Vision of INCDMTM Bucharest in RDI for the Smart Domain “Internet of Things –IoT”, Integrated in the COBOT Technology Platforms

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***Abstract*—The scientific paper creates an original vision in research and innovation for the intelligent domain << Internet of Things - IoT >>, integrated in the COBOT technology platform, developed in INCDMTM - Bucharest, in support of Industry 4.0.**

In brief, the paper contributes to attaining the objectives of the National Strategy RDI 2020 in Romania and the Europe 2020 Strategy, respectively increasing the Romanian competitiveness and contribution to the knowledge programs, increasing the role of Mechatronics and Cyber-Mix-Mechatronics in Romania and Europe and increasing the level and efficiency of smart knowledge.

***Index Terms*—Challenges in Romanian research and innovation, cyber mix mechatronics systems, multiplicative systems, smart specialized field, industry 4.0, Internet of Things –IoT, COBOT.**

I. Introduction

Research and Innovation domains in Romania are due to the advanced development of information and communication technology, along with integrative mechatronics that generate more and more objects / objects integrated with sensors and communication capability with other objects / things that transform the physical world into a matrix informative-knowledge system. The Internet Challenge of Objects -IoT allows today that things / objects in our environment are active participants who share information with other actors or members of the network, wired / wireless, using the same Internet Protocol-IP protocol that connects the Internet. Thus, objects / things are able to recognize events and changes around them and act and react in a quasi-autonomous way without human intervention.

In this exposed context (Fig. 1), challenges in research, development and innovation create an "intelligent planet," where physical, digital and virtual worlds converge to create smart environments that can make energy, transport, cities and many other intelligent domains.

II. Internet of Things – Technology Platforms

The development of some generic technologies such as "nano electronics", "communications", "sensors", "smart phones", "embedded systems", "cloud computing and software" will be among the key to supporting future innovations of IoT and cyber – mechatronics products, which affects many industrial sectors.

Fig.1 Internet of things – Enabled technologies.

Fig. 2. Internet of things – Technology platforms.

In Romania, many projects and initiatives address technologies and knowledge about the Internet of Things and Cyber-Mix Mechatronics.

Thus, the integration of knowledge in this context is conceptualized as the process through which disparate, specialized knowledge, located in several projects in Romania (and at the level of the European Union), are increasingly combined, applied and assimilated.

INCDMTM-Bucharest is developing research in IoT on

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the Internet of Things that aims at defining IoT technology and developing research challenges at national (and European) level with a view to the global development of multidisciplinary science. Motivation for the Internet of Things is to address the high potential of IoT-based capabilities in Romania (as well as in Europe) - to coordinate / encourage the convergence of ongoing activities on the most important issues - to build a broad consensus based on modalities IoT in Romania (as in Europe), (see Fig. 2).

III. Smart Appliances of the Internet of Energy

The outlook for the future is the emergence of a network of interconnected and uniquely identifiable objects, and their virtual representations in a similar Internet structure, which is positioned over an interconnected computer network, allows the creation of a new platform for economic growth.

Then the major areas of street Internet applications are the creation of intelligent environments / spaces and stand-alone things (eg smart transport, cities, buildings, energy, life, etc.) for climate, food, energy, mobility, health.

Thus, in this context, the new Internet energy concept requires web-based architectures to easily guarantee the provision of on-demand information and to change the traditional electricity system into a highly automated networked smart grid, applying greater intelligence to operate, self-healing when necessary. This requires the integration and interconnection of the electricity grid to the data network represented by the Internet, allowing for the perfect and consistent operation of power generation, transmission, delivery, distribution stations, distribution control, measurement and billing, diagnostics of computer systems.

This concept of INCDMTM allows the ability to produce, store and use energy efficiently by balancing supply / demand by using a cognitive Internet of energy that harmonises the energy network by processing data, information and knowledge over the Internet. Thus, the Internet of Energy will influence the information highlighted by the Internet to connect computers, devices and services to the Intelligent Energy Distributed Network, which is the freight highway for renewable energy, enabling stakeholders to invest in green technologies and sells excess energy to various utilities (Fig. 3).

