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Module 4

Building Economical Value Chain in Agriculture Using Digital Technologies

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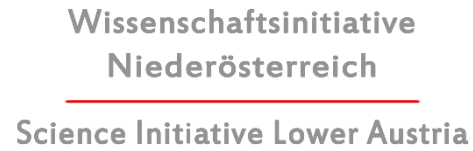

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Modules

1. Introduction to the Digitization in the Agriculture
2. Digital Skills for Improving the Agricultural Business
3. Managing the Agricultural Business in the Digital Economy
4. Building Economical Value Chain in Agricultural Using Digital Technologies
5. Financing the Digital Transformation of the Agricultural Business

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Learning Objectives of Module 4

After completing this module, you will:

- ✓Be able to understand the concept of value creation and value chain in the context of agriculture.
- ✓Learn about competitive advantage and competitive strategies.
- ✓Understand how different technologies can be applied in order to create value and overcome challenges in the agricultural value chain.
- ✓Understand how to embrace using creative and problem-solving skills to instill (technological) change.

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Unit 1

Economic Value Chains in Agriculture

Objectives

- ✓ Learn what the concept of creation of economic value.
- ✓ Understand the concept of Value Chains by Michael Porter.
- ✓ Understand the Agricultural Value Chain.
- ✓ Be able to identify your competitive and comparative advantage.

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Importance of Creating Economic Value (1)

Value creation is the process of turning labor and other resources intc something that meets the needs of others (your customers).

> *Example: Processors create value by acquiring raw materials and processing them in order to produce something useful. (I.E potatoes chips producers obtain potatoes from farmers to process them into chips and sell them to customers. Farmers create value by turning seeds into crops and so on.)*

Value is what sets you apart as a business from your competitors, acquires and retains long-term customers and satisfies the needs and the wants of your customers.

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Importance of Creating Economic Value (2)

In economic terms, the value that is created and captured is directly linked to the company is the profit margin

Understanding how your business creates value and searching for ways to add more value is key to create competitive strategy:

Value Created and Captured – Cost of Creating that Value = Profit Margin

Example: 20 EUR Processed Agricultural Product Sold - 15 EUR Total cost of producing = 5 EUR Profit margin

Creating vs. Capturing Value

CREATE Value

- Increase of value from transforming inputs to final output delivered to customers
- Processed vegetable or fruit are more "valuable" than before they were processed. Value is added as they were transformed from one stage (input) into another (final product).
- The value or the extra benefit is the increased customer's willingness to pay for the good or the service.

CAPTURE Value

- The ability of a business to "capture" the value created itself in a form of retained profit.
- You may have created great value with your product, however most of that value may be captured by your customer (since their bargaining power is huge and they can turn the price down) or by your suppliers (since the inputs for creating your product may have high price).

Creating Value in the Agricultural Sector

CREATE Value

In the agricultural sector creating value can occur in the different stages of the agricultural chain. Here are some examples.

- **Innovation**. *Research about using alternative crops that can be grown instead of traditional crops being more resistant to diseases, weather conditions etc.*
- **Industrial innovation**. *Processing of traditional crops into non-food end uses. Production of ethanol from corn, biodiesel from soybean, particleboard from straw.*
- **Coordination and Integration**. *Integration of production and packaging stages and delivering product "from farm to fork".*
- **Minimizing costs**. *Using drones to detect water deficiency in concise areas of the field without additional waste on other areas.*

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Activity: Describe your experience

Think about the nature of your (agricultural) business and elaborate on the following:

1. *How do you create value?*
2. *Who primarily is capturing the value your business activity creates?*
3. *How can you improve in the process of creating value and in what ways can you capture more value?*
4. *Can (digital) technologies be used in your case to improve the process of value creation and capture?*

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Michael Porter's 5 Forces Framework (1)

Michael Porters' 5 forces framework determines what proportion of the value is captured by you (your company/ firm) or by others:

1. **Buyers power:** The ability of buyers to bring down the price of the product you created.
2. **Suppliers power**: The extent to which suppliers can push up the price of the inputs (in turn capturing value themselves). (Agricultural cooperatives have higher barraging power than individual farmers when negotiating prices with suppliers of seed).
3. **Rivalry within the industry**: The amount to which value is competed away by price competition within an industry (in turn resulting in the customer capturing greater value through better prices).
4. **The threat of substitutes**: Whether the value is taken away by substitute products.
5. **The threat of new entrants**: Whether new entrants are able to enter the industry or not (which would drive down the price charged through greater competition in the industry).

Michael Porter's 5 Forces Framework (2)

Use the Porters' **Five Forces Model** and discuss the following:

- To what extent each of the forces capture your product value?
- In what way you can shift greater value capture to your business?
- How can (digital) technology create advantage within the 5 forces model?

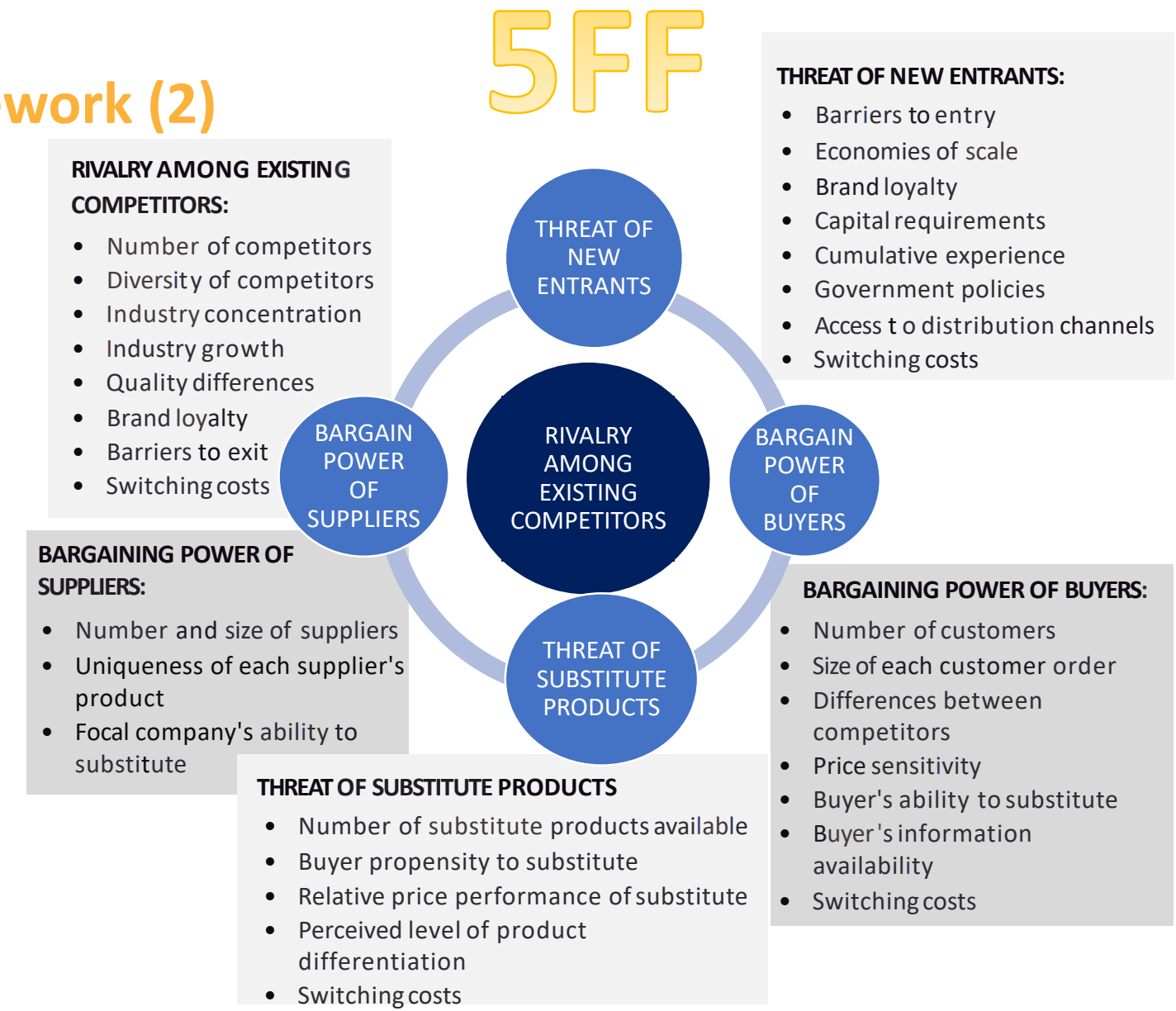

Image 2. Adapted Porter's five forces diagram, Source: https://www.business-to-you.com/porters-five-forces

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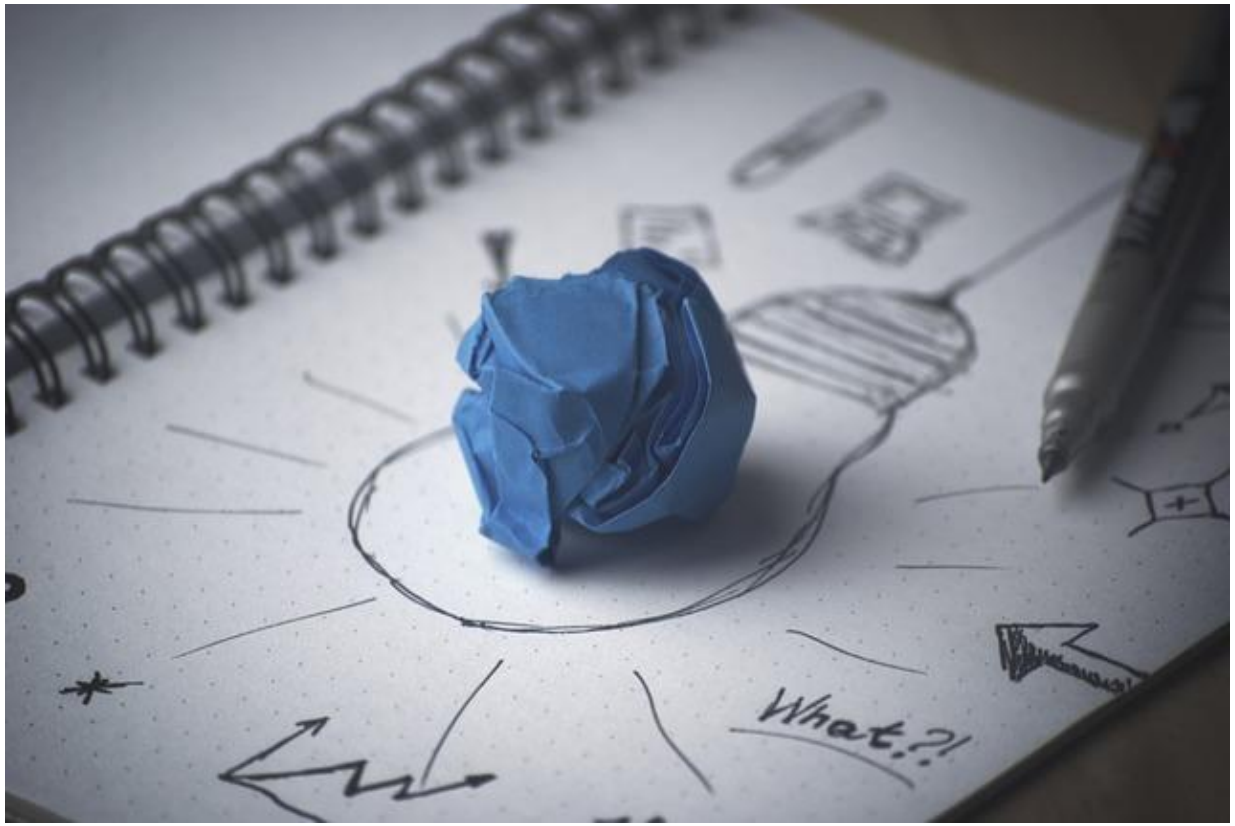
Value Proposition Design

One tool for designing, testing, creating and managing product/services that will bring value to your customers and to your company is the Value Proposition Design created by Alexander Osterwalder and Alan Smith.



