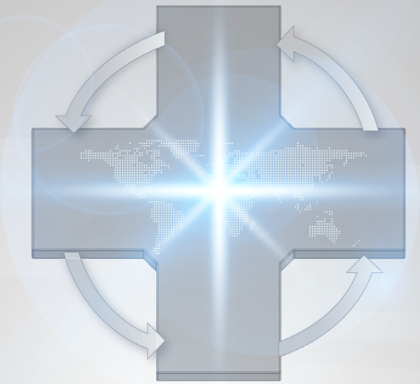
Digital Transformation of Economic Science



Vision for a new road in the history of the future

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FORUM ITFES
INFORMATION TECHNOLOGIES AND THE FUTURE OF ECONOMIC SCIENCE

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AN OPEN PLATFORM FOR COLLABORATION

REVISION MARCH 2023

ISBN 978-619-7702-08-8
2023, Sofia, Bulgaria
www.itfes.org

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Preface

At the time of writing this book (at the end of 2021), the Western world[1] is on the verge of total collapse. The second year of the COVID-19 pandemic is underway, as a result of which the vast majority of the problems in the West, which have so far somehow passed under the radar of public attention, have been brought to light: a shortage of key commodities, a crisis in the medical sector, a crisis in the energy sector, incapacity for rapid changes in every sector, and an endless string of inadequate managerial decisions. Opinions in our society are extremely polarized, while representatives of the business, media, scientific and political elites shift responsibility between one another for each subsequent crisis. The avoidance of responsibility and the wrong measures have shown our societies that people "at the top" do not know precisely what they need to do to prevent a given crisis or to deal with an unforeseen crisis, which creates prerequisites for public discontent, disobedience, strikes, conflicts, and chaos.

We, the authors of this book, ask ourselves the question: ***"What has happened to our Western world? Are we witnessing the end of a 500-year era of technological advantage of the West over the rest of the world?" "How did it come to this, and what awaits us in the future?"***

To the first question, our answer may seem unconventional. The roots of the vast majority of problems in the Western world nowadays can be traced to a term that has acquired a mythical meaning: **ECONOMY**.

Over the past 40 years, we have seen an extraordinary increase in the influence of scientific knowledge of **economy** over the global worldview. Think about it, how many times a day do you hear that word? How many of your

[1] The Western world, by definition, encompasses the countries influenced by the so-called "Western culture." These are the countries of Europe, including Russia, North America, Australia, and New Zealand.

acquaintances have graduated with an economics degree? How many young people are enrolled to study *management* and *economics* because they are aspiring to hold a managerial position or to set up their own business? Economic science is the science that should give us applied knowledge for modeling complex industrial systems and also for strategic management of such systems. It is also the science that should give us knowledge of crisis management. Therefore, representatives of this community occupy a significant portion of management positions in both industrial and geopolitical economic units. Even if they do not hold managerial positions, they have completely occupied the public positions of *advisors* of the ruling elites in most of the Western countries.

And here comes the paradox! To our great regret, knowledge of economy, seen in comparison with scientific knowledge of medicine, still exists at a medieval, or scholastic, level of development and, therefore, has significant functional flaws. It remains at a scholastic level of development because, to this day, economic science has failed to define and derive an unambiguous definition of:

1. The objective meaning of the term *economy*.

2. The object of study of economic science.

3. The principal setup and way of functioning of the industrial enterprise as a multitude of assets and their trajectories within the enterprise, in one with the multitude of people and the cognitions they need in order to manage these trajectories.

Similar to the lack of knowledge of an "anatomical" and "physiological" model of the "human body" in medieval medical science, modern economic science lacks a systemic understanding of the industrial enterprise.

This low-quality knowledge of economy, combined with its tremendous influence over our perception of the world, leads to a drastic decline in the quality of our ruling elites, as it is accepted to rely precisely on economic science for everything related to the management of geopolitical and industrial systems. However, this decline finds the most vivid manifestation in the emergence and persistence of a very negative trend in the development of the industrial human capital of our nations compared to that of the East Asian nations. It is enough for each of us to imagine the amount of machinery and equipment for which we rely on East Asia and what would happen if these supplies were to cease. The emergence of such a highly developed industry for machines did not happen by chance. Paradoxically, the East Asian industry for machines is becoming a world hegemon thanks to the Western world transferring its technological innovations to the East as a requirement for the implementation of the political ideology of the "Knowledge Economy." Consequently, this politics has made the West 100% dependent on the East Asian industry for machines today.

This drastic decline in the quality of the ruling elites of the Western world also has many other disturbing manifestations and prospects for even worse long-term consequences. Despite that, there is no sign of serious efforts and investments to exit this state through the transition of scientific knowledge of economy from a medieval (scholastic) to a modern (systemic) level of qualitative development.

Many people will consider this answer contradictory and perhaps absurd because it is extremely difficult to accept that the most recognized professionals in the field of economics suffer from a substantial cognitive gap in terms of basic definitions in economic science. Such an assumption sounds as absurd as the assumption that the most prominent medical professionals have no systemic knowledge of the anatomy and physiology of the human body.

It all seems scandalous and confusing, but it is a fact. A fact that we will justify in detail in this book.