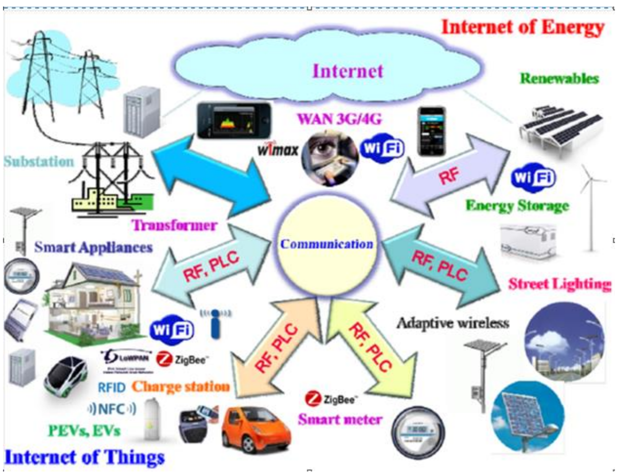

Fig. 3. Smart appliances of the internet of energy.

According to fig. 3, Internet energy applications are connected via the Internet of the Future and the "Internet of Things", allowing for seamless and secure interaction of intelligent systems embedded over heterogeneous communication infrastructures [1].

Thus, developments in the global environment and developments in Romania's policy, science and technology policy and intelligent industrial policy and digitized enterprise converge to the objective of supporting these links at national level. That is why INCDMTM have to achieve real coordination and cooperation in Romania, as well as at European level, have to support the national connection of the scientific groups with other national scientific and innovation networks and research institutes based on the intelligent industrial application research, digitized enterprise.

The creation of national IoT networks will allow for better coordination of knowledge-producing projects in the field of IoT, cross-country interdependence and cooperation at European level through integration and interconnection (see Figure 4).

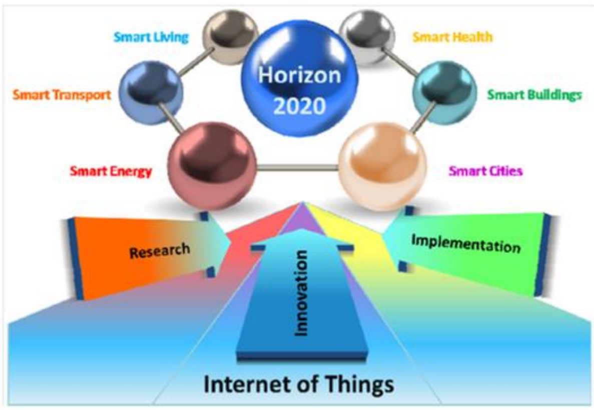

Fig. 4. Internet of things – Horizon 2020.

This concept of linkage will contribute to the consolidation and replication of the success factors achieved through specific IOT projects and will be an instrument that will help to promote the exchange of ideas, solutions, results and their validation among research projects at national level and European.

IV. Examples of Concepts Developed by INCDMTM

Integration of IoT with mechatronic and cyber-mixmechronic systems for remote monitoring, remote control and remote configuration processes have led to new concepts of intelligent systems.

The following are the concepts of COBOT technology platforms for different applications in intelligent industrial environments.

Fig. 5 shows "Pressure Management of Water Pump Stations through Intelligent Monitoring Systems" for the following parameters:

Parameters monitored on the water distribution network

1. pressure - 32 locations
2. residual chlorine concentration - 30 locations
3. Flow - 10 locations
4. flow direction
5. flood fireplace

6. burglary

Fig. 6 shows “Plant growth management” to monitor the following activities:

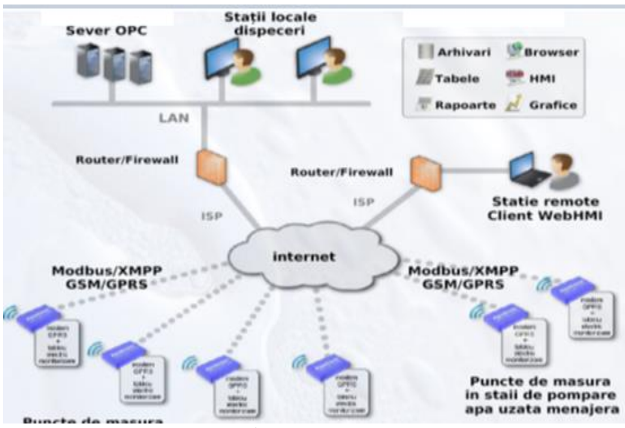

Fig. 5. Pressure management of water pumping stations through the digitized monitoring system.

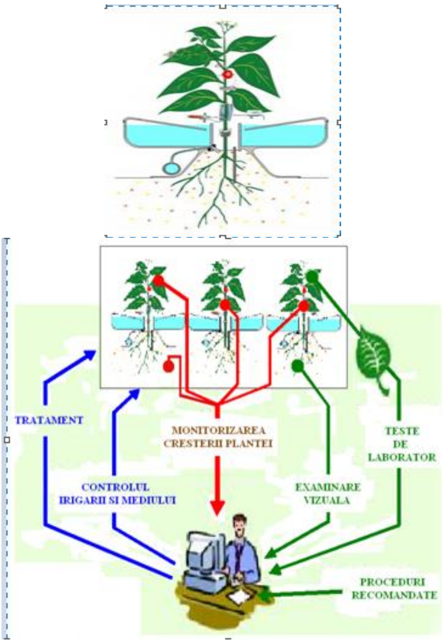

Fig. 6. Plant growth monitoring.

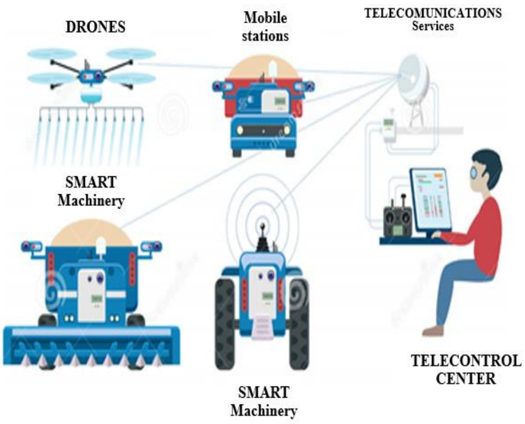

Fig. 7. The basic principle for smart farming.

Monitoring mainly pursues the following activities:

1) Establishing environmental parameters that influence plant development (soil, air, water)
2) Establishing the parameters to be monitored in plant development
3) Establishing and building sensors for monitoring
4) Development of monitoring software
5) Experiments in the laboratory and in the field
6) Dissemination.

Fig. 7 shows “the basic principle for smart farming”

In Fig. 8, "Industry 4.0 - Interconnected Reality of Industrial Production Value Chains" is represented:

Fig. 8 Industry 4.0 - Interconnected reality of industrial production value chains.

Interconnected manufacturing and control processes in complex industrial environments will determine the future of Industry 4.0 and help implement dynamic, real-time and self-sustained processes by providing active and passive detection and interconnection solutions [4]-[5].

The interconnection of individual production steps means that these steps can be combined in any way they need, with maximum traceability of information and field status. This enables us to create fully observable production lines in real time, efficiency and flexibility being the main features of intelligent factories [3].

Figure 9 shows the "COBOT Technology Platform for Integrated Control in the Digitized Enterprise and Industry 4.0 in the MixMecatronic Field".