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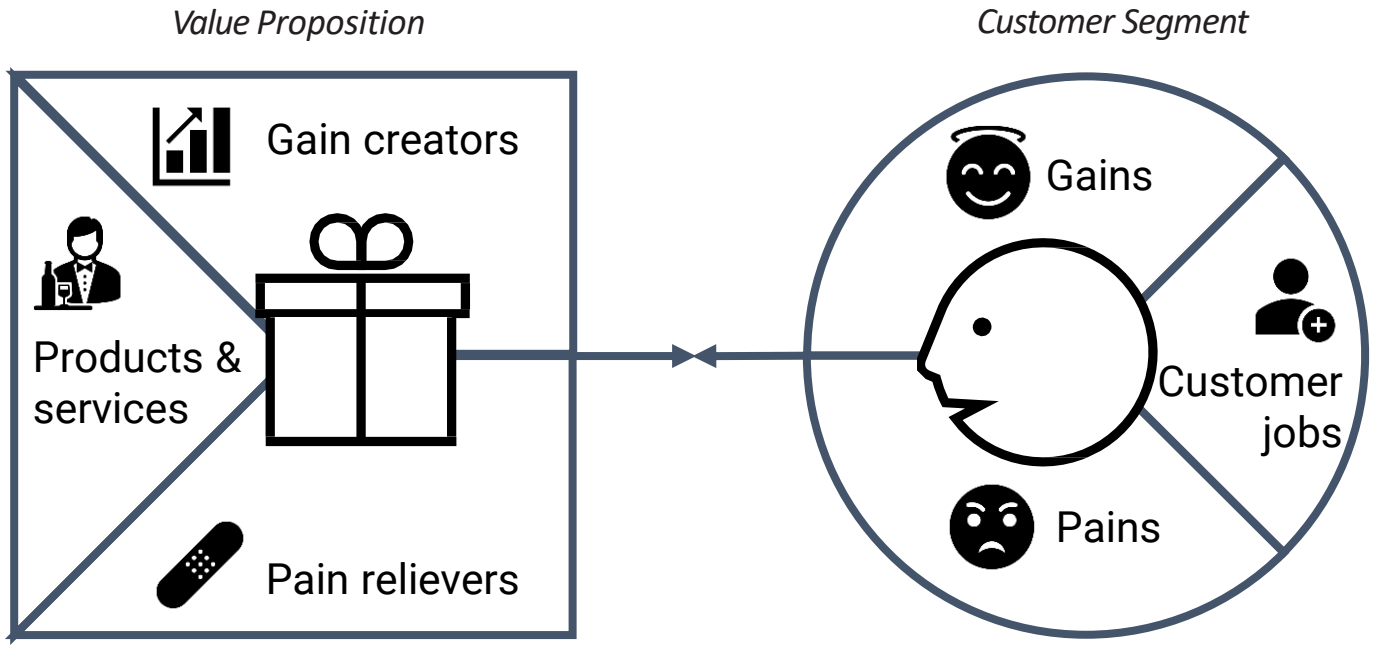
Value Proposition Canvas (1)

At the heart of Value Proposition Design is the Value Proposition Canvas, a simple template made up of two sections that will help you specify a compelling value proposition.

- It helps you to define your product and value it brings to the customers.
- It also helps define your targeted customers.
- Ultimately it helps you visualize, design and test how your product is different and distinguishes you from your competitors



Download: A template of Value Proposition Canvas in English (https://neoschronos.com/download/value-proposition-canvas/docx/)

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Value Proposition Canvas (2)

Customer Segment Section (Right hand – fill this out first)

1. **Customer Jobs –** List the key tasks your target customers have to complete. Think more broadly than functional jobs (e.g., eat healthy) and include social jobs (relationships) – such as looking good, fitting in or exercising power, and emotional jobs (feelings) – such as feeling safe and secure. Rank the jobs to be done by importance.
2. **Customer Pains –** List here the pains people experience in getting their jobs done, pain points that annoy before, during, and after trying to get a job done, including risks of bad outcomes and obstacles to getting a job done. Rank the pains by severity.
3. **Customer Gains –** List the gains that people require, expect or desire from getting a job done. These gains may be functional (utility), social, emotional, or financial. Rank these gains by relevance to the target segment.

Value Proposition Canvas (3)

Value Map Section (Left hand)

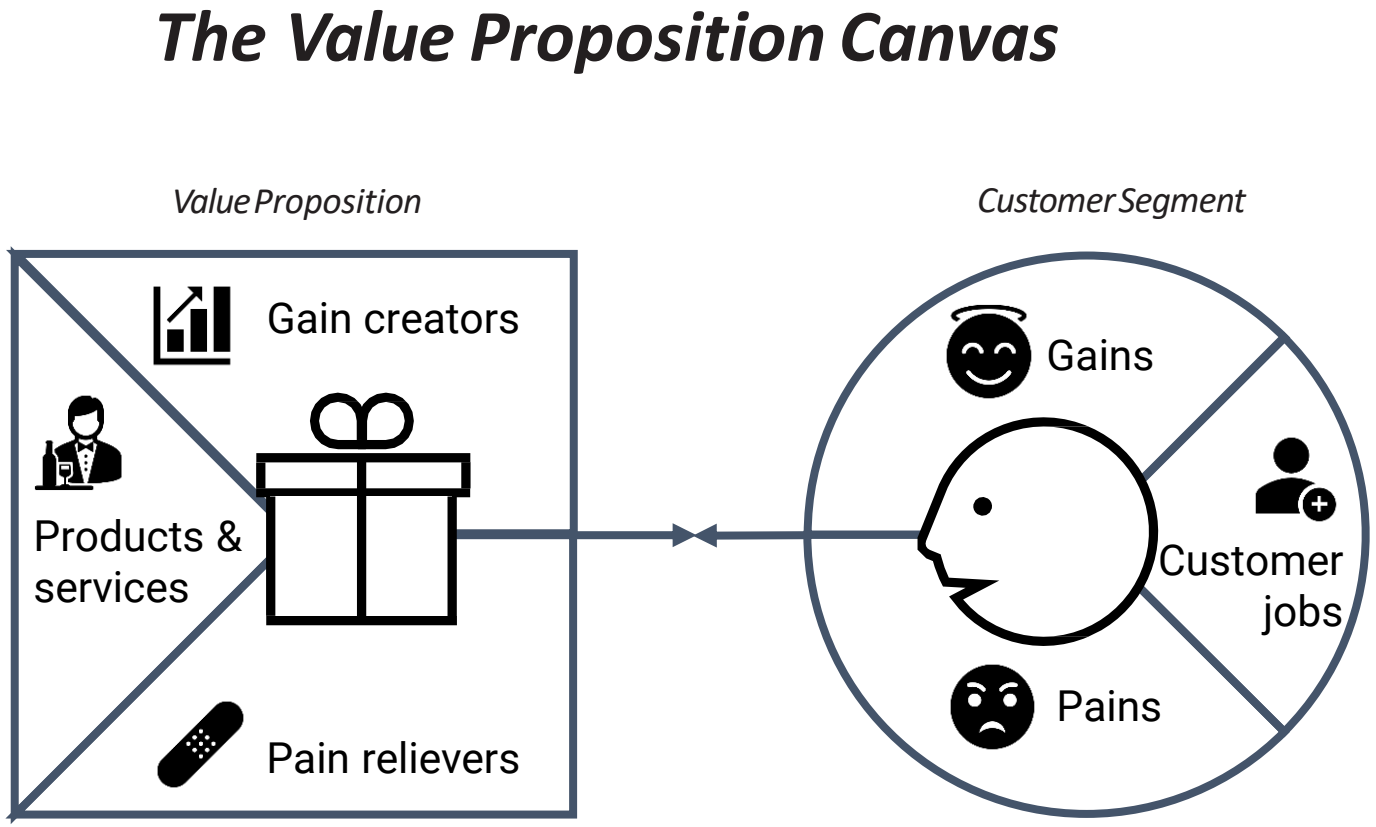
4. **Pain Relievers –** List here how you could alleviate specific customer pains identified in (2). Pain relievers explicitly outline how you intend to eliminate or reduce some of the things that annoy your customers before, during, or after they are trying to complete a job or that prevent them from doing so.

5. **Gain Creators –** List here the ways you could create the customer gains identified in (3). Gain creators explicitly outline how you intend to produce outcomes and benefits that your customer expects, desires, or would be surprised by, including functional utility, social gains, positive emotions, and cost savings.

6. **Product(s)/Service(s) –** Finally, list product or service ideas that map to the customer jobs in (1), or in the case of a single product or service innovation project, attributes and features that could help people get their most important jobs done, alleviative the most pain, and create the most gains.

Activity: Value Proposition Canvas

1. *Use the template to design your product/service value proposition using the previous 6 steps.*
2. *What can you learn from the value proposition of your product. Is there a better way to satisfy your customer needs?*
3. *Can (digital) technology improve your value proposition?*



The Concept of Value Chain

A **Value Chain**, in business terms, is a set of activities that an organization carries out to create value to its customers.

The general value chain proposed by Michael Porter can be used for companies to analyze their activities and how they are all connected. The activities in the value chain and the way they are performed affects costs and profits and will help you understand the sources of value you create and capture.

Using technology in various stages can help you create more and capture more value.

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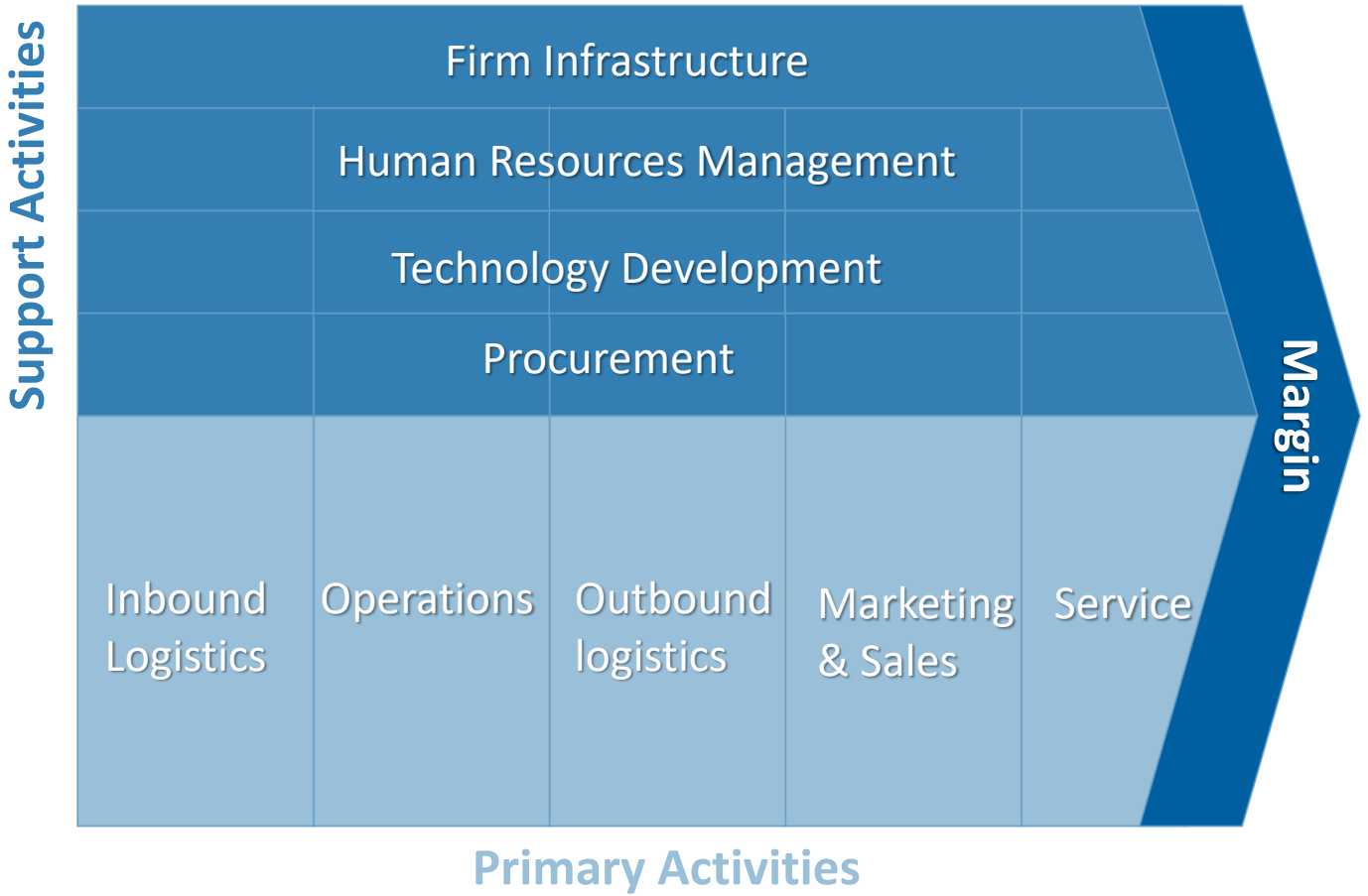
Michaels Porters' Value Chain

Porter's Value Chain focuses on systems, and how inputs are changed into the outputs purchased by customers.