This problem affects each and every one of us, both individually and as a society, and we believe that it is high time society as a whole takes a serious approach to resolving it because otherwise, the answer to the question *"What awaits us in the future?"* will become extremely negative.
For this reason, we – the authors of this book – established a foundation called "Information Technology and the Future of Economic Science." On behalf of this foundation, we have also created a strategy for building and developing a global discussion forum, the primary purpose of which is to raise awareness about this highly neglected but extremely serious problem and to call upon the people of the Western world to unite in the name of its urgent resolution.
The creation of this book, ***"Digital Transformation of Economic Science: Vision for a New Road in the History of the Future,"*** has an identical purpose. In the Introduction, we present all of the "disregarded evident facts" that develop a worldview, the basis on which the book is written. These "disregarded evident facts" have thus far been overlooked in our society, but in the individual chapters, we make a detailed presentation of each of them. We have tried to clarify this huge problem as precisely as possible by relying on solid facts and logically-sound critical analyses.

However, that is not the main purpose of this book.

As the title suggests, we are proposing a specific and engineering-designed solution for discussion among the societies of the Western world. This solution builds on unique discoveries in the field of economic science made by engineers - colleagues of ours - here in Bulgaria. Through this book, these discoveries are fully unfolded for the first time and are established as a basis for the implementation of an "engineering enlightenment" of the Western world. According to many academics, and in our personal opinion, each of these discoveries has the potential for several Nobel Prizes in Economics, and the effect of their potential mass dissemination in both education and the commercial market could be in the trillions of dollars.

Through a critical examination of the path that our current "economic leaders" represented by the World Economic Forum are guiding us on, we will present an alternative road for the Western world. A road that will be built upon the unique discoveries and recognized as "Digital Transformation of Economic Science."

After reading this book, each reader will be provided with a choice that will determine not only their own future but the future of their children too. Thus, this personal choice ought to and must be made conscientiously with the utmost regard for its significance.

Introduction

The central and most important for the worldview foundation in tracing the path called "Digital Transformation of Economic Science" is the part built upon seven content sequencing worldview ideas - the first six are defined as "disregarded evident facts" and the last - as "one little-known fact."

1st disregarded EVIDENT FACT:

The industry for machines is a leading industry of paramount importance for the development of all other industries.

The industry for machines is comprised of a multi-million multitude of enterprises for machines that provide machines and spare parts to all industries as well as household machinery. In addition, this industry offers various services, such as repair and maintenance services of machines, and in some cases, even modernization of different machines, among many others.

It is perfectly clear that today the industry for machines represents the basis for the operation and development of all other industries.

It is enough to imagine our modern global world with no machinery – no household appliances such as cookers, fridges, washing machines, air-conditioners, etc.; no transport vehicles such as cars, trains, airplanes, and so on; no agricultural machinery; no textile industry or food industry machinery; no medical machinery; no smartphones or computers; no machines whatsoever.

If some unknown force suddenly wiped out all machines in our contemporary world, this would lead to a devastating calamity comparable to a nuclear war.

Furthermore, the industry for machines is a *meta-industry*: not only does it provide machinery for all other industries, but it does so for itself as well.

These facts establish the industry for machines at the highest, supreme rank among all other industries.

2nd disregarded EVIDENT FACT:

The scientific understanding of the ontological model of the enterprise for machines is the most significant knowledge and task of economic science; this designates it as a "fundamental scientific knowledge of economy."

The entire global collection of enterprises for machines can be compared to the global population. Each individual person is unique, but the blueprint of the human body is the same and can be understood through the ontological model of the human – widely known as the anatomical and physiological model of the human body.

The same holds true for all enterprises for machines – they are all unique; however, the makeup of each one can be understood through the knowledge of the ontological model of its economy.

The fundamental scientific knowledge of economy in the form of an ontological model of the economy of the enterprise for machines does exist. It is commonly known as 'double-entry bookkeeping' and was conceived more than 500 years ago by an Italian monk by the name of Luca Pacioli. This scientific knowledge of the 'double-entry bookkeeping' model has been invaluable to date, yet as early as the last decades of the 19th century, it was found to suffer from great shortcomings with respect to managing the effectiveness of the industrial economy (specifically, the effectiveness of industrial labor) in the context of the Industrial Revolution. Practical necessity gave rise to three engineering waves, which aim to remedy some of these shortcomings.

3rd disregarded EVIDENT FACT:

The history of the fundamental scientific knowledge of economy clearly shows three engineering waves of its development, all originating in the USA.

The first engineering wave in the development of the fundamental knowledge of economy dates back to the 1890s up to the 1920s. It involves the creation, development, and dissemination of knowledge of operational modeling of processes in the enterprise. This wave is associated with the names of the US engineers Henry Robinson Towne and Frederick Winslow Taylor.

The second engineering wave in the development of the fundamental knowledge of economy covers the 1930s, 40s, and 50s. It involves the creation, development, and dissemination of knowledge of production management focused on quality. It is associated with the names of the US engineers Walter Andrew Shewhart, William Edwards Deming, and Joseph Moses Juran.

The third engineering wave covers the 1970s, 80s, and 90s. It involves the creation, development, and dissemination of knowledge of computer-integrated modeling of the sales, production, and supply processes.

The key concepts for the knowledge of this computer-integrated modeling are MRP I (Material Requirements Planning) and MRP II (Manufacturing Resource Planning). MRP I refers to a knowledge of computer-integrated modeling of the sales, production, and supply processes without taking into account the production capacity of the enterprise. MRP II refers to the same type of knowledge; however, also considering production capacity.

