPLY CHAIN: STEP 1 – INTELLECTUAL PROPERTY

- Inventions...
  - In this case: MIT Media lab, Prof Joe Jacobson

- ... lead to **patents**!
  - Owner can forbid others to copy
  - IP is often first step in technology value chains
  - In many cases owners simply license technology to others, who exploit the idea

- Beyond patents...
  - Engineering specs, so other parties can implement
  - Fully operational!
E-INK SUPPLY CHAIN: STEP 2 – COMPONENT

- Producing charged ink
- Encapsulating ink
- Produce roles of “e-paper”
E-INK SUPPLY CHAIN: STEP 3 – THE SUBSYSTEM

- Cut to right size
- Add display driver electronics
- Laminate
E-INK SUPPLY CHAIN: STEP 4 – THE DEVICE

- Device
- Operating system
Is this supply chain complete?
SOLAR PANEL SUPPLY CHAIN: PRODUCTION

- Production of solar cells: https://www.youtube.com/watch?v=KFTRafevNlk
- Production of solar panels: https://www.youtube.com/watch?v=G4ESiVPZjBU
Quartz → Silicon wafers → Solar cells → Solar panels → Installation
Bekaert: steel wire transformation and coatings
Cost breakdown of the module...

And of the whole product...

Flowback of added value...
The activities that a firm performs become part of the value added produced from a raw material to its ultimate consumption. Along the way, many different firms or businesses have their own activities along the supply chain. Thus, each firm has its own value chain.
Most organizations engage in many activities to create value. Value is the amount that buyers are willing to pay for product/service that a firm provides.

Porter’s value chain (1985); McGee (2014)

All activities have costs. Profits alter when the value created by the firm exceeds the cost of providing it. Thus, every activity should be weighted in relation to creating a margin.

Organised like a production line, headings differ according to nature of operations.

Firm Infrastructure
Human Resource Management
Technology Development
Procurement
Inbound Logistics
Operations
Outbound Logistics
Marketing And Sales
Service

Primary Activities

Support Activities

Overhead service elements

Value Chain

Organised like a production line, headings differ according to nature of operations.
Inbound logistics
• Activities associated with receiving and storing the materials needed to manufacture the products, such as material handling, warehousing, stock management...

Operations
• All of the activities required to transform inputs into outputs and the critical functions which add value, such as machining, packaging, assembly, service, testing, and so on

Outbound logistics
• All of the activities required to collect, store, and physically distribute the output. This activity can be extremely important, as in many industries control over distribution strategies is a major source of competitive advantage—as up to 50% of the value created in many industry chains occurs close to the ultimate buyer

Marketing and sales
• Activities associated with informing potential buyers about the firm’s products and services, and inducing them to do so by personal selling, advertising and promotion, and so on

Service
• The means of enhancing the physical product features through after-sales service, installation, repair, and so on.

Porter’s value chain (1985); McGee (2014)
VALUE CHAIN

- Procurement
  - The acquisition of inputs or resources. Although this is the responsibility of the purchasing department, almost everyone in the firm is responsible for purchasing something

- Human resource management
  - This consists of all activities involved in recruiting, hiring and training, developing, rewarding, and sanctioning the people in the organization

- Technology development
  - This is concerned with the equipment, hardware, software, technical skills, and so on, used by the firm in transforming inputs to outputs

- Firm infrastructure
  - This consists of the many activities, including general management, planning, finance, legal, external affairs, and so on, which support the operational aspect of the value chain.

Porter’s value chain (1985); McGee (2014)
“(...) up to 50% of the value created in many supply chains occurs close to the final buyer.”

J. McGee 2014
The last steps towards the customer are integral part of the supply chain: a/o distribution and marketing

- Especially in consumer markets these last steps represent a substantial challenge
  - Value of brand name, existing retail network
- Internet is a game-changer in this respect
  - see Facebook, Google
- In business markets approaches vary strongly; it is possible for companies to
  - use mass distribution
  - collaborate with smaller, specialized partners
  - build their own distribution channel
It’s the overall customer experience that counts: “the whole product”

Complementary products and services that are needed to provide a complete solution to the end-user
- E-book reader and e-books
- HD-DVD TV’s/players and HD programs & DVD’s
- OS and Software
- Game console & games

But also
- developers for database applications
- support, training and maintenance
- Customization, adaption to local language

Your offering may depend on complementary technologies
- digital photography and data storage, internet, printers...
Apple strategy: maintain tight control over hardware, software and the services they access

- First Apple Macintosh opened with special screwdriver that only recognized service technicians possessed
- No expansion slots