The COBOT technology platform for integrated verification and control processes is logically structured on the intelligent mechatronics and cyber-mixmechatronics architecture (4D / digital ultra-precision measuring system / control and control system / pneutronic antivibration system / etc) + architecture Mechatronic system for leakage of casting parts (casting system / casting / casting system / instrument pneumatic air / plunger system which ensures the closure of all the holes of the casting and thus ensures the space enclosed in the pneumatic / Input / Output Actuator / Mechatronic Mechatronic Metering System / Leakage Mechatronic System Check piece (after result display) / Mechatronic Operating and Leak Test System optical signalling system leakage checking process - system operation - system non-functioning alarm - total system / pneumatic supply / electrical system blocking), cyberspace architecture and remote monitoring – remote service – remote configuration and remote control centers and with a very important role in the activities collaboration with 4D intelligent mechatronic systems and leakage checking, the collaborating man with them, in fact highlighting the technological "cobot".

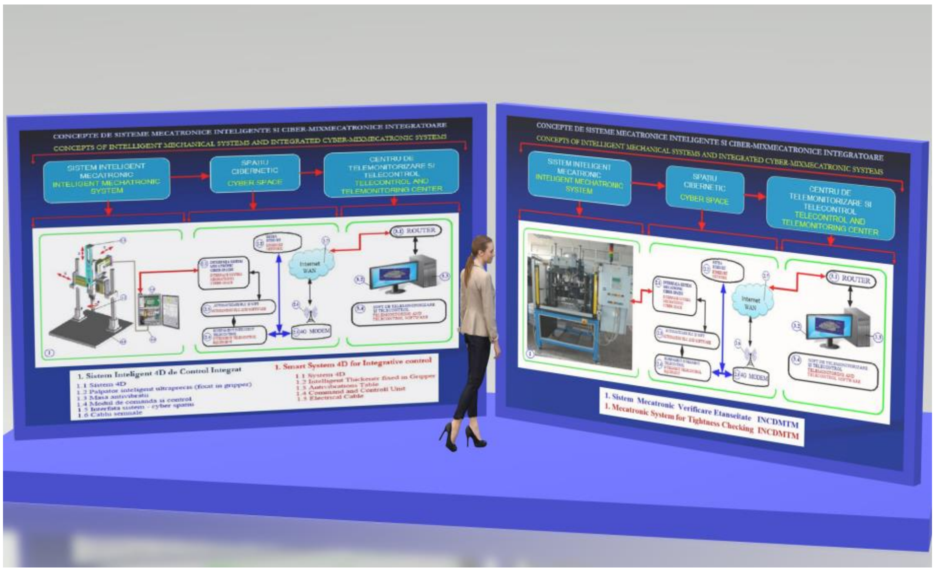

Fig. 9. COBOT technology platform for verification and control processes in enterprise and industry 4.0, in MixMechatronic field

In the figure 10, the "COBOT Technology Platform for Intelligent Measurement and Control Processes in the Digitized Enterprise and Industry 4.0 in the Technological Equipment field" are represented:

The COBOT technology platform for intelligent dimensional measurement and control is logically structured on the dimensional control mechatronic robot architecture (intelligent mechatronic systems like control robots / control robot interfaces - cybernetic spaces / intelligent mechatronic systems for managing and coordinating processes / support systems for control robots / digital touch probe systems for measurement and control / mechatronic systems for operating and collaborating with the robot operator (the collaborative man), on the architecture of cyberspace working and collaboration with the digitized enterprise and on the architecture of monitoring and telemonitoring centers, teleconfiguration, service - teleservice and control and telecontrol (routers / computers / etc.) and collaboration with collaborative man with control robots (special programs for measuring and controlling processes / on special software for measurement and control / man collaborative, etc.)