This third engineering wave of development of the fundamental scientific knowledge of economy stems from the work of two IBM engineers – Joseph Orlicky and Oliver Wight.

In the early 1990s, Gartner employees introduced the concept of ERP (Enterprise Resource Planning) as a vision for the upcoming development of the MRP systems. They claimed that the ERP systems were a new generation of MRP systems, which integrated a set of specialized enterprise software applications for digital modeling of the management of finance, human resources, distribution, manufacturing, supply chain, services, etc. ERP tools (both MRP systems and business applications) should share a common digital process and database.

The approach of integrating many and diverse business applications to the classic MRP system has ensured the exceptional market success of the current ERP software (worth over 500 billion US dollars per year). However, this approach leads to the significant departure of the functional constructs of all modern ERP systems from the cognitive universalism, which is inherent in the functional construct of every pure, application-free MRP system. This departure from the cognitive universalism hinders the development of this type of system as an indispensable means of addressing the major flaws of the fundamental scientific knowledge of economy.

4th disregarded EVIDENT FACT:

Compared to the fundamental scientific knowledge of medicine, the fundamental scientific knowledge of economy is still at a "medieval" level, and therefore, it still has major functional flaws.

A closer look at the current fundamental scientific knowledge of economy will show that it comprises numerous and conceptually different elements that are unrelated in terms of content. For instance:

(1) knowledge of accounting modeling, (2) knowledge of productivity and quality management, (3) knowledge of planning and control, (4) knowledge of human resources (HR) management, (5) knowledge of change management, (6) knowledge of project management, (7)

knowledge of crisis management, (8) knowledge of business modeling, among many others.

It is clear that these elements do not form a robust and monolithic foundation for economic science, in the form of a systemic ontological model of the enterprise for machines, unlike the foundation that was developed by medical science at the very beginning of the Renaissance (in the form of a systemic anatomical and physiological model of the human body).

This means that, in the era of digital information technologies, the fundamental scientific knowledge of economy has only evolved to the level of medieval scholasticism compared to the fundamental scientific knowledge of medicine.

The above is the result of two major flaws intrinsic to the way the fundamental scientific knowledge of economy is commonly taught today:

First major flaw:

The fundamental scientific knowledge of economy does not provide a comprehensive and clear understanding of the principle setup and way of functioning of the enterprise as a systemic **object**. Just as medieval medicine could not provide a systemic explanation of the human anatomy and physiology, so is modern economic science incapable of providing a systemic explanation of the "anatomy" and "physiology" of the enterprise for machines.

Second major flaw:

The fundamental scientific knowledge of economy does not provide an understanding of the principle setup and way of functioning of the enterprise for machines as a systemic **subject**.

In other words, economic science does not provide any systemic knowledge of the nature and meaning of collective, and therefore, of individual professional responsibility for sustaining the operation of an enterprise for machines.

These major flaws, combined with the enormous influence and authority that economic science has in today's Western world, have a strong negative impact on the development of human capital in the industrial sector of the Western world. This negative impact is amplified by the fact that modern economic science denies the historically proven culturally traditional worldview ideas of the basis of the development of Western societies:

(1) it rejects the nature of the Man as a Maker and a Creator in the image and after the likeness of God, (2) it rejects that human virtue is the primary source of economic activity, (3) it rejects that the unity of human labor is the foundation of economic efficacy.

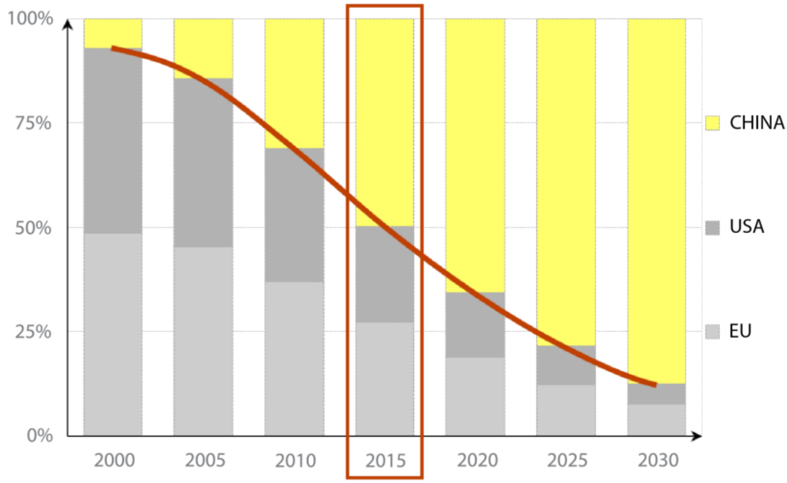
5th disregarded EVIDENT FACT:

The flaws of the fundamental scientific knowledge of economy lead to an unfavorable development of human capital in the Western world.

The flaws of the fundamental scientific knowledge of economy and the fact that modern economic science denies the historically proven culturally traditional worldview ideas lead to an illogical and detached from reality understanding of how the human capital of the countries that have chosen to develop according to the dogmas of this science should be developed and reasonably distributed.

Proof of these claims, but also proof that the Eastern world does not rely on economic science in the management of its future, is manifested in the comparison of the development of the combined workforce potential of the USA and the EU to that of China within the field of machine engineering technologies.

