



# **Fostering Digital Transformation of SMEs: A Four Levels Approach**

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# Introduction



- **Digital technologies** bring changes to different sectors that requires businesses to **transform** in order to meet the **current demand**
- Examples :
  - Internet of things (IoTs)
  - additive manufacturing
  - big data, artificial intelligence
  - cloud computing
  - augmented and virtual reality

- This breeds the era of **Industry 4.0**
- **SMEs** could **implement** it in their business **faster and better** as they are more:-
  - Flexible
  - Decentralize
  - Small customer base
  - Optimized decision making
    - Which are more affordable for SMEs.





- **Industry 4.0** involves fundamental **changes** in
  - **configuration** and execution of business processes
  - **operational** routines
  - **organizational** capabilities

- This makes it **harder** for SME to **transition** into Industry 4.0 as they may be **limited** in terms of:-
  - resources
  - cognitive assets
  - business environment
    - Human resource
    - Transaction capacity
    - Decision support





This paper **analyzed** digital transformation in SMEs undergoing the **Smart Districts 4.0** project in **Apulia, Southern Italy**.

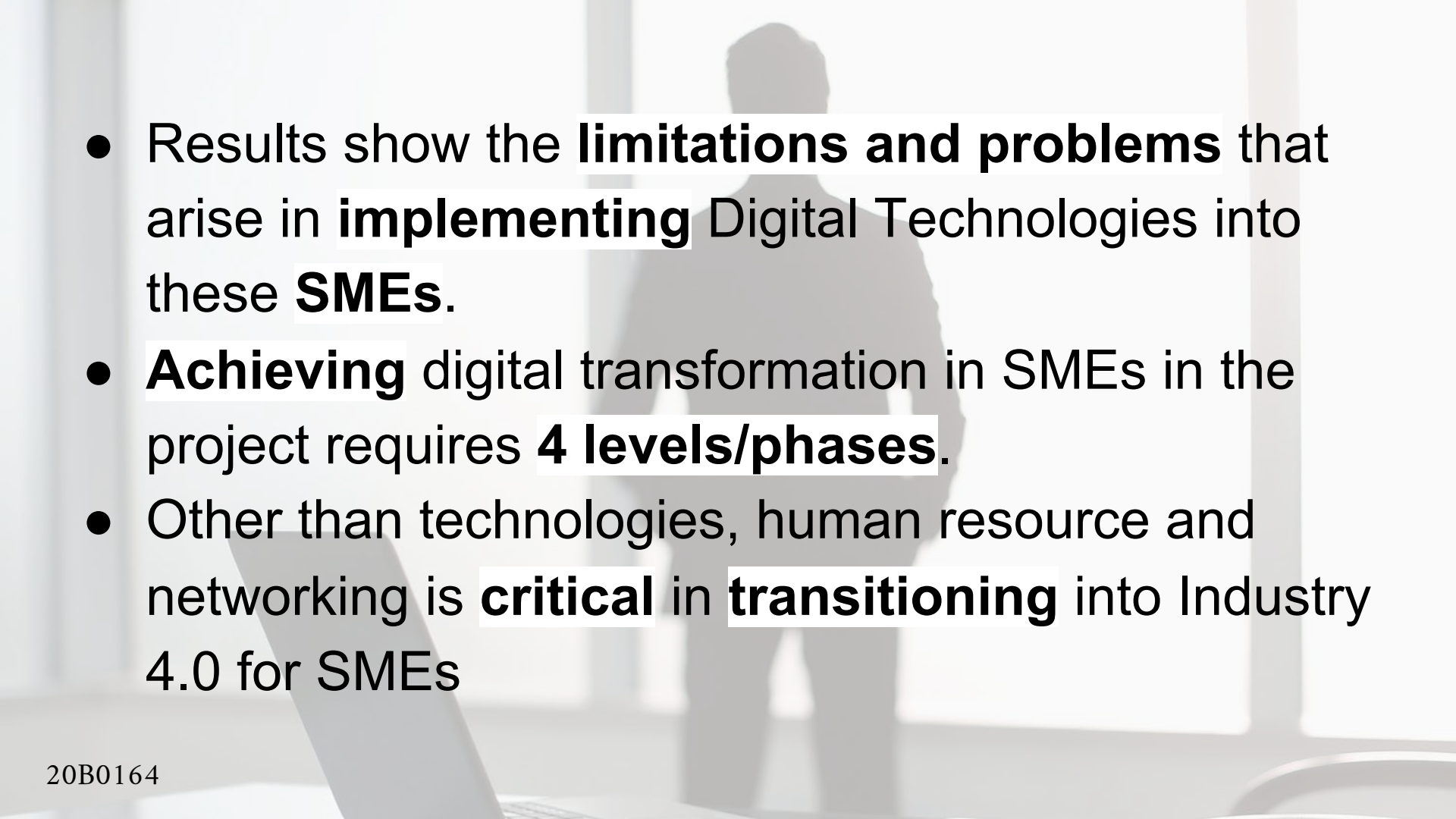
- It also tries to see on how to **capture SMEs interest** in **accepting** and implementing **Digital Transformation**



The SMEs are **divided** into three business sectors:-

- Agri-Food
- Clothing-Footwear
- Mechanics-Mechatronics



- 
- Results show the **limitations and problems** that arise in **implementing** Digital Technologies into these **SMEs**.
  - **Achieving** digital transformation in SMEs in the project requires **4 levels/phases**.
  - Other than technologies, human resource and networking is **critical** in **transitioning** into Industry 4.0 for SMEs



# Literature Background

# Digital

**Transformation**  
Repeating business and non business process which is made up of **additional** and **innovative changes**.