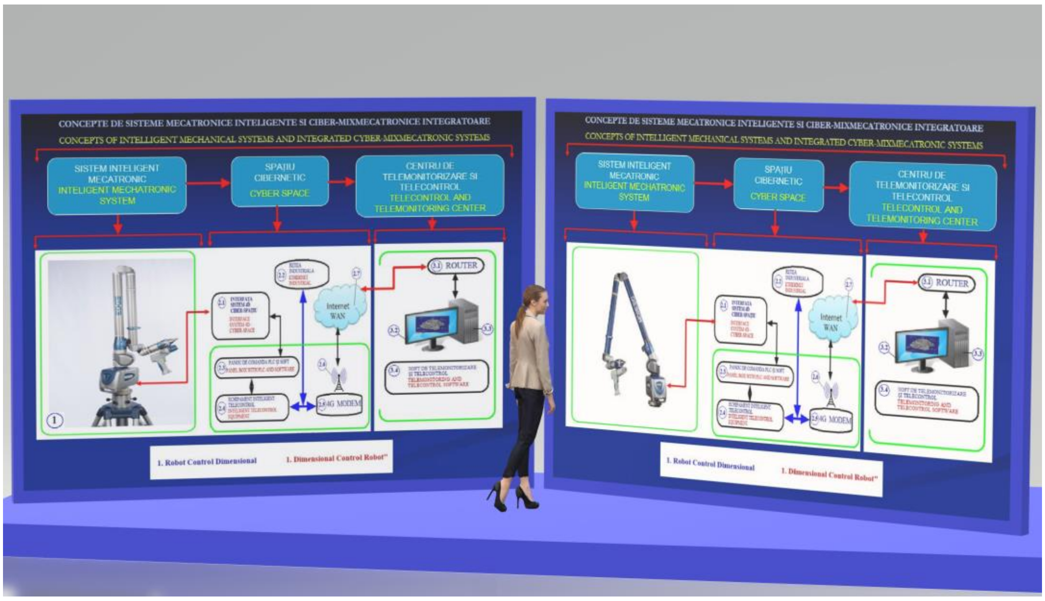

Fig. 10. COBOT technology platform for verification and control processes in enterprise and Industry 4.0, in mixmechatronic field, in the technological equipment field.

In Fig. 11, there is a "COBOT Technology Platform for Intelligent Medical and Biomedical Patient Handling Analysis and Recovery":

The COBOT Technology Platform for Patient Walkthrough Analysis and Recovery is structured and built on the Intelligent Walkthrough Analysis Mechatronics System architecture (the actual stripe / alarm and alarm / stop / lock / individual operating system / etc.) on the mechatronics track gauge architecture (the actual band / the computerized system for medical recovery parameters / warning and alarm system / stop-lock / individual operating system / etc.) on (4GMODEM / Antenna / Internet WAN / Intranet, etc.), on the architecture of remote monitoring / remote service / remote control / remote configuration centers (routers, computers, software and software), the architecture of the cybernetic spaces of the two intelligent mechatronic systems of Analysis and Walk back Recovery specialized analysis and recovery/etc.)

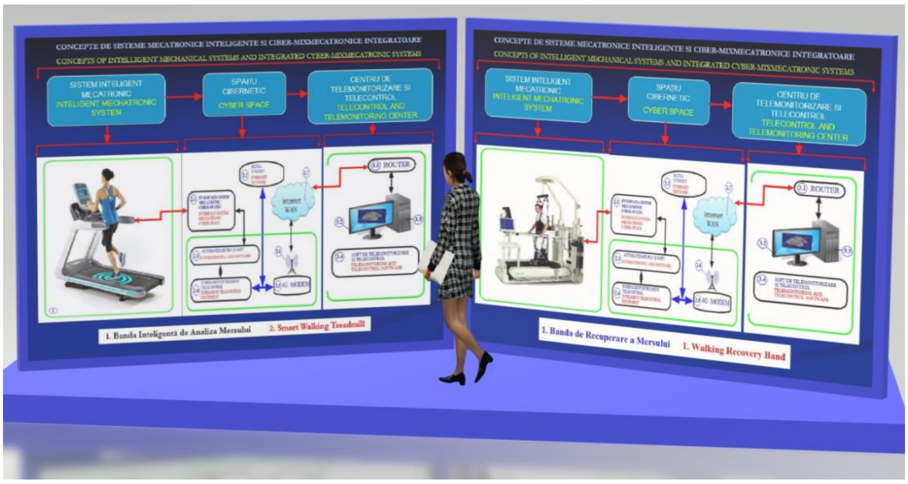

Fig. 11. COBOT technology platform for intelligent medical and biomedical patient handling analysis and recovery.