The technological labor force parity between the West and China, as seen in late 2015, might have been slightly exaggerated; however, the exaggeration is in favor of the West. The truth is that China, in regard to the workforce potential for developing the industry for machines, is already ahead.



The trend of development of Western and Chinese technological elites

If this process – as unpleasant as it is for the whole Western world – does not happen to lead to a world war in the coming years, by the end of 2030, the positions from the early 21st century will have swapped.

In line with the theory of "Knowledge Economy" and its inherent idea of deindustrialization, for more than two decades now, the Western world has been purposefully discouraging the development of the engineering human capital of the Western world. At the same time, the Western world has been mass-producing a range of social workers, social science professionals, and above all others, professional economists. And this is even more reckless.

It is reckless because some of the finest young people of the West are becoming professional economists. After four, five, or more years of study at leading universities, these people can write brilliant theoretical essays on the topic of economy, but none of them can actually give a decent explanation of the objective meaning of the term "economy." They are even less capable of explaining a perfectly clear construct – the universal, principle setup and way of functioning of the enterprise for machines in its capacity as an **object** and a **subject**.

It turns out that the Western educational system has been turned into a machine for intellectual and professional distortion of its most valuable human resources. It sounds absurd, but this is a fact. A fact that presents a grave issue for the future of the Western world.

6th disregarded EVIDENT FACT:

The problem with the unfavorable development of the human capital in the Western world has only one reasonable SOLUTION: the development and widespread study of a new type of ERP systems - holistic ERP systems.

Today's digital information technology market offers a wide range of different ERP systems. Alongside these, there is a similar in nature wide range of technology parks engaged in designing and subsequently developing these ERP systems.

The process of designing and developing ERP systems involves the employees acquiring specific, as well as general, ontological knowledge of the systemic setup and way of functioning of various types of enterprises, including enterprises for machines.

Through this process, every employee possessing the intellectual capacity to generate such ontological knowledge independently would inevitably be able to describe the nature of an enterprise for machines using the following three common projections:

First common projection:
Every enterprise for machines is a **subject** that, in turn, belongs to a set of **subjects,** all of which – in their capacity as customers and/or suppliers of machine engineering products and/or services – collectively make up a logical fragment of the global industry for machines.

Second common projection:
Every enterprise for machines is a systemic **object** which comprises a set of **objects** defined as capital assets, some of which are owned, others - borrowed.

Third common projection:
Every enterprise for machines exists in its capacity as a systemically and continuously realized **object** by retaining and re-allocating (altering) its capital assets through the coordinated operation of five technological systems:

(1) Technological system for Sales;
(2) Technological system for Production;
(3) Technological system for Supplies;
(4) Technological system for Financing;
(5) Technological system for Implementation of the Technological Environment of the enterprise.

If these three conclusions are analyzed thoroughly at the level of a technology park and are then employed in a capacity of a cognitive foundation for the development of the functional construct of a new type of ERP systems (holistic ERP systems[2],), this would mark a return of this class of digital systems to the cognitive universalism that they were initially designed to have. This type of system should have exactly seven functional subsystems, ordered and defined as follows:

1) Functional subsystem "Subjects";
2) Functional subsystem "Objects";
3) Functional subsystem "Implementation of the technological environment";
4) Functional subsystem "Sales";
5) Functional subsystem "Production";
6) Functional subsystem "Supplies";
7) Functional subsystem "Finances ".

These seven functional subsystems are just a first step in building the functional construct of this new type of ERP systems. The most important factor is that these ERP systems incorporate knowledge about managerial modeling of the professional development of people who can comprehend the enterprise as a systemic object and subject and, therefore, can bear the responsibility for introducing innovative changes to its development. Incorporating such knowledge would turn this new type of ERP system into

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[2] *Holistic "ERP systems are digital systems for managerial modeling of the economy of the enterprise for machines, as a systemic object and subject, in its (the enterprise's) three aspects: strategic, tactical, and operational. They are designed and based on a holistic business model ontology - a universally applicable knowledge of the principle setup and way of functioning of the enterprise for machines in terms of theory and terminology - derived from industrial practice.*

the most effective, feasible solution to the conundrum of the current, unfavorable development of the human capital in the Western industry for machines. This is true due to the fact that several months of study, both theoretical and applied, of the functional construct of such a digital system would result in knowledge about the economy of the enterprise for machines that is much more valid and applicable than the knowledge that can be formed after several years of diligent study of microeconomics at the most prestigious, specialized universities.

All that is needed is for these digital systems to be studied on a mass scale. Naturally, questions arise:

What is the condition of the technology parks currently engaged in designing a prototype of a holistic ERP system? Have any of these parks made a major breakthrough in designing such a prototype?

This leads us to one little-known fact.

One little-known FACT:

Up until mid-2018, Bulgaria had a technology park operating under the name of IDEUM Base, which made a remarkable breakthrough in designing an effectively functioning prototype of a holistic ERP system.

This Bulgarian technology park, which achieved great success in creating and developing a holistic ERP system, was called IDEUM Base by its founders. IDEUM is the Bulgarian acronym for the phrase Industrial Soul-unifying Managerial Modeling („Индустриално Духовно Единяващо Управленско Моделиране").

The groundwork of the IDEUM Base - as an actual Bulgarian technology park for strategic innovations in the field of fundamental scientific knowledge in economy – was laid in early 1998, when two small Bulgarian companies agreed to cooperate in order to develop a unique IT product for modeling industrial enterprises and systems.