Allows:

- **Automatization** of business process.
- Making current **logistical** and **administrative** business **more efficient**.

Helps the **business** to be more **competitive**(with the market).



**Despite** its technological profile, it **requires** both of these **abilities**, in order to **implement** the process into the **organisation**, which are:

- Ability to **adapt** current business **model** to new **technologies**.
- Ability to **lead** technological **innovations** in the socio-technical **environment**.



# Digital Transformation & Industry 4.0

An illustration of two small, stylized human figures pushing a large, light-grey, three-dimensional rectangular block. The figures are positioned at the bottom left and bottom right of the block, appearing to exert effort to move it. The background is a light, hazy sky with soft clouds.

- With the **expanding** scenario of digital **transformation**, the German government **launched** the concept of **industry 4.0** as an **initiative**.
- This was done with a **method** of **precaution** towards long-term **competitiveness** of manufacturing industry.

# Industry 4.0

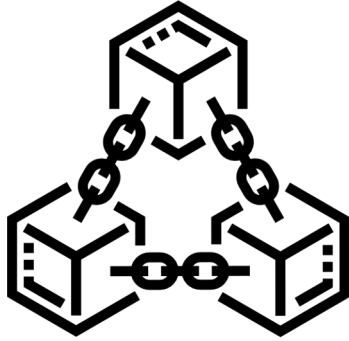
Also known as

- Industrial Revolution 4.0
- IR 4.0
- Fourth Industrial Revolution.

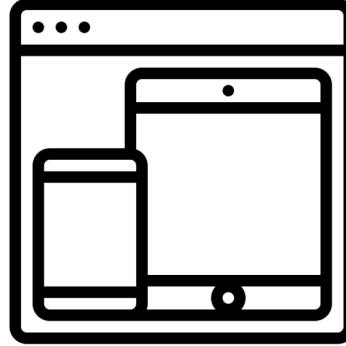
Described as a new **industrial scenario** where **multiple**, different emerging digital transformation, **strengthened** by Internet of Things (IoT), **allows** for **cyber-physical and intelligent systems**.

This in turn can create **value** for the industrial **activities**.

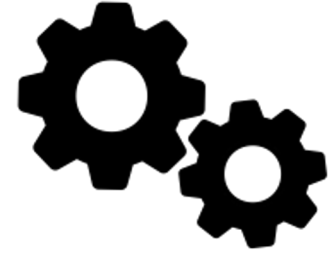
# Internet of Things



The IoTs can be summarized up as physical objects that are **connected** to the internet, where they are **sharing and collecting data**.



Due to the existence of **digital platforms**, existing industries face a transformation to a **digitalized era**.



All sorts of machines, devices, products can be **associated** together, where they can **adapt** themselves and be **flexible** to take immediate action to any **market change**.

# IoT and Its Influence in Industry 4.0

By **integrating** the physical(objects) and the DT in industrial manufacturing, Industry 4.0 focuses at establishing intelligent, self-regulating and **interconnected** industrial value creation.