- The value chain model proposed by Porter is comprised of chain of activities common to all businesses divided into support and primary activities.
- Click on the following link to learn how the marginal value is created between the activities.

click



Michaels Porters' Value Chain

Porter's Value Chain
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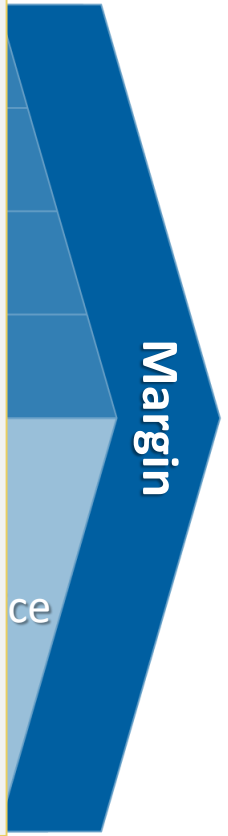
The value chain displays total value and consists of value activities and margin. Value activities are the physically and technologically distinct activities a firm performs. These are the building blocks by which a firm creates a product valuable to its buyers. Margin is the difference between total value and the collective cost of performing the value activities. Margin can be measured in a variety of ways. Supplier and channel value chains also include a margin that is important to isolate in understanding the sources of a firm's cost position, since supplier and channel margin are part of the total cost borne by the buyer.

Every value activity employs purchased inputs, human resources (labor and management), and some form of technology to perform its function. Each value activity also uses and creates information, such as buyer data (order entry), performance parameters (testing), and product failure statistics. Value activities may also create financial assets such as inventory and accounts receivable, or liabilities such as accounts payable.



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Primary Activities

Michaels Porters' Value Chain - Primary Activities

- **Inbound logistics.** All activities linked to receiving, storing, and distributing inputs of the product. Your supplier relationships are a key factor in creating value here.
- **Operations.** These are the transformation activities that change inputs into outputs that are sold to customers. Here, your operational systems create value.
- **Outbound Logistics.** These are the activities that deliver your product to your customer. Collecting, storing, and physically distributing the product to buyers, such as finished goods warehousing, material handling, delivery vehicle operation, order processing, and scheduling. They may be internal or external.
- **Marketing and Sales.** These are the activities associated with providing the means by which buyers can purchase the product and affecting them to do so, such as advertising, promotion, sales force, quoting, channel selection, channel relations, and pricing. The benefits you offer, and how well you communicate them, are sources of value here.
- **Service.** These are the activities linked with providing service to enhance or maintain the value of the product, such as installation, repair, training and product adjustment.

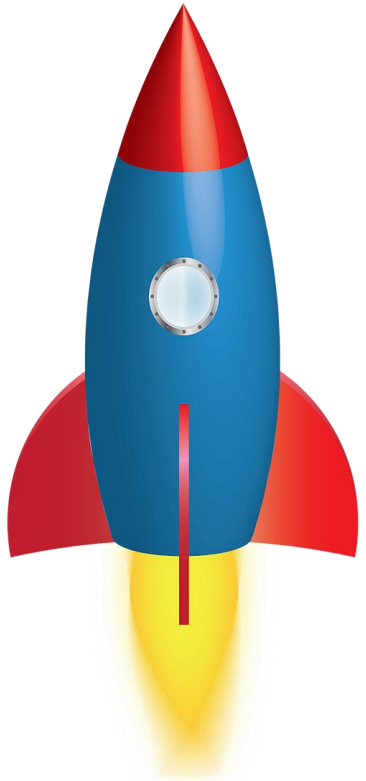
Michaels Porters' Value Chain - Support Activities

- **Procurement (purchasing)**. What the business does to get the resources it needs to operate. (i.e., finding vendors and negotiating best prices.).
- **Human resource management.** How well a company recruits, hires, trains, motivates, rewards, and retains its workers. People are a significant source of value, so businesses can create a clear advantage with good HR practices.
- **Technological development.** These activities relate to managing and processing information, as well as protecting a company's knowledge base. Minimizing information technology costs, staying current with technological advances, and maintaining technical excellence are sources of value creation.
- **Infrastructure.** These are a company's support systems, and the functions that allow it to maintain daily operations. Accounting, legal, administrative, and general management are examples of necessary infrastructure that businesses can use to their advantage.

Michaels Porters' Value Chain - Activity Types

Within each category of primary and support activities there are 3 types of activities that play different role in creating competitive advantage:

- **Direct**. Activities directly involved in creating value for the buyer, such as assembly, parts machining, sales force operation, advertising, product design, recruiting, etc.
- **Indirect**. Activities that make it possible to perform direct activities on a continuing basis, such as maintenance, scheduling, operation of facilities, sales force administration, research administration, vendor record keeping, etc.
- **Quality Assurance.** Activities that ensure the quality of other activities, such as monitoring, inspecting, testing, reviewing, checking, adjusting, and reworking. Quality assurance is not synonymous with quality management, because many value activities contribute to quality.



Define Your Value Chain and Understand Your Value Creation

Use the previous 3 slides and go through the following steps:

- **Step 1:** Write down your primary activities and sub-activities for each of them.
- **Step 2:** Write down your supporting activities and sub-activities for each of them.
- **Step 3:** Identify the links between them and list them by level of importance. (i.e.. precision farming decreases costs and increases yield).
- **Step 4:** Try to identify in which activity and sub-activity you can increase value and write them down.
- **Step 5**: Try to identify how (digital) technology can help you in the process of value creation.

Tips:

- ✓ Opportunities that can improve your value chain will lead you towards defining your generic business strategy (check the section for competitive and comparative advantage)
- ✓ Your list will be long. Try to prioritize them.
- ✓ Try to identify the cost drivers and sources of differentiation from your customers.
- ✓ Think of how you can implement positive changes of the identified priorities.

Agricultural Value Chain (1)

The Agricultural Value Chain is integrated variety of activities necessary for an agricultural product to move from the producer to the final consumer.

It is affected by the final (finished) product which goes through series of stages required from farm to fork.

At each stage, the agricultural product changes hands, through different chain actors, adding value and making transaction costs.

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Agricultural Value Chain (2)

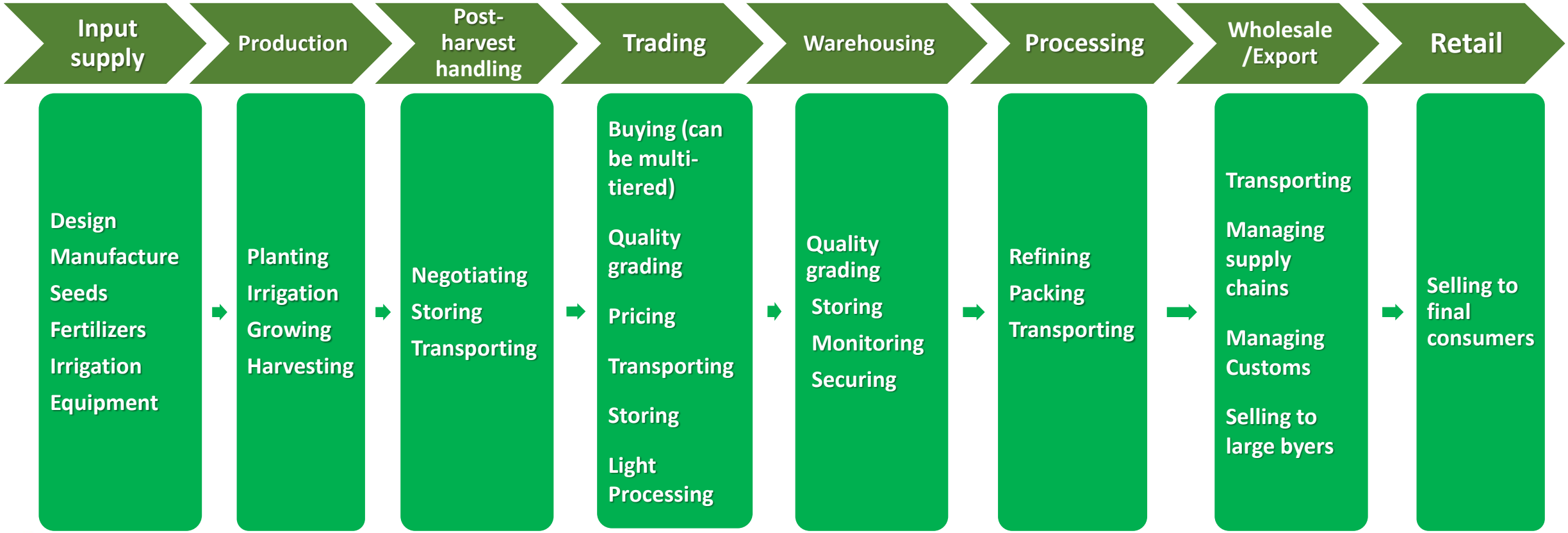
The Commercial Agricultural Value Chains differ by the type of the agricultural final product being consumed by the final customer. This affects what are the main stages in the agricultural value chain and what are the main actors.

If it is a processed product, the value is created in several stages in the value chain (input supply, production, trading, processing, retailing)

If the agricultural product (as crop) is directly sold to final consumers the value chain will consist only of few stages.

Agricultural Value Chain Models

The following model represents a comprehensive **typical** Agricultural Value Chain Model:



Loose vs. Tight Agricultural Value Chain Models

The Agricultural Value Chain may be:

- **Tight agricultural value chain**. It represents a holistic value chain, consisting of several chain activities required to bring the final product to the consumer. They are more formally organized and sophisticated. The comprehensive model on the previous slide represents a tight value chain.
- **Loose Agricultural value chain.** It represent a simplified value chain, consisting of few chain activities required to bring the final product to the consumer. They are less formally organized and less sophisticated. Such value chains are usually typical for Small Holder Farmers (SHF).

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Loose vs. Tight Agricultural Value Chain Models (2)

The following model represents a **loose** Agricultural Value Chain Model

Producer Driven vs. Buyers Driven Value Chains

Based on the governance structure, the value chains can be producer- or buyer-driven.

- **Producer-driven value chains** are more capital intensive, key producers in the value chain, usually control key technologies, influence product characteristics and control various links in the value chain.
- **Buyer-driven value chain** are often labour intensive. In these types of value-chains the consumers lead the coordination activities and influence product specifications.