One of the companies had its roots in a software engineering school that was one of the most successful programming schools in Bulgaria in the mid-1990s. The company employed three gold medallists in international programming competitions. Working jointly with four other software engineers, they were involved in completing software development contracts for insurance companies, commercial enterprises, and banks.

The other company was a special venture. It brought together the ideas of two mathematicians and two machine engineers with somewhat unconventional interests and a talent for studying the practical efficiency of the scientific knowledge of economic management of an enterprise. They were well aware of the two major flaws of the fundamental scientific knowledge for managerial modeling of the industrial economy and believed in designing an IT solution that could integrate an improved quality of knowledge - knowledge that explains, complements, and substantively replaces the current scientific knowledge for managerial modeling of enterprises for machines, which can be considered the main building blocks of any well-developed national economy.

The above concept was enthusiastically embraced by the software developers and led to the decision to merge the two companies. The idea for such an IT solution became a shared strategic goal underpinning the 20-year operation of the IDEUM Base.

In pursuing this goal, the IDEUM Base went through three stages of cognitive development.

During the first stage, the IDEUM base developed a cognitive platform designed to provide an understanding and perception of the enterprise for machines as a **systemic object.** Subsequently, based on this platform, the first version of the IT solution for modeling the enterprise as a **systemic object** was designed and launched. This first cognitive platform was called **"The Industrial Cross**."

During the second stage, the IDEUM base developed a second cognitive platform dealing with the meaning, essence, and hierarchy of the knowledge necessary for the existence of the enterprise in its capacity as a **systemic subject.** On this basis, a second version of the IT solution for managerial modeling of the enterprise for machines as a **systemic object and subject** was developed and rolled out for use in scientific research. This second cognitive platform was called **"The Tree of Industrial Cognition".**

During this third stage, IDEUM Base designed its third cognitive platform. It supplemented and deepened the understanding of the enterprise as a **systemic subject**. Based on this platform, the third version of the IT solution for managerial modeling of the enterprise as **a systemic object with a systematically implemented subjecthood** was developed and rolled out for use in scientific research. This third cognitive platform was called **the "Subjecthood Implementation System**."

During all these years, the IDEUM Base continuously carried out secondary research in the academic fields of management consulting and management software, only to determine that academics had not resolved the two major flaws of the fundamental scientific knowledge of economy. The primary research conducted by IDEUM Base demonstrated that the second version of the IT Solution created by IDEUM Base is an indispensable tool for eliminating the first major flaw, and the third version solves the second major flaw of fundamental scientific knowledge of economy.

This third version clearly integrates the understanding needed to create accurate and clear job descriptions. However, it could not be ascertained if this IT solution integrates the effective, practical knowledge necessary to develop the next generation of innovative, technological elites – this conclusion required hard-to-achieve experimental research.

Creating the necessary conditions for this hard-to-achieve experimental research became an integral part of IDEUM Base's endeavors in the years following the third stage of development.

After the necessary conditions for the experimental research necessary to determine if IDEUM Base's third IT product successfully integrates knowledge for the development of the next generation of technological elites (elites who can thoughtfully and deliberately design and develop high-tech industrial systems) were secured, the experimental design was carried out within a year and a half. The results of this experiment are very impressive.

The success of this last experiment, along with the results of all the previous experimental research, leads to the indisputable fact that it is possible to create IT products that integrate improved-quality, even flawless, knowledge for the fundamental scientific knowledge for managerial modeling of the enterprise for machines.

Thus, the IDEUM Base's legacy to the Bulgarian people, and through them to all Western nations, is invaluable engineering knowledge for the design and development of **holistic ERP systems** as a key tool in addressing the issues of the unfavorable development of the Western human capital.

The **six disregarded facts** and the **one little-known fact** we have presented outline the key points that will be addressed in this book. So, let us proceed to Chapter 1, which delves into the First Disregarded Evident Fact.

Chapter 1: The first disregarded, evident fact

The industry for machines is a leading industry of paramount importance for the development of all other industries.

The industry that manufactures and maintains machinery is called the industry for machines. But what is an industry? The term "industry" is currently understood as a multitude of enterprises linked based on their primary activity. According to modern economics, there are many types of industry: manufacturing, construction, agriculture, IT, etc. These industries are then grouped into three sectors: primary, secondary, and tertiary.

The primary sector includes all "extractive industries," i.e., industries engaged in the extraction and production of raw materials - agricultural, logging, mining, etc.

The secondary sector includes all "processing industries," i.e., industries that convert raw materials into a finished product - machine-building, chemical, textile, etc.

The tertiary sector includes all "service industries," i.e., industries that supply services - transport, trade, tourism, education, marketing, etc.

Considered on a global scale, the industry for machines consists of two types of enterprises: (1) enterprises that produce machine goods and (2) enterprises that provide machine services. Based on modern economics, this fact positions the industry for machines in both the secondary and tertiary sectors.

The enterprises that produce machine goods are those which produce a wide variety of machine components, assemblies, and complete machinery, as well as tools, accessories, and devices necessary for the manufacturing, maintenance, and repair of various types of complete machinery and parts thereof.

The enterprises that provide machine services are those which maintain and repair existing machinery.

In the modern world, the multitude of objects defined as machines and machine parts, as well as tools, accessories, and devices for their production and maintenance, is enormous in its scope and variety. Perhaps this multitude - seen as different classes and types of complex artificial objects - is larger in composition than the multitude of all other objects produced by all other industries.