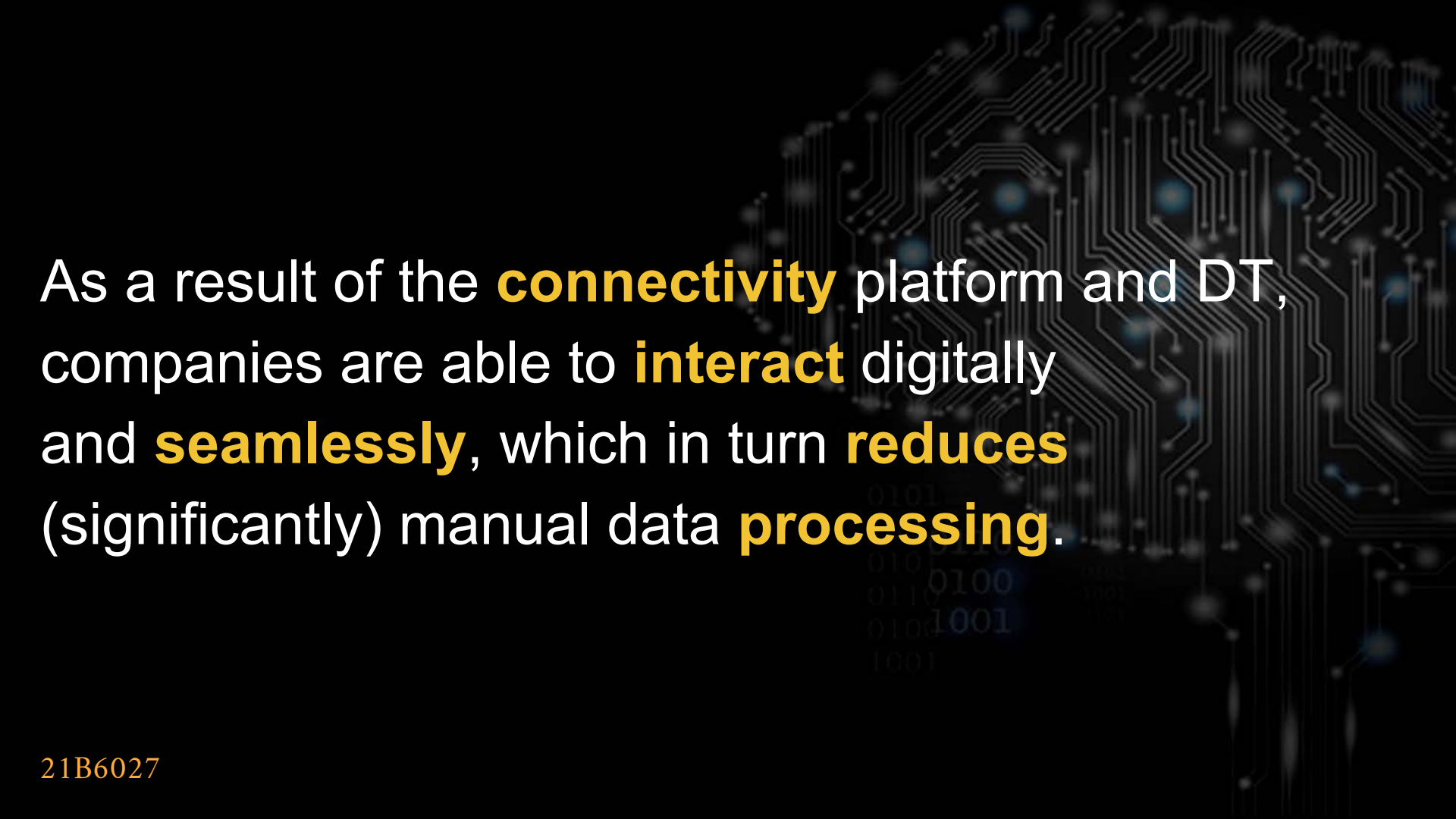


The large **adoption** of DT for companies' business **process** allows for the availability of **smart** machines, storage systems and production facilities, which can **communicate** with one another, initiate actions and mutually **control** each other.

As a **result** of IoT in the companies, there are technological **leaps** in:

- Engineering
- Manufacturing
- Material Flow
- Supply Chain Management





As a result of the **connectivity** platform and DT, companies are able to **interact** digitally and **seamlessly**, which in turn **reduces** (significantly) manual data **processing**.

# Fundamentals for Digital Transformation

Three elements of digital transformation has been described in the article, where they are said to be the foundations for digital transformation.