EXAMPLE
The diary value chain is a buyers-driven value chain where the consumer preferences, food quality and safety concerns have crucial role in product handling and packaging.

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Capturing Value Through Upgrading

Upgrading means improving farming business activities and skills in order to capture more value in the value chain, meaning increased profits, decreased costs or both. Examples of upgrading can be the following:

- **Horizontal coordination.** Coordinating your activities with others at the same stage in the value chain.
- **Vertical upgrading.** Moving away from one-time only buyer seller interaction to long-term business relations and to controlling more stages of the value chain.
- **Functional/Process Integration.** Improved processes with the value chain of the organization for transforming farming inputs into farming outputs more efficiently.

Activity: Capturing value through upgrading.

Discuss the following example and decide what kind of upgrading does it represent and why:

1. *Collaboration with other farmers in producers' groups, cooperatives and similar for gaining bargaining power.*
2. *Becoming processor of the crops that previously were only produced and sold to the traders and producers.*
3. *Increasing yields or minimizing the costs by instilling improved farming practices like planting techniques.*

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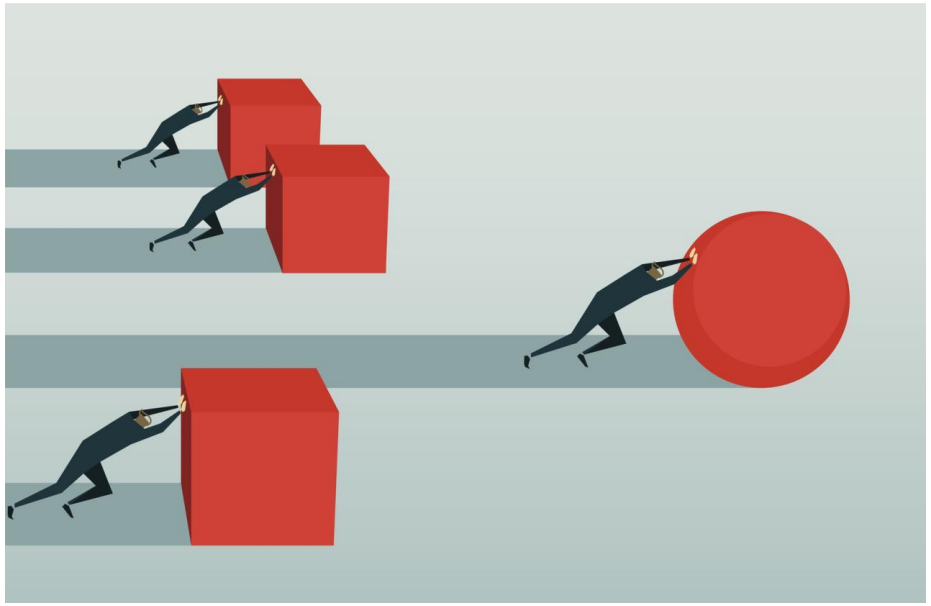
Competitive Advantage

Competitive advantage is what distinguishes a company from its competitors. It is the attribute of creating and capturing value better than your business competitors. It is the heart of a firm's performance in competitive markets.

Creating competitive advantage can be identified in the various elements of the value chain of the organization. Once it is identified, it can be used to improve it and upgrade it.



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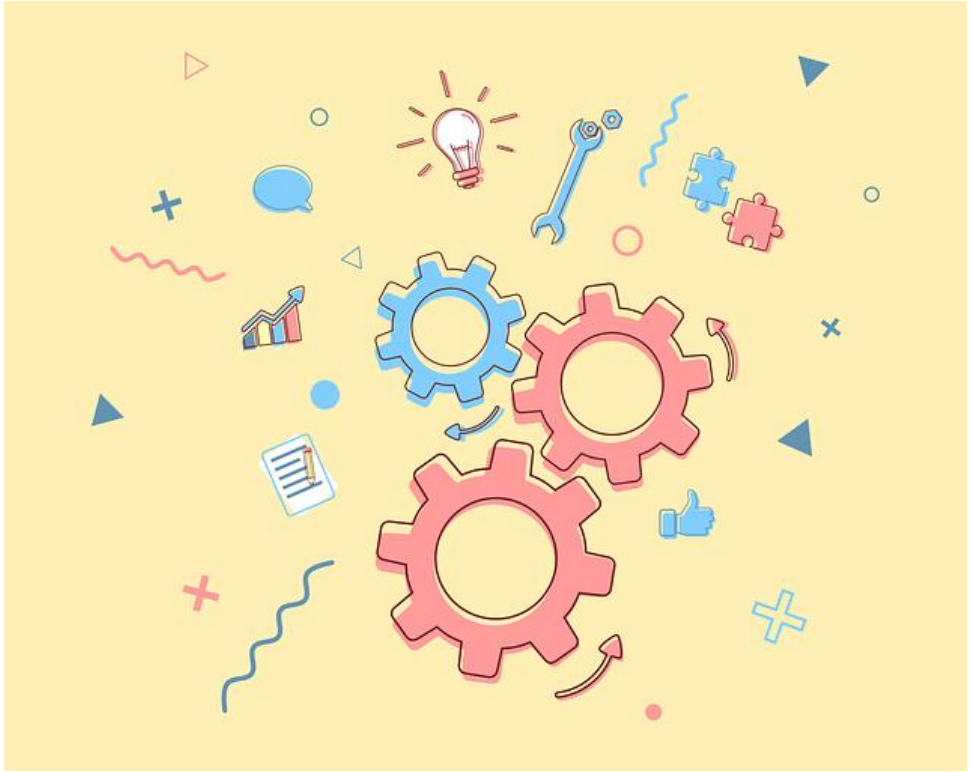
Competitive Strategies

There are two generic competitive strategies that can be applied in order to gain competitive advantage:

- **Cost Strategy.** Minimizing the costs incurred in providing value (product or service) to a customer or client.
- **Differentiation Strategy**. Offering product or service value to your customers that is unique or different than you competitors.



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Cost vs. Differentiation Competitive Strategy

Cost Strategy example

- A farmer uses sensor-based irrigation systems to save water and to plant seed. Thus, it has lower costs for inputs of production including irrigation and seed material than the competitors and can offer the same product at lower costs, at the same price and capture more value for the company.

Differentiation Strategy example

- A farmer produces organic produce, thus being different that its competitors which are non-organic producers.
- An input provider company produces super-seed using advanced selection and combining technology of seeds that are resistant to diseases.

Activity: Describe Your Experience

1. *What do you think is your competitive advantage and why?*
2. *What kind of competitive strategy are you using and why?*
3. *In what stage of the agricultural value chain can you create competitive advantage?*
4. *How can usage of technology help you in gaining competitive advantage?*

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Unit 2

Using Digital Technology for Gaining Competitive Advantage

Objectives

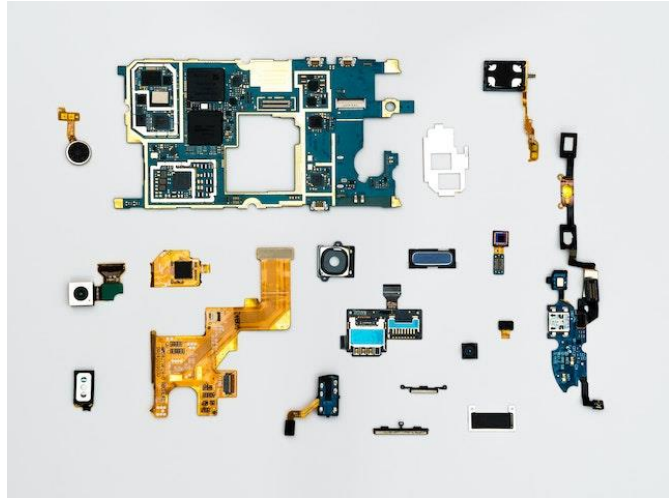
- ✓ Learn by examples how digital technology can create competitive advantage.
- ✓ Understand how digital technologies can create value in different stages of the value chain.
- ✓ Differentiate how digital technology can support competitive strategies in agriculture.

Sensor Technology for Overcoming Agricultural Value Chain Challenges (1)

Sensors are devices that detect particular inputs, such as light, motion, pressure, heat and react by converting them into a signal or other required representations if information output. A very efficient tool in agriculture, precision sensors do not only transmit data that helps farmers monitor but also improve their products and keep abreast of changes in the field and ecosystems.

Sensors may collect data on:

- Yields;
- Rainfall and irrigation;
- Atmospheric conditions such as temperature, humidity, and light levels;
- Soil properties such as moisture, pH, nutrient levels, and temperature;
- Vegetation cover (as an indication of crop health).



Source | Dan Cristian Pădureț, Pexels

Sensor Technology for Overcoming Agricultural Value Chain Challenges (2)

There are various **types of sensors** used in agriculture for overcoming value chain challenges:

- **Optical Sensors**

  They measure and record data about crops and soil in real time by using the reflectance of light shined on growing plants.

- **Electrochemical Sensors For Soil Nutrient Detection**

  They systematically monitor plant health and provide early diagnoses of disease and stress.

- **Mechanical Soil Sensors**

  They measure soil compaction or "mechanical resistance, i.e. detect the force used by the roots in water absorption and are very useful for irrigation interventions.

Sensor Technology for Overcoming Agricultural Value Chain Challenges (3)

- **Dielectric Soil Moisture Sensors**

  Measuring moisture based on the electrical property changes dependent on the moisture present.

- **Location Sensors In Agriculture**

  Usage of GPS satellite signals for precise positioning of agricultural machinery and work.

- **Airflow Sensors**

  Measure soil air permeability and allow increasing the quality of crops and yield.

Sensor Technology for Overcoming Agricultural Value Chain Challenges (4)

- Sensor technology does not create nor captures value by itself.
- It represents a tool that obtains data that, if used right, can result in-data based decision making that can decrease costs and increase profitability.
- The data used, can create and capture value primarily in the process of production, in-put supply and post harvesting in the agricultural value chain.
- One can have information about the soil real time quality, however if this information is not used on time (to intervene by irrigation or other proper disease treatment) or not understood by the user it will not result in value creation and value capturing.
- Sensor technology must be accompanied by other (software) analytical tools and professional knowledge so it can create value and synergies in the agricultural value chain.

Activity: Sensor Technology and Agricultural Value Chain

Read the example by clicking on the link bellow and answer the following questions:

1. *How can the described sensor technology be used, what data can be obtained and how that data can be used.*
2. *In what stage of the agricultural value chain, the value is created / captured?*
3. *What strategy can be supported by applying the described sensor technology (cost vs. differentiation)?*

click

Source | Meteobot logo

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Read the
answer t

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Meteobot is an automatic weather station that gives real-time information about the weather and soil conditions in the fields, specialized for precision farming. The station contains high-quality sensors for measurement of **rainfall, soil temperature and soil moisture, air temperature, wind speed, air humidity and leaf wetness**. It's equipped for a completely autonomous work and connected to a mobile app where the user can view current and historical data, as well as weather forecasts from the nearest stations. In addition, the weather data from the field can be automatically transmitted to **disease models**, which can generate forecasts for plant disease risks based on rain, temperature, air humidity, leaf wetness, solar radiation, etc. These models provide the forecasts by taking into account the conditions, which favor their occurrence and development. The models contain rules and algorithms, obtained from scientific research and many field trials. Another type of model is the **Meteobot Nitro** which is a precision fertilizing system which gives recommendations about the amount of nitrogen that is necessary to achieve the planned yield and grain quality with the minimum possible cost for nitrogen fertilizers. For automation of the agricultural process, Meteobot has introduced three types of models. The first one is the **Meteobot Hydro** model, which contains a controller for valves and pumps and automatically turns on the watering system based on the measured soil moister and rainfall. **Meteobot Silos** is a grain silos ventilation automation system. It turns fans on and off depending on air temperature and relative humidity. Finally, the **Meteobot Control** is a system for automation of fogging, sprinkling and cooling installations, frost protection machines, etc. It turns the installations on and off depending of air temperature and humidity, and the dew point.
You can read more by clicking on the link: https://meteobot.com/en/testimonials/

Source | Meteobot logo

Sensor Technology for Overcoming Agricultural Value Chain Challenges (5)

Value creation and optimization using sensor technology can be applied in various **value chain stages**:

- **Input supply.** Defining which fertilizers and seeds to use based on the data obtained for the soil quality. *Reducing cost* for improper fertilizer and seed selection based on the compatibility of the seed and fertilizer to the soil quality (determined by usage of the various sensors).
- **Production**. Data obtained from sensor technology can be used in the process of planting, irrigation, growing and harvesting, particularly *using the right amount of resources* at the *right timing*.