Nowadays, the most diverse artificial objects made by the industry for machines are defined by the generalized term "tech" - from the Greek "τεχνικός," meaning art, craft, craftsmanship. Thus, higher education institutions that develop and disseminate knowledge about the principle setup and way of functioning of these objects are identified as "Technical Universities" or "Institutes of Technology."

But where does the industry for machines originate?

It all began with the development of the six classic, simple mechanisms: the wedge, the inclined plane, the wheel and axle, the lever, and the pulley. A mechanism is a mechanical device that performs mechanical movements in order to convert the energy of an external source into some kind of useful work. A large part of mechanical machinery is based on these simple mechanisms.

The wedge and the inclined plane have been known since prehistoric times. The wheel and axle were invented in Mesopotamia in the fifth millennium BC. The advent of the lever happened around the same time in the Middle East, where it was used to make simple scales and to move large objects in ancient Egypt. The earliest records of the pulley date back to Mesopotamia from the second millennium BC. There is also a seventh classic mechanism, which was invented much later. This seventh classic mechanism is the screw. It first appeared in Mesopotamia around 900 BC.

A machine is a complex mechanism, or a combination of mechanisms, that performs mechanical movements for the conversion of energy and materials to perform work. However, this only applies to mechanical machines. Unlike mechanisms, machines are not limited to mechanics. For example, machines also include electric machines: electric motors, transformers, computers, smartphones, etc., where mechanical energy is replaced by electricity. Thus, we can deduce the following modern definition of the term "machine": a machine is a complex object that converts one type of energy into another.

Machines ease, mechanize, and automate the physical and intellectual work of humans and increase their productivity.

The development of machines begins with the creation of the clock as a time-measuring machine. The first clocks were sundials and appeared around 1500 years BC in Egypt and Babylon. Then, water clocks appeared around 1500 years BC. One of the first machines to ease human labor was the mill. It appeared around 300 years BC and used the energy of flowing water. Another early machine is the ballista, which was used in the military. The first record of the ballista is around 400 BC in Ancient Greece, and it is important to note that ballistae are the first machines in which all processes and mechanisms are subject to preliminary calculations and planning. Later, machines for the manufacturing of weapons were invented, which relied on the use of water mills. These were the first lathes. This is how the history of the industry for machines begins. However, in the middle of the 18th century, this industry was elevated to a whole new level. The First Industrial Revolution marks the beginning of a major shift from manual to machine labor, thanks to numerous inventions and, above all, the steam engine. The First Industrial Revolution began in Britain - the world's leading trading nation at that time - and this revolution made Britain the world's technological leader.

The First Industrial Revolution marked a turning point in the history of humanity. People's lives will never be the same again. In reality, there is no manufacturing industry that was not affected by the introduction of the steam engine. Increasing the economic efficiency of human labor also raised the standard of living, which resulted in significant growth of the Western world's population.

This was merely the first time that the industry for machines changed the entire world.

The First Industrial Revolution was followed by two more, each of which redefined humanity. Both subsequent revolutions were also initiated and realized by the industry for machines.

The Second Industrial Revolution was a period of mass industrialization and began in the late nineteenth century. The prominent inventions during this period were the electrical machines and the emergence of the assembly line. Since the United States was the leader of this industrial revolution, it inherited the title of "world technological leader" from Britain. The multitude of inventions and the possibility of their widespread distribution, which resulted from the advancement of the industry for machines, gave rise to the process called "globalization."

The Third Industrial Revolution, also known as the "Digital Revolution," began in the middle of the twentieth century. It is characterized by the development of semiconductors, mainframe computers (in the 1960s), personal computers (in the 1970s and 1980s), and the internet (in the 1990s). The advent of the computer and the possibility of an instant connection between people regardless of where in the world they were located allowed the expansion of the process of "globalization" to its contemporary level.

Today, we live in a constantly connected world, with high economic efficiency of human labor. A world where we are used to having access to almost anything at any given time. A world populated by 7.9 billion people, up from just 770 million at the start of the First Industrial Revolution (Figure 1.1)

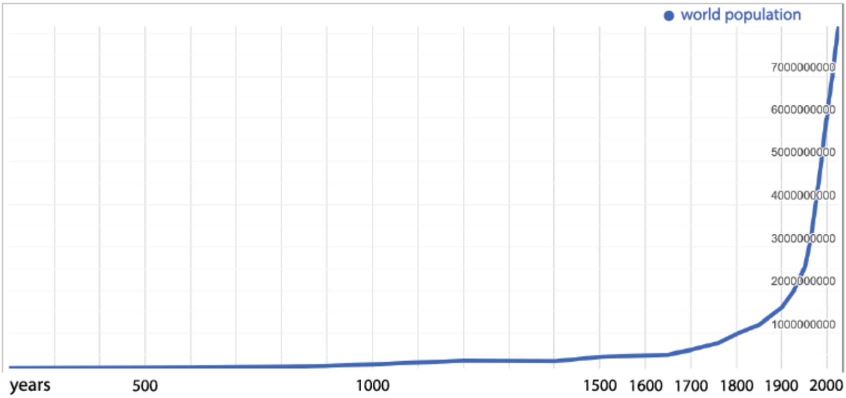

Figure 1.1. World population growth over time

All of this is made possible by the industry of machines.