Unsuccessful strategy for 30 years

- Apple could not beat the power of modularity and scale of
  - Intel
  - Microsoft Windows
  - PC manufacturers
  - Software & add-on vendors

Dow Jones Apple vs. Microsoft, Dell, Intel (1984-1997)
this integral control has become a major asset

- iPod, iPhone, iPad
  - designing and manufacturing devices
  - operating systems
  - application software
  - developer tools, relations
  - internet application
  - content provision
  - marketing, brand name
  - ‘vertical integration’

- it is the right approach for the digital entertainment age
  - Jobs wanted to make complex devices like computers and smartphones into truly mass-product products
  - for that he needed to control all aspects of the customer experience

- ‘Apple is the only company that controls the whole widget. it turns out that this is Apple’s greatest strategic advantage’
Apple, the sequel... (1998 – 2012)
SUPPLY & VALUE CHAIN DIMENSIONS

SUPPLY CHAINS CAN COLLIDE
SUPPLY CHAINS CAN COLLIDE

SUPPLY & VALUE CHAIN DIMENSIONS

- What changes...
  - Distribution
  - Printing, post-press
  - Prepress

- What remains (+/-) the same...
  - Layout
  - Content creation
  - Brand owner

- The new supply chain
  - Reader device
  - Telecom network
  - Online store
  - Prepare for posting

- The real questions for newspaper publishers: will they still make money?
  - At what price can they sell a digital newspaper?
  - What commission will they need to give for ‘distribution’, and to who?

- One of the biggest battles on e-books / e-newspapers (and music, video, television) are the relations between content owners/publishers and device/service suppliers...
  - Who owns the billing system, commissions
### Supply & Value Chain Dimensions

#### Research
- **3-5y**

#### Preclinical
- **1-2y**

#### Phase I
- **1-2y**

#### Phase II
- **1-2y**

#### Phase III
- **2-3y**

#### Pre-registration
- **1-2y**

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**RELEVANCE OF TIME DIMENSION**
SUPPLY CHAIN: THE Optrima CASE

- VUB spin-off
- Core technology: 3D imaging
- Enormous range of application areas
SUPPLY CHAIN: THE OPTRIMA CASE

The Optrima supply chain 1.0.

Sensors
DepthSense™ is a proprietary and patented, native CMOS imager technology providing robust operation in a wide variety of environments, state-of-the-art sensor properties, and superior image information.

Modules
Camera Modules are low-cost, real-time 3D components designed for further integration into your products. Reference designs are available for implementation guidance. These modules provide a complete system for easy integration into your application.

Cameras
OptriCam™ is a family of 3D Time-of-Flight Camera Systems based on DepthSense™ Sensor and technologies. 3D Cameras are used in a variety of applications from Consumer electronics.
SUPPLY CHAIN: THE OPTRIMA CASE

The Optrima supply chain 1.0.
Brussels, Belgium – November 16th, 2009 – Softkinetic S.A., the leading 3D gesture recognition software developer, and Optrima N.V., the inventor of the Current Assisted Photonic Demodulation (CAPD) 3D sensing technology, today announced a strategic joint venture to introduce the Softkinetic-Optrima™ solution - the most complete 3D depth-sensing imaging and gesture recognition interface solution on the market.

BRUSSELS – 10 September, 2010 – in3Depth Systems SA/NV, the financial holding controlling Softkinetic and Optrima has announced the closing of the first part of its Series B financing round, with an €8 million strategic investment by Belgacom and SRIW.
Merging with SoftKinetic

- SoftKinetic: iisu™ (Interface-is-U)
  - Strong middleware
  - Known in the market
- Optrima
  - Strong 3D camera technology
- Together → unique position with whole stack
- Branding
  - KISS (Keep it Stupid Simple)
    → SoftKinetic will do!
SUPPLY CHAIN: THE OPTRIMA CASE

Merging with Softkinetic.

Tokyo, Japan - Sony Corporation is announcing that it has completed the acquisition of Softkinetic Systems S.A., after reaching an agreement with the company and its major shareholders. With this acquisition, Softkinetic - which possesses time-of-flight ("ToF") range image sensor technology, as well as related systems and software - has become a wholly-owned subsidiary of Sony.

Sony will focus on combining Softkinetic's ToF range image sensor technology expertise with its own technologies with the aim of developing the next generation of range image sensors and solutions, not only in the field of imaging, but for broader sensing-related applications as well.
Softkinetic... Sony Depthsense Solution
Opportunities for using 3D sensing technology are limited only by imagination.

We provide the essential building blocks of this innovative technology: time-of-flight Depthsense® sensors used in cameras and modules, and advanced Depthsense® software libraries.