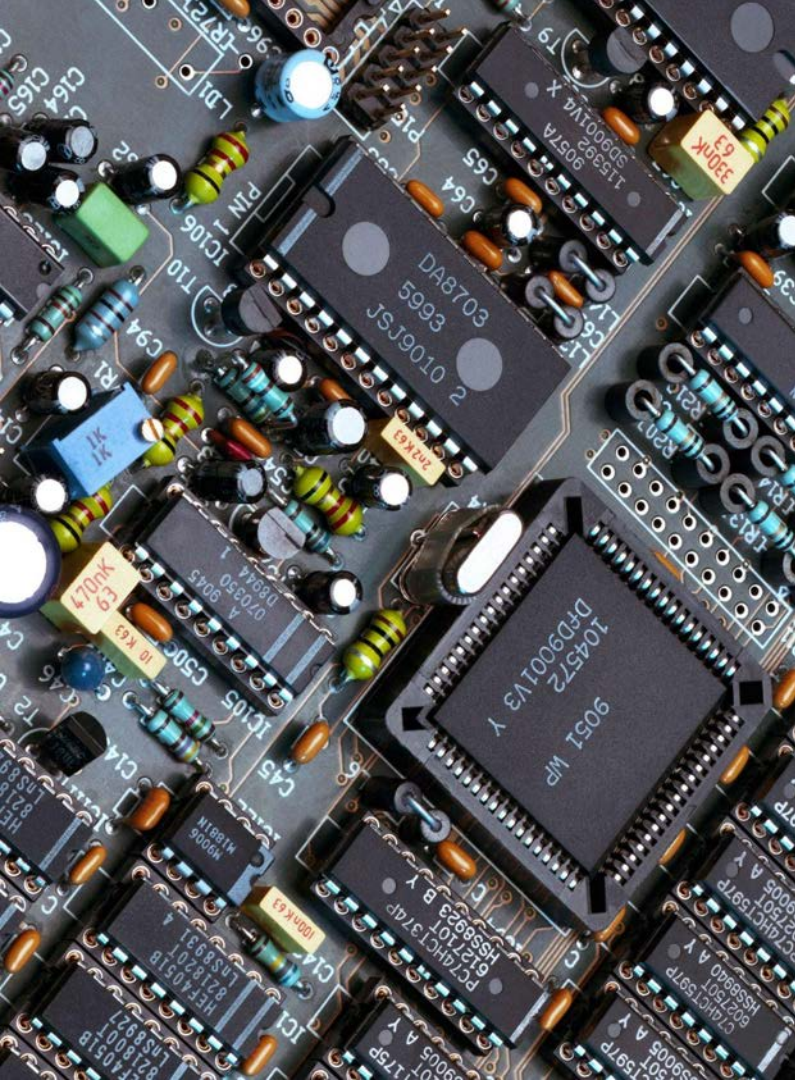
**Digital Artifacts**

**Digital Platform**

**Digital Infrastructure**





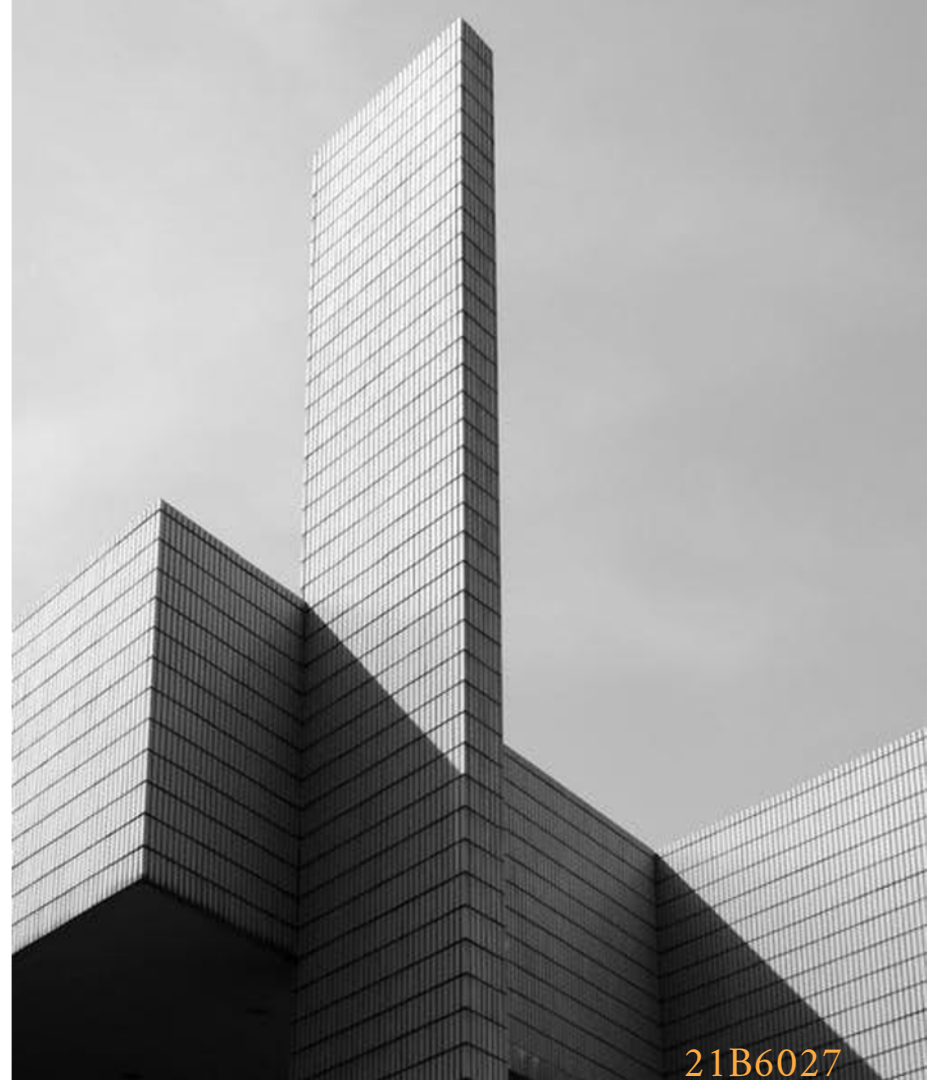


# Digital Artifacts

Defined as a digital component, **application** or media content, that is part of a new product / service and offers a **specific** functionality or **value** to the **end-user**.

# Digital Infrastructure

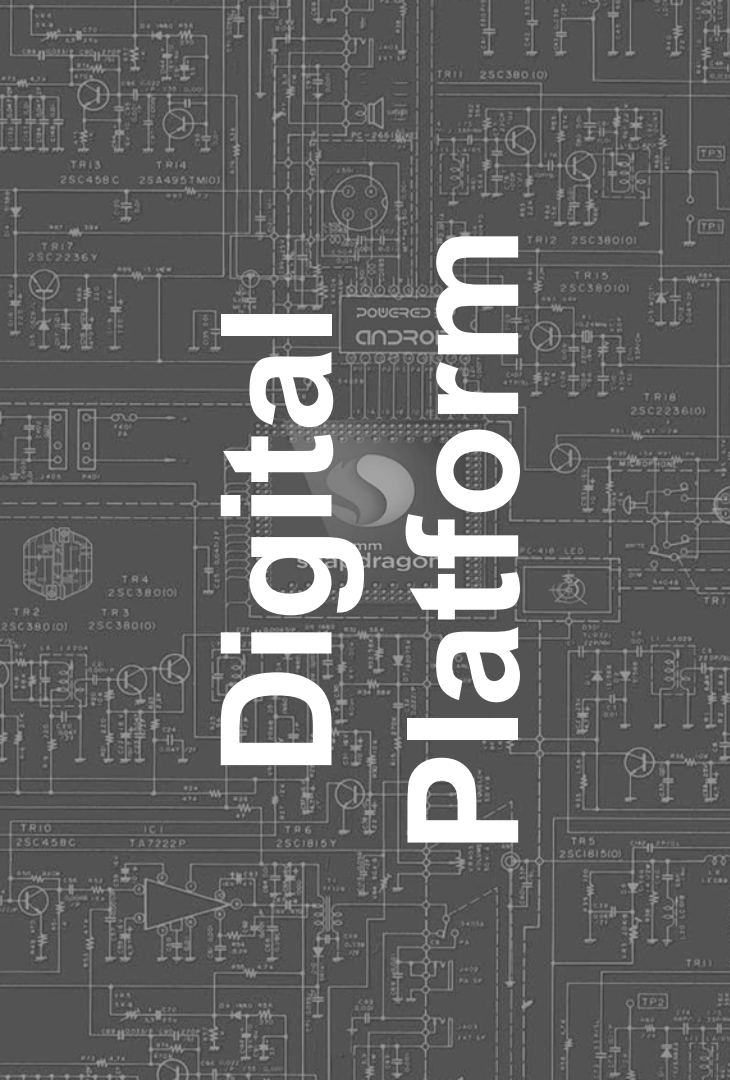
- Defined as digital technology **tools** and systems, which offer **communication**, **collaboration** and/or **computing capabilities**.
- Infrastructure, in general, refers to the basic **physical** and organizational **structures** needed for the **operation** of a society or organization.





As **digitalization** brings basic **information technologies** and organizational **structures**, digital **infrastructures** are considered as **sociotechnical** systems, which consists of more than technology **components**.