Sensor Technology for Overcoming Agricultural Value Chain Challenges (6)

- **Post harvesting.** By placement of various sensor technology in the process of transporting the producer will ensure that the right conditions are maintained in the transportation facilities, thus ensuring *sustained quality* throughout the value chain.
- **Trading**. Sensor technology can be applied in the quality grading activity within the trading stage of the value chain. By applying sensor technology measuring various data such as size, shape, resistance, (etc.) the sensors can *determine the quality of various agricultural products* and *avoid inconsistencies* of product quality in the process of buying and selling.
- **Warehousing.** Sensor can be applied for *ensuring quality* in the process of storing such as temperature, humidity and others in order to ensure that the adequate storing conditions are maintained.

Sensor Technology for Overcoming Agricultural Value Chain Challenges (7)

Value creation and optimization using sensor technology in various value chain stages:

- **Processing.** Sensor technology has various applications depending on the type of producer and the process of production used. In the process stage usage of sensors primarily affects optimizing the process of production, *increasing efficiency* and *ensuring quality control*.
- **Wholesale/export** and **Retail.** Within these value chain stages, sensor technology can be used primarily in the process of transporting and storing *for ensuring quality control*.

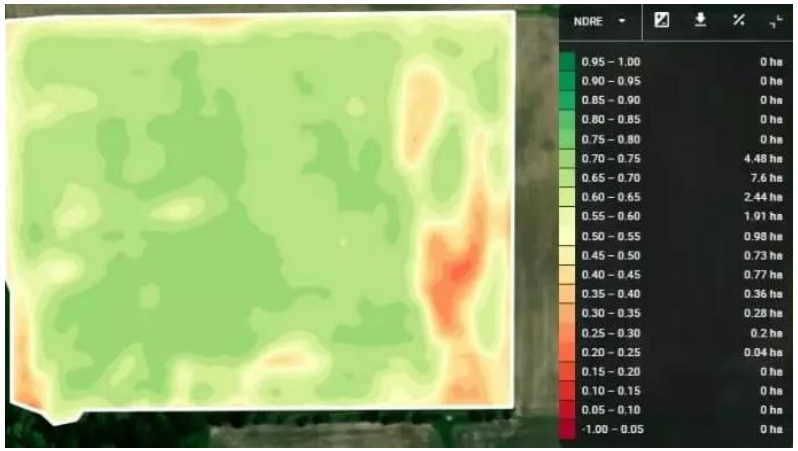
Sensor Technology can create competitive advantage by primarily decreasing costs, optimizing efficiency and quality control, in the value stage chain of input supply, production and post-harvest handling, thus supporting cost strategy.

It can also be applied in the process of input production and supply for developing products like seed with superior quality or new hybrid seed forms that will be used in the process of production. However, its current usage is more applied for cost leadership rather than differentiation.

Precision Farming for Overcoming Agricultural Value Chain Challenges (1)

Precision farming can create competitive advantage by decreasing costs, increasing production, optimizing efficiency and quality control, in the value stage chain of input supply, production and post-harvest handling, thus **supporting cost strategy**.

The competitive advantage by using precision farming is created primarily by **adequate field mapping** and **zoning** (**managing fields as separate areas rather than single block**). Thus, making **data-based decisions on mapped usage of input resources** (fertilizers, water, pesticides), **process resources** (mapped machinery work based on the exact location where needed.



The NDRE map shows that the vegetation in the field is gradually losing chlorophyll. The leaves turn yellow and dry out as all the juices are sent to fruits. It indicates the maturation of the crop and its soon harvesting.

Source | EOSDA NDRE Monitoring Software

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Precision Farming for Overcoming Agricultural Value Chain Challenges (2)

If analyzed properly the data can be used for:

- Real-time decision for maximizing current production;
- Determining what crops are adequate for the specific zone for future production;
- Applying variable-rate technology (VRT) allowing fertilizer, chemicals, lime, gypsum, irrigation water and other farm inputs to be applied at different rates across a field, without manually changing rate settings on equipment or having to make multiple passes over an area.

A corn field at the early season is divided into three zones: yellow zones (Zone 2) requires a standard amount of fertilizer, green zones (Higher vegetation) - reduced, red zones (Lower vegetation) - increased.

Source | EOSDA Crop Monitoring Software

Nanotechnology for Overcoming Agricultural Value Chain Challenges (1)

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. It can find various usage in agriculture including:

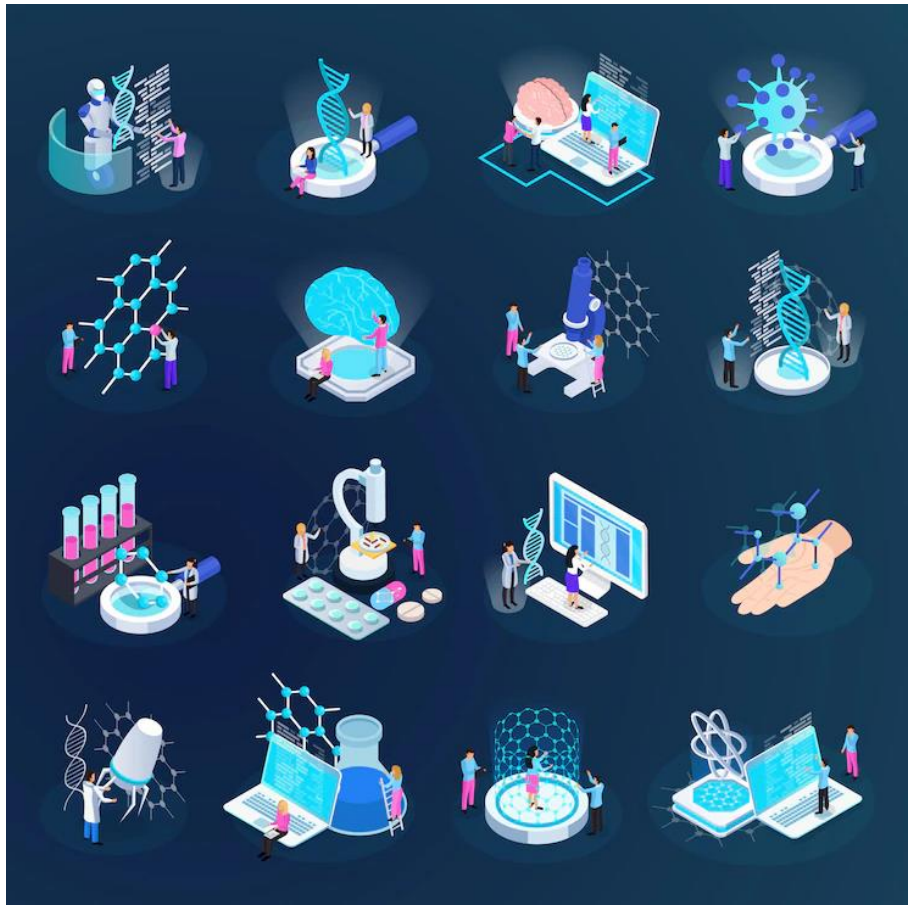
- **Nanoformulations** of agrochemicals for applying pesticides and fertilizers for crop improvement;
- **Nanosensors** in crop protection for the identification of diseases and residues of agrochemicals;
- **Nanodevices** for the genetic engineering of plants; plant disease diagnostics; animal health, animal breeding, poultry production; and postharvest management.
- Nanotechnology uses include **nanoparticle-mediated** gene or DNA transfer in plants for the development of insect-resistant varieties, food processing and storage, nanofeed additives, and increased product shelf life.

Nanotechnology for Overcoming Agricultural Value Chain Challenges (2)

Nanotechnology can be applied in **all** stages of the agricultural value chain

It can be applied to support both differentiation or the cost strategy of the company:

- **Cost**. Applying nano-sensors in crop protection for the identification of diseases and residues of agrochemicals;
- **Differentiation**. Nanoparticle-mediated gene or DNA transfer in plants for the development of insect-resistant varieties.



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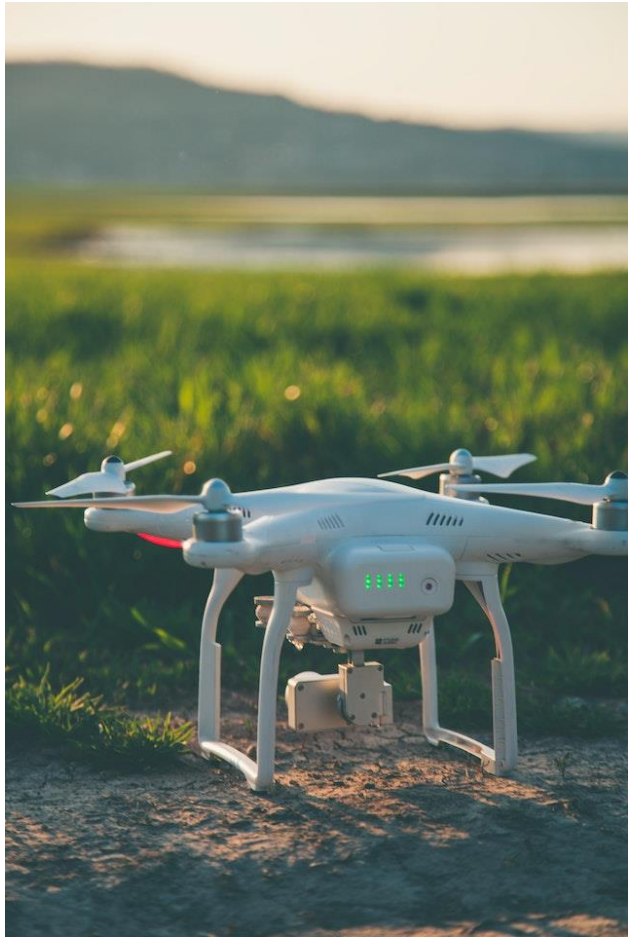
Usage of Drones for Overcoming Value Chain Challenges (1)

Drones can create and capture value in the input supply & production stage of the agricultural chain through:

- Obtaining field information data (when used with various sensor technology);
- Field mapping and imagery required for precision farming;
- Conducting primary activities such as production through planting/seeding , spraying and monitoring (health) quality;
- Conducting supporting activities such security ensuring.



Source Peter Fazekas, Pexels

Usage of Drones for Overcoming Value Chain Challenges (2)

Usage of drones creates competitive advantage and supports a cost leadership strategy through:

- Cutting agricultural costs (i.e., for planting and spraying by labor force);
- Boosting efficiency and productivity (i.e., provide data which zones specifically require treatment such as irrigation and disease control);
- Time saving.

Source Quang Nguyen Vinh, Pexels

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Usage of Drones for Overcoming Value Chain Challenges (3)

Usage of drones creates competitive advantage and supports a **cost leadership strategy** through:

- Cutting agricultural costs,
- Boosting efficiency,
- Improving productivity,
- Time saving.