We enable innovative businesses to bring depth-sensing solutions to market and make them part of everyday life.

<table>
<thead>
<tr>
<th>MOBILE</th>
<th>AUTOMOTIVE</th>
<th>HMD</th>
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<tbody>
<tr>
<td>ROBOTICS</td>
<td>GAMING</td>
<td>IOT</td>
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Horizontal vs. Vertical markets...
PIXAR

- American computer animation studio
  - “known for its critically and commercially successful computer animated feature films”

- Foundations laid in 1974
  - New York Institute of Technology’s (NYIT) established the Computer Graphics Lab (CGL)
    - developed digital compositing computers
  - collaborated with Georges Lucas

- Pixar Founded in 1986
  - search for investors led to an offer from Steve Jobs
    - after being declined by 35 venture capitalists and 10 large corporations...
    - Steve Jobs became major shareholder

- It became clear that sufficient computing power was still years away
  - In 1985 after they had a deal to make a computer-animated movie
  - Pixar became a hardware company
    - Pixar Image Computer as the core product
    - system primarily sold to governmental, scientific, and medical markets
    - Walt Disney Studios used the Pixar Image Computer and custom software written by Pixar

- Pixar Image Computer
  - launched May 1986
  - aimed at commercial and scientific high-end visualization markets
    - medical imaging, geophysics, meteorology
    - $135,000 + a $35,000 workstation
    - well ahead of its time
    - generated many single sales, for labs and research; did not sell in quantity
Pixar and Disney begin collaboration
- on CAPS, Computer Animation Production Systems
- hard- and software to develop Computer Animated movies

The animation movie studio
- 1995: launches first feature film: Toy Story
- in total 26 feature films and hundreds of short films
- Commercial success story
  - As of July 2019 feature films earned +/- $14 billion
  - $680 million average worldwide gross per film
  - 4 Pixar movies among the 50 highest-grossing films of all time
- Critical success story
  - 23 Academy Awards
    - 11 wins of Best Animated Feature
  - 10 Golden Globe Awards
  - 11 Grammy Awards

January 2006: acquisition by Disney
- for $7.4 billion in an all-stock deal
- catapulted Jobs, who owned 49.65% of Pixar, to Disney’s largest individual shareholder (7%) and a seat on its board of directors
SUPPLY CHAIN (AND CORE ASSETS)

ICT platform: technology

design studio: creative talent

movie distribution platforms: channels
Sectors, industries, & markets
Supply chains & value chains

**Standards**

Network effects & economies of scale
Business ecosystem actors
Regional clusters
1,00,00,00,00,000
Total Business crosses Rs. One Lakh Crore
Thank you, each one of our 15 million customers.
A standard is (a limited set of) common way(s) to do something or to approach/solve a problem.
A common way of doing something
- Can be achieved
  - bottom-up or top-down
  - unanimously or not
- It assures not everybody does it his/her own way

Standards can be...
- Part of society, very formal and entrenched
  - driving on right hand side, GSM, internet...
- Purely technical
  - form factors for screws
- Very long lasting or very transient
  - QWERTY/AZERTY
- Governed
  - Europe= GSM standard, US: competing technologies

Standards are a key dynamic in business ecosystems:
- The advent of a standard is part of the maturation process of an industry (see Industry Life Cycles)
- Standards often generate their own ecosystems and vice-versa
- Two or more competing standards...
- Standards can create opportunities for niche players
- Standards are reviewed and updated on a regular basis.
- Dagen H (H day), today mostly called Högertrafikomläggningen ("The right-hand traffic diversion"), was the day, 3 September 1967, on which traffic in Sweden switched from driving on the left-hand side of the road to the right.

- A pair of colored gloves used in 1967 by Swedish authorities in order to remind drivers they should drive on the right as the traffic was changed.
WHY STANDARDS?

STANDARDS

- Standards facilitate
  - Manufacturers know what is expected from them
    - To build a GSM telephone
    - To use the electricity grid
    - To write software for the internet
  - Ease of communication between actors
    - “5 liters of paint, RAL 1003”
  - Compatibility between users
    - PDF

- Society and economy needs standards
  - Allows products and people to work together and be interchangeable
  - Provide assurance that a product delivers a certain performance
  - Provide the tools (symbols, terminology) for designers, manufacturers and users to communicate.
STANDARDS

1. Official, public standards
2. De-facto standards
3. Dominant designs
4. # parallel standards
5. Quality standards
WHO SETS STANDARDS?