# Digital Platform

- They are a **shared**, common set of services and architecture, which serves to **host** complementary offerings, including **digital artifacts**.
- Also defined as a **software-based** platform, that operates as the **extensible** codebase of a software-based system, which provides **core functionality** shared by the modules that **interoperate** with it and the **interfaces**, which they interoperate with.
- Example of this includes:
  - Apple's iOS
  - Mozilla's Firefox browser.



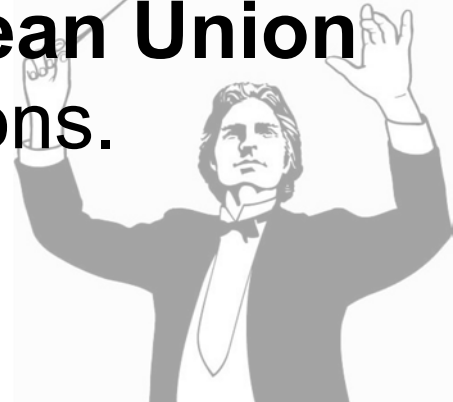
# SMEs and The Government's Role

For the Small and Medium Enterprises (SMEs):

- Digital transformation is more **concerned** with **digitalization** of the whole organization and business process.
- Its process requires an **innovative** cultural **approach** that can **sustain** radical changes of the companies' organizational settings towards a complex path to **digital configuration** in the present and the **future**.

## The Government's role:

- They function as an orchestrator and **funder** of initiatives (to the SMEs).
- This role is in **accordance** with the general **recommendations** from the **European Union** (EU) and other international institutions.



# Process of **Implementing Digital Transformation**

- The process of implementing digital transformation has been described to take a **4 stage path**, that is:
  - **Exploration** of digital transformation
  - **Development** of digital initiatives
  - **Digital** maturity
  - **Being** a digital organization
- These **paths** are associated with a **growing** level of changes due to the **introduction** of digital transformation within the **companies**.

## Trend of Industry 4.0 in Italy

- The **trend** for industry 4.0 amongst the **companies** is that they are based on a **technology-push innovation** approach, as they come from the **direct competitors** from inside the product firm's own industry.
- As a **result** from this approach, several scholars have **stressed** that this implies a **radical business model** innovation of manufacturing companies.

# Business Models

- As a sum of **mechanisms** and approaches for **value creation**, value offer and value capture, business models are interested in all their components by the **process of digitization** associated with Industry 4.0.
- Companies are able to **achieve new opportunities** and scenario of:
  - Data-driven value creation
  - New perspectives for servitization(industries using their products to sell outcome as a service) for the innovation in the value offer.
  - Larger opportunities for a more effective capture of the value created based on an extensive connectivity.

# Opportunities and Threats

- A high number of SMEs are **active in niche markets**, offering products **manufactured in small series or individual basis**.
- These companies frequently **need** basic versions of **machinery** and tools employed in the **production facilities** of large organizations.





There exist **critical factors** for the **success**, which are identified as:

- **Commitment** of a larger community of stakeholders and the need of adopting an industry-based perspective instead of the single company.
- **Cooperation** with multipliers and intermediaries to better perform on target groups
- **Focus** on specific business segments and scenarios, also through the identification of pilot projects to demonstrate the benefits of implementing digital transformation.

# **Difference** Between the **Large Companies** and the **SMEs**

Larger companies **understand** the **opportunities** and **challenges** of DT, while SMEs **struggle** in their process of DT.

- As a result of this, SMEs have taken a **cautious** approach to Industry 4.0, **fearing** that with **higher involvement** of the digital production process can be **detrimental** to their business.



Despite this, industry 4.0 has **unprecedented developments** for SMEs, due to their **opportunities** in participating in global digital **supply chains**.

**Investigation** in the **technical fields**, as well as the current research in industry 4.0 analyse how this industry **value** creation in **manufacturing**.

- Example: How new **technologies** can be **used** to provide new **services** and **product-service** systems.

## Remarks

This article on academic investigation on Industry 4.0 mainly **focuses** on **large** enterprises, and only **marginally** on SMEs.

However, **many** of these large **companies** either act as **suppliers** to the SMEs, or have them as the suppliers.



# **Research Method**

# Research Method

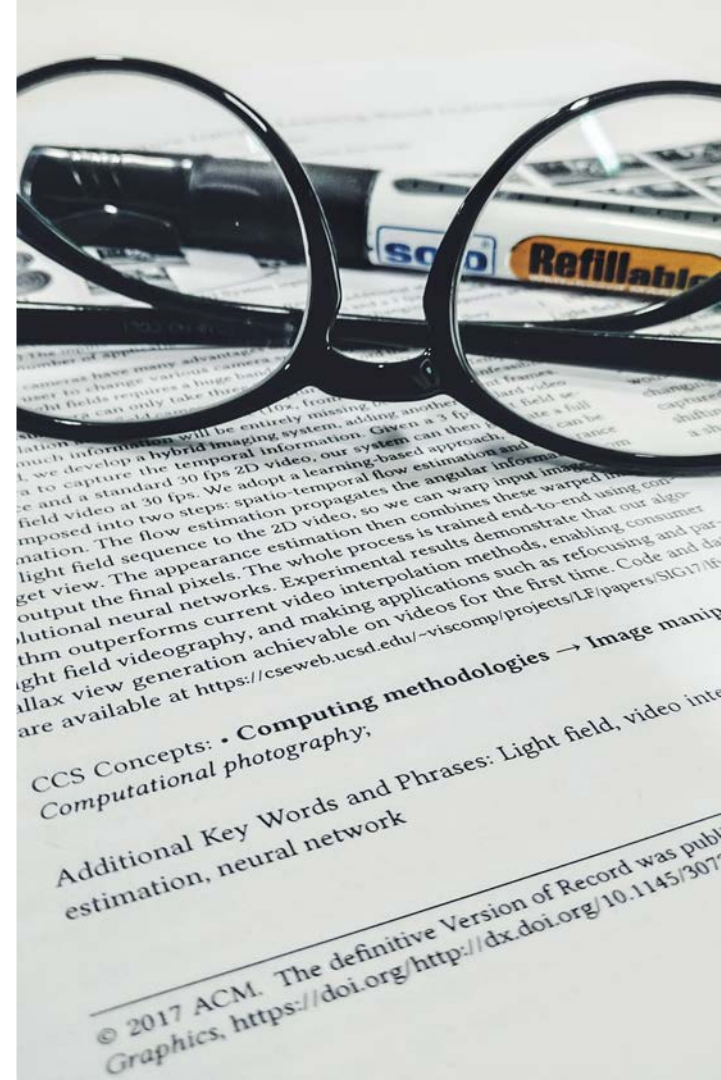
- **Qualitative approach** based method
- Due to the method of research an extremely rich amount of qualitative data was collected for an in-depth analysis
- **Qualitative research** is chosen because there are only a **limited** number of **cases** that can be **studied** thereby making large scale **quantitative** based research **inappropriate** to be used in this context. Hence, the research is to be conducted in cases that are extreme that are more clearly recognized.
- Research is **open ended** leading to an **interpretation** of the data.