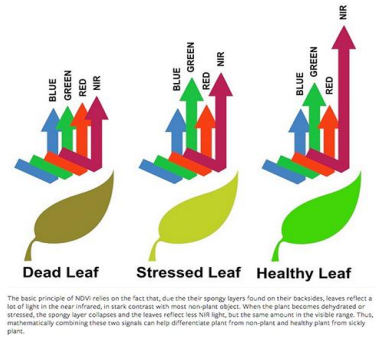
Source Tom Fisk, Pexels

Activity: Usage of Drones for Overcoming the Value Chain Challenges

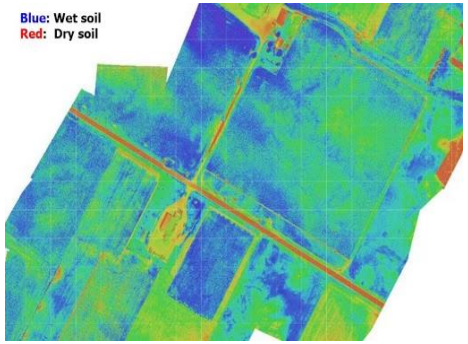
Click on the three example descriptions and discuss the following for each case:

1. *How is value created/captured?*
2. *What competitive strategy can be applied in each case?*
3. *How can you replicate the use the technology described in your business?*

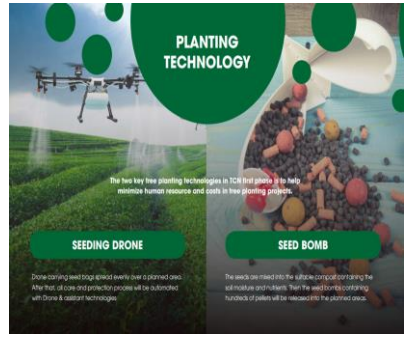
Click 1



Click 2



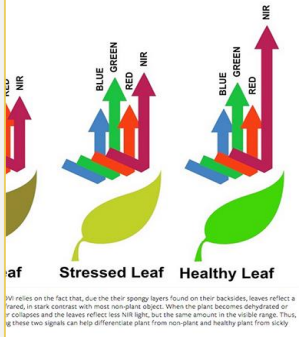
Click 3

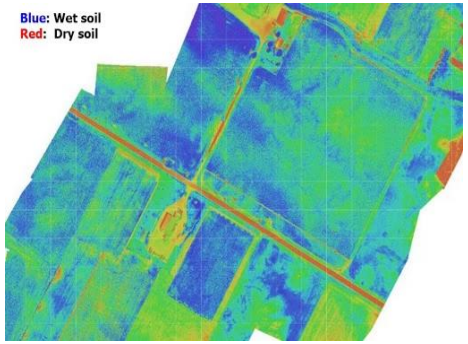


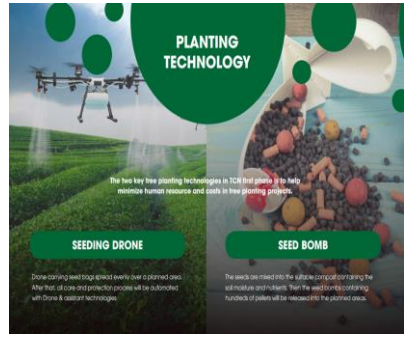
Activity: Usage of Drones for Overcoming the Value Chain Challenges

Click on the three example descriptions and discuss the following for each case:

Click 1 | Click 2 | Click 3







Plant health monitoring is one application for drone imaging that has already been widely used with remarkable effectiveness. The Normalized Difference Vegetation Index (NDVI), a specialized imaging tool used by drones, uses precise color data to assess the health of plants. This enables farmers to keep an eye on crops as they develop in order to address any issues as soon as they arise in order to save the plants. Simply said, this graphic demonstrates how NDVI functions.

Crop health is also monitored by drones equipped with "normal" cameras. To monitor crop growth, density, and coloration, many farmers currently utilize satellite images. However, accessing satellite data is expensive and frequently less efficient than closer drone surveillance.

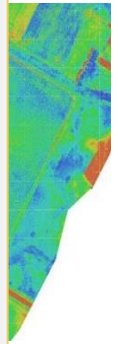
Activity: Usage of Drones for Overcoming the Value Chain Challenges

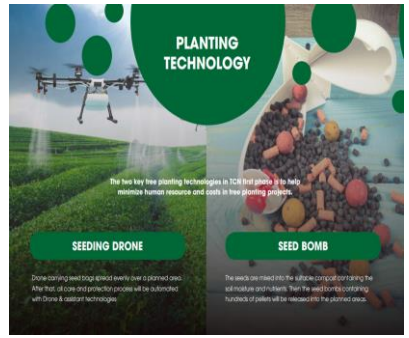
Click on the three example descriptions and discuss the following for each case:

1. *How is value created/cap*
2. *What competitive strateg be applied in each case?*
3. *How can you replicate th the technology described business?*

Click 1 Click 2 Click 3

The condition of the field and the health of the soil both are monitored via drone field monitoring. Drones can precisely map the field, providing elevation data that enables producers to identify any field abnormalities. The ability to determine drainage patterns and wet/dry patches, which enable more effective watering practices, is facilitated by knowledge of field elevation. Utilizing improved sensors, several sellers and service providers of agricultural drones also provide soil nitrogen level monitoring services. This makes it possible to apply fertilizers precisely, minimizing troublesome growth areas and enhancing soil health for years to come.





Activity: Usage of Drones for Overcoming the Value Chain Challenges

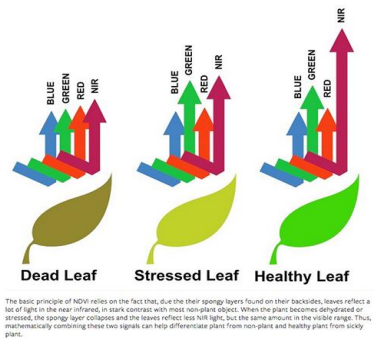
Click on the three example descriptions and discuss the following for each case:

1. *How is value created/captured?*
2. *What competitive strategy can be applied in each case?*
3. *How can you replicate the use the technology described in your business?*

Click 1

Click 2

Click 3



Ten drones are capable of plating four million trees a day. Automated drone seeders are mostly used in the forestry industry right now, but they have the potential for more widespread use on the horizon. With the help of drones, one can reach the areas without endangering workers.

Please check out the article from Agrodronas about aerial seeding with their drones https://agrodronas.lt/en/agricultural-services/aerial-seeding

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Usage of Drones for Overcoming Value Chain Challenges (4)

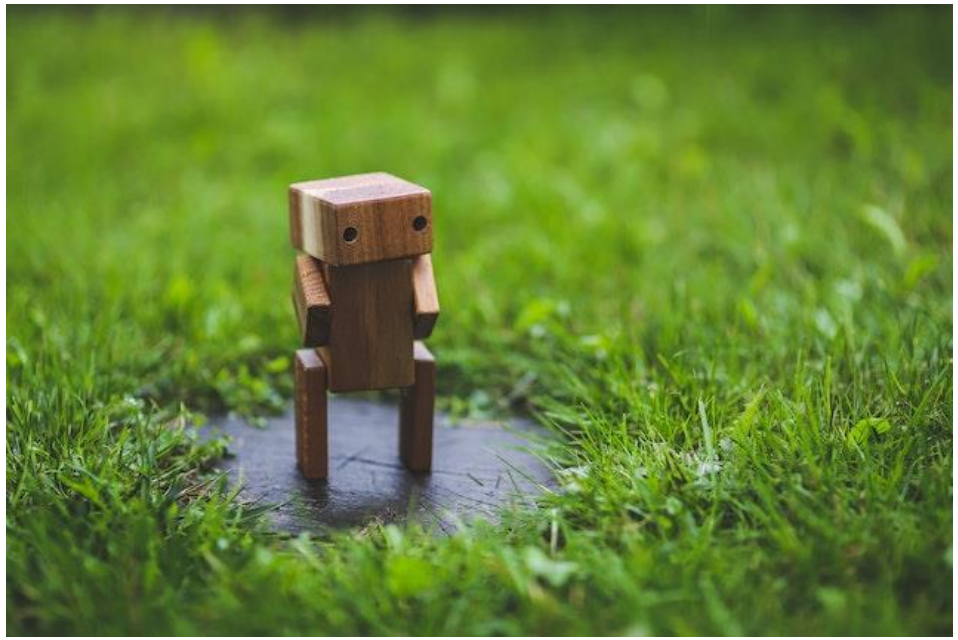
- "In Japan, scientists created insect-size drones capable of pollinating flowers in the same manner as bees. The drones use GPS to select the optimal flight path for pollinating all plants in a given area. As the world faces a crisis in dwindling bee populations, drones may very well become a replacement pollinator".
- "Only a few years ago, in early 2020, a team in Canada announced the development of a drone used for planting trees. Using a pressurized air cannon, the team successfully fired small pods of seeds into the ground. The group estimates a single drone operator would be capable of planting 100,000 seed pods per day, with the goal of planting one billion trees by 2028".
- "Drones have been used to help reduce herbicide use by 52% in a **Brazilian soybean field**. With a flight time of up to 90 minutes, the senseFly eBee X allows up to 500 hectares (1,200 acres) to be mapped, providing high quality images of fields. Accurate images of the landscape were processed and analyzed using **xarvio FIELD MANAGER** to automatically detect areas with weed infestation. The team quickly and efficiently gained access to the results and classification of weed infestation level within hours, with detailed accounts of weed thresholds. The results generated by the fleet of eBee X fixed-wing drones using xarvio FIELD MANAGER processing technology helped to generate herbicide application maps that saved, on average, 52% of herbicides for farmers in the 2018/19 season in Brazil".

Autonomous Robots/Machines for Overcoming Value Chain Challenges (1)

Agricultural robots are specialized articles of technology that are assisting or replacing farmers with a wide range of operations. They are capable to analyze, contemplate, and carry out a multitude of functions, and they can be programmed to grow and evolve to match the needs of various tasks.

The most common usages of robots in agriculture are:

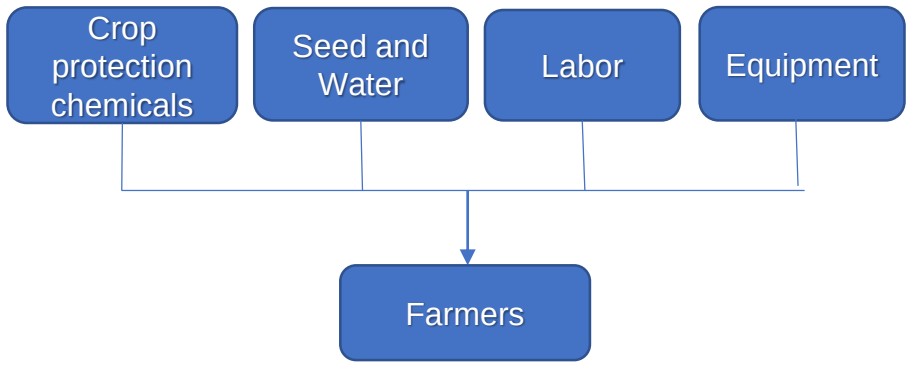
- Harvesting and picking;
- Weed control;
- Autonomous mowing, pruning, seeding, spraying and thinning;
- Phenotyping;
- Sorting and packing;
- Utility platforms.