1. Legislator, government agencies, military
2. National, regional, international, and sectoral standardization bodies
   - International Organization for Standardization (ISO)
   - European Telecommunications Standards Institute
   - International Telecommunication Union
   - World Wide Web Consortium
   - Universal Postal Union
   - American Petroleum Institute
   - DIN, ASA...
3. Sometimes standards emanate from groups of companies
   - USB: Compaq, DEC, IBM, Intel, Microsoft, NEC and Nortel.
   - Audio CD: Philips + Sony
4. Vast battles of influence and market share (especially in emerging industries) can introduce standards
   - Usually connected to de facto standards
   - Microsoft Windows vs. Apple Macintosh
Some Standards Battles

- Electric power
  - DC (Edison) vs AC (Westinghouse)

- Roads
  - Width, side of the road, signage

- Color television
  - Mechanical (CBS) vs electronic (RCA)

- Air travel
  - Door on front left, jetways/airbridges, taxi ways

- Video cassettes
  - Betamax (Sony) vs VHS (Matsushita+)

- Cellphones (1)
  - Several co-existing standards
  - TDMA (Ericsson/AT&T) vs CDMA (Qualcomm) vs GSM (EU) vs PHS

- Personal computers
  - Microsoft windows vs Mac OS

- 56k modems
  - K56flex (Rockwell/Lucent) vs x2 (US Robotics/3Com) vs v.90

- Smartphones
  - Iphone, windows, google
MY EXPERIENCE WITH STANDARDS

STANDARDS

- ‘Quadtree compression’ vs. CCITT Group IV
  - Invented @ VUB for SoftCore
  - Format to compress scanned pages
  - Arguably better technology
    - +/- 30% faster compression, better visualization
  - versus the absolute standard
    - The way fax machines compress images
    - Software libraries available at low cost
  - And that for a key element in the perception of customers: long term accessibility of documents...
    - What if SoftCore goes bankrupt? Will I be able to view my documents?
  - Lots of efforts to convince users, implicit ‘negative point’
  - Finally we dropped the technology
- Mobitex vs GSM SMS
  - Better technology
    - Packed switched
    - Much more reliable
      - In theory: depends on coverage!
  - Standard: GSM
    - At that time coming up at full speed
    - Massive investments
      - Main partners of RAM redirect funds to GSM
  - Volume volume volume!
    - Try to order 10,000 modems with a manufacturer if GSM operators order 10 million...
    - Impossible to match coverage
  - Downward spiral
    - Mobitex networks close...
    - Customers loose confidence
    - Best employees leave
  - Only alternative: survive in niche market
Is the standard public?
Adobe twice decided to make architectural information openly available
- Postscript
- PDF

In both cases they became dominant designs
- the inverse of protection of intellectual property!

They succeeded because no major competitor arose to grab market share

+ Adobe was respected as serious business partner

“PDF is now a formal open standard known as ISO 32000, maintained by the international organization for standardization”
How Standards Proliferate:
(See: A/C Chargers, Character Encodings, Instant Messaging, etc)

Situation: There are 14 competing standards.

14?! Ridiculous! We need to develop one universal standard that covers everyone's use cases. Yeah!

Soon:

Situation: There are 15 competing standards.
WHAT TRIGGERS STANDARDS BATTLES, AND WHAT ARE THE OUTCOMES?

- Are two (or more) businesses or business ecosystems vying for dominance?

- How important are network effects?

TIPPING
  - “fight to death”

TRUCE
  - Convergence
  - Comprise

TWO (OR MORE)
  - No tipping
  - Duopoly or oligopoly
Sectors, industries, & markets
Supply chains & value chains
Standards
**Network effects & economies of scale**
Business ecosystem actors
Regional clusters
DIRECT NETWORK EFFECTS

Value to user

Actual (or anticipated) number of users

Products with network effects

Conventional products

CUSTOMER

Products with network effects.
I derive value from others using the product
NETWORK EFFECTS

DIRECT NETWORK EFFECTS

CUSTOMER

facebook

skype

ebay
marketplace networks comprising buyers and sellers
  - eBay, Uber, Airbnb

networks of content creators, consumers and -often- advertisers
  - Instagram, Reddit, TikTok, YouTube, Twitter

workplace collaboration products for teammates and co-workers
  - Dropbox, Slack, Google Suite, Microsoft Teams

almost all products of members of Billion Users Club leverage a network effect
  - Apple: 1.6B iOS devices
  - Google 3B Android devices
  - Facebook 2.85B users across their social network and messaging apps
  - Microsoft over 1.5B devices running Windows, 1B running Office
  - China: WeChat, TikTok, AliPay 1B Chinese users

4 of the top 100 marketplace start-ups drive 76% of gross revenue
  - immense concentration at the top
Network effects are first of all a destructive force, driven by a vicious cycle where new users churn because not enough other users are there yet.