In the Fig. 12 is represented the COBOT technology platform for control processes and automotive production lines, in the Enterprise and Industry 4.0, Automotive

The COBOT technology platform for Intelligent Manufacturing Intelligent Control Processes is built and structured on the Automobile Body Control Robot Architecture (Intelligent Operating Mechatronics Intelligent Operating System / Intelligent Alarm and Alarm System / Mechatronics Coordinating System and control / cyber-interfacing system / intelligent self-adjusting and self-positioning system / etc.), on the robot architecture controlling automotive castings (engine / gearbox / injection pump / etc.), (the robot itself Intelligent control / Mechatronics Intelligent Operating System / Intelligent Alarm and Alarm System / Mechatronics Coordination and Control System / Mechatronics Coordinating and Command System with Measuring Metering / etc.), Cyberspace Architecture (Interface between control and external cyberspace / Internet WAN / Intra net / 4GMODEM / etc.), on the collaborative program architecture of the IT operator (collaborative man with control robots) and on the architecture of the remote monitoring centers – remote configuration – remote service – remote control (routers, computers / measurement / control / analysis / operational decisions).

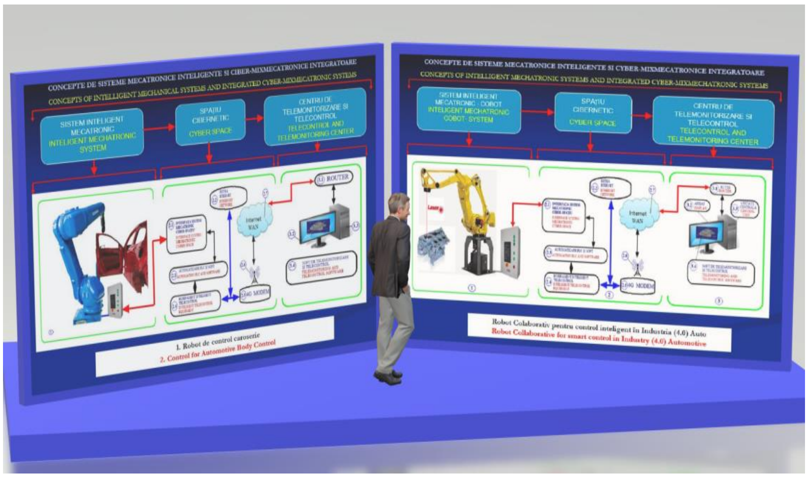

Fig. 12. COBOT technology platform for control processes and automotive production lines, in the Enterprise and Industry 4.0, Automotive.

In the Fig. 13 is represented a COBOT technology platform for intelligent control processes in the Digitized Enterprise and Industry 4.0 in the Electronics and Electrotechnical field

The COBOT technology platform for Intelligent Control Processes in the Electronics and Electrotechnical field is structured and built on the collaborative robot architecture - the COBOT for intelligent laser control (the robot itself / mechatronics precision positioning system of the electronic marker) / Intelligent operation and coordination mechatronics system / Mechatronics interfacing system with cyberspace / laser related system / control system viewing system / related system with measuring and control instrumentation etc.), on the collaborative robot architecture - COBOT Intelligent Laser Control (the robot itself / the mechatronics precision positioning system of the electronic circuit board (PCB) / intelligent operation and coordination mechatronics system / cybernetic interfacing system / laser related system / visualization of the measurement process (4GMODEM / Antennas / Internet / Intranet / etc.) and on the architecture of the remote monitoring, remote service, remote configuration and remote control centers (the collaboration of the robots), the architecture of the cyberspace routers / computers / programs - specialized software / etc).

Fig. 13. COBOT technology platform for intelligent control processes in the digitized enterprise and industry 4.0 in the electronics and electrotechnical field.