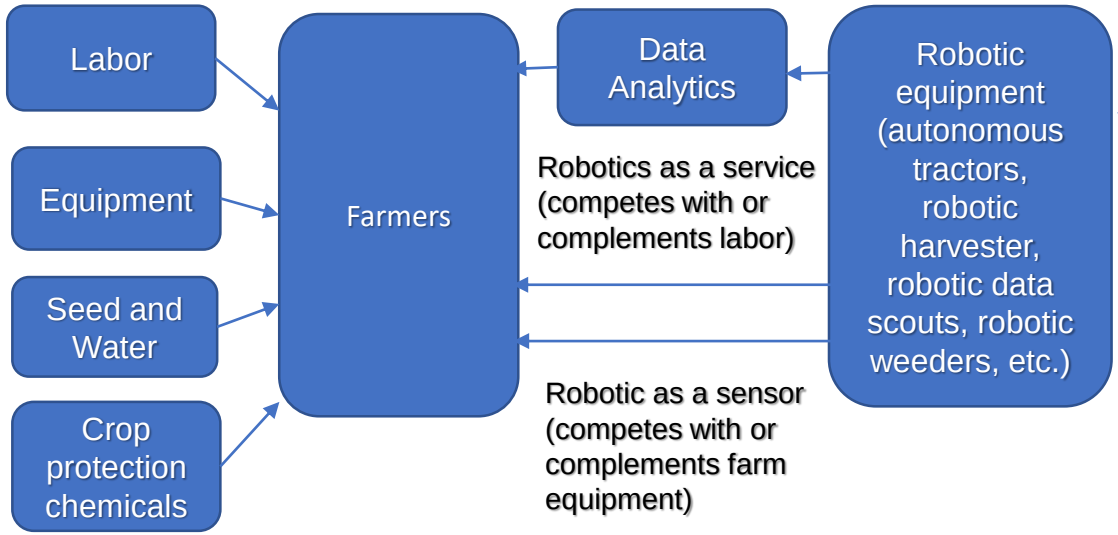
Source *Kaboompics.com*, Pexels

Autonomous Robots/Machines for Overcoming Value Chain Challenges (2)

Agricultural robots are replacing usage of labor in both primary production and supporting activities. Check the today vs. emerging value chain bellow:



Today's value chain



Emerging value chain

Autonomous Robots/Machines for Overcoming Value Chain Challenges (3)

- Autonomous robots/machines can be applied and in **all** stages of the agricultural value chain
- They can be applied to support primarily the cost strategy of the company
- It is mostly used in the stage of production to increase efficiency, save resources and increase crop quality.
- Check the examples in the following slides of usage of autonomous robots/machines for overcoming value chain challenges.

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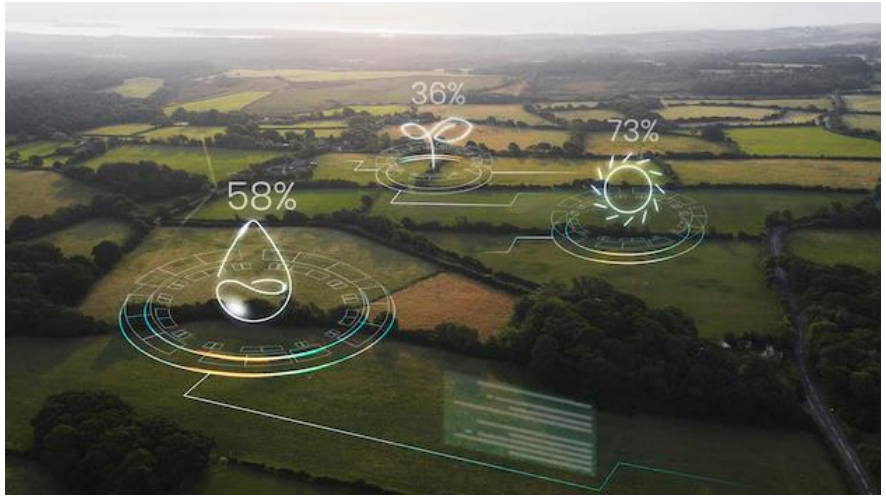
Internet of Things for Overcoming Agricultural Value Chain Challenges (1)

Agricultural **Internet of Things (IoT)** refers to a network in which physical components, such as animals and plants, environmental elements, production tools, and various virtual "objects" in the agricultural system, are connected with the internet through agricultural information perception equipment under certain protocols to perform information exchange and communication.



IoT in Agriculture can help creating and capturing value in the agricultural value chain by:

1. Improved data collection driving farming efficiency
2. Resource optimization
3. End-to-end production control
4. Reduced wastage and cost management
5. Cleaner process reducing the carbon footprint
6. Process automation
7. Accentuated product quality

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Source | Designed by Freepik

Internet of Things for overcoming agricultural value chain challenges (2)

Creation of Value using Internet of Things

IoT in Agriculture can be applied in multiple stages of the Agricultural Value chain. It can primarily bring value through:

- Process and cost efficiency;
- Increased product quality;
- Data-based decision making.

Read the example of applying IoT at a wholesale organic produce company by clicking on the link:

Internet of Things for overc

Creation of Value using Internet

IoT in Agriculture can be applied
stages of the Agricultural Value c
primarily bring value through:

- Process and cost efficie
- Increased product qual
- Data-based decision ma

Water Bit Example Farmers spend countless hours each month driving to their different fields, checking moisture levels and turning on and off irrigation valves. This costs time, money and can be very water and labor inefficient. However, with WaterBit's smart, solar-powered irrigation solution, growers don't even have to leave their pickup truck to get precise irrigation to crops - they can do it using our cloud-connected devices and dashboard. WaterBit is a smart irrigation company that uses IoT technology to make it easy to remotely and precisely monitor and irrigate fields. The core of our technology is the proprietary WaterBit Carbon node.
Smaller than a lunchbox, Carbon transmits data with long-range radio technology and is powered by a tiny solar cell - no batteries, which means no maintenance! It is paired with soil moisture probes and the WaterBit Pressure Sensor for monitoring; our Block Valve Controller to turn on and off waterflow; our Flow Meter for real-time data on water flow and usage. Using our online Dashboard, growers can see what's happening in their fields 24/7 and deliver exactly the right amount of water at the right time--all without wasting time or gas driving to field-to-field. This precise irrigation also leads to improved water efficiency, less leaching and run-off, and can improve crop yield and quality.
(Source: https://agtechfinder.com/directory/waterbit/waterbit-automated-irrigation-solution)

Activity: IoT for Overcoming Agricultural Value Chain Challenges

Please watch the video. Discuss your views following the questions:

1. *How IoT creates value for the specific agricultural user?*
2. *In which stage of the agricultural value chain the value is created?*
3. *Can it be applied on different stages?*
4. *Can you think how IoT can be applied in your case?*

Video external source link:
https://www.youtube.com/watch?time_continue=96&v=mAawssBP2ng&embeds_referring_euri=https%3A%2F%2Fhubblecontent.osi.office.net%2F&source_ve_path=MjM4NTE&feature=emb_title

Internet of Things for Overcoming Agricultural Value Chain Challenges (3)

- IoT can be applied and can integrate **all** stages of the agricultural value chain.
- IoT can be applied to support both differentiation or the cost strategy of the company.
- It is mostly used in the stage of production to increase efficiency, save resources and increase crop quality.
- Its deployment is costly and requires specific environment conditions, digital literacy among farmers, modern infrastructures and wireless internet coverage.

You can read more on the deployment of IoT technologies in agriculture and its challenges on this link.

Big Data for Overcoming Agricultural Value Chain Challenges (1)

In agriculture big data is viewed as a combination of technology and analytics that can collect, compile and process novel data in a more useful and timely way to assist decision making. The usage of big data can be beneficial for any specific segment or area, improving forecasting and operational efficiency or it can be used to provide information for the agricultural industry as a whole.

Source Arie van Ravenswaay, Pexels

Big Data for Overcoming Agricultural Value Chain Challenges (2)

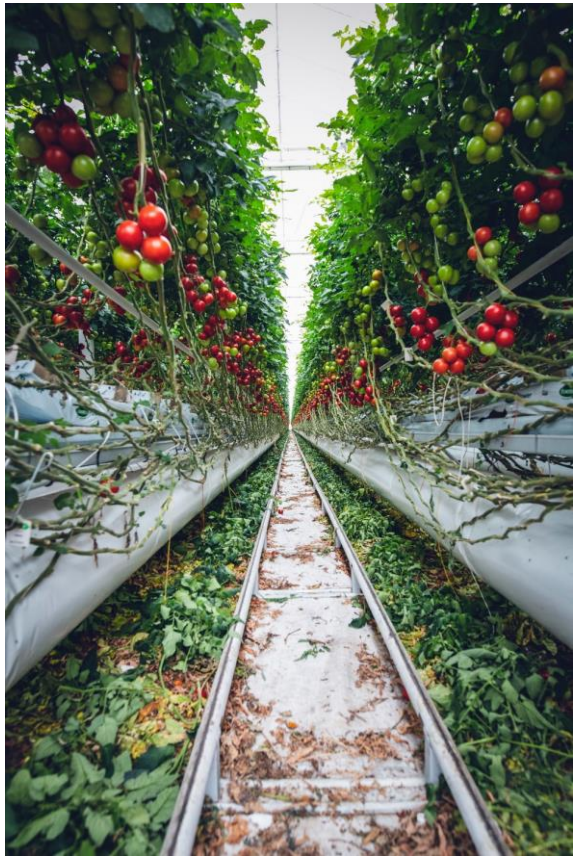
Big data can be analyzed for insights that lead to better decisions that drive **competitive advantage** and **add value** to the final product.

- **Yield prediction** is defined as a technology and algorithms utilized for collating and analyzing information on weather, chemicals, vegetation, and more to make the right decision for growers which makes the **production** process easier.
- **Pesticides use** is considered an issue due to its side effects on the ecosystem. Big data allows provides farmers with the opportunities for smart and precise pesticides application, allowing farmers to make better decisions with the pesticide application. Such monitoring helps food producers to avoid the overuse of chemicals.

Source, ThisIsEngineering, Pexels

Big Data for Overcoming Agricultural Value Chain Challenges (3)

- **General management of the supply chain** is one of most important fields in which analytics are used. Automated systems can aid in the optimization of fleet management and deliveries between different locations when it comes to food processing and production, taking into consideration the unique needs of each plant and simplifying the supply of the products. Big data can be used to improve the supply chain's operation at every stage.
- **Food safety. Big Data offers** both preventative and reactive solutions to food safety. The spices we add to our dishes and "the salmon" we put on our plate aren't necessarily from the country in which we reside, which is why the food science sector has optimized transportation and communication systems through big data and technology.



Source | Markus Spiske, Pexels

Big Data for Overcoming Agricultural Value Chain Challenges (4)

Big Data may integrate, process and analyze information from **all** stages of the agricultural value chain.

It can be applied to support both differentiation or the cost strategy of the company:

- **Cost.** Collection, processing and real time data-based decision for reducing waste of input material in the process of production.
- **Differentiation.** Collection, processing and analyzing real time data can result in combining/modifying different seeds under set-up favorable conditions in order to produce new or hybrid agricultural produce with superior characteristics. (more nutritious, more resistance to weather etc.

Artificial Intelligence for Overcoming Value Chain Challenges (1)

AI can help in the process of creating and capturing value in such as:

- **Monitoring soil health**
  AI systems can conduct chemical soil analyses and provide accurate estimates of missing nutrients.
- **Protecting crops**
  AI can monitor the state of plants to spot and even predict diseases, identify and remove weeds, and recommend effective treatment of pests.
- **Feeding crops**
  AI is useful for identifying optimal irrigation patterns and nutrient application times and predicting the optimal mix of agronomic products.
- **Harvesting**
  With the help of AI, it's possible to automate harvesting and even predict the best time for it.