- Slack: it doesn’t make sense to use the product until your colleagues are also on the platform.
- Uber: you can’t use the service until there are enough drivers, who won’t drive until there are enough rides.

-> the leaky bucket: “97% percent of those who signed up, would be out of there within five minutes”
I derive value from others using the product

Metcalfe's law
- The value of a network goes up as the square of the number of users
  - 10 users => $100; 100 users => $10,000
- Value of product increases with (anticipated) number of users

Apply to technologies where interaction or compatibility are important
- Communication: phones, e-mail, internet, PDF, Facebook

Network Effects and monopolies and standards
- Strong network effects lead to monopolies (facebook, MS office) or standards (phones, fax, email, www...)
- Central argumentation by Bell Telephone to receiving monopoly on US telephone services. In 1908 there were over 4000 local and regional telephone exchanges.
Nobody beats network effects...

Social network usage

- Facebook: 50%
- Twitter: 24%
- Pinterest: 16%
- LinkedIn: 5%
- Google+: 2%
- Anders: 3%
Do products with negative (direct) network effects exist?
NETWORK EFFECTS

- Indirect, lagged effects
- Supply of complementary goods and services (by third parties and by company) develops only if there is sufficient installed base
  - Software for OS
  - Games for console
  - VHS movies
- Critical mass, economies of scale
  - Local service offering, 24h support, language support...
- Apply more often than direct effects, but are less severe
Economic platforms having **two distinct user groups providing each other with network benefits**.

- Credit cards (cardholders and merchants)
- Operating systems (end-users and developers)
- Travel reservation services (travelers and airlines)
- Yellow pages (advertisers and consumers)
- Video game consoles (gamers and game developers)
- eBay

Particularly useful for analyzing the chicken-and-egg problem of standards battles,

Possible strategy: one user group gets free use of the platform in order to attract the other user group.
NETWORK EFFECTS

FREEMIUM EXAMPLE: STRAVA

CUSTOMER
Switching Costs are the costs associated to a switch. These can be orders of magnitude larger than costs of a new product.

The resilience of a standard depends a/o on the Switching Costs.

- Google search to Bing; Ford to Volkswagen: no switching cost
- The total cost of installing an ERP system is up to eleven times greater than the purchase price of the software
- infrastructure upgrades, consultants, retraining programs...
- Change side of the road on which you’re driving...

Switching Costs can be so large that switching is virtually unthinkable: ‘lock-in’

Types of lock-in

- Contractual commitment
- Durable equipment and aftermarkets
- Brand-specific training
- Information and databases
- Specialized suppliers
- Search costs
- Loyalty programs
Economies of scale = cost advantages that a business obtains due to expansion.

Factors that cause average cost per unit to fall as the scale of output is increased:

- **Operations**: The size of a facility and the usage levels of other inputs increase.
- **Purchasing**: bulk buying of materials through long-term contracts
- **Managerial**: increasing the specialization of managers
- **Financial**: obtaining lower-interest charges when borrowing from banks and having access to a greater range of financial instruments
- **Marketing**: spreading the cost of advertising over a greater range of output in media markets, volume buying
- **Technological**: taking advantage of returns to scale in the production function.
- **Services**: offering

Related to the **learning curve**

- Graphical representation of the relationship between the cost and output over a defined period of time (H. Ebbinghaus, 1885)
- New skills or knowledge can be quickly acquired initially, but subsequent learning becomes much slower.
- The slope of the learning curve represents the rate in which learning translates into cost savings for a company.
- The steeper the slope of the learning curve, the higher the cost savings per unit of output.
(DIS) ECONOMIES OF SCALE

THE LEARNING CURVE

SUPPLIER

Average production cost / unit

Cumulative total output

Learning curve
DISECONOMIES OF SCALE

- Cost increase / efficiency decrease due to size
- Sources of diseconomies of scale (wikipedia)
  - Cost of communication
  - Duplication of effort
  - Office politics
  - Isolation of decision makers from results of their decisions
  - Slow response time
  - Inertia (unwillingness to change)
  - Cannibalization
  - Large market portfolio
  - Inelasticity of Supply
  - Public and government opposition
**ECONOMIES OF SCOPE**

- Cost advantages resulting from firms providing a variety of products rather than specializing in a single product or service. Can be the result of:
  - one good producing another good as a byproduct
  - joint manufacturing, marketing, distribution
  - common brand name

- **Examples:**
  - Production of timber and particle board
  - Corn and ethanol production
  - Production of beef and hides
  - Cable TV operators offering high-speed internet service
  - Gas stations that exploit small supermarkets
  - Newspaper shops that act as post office and parcel pickup point
  - Amazon developing Amazon Web Services
  - Joint cargo and passenger transportation in airlines
  - Colluyt focuses on Belgium and develops:
    - Colruyt; Bioplanet; Spar; Bike Republic; Cru; Dats24; Dreamland; Okay; Jims…

- **Diseconomies of scope**
  - the average cost of production of the joint production of services is higher than in case of separate organizations.
  - the complexity of managing the organization may be the reason.
  - In some case companies decide to split up in separate organizations.