## Research Context

The aim of the **Smart District 4.0** project is to **support** the digital transformation of the **SMEs** operating in the three industrial sectors such as Agri-Food, Clothing-Footwear and Mechanics-Mechatronics.

# Data Collection and Analysis

- Data **collection** from multiple **sources** and **combining** those data via **triangulation**.
- Data **collected** has been based on **secondary sources** such as :
- Archival Records, documentary information, Smart District 4.0 web page and social networks accounts.
- The **primary source** of data are the **interviews** conducted with seven key **informants** which consist of those that are **responsible** such as the **top management** and **project managers**.





# Data Collection and Analysis

- **Interviews** were set up via **email** or **phone call** where the interviewees are briefed about the **goal** and the main **questions** that will be asked during the interview.
- The **face-to-face** interview has a duration of 50 min per informant.
- After the interview, the **answers** are sent back to the informant for **validation**.
- The interviews were structured according to the following phases: **plan, develop instruments, collect data, analyse data and disseminate findings**.



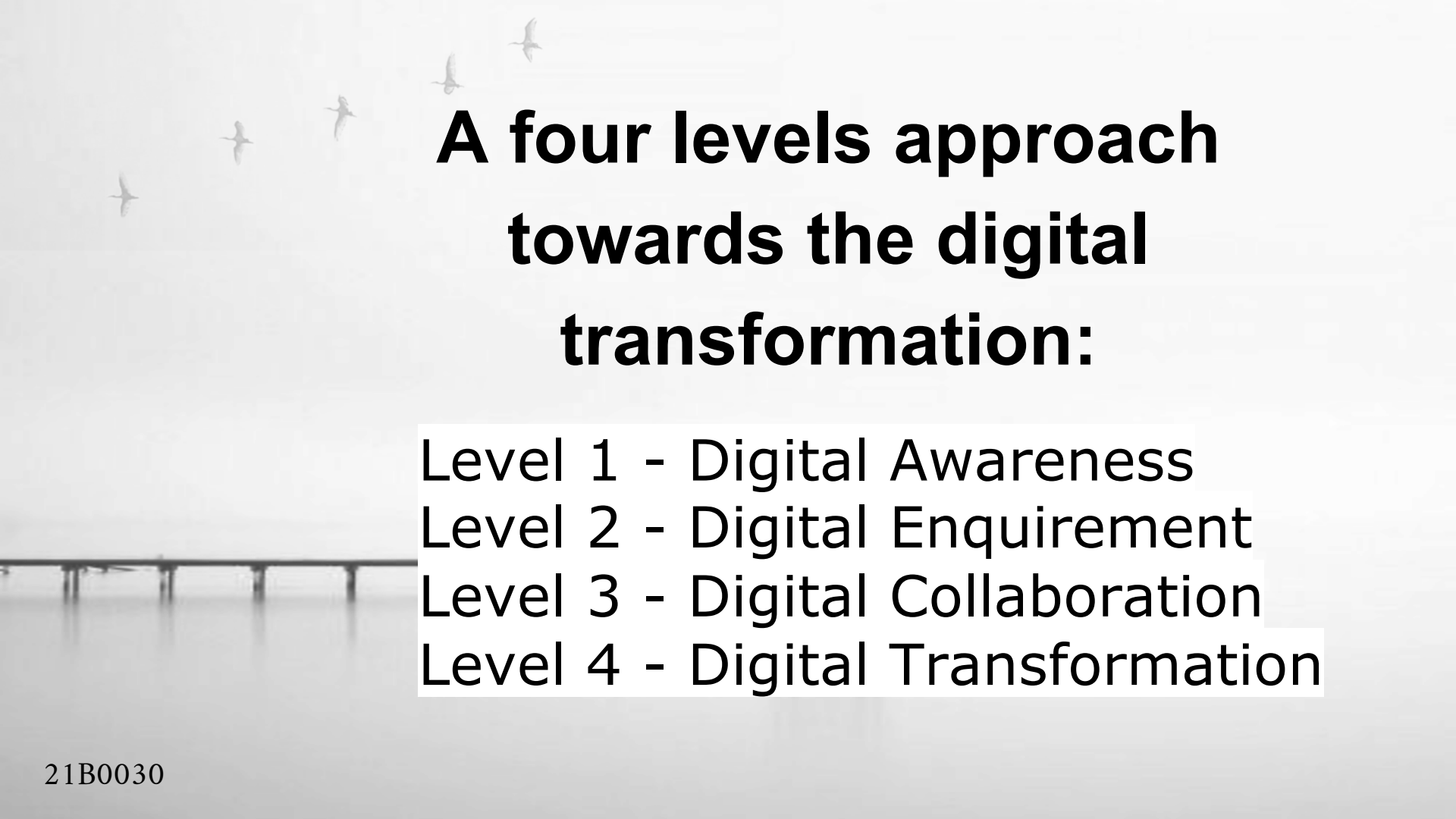
# **FINDINGS**





# **Allowed to comprehend the level of engagement towards the digital transformation of Apulian SMEs**

- **Agri-food**
- **Textile**
- **Clothing-Footwear**
- **Mechatronics-Mechanics industries.**

A background image showing a long pier extending into a body of water under a hazy sky. Several birds are flying in the sky above the pier.

# **A four levels approach towards the digital transformation:**

Level 1 - Digital Awareness

Level 2 - Digital Enquirement

Level 3 - Digital Collaboration

Level 4 - Digital Transformation

## 1) Level 1 - Digital Awareness:

- grounded on the **awareness** about the potentiality of DT on SMEs.
- participation of a larger and differentiated community of stakeholders
- aimed at informing about the project and collecting subscriptions

## 1) Level 2 - Digital Enquirement:

- the **technological solutions** presented in terms of functionalities and potentialities to sensitize SMEs and all the other stakeholders
- involved through **workshop and focus group**
- modalities of SMEs engagement regard a more powerful interest of SMEs in the project of DT



### 3) Level 3 - Digital Collaboration:

- accompanied into an **activity of exploration** of the potential benefits of digitalization in their own business processes and strategies.
- Companies are **engaged**; they are allowed to use the G Suite (all Google workspace) to sustain their administrative and communication processes.

### 4) Level 4 - Digital Transformation:

- **highest engagement** that sees a limited number of SMEs interested in
- the technologies made **available** are mainly digital solutions
- more relevant **impact** on the company's (such as strategic and organizational issue)