Realistically, "*Do we need machines?*" The genuine answer is "*Yes!*" but the truth is that we could live without them. People had lived without machines for thousands of years. However, to the question "*Can we live without machines in the 21st century?*" the answer of 99.9% of the population would be a categorical "*NO!*" Mankind has become reliant on the assistance of machines, making it difficult for us to imagine life without them. Let us consider for a moment - "What is the order of magnitude of the increase in economic efficiency of Man since the introduction and the ever-expanding use of machines in the modern agricultural industry?" - in percentages, in dozens of percentages, in times, in dozens of times, in hundreds of times, or more? Let us ask ourselves the same question about the construction industry, the logistics industry, the chemical industry, the IT industry, and so on. The truth is that the industry of machines has increased the efficiency of the former two by the hundreds, and perhaps even more, while the latter two, the modern chemical industry and the IT industry, would be impossible without machines.

When we discuss machines, most people think of the end-product machines, such as submarines, ships, planes, cars, and computers. In truth, the production machines that manufacture the end-product machines are, in most cases, larger and more complex than the end-product machines they produce.

It was precisely the manufacture and maintenance of such production machines that gave our world the immense freedom that writers of the so-called "science fiction" genre, such as Jules Verne, could only dream of.

And yet, the emergence and subsequent development of the industry of machines did not happen by chance. It was based on the efforts and intellect of a multitude of people classed as "mechanical engineers." By the term "mechanical engineers," we do not only include graduates of Technical Universities and Institutes of Technology. For clarity, we define the term "engineer" as a person who practices engineering. Engineering comes from the Latin word "ingenium," meaning ingenuity, intelligence, knowledge, and skill. Engineering is an area of intellectual human activity, discipline, and profession, which is tasked with applying science and technology, understanding the universal natural laws, and using natural resources to solve mankind's problems and achieve the goals and objectives of humanity. According to the American Engineers' Council for Professional Development (ECPD), engineering is *"a creative application of scientific principles to design or develop structures, machines, devices, production processes, or work on their use separately or in combination; constructing or driving them with full knowledge of their design; predicting their behavior under certain regimes."*

Thus, we consider the term "machine engineer" to encompass the whole range of engineers who deal with machinery, regardless of whether these machines are mechanical, electrical, hydraulic, etc. Therefore, "machine engineers" is the umbrella term under which all mechanical, hydraulic, automotive, aeronautical, aerospace, energy, electrical, computer, electronic, and industrial engineers are united. It is precisely the contributions of machine engineers that make it possible to develop the worldwide industry for machines through the establishment and development of the distinct engineering sciences. All of these machine engineers provide the foundational scientific and reference knowledge of the principle of operation of machines that is necessary for the education of engineering students all around the world. This foundational knowledge is then systematically upgraded within each engineering specialization, thus forming the higher education curriculum for the engineering disciplines. Engineering science gradually became a well-defined science with unified theory and terminology, which made it possible to create engineering communities for networking, association, and exchange of experience.

As mentioned, the First Industrial Revolution was a direct consequence of the creation of the steam engine. The first steam engine was created in 1698 by the machine engineer Thomas Savery, and the development of this revolutionary device led to the Industrial Revolution in the following decades.

With the onset of the Industrial Revolution, there was a need for the academic study of the principle structure of machines and technology. One of the first educational institutions in the field of engineering was Gaspar Monge's Polytechnic School, founded in 1794. Electrical engineering was established in the 19th century, and in the 20th century - radio engineering, astronautics, cybernetics, computing, robotics, and others.

The remarkable engineers who contributed to the creation of these engineering fields are many: Nicola Tesla, Alessandro Volta, Michael Faraday, Georg Ohm, James Clark Maxwell, Heinrich Hertz, the Wright brothers, Werner von Braun, and many others.

Through their ideas, labor, inventions, and discoveries, all of these engineers have made immense contributions to the development of mankind.

Just as important is another kind of machine engineer, namely, machine engineers who did not invent end-product machines with a key value to mankind, which is why they are not quite so well-known. In reality, however, their contributions should be considered on a par with the contributions of the inventors of the steam engine, the electric motor, the space rocket, and the like. That is because these machine engineers contributed to the science of the creation, development, and management of enterprises for machines as complex systems of **objects** and **subjects** operating in synchronization. That is, these engineers made it possible for new inventions to be mass-produced and thus be made available to the masses. Such engineers of note are Henry Towne, Frederick Taylor, William Deming, Joseph Juran, Walter Schuhart, Joseph Orlitsky, and Oliver Wight. They were responsible for the inception of the scientific study of the management of mechanical construction enterprises in their entirety. Subsequently, this scientific study was further developed and passed through three waves of development. The engineers mentioned above all worked and lived in the United States. As previously stated, the Second and Third Industrial Revolutions also originated in the United States, thus elevating the U.S.A. to the position of a world leader in technology, trade, and power. We believe that the work of these not-quite-so-well-known machine engineers was integral in the development of the industry for machines, which in turn was a key factor in elevating the U.S.A. to its status as a global leader.

At the end of the 19th century and the beginning of the 20th century, the United States became the source of many brilliant minds in the fields of science and technology. One machine engineer stood out above the rest for his remarkable impact on the overall production process, not only in the United States but also all around the world.