A business ecosystem is the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.
OVERVIEW OF ACTORS

- **Materials, Components, subsystems**
  - ExxonMobil Chemicals, Intel, Softkinetic...
  - Excellence; value proposition; permanent innovation
  - Recurring business;
  - Can be critical cost element

- **R&D/Design, Manufacturing, Brand name**
  - Are the end-user product suppliers
  - Can outsource part of activity
    - Pharma & Biotech, Apple & Foxconn

- **Investment goods supplier**
  - Trinean, BEST sorting, IBM...
  - Integrators: width of expertise
  - Innovation, value proposition, service & support
  - Long sales cycle

- **Services supplier**
  - Banks, shops, consultants, transport...
  - Some services are recurring, others are project-based -> impact on sales effort
  - People-related, therefore hard to scale
  - Often low startup costs

- **Retail channel**
  - Final steps to end-user
  - Many ways to fulfill this function

- **Complementary products suppliers**
  - Apple: software/apps, digital content, ...

- **Ecosystem animator**
  - Microsoft & Windows community

- **Finance**
  - Banks, investors, subsidies...

- **Regulator**
  - Governments, standards bodies
  - Gov’t plays variety of roles in ecosystem: lawmaker, policymaker, investor, ...
  - Standardisation bodies

- **Staff functions**
  - Consultants
  - Trade shows, conferences & seminars...
  - Professional press, journalists, industry experts, opinion leaders
The (often) paramount role of Government.
Governments can play key enabling and/or inhibiting roles in ecosystems.

Guarantor/supplier of core societal functions:
- Rule of law
- Education
- Financial stability
- Mobility
- Infrastructure
- ...

Regulator:
- Genetically modified organisms
- Patent regulation
- Standards
- ...

Initiator:
- VIB, IMEC, GIMV
- GSM standard
- Military
- Support for Venture Capital
- Support for Research and Development
- ...

The Belgian situation...
- Flanders
- Brussels
- Wallonia
- Federal
- Europe
Biotech staff functions.
You almost never can provide the whole product on your own

- There are exceptions...
  - Google, Facebook, eBay... (Don’t underestimate their core assets! (see later))
  - Standard Oil, IBM in the 60’s came very close
- Full vertical integration = covering the full supply chain
  - From raw material to customer services

Different roles are possible

- Architect or module in the supply chain or ecosystem? Both can be realistic strategies, much depends on sector. Some examples:
  - Trinean: Full solution for biomedical lab analysis instead of just the reader component (‘it’s better to sell one copy at 100,000 euro than 1,000 at 100’)
  - Intel: component -> subsystem
- Alternatives must be considered closely
- We will see later that keeping your options open might be a sensible approach

Role in ecosystem generally impacts many aspects:

- Competitive position; capital needs; minimum size; scalability...
YOUR PLACE IN THE ECOSYSTEM: BEKAERT

BEKAERT

better together

Bekaert: steel wire transformation and coatings
Sectors, industries, & markets
Supply chains & value chains
Standards
Network effects & economies of scale
Business ecosystem actors

Regional clusters
Regional clusters are subsets of a business ecosystem connected to a specific region or area.
EXAMPLES

- **Mythical**
  - Silicon Valley
  - Hollywood

- **Massive**
  - A narrow belt in the US. northeast and the eastern part of the midwest dominated US manufacturing up until the mid fifties
    - 64 percent share of manufacturing employment
    - Today called the Rust Belt...

- **In Belgium**
  - Biotech and pharma
  - Petrochemical
  - Diamond trade
  - Car manufacturing
  - Government
Factors that trigger the emergence of clusters

- local demand
- prior existence of supplier industries
- natural resources
- innovative firms
- chance events.