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Artificial Intelligence for Overcoming Value Chain Challenges (2)

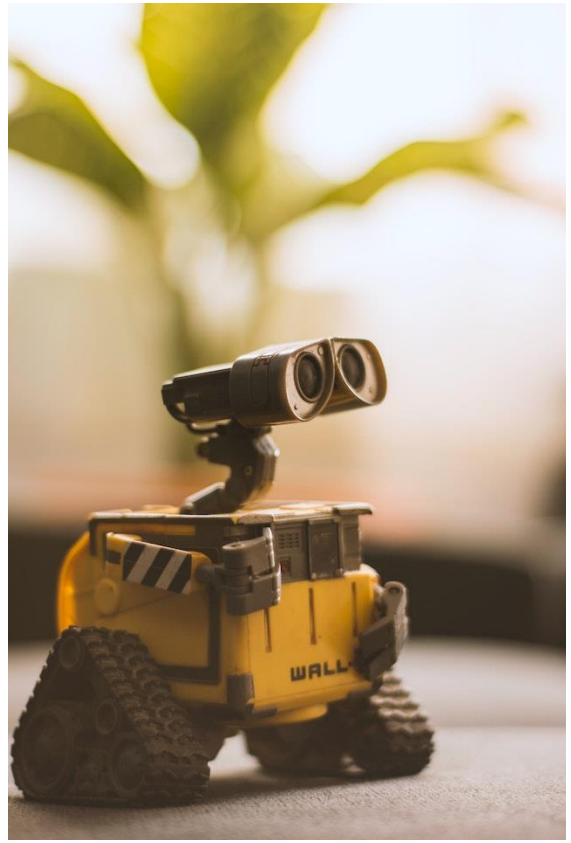
AI and Machine Learning add additional value to the existing data-management systems by conducting accurate estimations and predictions based on historical data.

By incorporating AI in robots and data-management systems autonomous real-time decision making can be conducted, thus saving time, increasing efficiency, provide accurate future estimations and predictive analytics.

Real-time decision making, future estimations and predictive analytics are the biggest benefit AI provides.

Artificial intelligence in Agriculture can be applied in multiple stages of the Agricultural Value chain it can primarily bring value through:

- Cost savings,
- Solving labor shortage,
- Improving the quality of the product.



Source | Lenin Estrada, Pexels

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Blockchain for Overcoming Value Chain Challenges (1)

Blockchain technologies can track and store all kinds of information regarding plants, including the quality of the seed, how crops grow, and even create a record of a plant's journey once it leaves the farm. This data can increase the transparency of supply chains and reduce issues related to illegal and unethical production.

Blockchain technology creates transparency between all parties involved and facilitates the collection of trusted data. Blockchain can record every step of a product's chain of value, from product creation to disposal. Reliable data on agricultural processes is invaluable for the development of data-driven facilities and insurance solutions to make farming smarter and less vulnerable.

Blockchain farming and distributed ledger technology (DLT) have the potential to increase efficiency, transparency, and trust throughout agricultural value chain.

Blockchain for Overcoming Value Chain Challenges (2)

The blockchain can create and capture value in the agricultural industry by:

- Tracking a product along its entire path from farmland to store shelf;
- Improving food safety and eliminating counterfeit items;
- Providing farmers and businesses with access to agricultural financial services;
- Generating smarter market data for better decision-making with data science in agriculture;
- Legally proving certifications to relevant authorities.

Unit 3

Creative and Problem-Solving Skills for Initiating Technological Change in Agriculture

Objectives

- ✓ Learn why creative and problem-solving skills are important for initiating technological change in agriculture.
- ✓ What are the benefits that creative and problem-solving skills are bringing to perspective farmers.
- ✓ Gain new insights.

Creative Thinking and Problem-Solving Skills

Creativity is defined as the tendency to generate or recognize new and original ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others.

Creative thinking is the ability to consider something in a new way through a different perspective.

Problem solving can be simply defined as an action of defining a problem or determining the cause of the problem followed by identifying, prioritizing, and selecting alternatives and implementing a solution.

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Why Creative Thinking and Problem-Solving Skills are Important? (1)

In the context of embracing (digital) technology in agriculture there are various aspects why creative thinking and problem-solving skills are important:

- Technological change is not always determined by the open opportunities and available capacities but by being open-minded for embracing changes and accepting new challenges;
- They provide creative solutions to complex problems;
- They help adapting to change;
- They stimulate innovation and growth.

Source | Greta Hoffman, Pexels.com

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Why Creative Thinking and Problem-Solving Skills are Important? (2)

Considering technological change can be initiated by:

1. **Having a problem*:*** The costs and waste of inputs to agricultural production such as water for irrigation and seed are high for obtaining the required yield of agricultural produce.
2. **Need for adaptation**: The climate conditions in the geographical area of the farm are changing rapidly, thus the farmers need to adapt the process of production to bear with the harsh conditions.
3. **Need for innovation**: Hybrid engineering for obtaining new types of seedlings, resistant to certain disease.

Source | Nadezhda Moryak, Pexels.com

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Why Creative Thinking and Problem-Solving Skills are Important? (3)

Embracing advanced digital technologies in modern agriculture is already happening. It will become a necessity in the future and farmers will need to adapt sooner or later.

Source | icon0.com, Pexels.com

Creative Problem Solving

Having a problem and adapting to a change are closely related. In certain cases, the problem is yet not completely defined. Creative problem solving is e less-structured method that determines potential solutions regardless of that and encourages open-ended solutions and instills creativity.

The following are the 4 generic principles for creative problem solving:

1. **Balance between divergent and convergent thinking**. Divergence thinking generates ideas in response to a problem, convergence narrows them down in a short list leading to concrete solutions.
2. **Label Problems as Questions**. By modifying the problem into question, you are shifting the focus from obstacles/challenges to solutions.
3. **Avoid Judgements of ideas**. Usually, judgement happen during brainstorming. However, judgements must be avoided and concerns over ideas may be explored only after exploration and the development of an idea.
4. **Switch to "Yes, And" instead of "No, But".** Negative context, expression and words discourage creative thinking. Use positive language to instill openness, creative and innovative ideas.

Design Thinking

While creative problem solving is less structed process, **design thinking** is more organized approach leading to innovation and development of new products/processes/solutions.

Check Module 3 for more details on the Design Thinking methodology!

Activity: Try to solve a problem.

1. *Think of a problem you are trying to solve within your business/activity.*
2. *Use the creative problem solving or design thinking methodology to approach the issue and to define final solutions to the problem.*
3. *Think about solutions that involve usage of digital technologies.*

Source | Eva Bronzini, Pexels.com

Are You Prepared to Build a Value Chain?

We‘re at the end of Module 4!
But before we finish, there are some closing questions where you can test your knowledge!

Don‘t worry; it won‘t be difficult if you have followed the course!

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Check your knowledge!

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According to Porter's value chain the primary activities include:

Only one answer is correct!

A. Human resource management

B. Infrastructure

C. Operations

D. Procurement (purchasing)

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Creating value in the agricultural value chain can occur in:

Only one answer is correct!

A. Production stage

B. Post-harvesting stage

C. Processing stage

D. All of the above

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The blockchain can create and capture value in the agricultural industry by:

Only one answer is correct!

A. Predicting the best time for harvesting

B. Improving food safety and eliminating counterfeit items

C. Providing farmers with opportunities for smart and precise pesticide use

D. Reducing the carbon footprint

The Internet of Things can be applied in all stages of the value chain, but in which stage is it mostly used?

Only one answer is correct!

A. Production

B. Retail

C. Trading

D. Processing

Usage of drones creates competitive advantage and supports a cost leadership strategy through:

Two answers are correct!

A. Cutting agricultural costs

B. Increased product quality

C. End-to-end production control

D. Time saving

Offering product or service value to your customers that is unique or different than you competitors is the cost strategy used to gain competitive advantage

False

True

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Sensor technology must be accompanied by other (software) analytical tools and professional knowledge in order to create and capture value.

False

True

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Nanotechnology can be applied to support both cost and differentiation strategy.

True

False

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About the Project

AgriSkills – Entrepreneurial Skills for Digitalization of Rural Agriculture is a European project funded by Erasmus+ Program. Our goal is to raise awareness about the digital transformation in agriculture and to provide a training program for entrepreneurial skills in digital, precision and smart farming. Digital agriculture, smart and precision agriculture are important to improve the sustainability of the food industry.

The results of the project stimulate the awareness, knowledge, and skills of learners and trainers in the field on the issues of digitalisation and digital farming:

- *Survey* on the real needs in skills, knowledge and competence development.
- *AgriSkills Training Program.* Developed training program organised like a "guided tour" through the whole range of digital opportunities in agriculture and introducing the needed skills and competencies implemented into a complete training.
- *AgriSkills Reference Catalogue* with collected good practices. AgriSkills will showcase many inspiring initiatives as practical examples, technologies and business models that can be applied in practice.
- *E-learning Platform* as a completely new training approach for digital farming topics for our target groups. Link to the platform: *https://training.agriskills40.com*.

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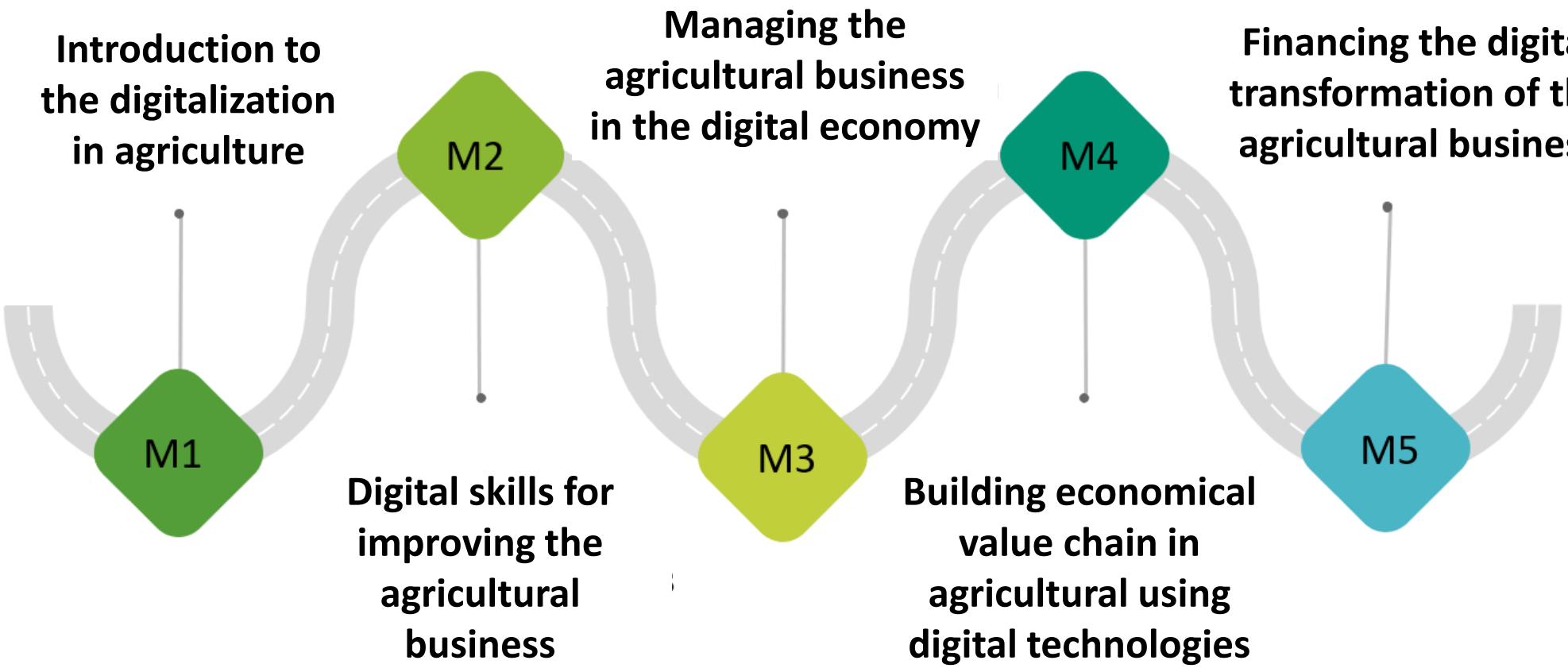
AgriSkills Learning Roadmap



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Congratulations!
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