The background of the slide features a soft, warm-toned image. In the upper left, there are long, thin, green plant leaves, possibly from a palm or similar tropical plant. These leaves cast long, dark, and intricate shadows across the light-colored background. In the lower right corner, a portion of an open notebook is visible, showing several horizontal lines on its pages. The overall lighting is bright and diffused, creating a serene and naturalistic atmosphere.

# **The Levels of Engagement Towards Digital Transformation of Apulian SMEs**

## A. The first level of engagement:

- was **oriented** (to date) to a **sample** of about **1,000 enterprises**
- contacted by **phone or by email**
- Digital technologies **adopted** - No technologies
- **Awareness** about the **adoption of digital technologies** in different industries
- Expected **output** - **financed** by the **Italian ministry of economic development**

## B. The second level of engagement:

- **adherents** SMEs agree to participate in **focus groups**
- Digital technologies **impact-haring** of digital goals **attainment** and **best practices**
- **Expected output** - Awareness of the available tools for digitization



C.

### The **third** level of engagement:

- **Modalities** of SMEs engagement- Subscription of collaboration platform licences
- **Benefits** of training sessions and assistance with a remote support service 24/7
- **Trust** amongst the network composed by suppliers
- **Change** management (in the way of working and collaboration between business functions)

D.

### The **fourth** level of engagement:

- Analysis of
  - **Business** models
  - Process **maps**
  - Development of a **customized digitization project** (pilot)



## Digital Transformations In the Pilot Cases

- ★ The pilots identified to date are located:
  - ❖ **Two** in the Agro–Food chain
    - Overall **Supply Chain Traceability** (blockchain)
    - IoT for **Precision Farming**(Dashboard and Analytics; DSS)
  - ❖ **One** in the Textile–Clothing–Footwear sector
    - application of IoT for Product–Service based on **wearable devices** (IoT and Service Platform).
  - ❖ **One** in the Mechatronics–Mechanic industry
    - IoT for **Product Predictive Maintenance** (Dashboard and Analytics; DSS)



## 1. The first pilot (Agro–Food)

- Overall business process traceability
- **Industry:** Agri–food
- **Pilot SMEs:** Producer, packer and distributor of meat + large-scale distributor
- **Digital transformation intervention:** Transfer the information to process manufacturing suffered
- **Type of digital technology:** Blockchain

## 2. The second pilot (Agro–Food)

- Precision farming
- **Industry:** Agri–food
- **Pilot SMEs:** Energy plants powered by renewable sources Installer
- **Digital transformation intervention:** Connection of the pilot and the sensor network an Smart District 4.0 platform
- **Type of digital technology:** IoT and Big Data Analysis

### 3. *The third pilot (Clothing–Footwear)*

- Product-service based on wearable devices
- **Industry:** Textile–clothing–footwear
- **Pilot SMEs:** Manufacturer of workwear + manufacturer of products and technologies for the improvement of the quality of life
- **Digital transformation intervention:** Developing DPI smart prototype perfectly integrable with the various sensor system
- **Type of digital technology:** IoT and Big Data Analysis