Once a cluster is formed a self-reinforcing cycle promotes its growth

- support of local public and private institutions
- initial transitory advantages get "locked in" within the cluster
- Tipping point
- agglomeration economies attracting new specialized firms to locate within the cluster and gain from increasing returns to scale
Critical mass
- The existence of a large pool of individuals with specialized skills
  - reduced search and hiring costs
  - requisite quality skill set is easily available
  - individuals with skills are attracted to the cluster
- The existence of firms providing specialized inputs

Dynamics
- High levels of technological spillovers and innovation due to proximity
  - since information flows are easier locally than over distances.
- existence of sophisticated buyers
- access to specialized suppliers gives high levels of flexibility and are able to implement innovations more rapidly
- high levels of competition and peer pressure within the cluster act as an important stimulus for innovation.

Trust and the related concept of social capital
- deals in valuable diamonds are sealed by a handshake on the diamond exchange
- when trust breaks down, unwritten rules must be codified and third parties brought in to resolve differences.

Under certain conditions clusters slow technological innovation
- resource diseconomies
- insular competitive practices
- lock-in in ageing technology
Silicon Valley stretches about 100 kilometer between San José and San Francisco

- "Core" Silicon Valley initially didn’t include San Francisco
- Recently several startups located in San Francisco
  - Uber, ...
- Culturally and economically both are closely linked

- Mediterranean climate

- Inhabitants:
  - Silicon Valley 2.44 million
  - San Francisco 750,000
  - Bay Area around 4 million.

- In size and population the greater Bay Area is in the same order of magnitude as Flanders.
UNICORNS OF SILICON VALLEY AND SAN FRANCISCO

Sources: PitchBook, CBInsights, Crunchbase, Wikipedia

DATE OF $1B VALUATION

2010-2013 / 20
2014 / 20 Unicorns
2015 / 21 Unicorns
2016 / 23 Unicorns
2017 / 20 Unicorns
2018 / 35 Unicorns
2019 / 47 Unicorns
Silicon valley employment.
Industry concentration
According to the United States Census Bureau, of the 280 defined metropolitan areas, the San Francisco Bay Area has the highest median household income in the nation with $62,024 (40% above national average).
• Value added per employee in Silicon Valley’s industry clusters is $326,100.
• In 2004, the region’s value added is $224,200 per employee.
• This is more than two-and-half times US value added per employee.
PERCENTAGE OF THE TOTAL POPULATION WHO ARE FOREIGN BORN

- Silicon Valley: 35%
- San Francisco: 30%
- California: 25%
- United States: 15%

Source: Highcharts.com
Nearly three-quarters of Silicon Valley women who work in computer, mathematical, architectural, and engineering occupations were born outside of the U.S., mostly in Asia. Slightly more than 70 percent of men in those professions are foreign born.

""

Tekla S. Perry
05 Mar 2018
Greetings!

Warning to Austin home buyers: Prices are about to skyrocket. That’s one likely result of the wave of tech companies moving their headquarters from the Bay Area to the Texas capital, a group that today expanded to include Oracle.

Oracle’s news came a couple of days after Elon Musk said he had moved to Texas, and 10 days after Hewlett Packard Enterprise said it would move its headquarters to Houston. As we reported a couple of weeks ago, the CEOs of Splunk and Dropbox had both moved to Austin as well, along with venture capitalists like Joe Lonsdale from SVIC.

The migration out of the Bay Area isn’t all heading to Texas, mind you. Some people are moving to other parts of California or elsewhere in the U.S., such as Miami. But wherever they’re going, their departures from the Bay Area are sure to erode the pre-eminence that the region enjoys in tech. For many, such as Oracle, it follows a big investment in Texas, including with the hiring of thousands of employees.

A majority of The Information subscribers responding to a survey this week said the Bay Area would be diminished as the tech center’s center of power after the pandemic. Seventy percent said they thought the
THE FLEMISH BIOTECH CLUSTER

Scientific excellence
Flanders rich history of top researchers.

- Marc Van Montagu and Jeff Schell invented the first method to genetically modify plants
- Walter Fiers was the first in the world to sequence a full gene and a full genome
- Désiré Collen discovered one of the very first successful biotech drugs (tPA)
- Erik De Clercq and Rudi Pauwels developed most of the currently available anti-HIV drugs
- Paul Janssen, one of the most prominent drug developers of the 20th century

Political support

- Sustained support by Flemish Government for biotechnology
- Broad spectrum of tax and other incentives for biotech companies
  - one of the most generous subsidy schemes for R&D activities
  - one of world’s most attractive tax incentives for patented products
- VIB as a catalyst for the regional cluster
  - start-ups have raised several € millions
  - turning out hundreds of trained people every year
  - signed hundreds of agreements with regional biotech companies, providing them access to novel technologies and products
Innovation in Flanders

- per capita, Flanders Life Sciences ranks
  - 2nd in # scientific publications
  - 1st in # patent applications
  - 1st in venture capital
  - 3rd in # drugs in the clinic
  - 2nd in # biotech companies