Fig. 14 is a COBOT technology platform for positioning processes in metrology laboratories in Enterprise and Industry 4.0, in the field of Intelligent Metrology

The COBOT technology platform for positioning processes in metrology laboratories is built and structured on the collaborative robot architecture - COBOT for intelligent positioning (the intelligent robot with 12 axes - 6 Cartesian and 6 polar proper / drive system for each 12 axes / robot movement visualization system / intelligent operating and coordinating system / intelligent integration system sensors and transducers for precise and accurate measurement / positioning processes / etc), on the collaborative robot architecture - COBOT for intelligent positioning (Intelligent 6-Axis-3 Cartesian and 3-Axle Robot / Drive System for Each of the 6 Axes / Robot Movement Viewing System / Intelligent Operating and Coordinating System / Intelligent Integration Sensor and Transducer for Measurement / Positioning Processes precise and very precise / etc.), per country (antennas / 4GMODEMs / Internet / Intranet / interfacing systems / etc), on the architecture of monitoring / remote monitoring, configuration / remote configuration, control / remote control and service / remote service centers (routers / computers / programs - specialized software / etc).

Fig. 14. COBOT technology platform for positioning processes in metrology laboratories in enterprise and industry 4.0, in the field of intelligent metrology.

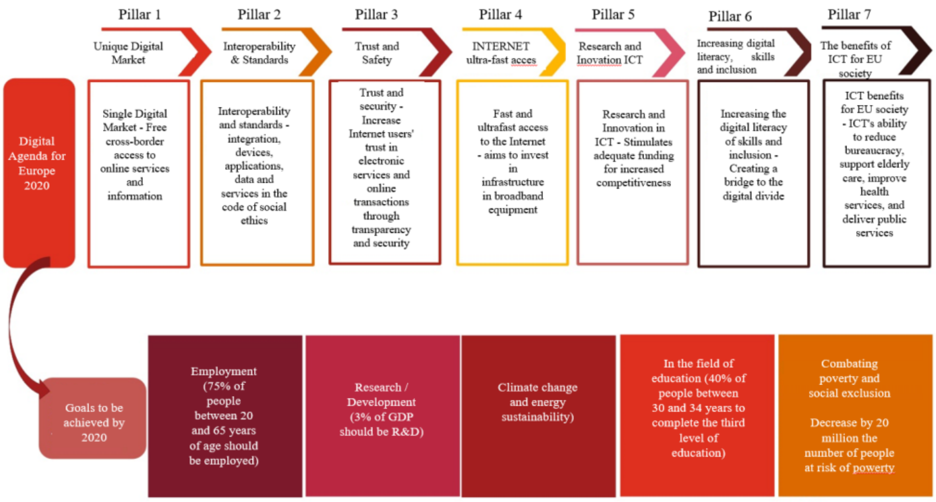

Fig. 15. The enterprise and industry digitization strategy 4.0 is synthesized at national and European level in the following chart.

V. Conclusions

The Enterprise and Industry Digitization Strategy 4.0 is synthesized at national and European level in the following chart.

Thus:

Pillar 1

Single Digital Market - Free cross-border access to online services and information

Pillar 2

Interoperability and standards - integration, devices, applications, data and services in the code of social ethics

Pillar 3

Trust and security - Increase Internet users' trust in electronic services and online transactions through transparency and security

Pillar 4

Fast and ultrafast access to the Internet - aims to invest in infrastructure in broadband equipment

Pillar 5

Research and Innovation in ICT - Stimulates adequate funding for increased competitiveness

Pillar 6

Increasing the digital literacy of skills and inclusion - Creating a bridge to the digital divide

Pillar 7

ICT benefits for EU society - ICT's ability to reduce bureaucracy, support elderly care, improve health services, and deliver public services

Goals to be achieved by 2020:

- Employment (75% of people between 20 and 65 years should be employed)

- Research / Development (3% of GDP should be allocated to R / D)

- In the field of education (40% of people between 30 and 34 years to complete the third level of education)

- Combating poverty and social exclusion.

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