### 4. *The fourth pilot (Mechatronics)*

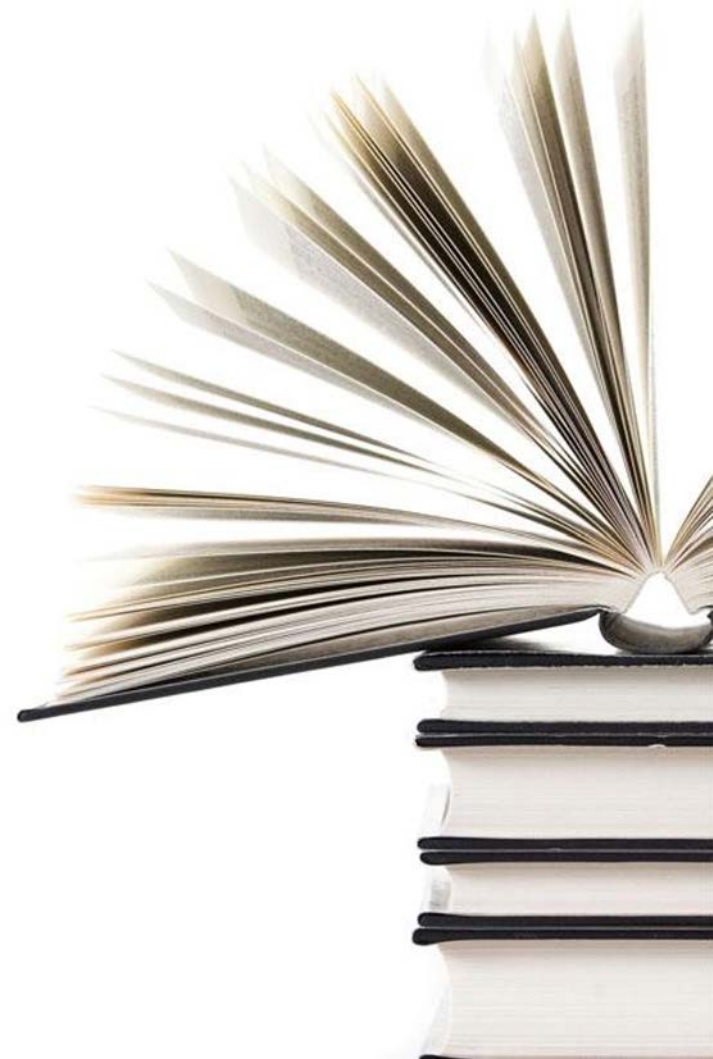
- Predictive maintenance
- **Industry:** Mechatronics–mechanics
- **Pilot SMEs:** Leader in processing and handling of polyurethane foam, polyester fibre and fabrics
- **Digital transformation intervention:** Identification of one or more parameters that are measured and extrapolated
- **Type of digital technology:** IoT and Big Data Analysis





# Discussions

- SME is understood to be **limited** by research and development, and **implementation** when trying to implement **digitalization**
- The **4 levels** from Smart District 4.0 prove as an **adaptable** and **attainable** process in **SMEs DT**



The phases **implemented** in the project may **enable** SMEs to

- **Grow** commitment and awareness on the benefits of digitalization
- **Exist** in digital business roadmap
- Make them more **competitive** in Industry 4.0



**Issues** regarding **SMEs** and **digitalizations** could be their **reluctant** to changes.

Growth of SMEs in digitalization is also dependant on three elements of technologies they adopt



- **Digital artifacts**
  - Infographic
  - Video
  - Website
  - Software/Application
  - Media



- **Digital infrastructures**
  - Cloud computing
  - Data analytics
  - Social media and online communities



- **Digital platforms**
  - IOS Android
  - Operating system
  - Software ecosystem





# Conclusions

- **Smart District 4.0** is an ongoing pivotal initiative.
- Aimed to **sustain** the process of **digitalization** into the Apulian **SMEs**.
- Specific focus:
  1. Agri-Food
  2. Clothing-Footwear
  3. Mechanics-Mechatronics



## An extreme **case study**.

To characterized their study with **novelty** and **originality**, **Small District 4.0** has allowed to:

1. Derive useful **insights** for the **advancement** of the **debate** on the **challenges** and **opportunities** of **digital transformation** in SMEs.
2. Identify **limitations** affecting this **process** and **critical** areas of **interventions**.

## Smart District 4.0 conceived as:

1. A **strategic** project with meaningful relevance for regional SMEs
2. A **lever** for the reinforcement of the competitiveness and innovation performances of the region
3. Its **successful** positioning into the industrial patterns of the so-called Industry 4.0 phenomenon





Showed **importance** of **networking** into the achievement of a process of digital transformation.

**Critical** for successful transition towards digital configuration (in coherence with Industry 4.0) has been the **human and social capitals**, despite technology being essential in the process of digitization.

Further **elements** of strengths of this case and features of **novelty** in the **debate** on the Industry 4.0:

1. **Focus** on single SME as **node** of a larger regional **value chain**.
2. **Involvement** of **industrial** and **research organizations**.
3. **Principles** of **networking** and **community buildings**.

The process of **collaborative** and **ecosystem** is coherent with **characteristics** of aspirational digital phase.



# Implications for Theory

Implications for theory arise at the **intersection** of **research** streams focused on **regional development, innovation ecosystems** and **digital transformation**. All these items disclose **new roots** for the **development** of across disciplinary research agenda.



# Implications for Practices

Implications arise for the agenda of **policy** makers in terms of **definition** of **strategic goals** and implementing **initiatives** with specific **contextualization** resulting from the **correlation** with regional and industrial features.




# Limitations and Future Research

This research present some **limitations for future research.**

Limitations:

1. The **preliminary evidences** associated to the current stage of the **Smart District 4.0 project.**
2. Context **analysed** in terms of **SMEs** , **industrial** domains and **regional** dimension.
3. The need to **develop** an **ad hoc** dashboard or **key performance indicators** to assess the **achievement** of the **SMEs** towards the **digital transformation.**



**Q&A**