Source: presentation by Rudy Dekeyser, Managing Director Vlaams Instituut voor Biotechnologie VIB, during course ‘business aspects of biotechnology’
Within the European Union, Belgium and Flanders rank:

- #1 for biotech market capitalization
- #1 for clinical trial procedure speed
- #2 for clinical trial applications per capita
- #3 for pharma and biotech patent applications per capita
- #3 for number (bio)pharma researchers per capita
A FEW BIOTECH STARTUPS…
FLANDERS ECOSYSTEM ACTORS

- biotech incubators and accelerators:
  - Bioscape Ghent.
  - Bio-Accelerator Ghent.
  - Bio-incubator Leuven.
  - Incubator Darwin Antwerp.
  - BioVille Hasselt.
  - JLABS Beerse
    - part of Johnson & Johnson.
  - Food Port Tienen
    - part of Feed Food Health Campus.
  - imec.iStart
  - Obelisc bio-accelerator offers

- Science Parks focused on biotech and related fields:
  - Tech Lane Ghent.
  - Science Park University of Antwerp.
  - BlueGate Antwerp.
  - Arenberg Research Park.
  - Haasrode Research Park

- medtech-related R&D and business incubation:
  - strategic research centers
    - (VITO, VIB, imec);
  - research and technology centers
    - (IBiTech, NERF, IMO, Leuven Medical Technology Center, BIOMED).
  - university hospitals
    - (UZ Antwerpen, UZ Brussel, UZ Gent and UZ Leuven),
  - specialized campuses
    - Health Sciences Campus Gasthuisberg.
  - federations
    - MedTech Flanders, beMedTech.
  - innovation clusters
    - DSP Valley, flanders.health.
Contract Research Organisations

- Biogazelle (Ghent)
- Bio-Plus Safety Pharmacology (Mol),
- Bio4ward (Landen),
- BARC (Ghent),
- BioMARIC (Ghent),
- BioLizard (Ghent),
- BISC Global (Ghent),
- Conforma (Destelbergen),
- Clinitude (Leuven),
- Digital Cell Imaging (Keerbergen),
- EMTEX (Sint-Martens-Latem), the European Center for Chirality (Ghent),
- EGAMI (Antwerp),
- Innogenetics Biologicals (Ghent)
- Icometrix (Leuven)
- KasaConsult (Hoegaarden)
- Medpace (Leuven)
- Ontoforce (Ghent)
- ProGenTomics (Ghent)
- ProDigest (Ghent)
- Q-Biologicals (Ghent)
- InnoSer (Hasselt)
- and more.

Venture Capital Funds investing in Biotech

- GIMV
- PMV
- Vesalius
- Capricorn
- BioVest
- QBIC
- Gemma Frisius
- Theodorus
- Vives
- LRM
- SRIW
- TOLEFI
- Investsud
- SFPI-FPIM,
- V-Bio Ventures
- Medical technology
  - On the intersection of healthcare, nanotechnology, biotechnology and even cybersecurity.

- Flanders-based start-ups and companies are at the top of their games.

- Some contributed to major breakthroughs in
  - advanced microscopy
  - medical imaging
  - biochips (for advanced diagnostics)
  - active implants (pumps, drug delivery systems, neurostimulators)

- Flanders home to numerous organizations active in medtech-related R&D and business incubation:
  - strategic research centers
    - VITO, VIB, imec;
  - university hospitals
    - UZ Antwerpen, Brussel, Gent Leuven
  - specialized campuses
    - Health Sciences Campus Gasthuisberg
  - federations
    - MedTech Flanders, beMedTech
  - research and technology centers
    - IBiTech, NERF, IMO, Leuven Medical Technology Center, BIOMED
  - innovation clusters
    - DSP Valley, flanders.health
Chemicals R&D

Major European R&D centers in Belgium:
- **Total Petrochemicals Feluy**: the largest R&D center of the Total Group (500 employees)
- **Dow Corning**: European headquarter is established in Belgium, Seneffe (120 employees)
- **Procter & Gamble**: European Research Centre in Brussels is a global business unit for Home & Fabric R&D (450 employees)
- **Solvay**: Research & Technology – Brussels Center, the main R&D center of the group (275 employees)
- **Recticel**: International Development Centre in Wetteren (130 employees)
- **Agfa-Gevaert**: important R&D activities in Antwerp (500 employees)

Worldwide technical competence centers in the cluster of Antwerp
- **BASF** Antwerp for MDI
- **Evonik-Degussa** for methionine
- **Bayer** for Makrolon
QUESTIONS?

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