His name was Frederick Winslow Taylor, and he was born in 1856 in Philadelphia. Taylor became one of the prominent persons to mark the so-called "Progressive Age" in the United States. His postulates and methods became the basis of modern production, and even the great Henry Ford followed his rules for "organizing production." Also known as the "Father of Scientific Management," Taylor, along with his teacher Henry Towne, laid the foundations of the science of "management." The development of a new and smarter form of industry based on this knowledge led to the astonishing fact that between 1880 and 1920, the number of professional engineers in Philadelphia alone increased from 7,000 to 136,000 - a nearly 2000% increase.

Another little-known fact is that between 1929 and 1932, due to the so-called "mass industrialization" of the Soviet Union, Stalin contracted the American architect Albert Kahn to train Russian architects and engineers in American technology for the construction of industrial buildings. Under this contract, Khan created a plan for the industrial modernization of the Soviet Union. Khan's company trained over 4,000 Soviet personnel and designed over 500 industrial enterprises. The Soviet Union paid over 2 billion dollars for these services, which is equivalent to about 250 billion dollars today.

A detailed examination of the three engineering waves will be conducted in Chapter 3; however, at this point, it is important to mention that machine engineers play a major role both in the creation and improvement of new machines and in the creation, development, and management of the systems of machines and humans, also known as "enterprises for machines."

We make this explicit statement because nowadays, at the beginning of the second decade of the 21st century, the role of machine engineers and the industry for machines in the achievement of such prosperity in the Western world seems to be forgotten. Today in the West, the profession of machine engineer is seen as "dirty" and lacking prestige. Something we simply cannot agree with!

Western societies seem to have forgotten the beginnings of the three Industrial Revolutions and the fact that none of them started at an insurance company or an advertising agency. It was the machine engineers, not the "brilliant work" of lawyers, economists, marketing specialists, and the slew of other social science professions, that have made the West a world leader and have made our lives what they are today by expanding the scope of possibilities and by creating added value.

What is added value? It means to increase the potential of the environment for human existence.

Production is the primary source of added value, and production is the "goose that lays the golden egg" for the United States. The goose in this analogy is the multitude of machinery companies, farms, construction companies, and mining companies, and the industry that makes them as efficient as possible is the industry for machines. But contrary to modern logic, according to which the management of complex systems ought to be directed by people with economics degrees, the real industry for machines has always been, and will always be, developed and managed by machine engineers.

Why? – We will examine this question in the next chapter.

Chapter 2: The second disregarded, evident fact

The scientific understanding of an ontological model of the enterprise for machines is the most significant knowledge and task of Economic science; this designates it as a "fundamental scientific knowledge of economy."

Having considered the importance of the industry for machines as a supreme leading industry for the development of all other industries in the previous chapter, it is absolutely logical that the way to structure, develop, and maintain the basic building block of this type of industry – the enterprise for machines – should be subject to scientific research and widespread study. Logically, economics should be the science to which this responsibility belongs. It is more than obvious to any sensible person that economics has gained public recognition as the science that can and must create, develop, and disseminate knowledge of the systemic understanding and, therefore, the systemic and thoughtful management of an enterprise. Accordingly, any person who wants to run an enterprise or even start his own business pursues a degree in economics precisely in search of that knowledge. But does such knowledge exist? In this chapter, we will delve into the search for an answer to this question, starting at the very beginning. Let us consider the meaning of the term *"economics"* and what this mythical phenomenon is.

2.1. Understanding the concepts of "Economy" and "Economic Science"

After reading thousands of pages of literature on this topic and examining numerous studies conducted precisely for this purpose, it appears that the answer to this question is not simple at all. Today, at the beginning of the third decade of the 21st century, with its abundance of freely available information on the internet, it takes hundreds of man-hours of focused research to attain a clear and usable grasp of the objective meanings of "economy" and "economic science." But why is it so time-consuming to achieve such an understanding? After all, every well-educated individual who freely and regularly use the internet and other sources of information, but has never set a deliberate or explicit goal to attain such an understanding, believes that they, themselves, have a clear idea of the objective meaning of the terms "economy" and "economic science." And not only that – they also believe that their understanding of these terms is quite similar to the understanding of others like them. But is there a false sense of understanding and insight being created? We are all aware how tendentiously economics universities, management institutes, and the like are multiplying. The vast number of graduates of such educational institutions then go out into the world and intervene at different management levels and regularly participate in the media space, expressing their views on various topics about life in general. We are used to listening to them because we have come to trust that these huge investments of the Western world in developing and disseminating scientific knowledge about the phenomenon called "economics" - investments of billions of man-hours and tens of billions of euros per year – are justified by professional economics textbooks, a considerable number of publications, and copious articles on the matter. These publications ought to contain meaningfully similar definitions of at least the two terms: "economy" and "economic science." However, if one carefully reads and then compares and contrasts the subsequent texts, excerpts from various publications on the internet, and other sources such as books and textbooks on economics, one will realize that the readily bestowed trust is completely unfounded.

The first example of a definition of "economy" and "economic science:"

"Economy- 1) property, wealth, objects, and processes used by people to provision for life, to meet needs in order to create the goods, conditions, and means necessary for human existence through the exertion of labor; 2) A science about ownership, the ways in which people achieve it, the

interaction between people in the process of production and exchange of goods, and the laws and regulations related to ownership." [1]

The second example of a definition of "economy" and "economic science:"

"Political Economy or Economics is a study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing.... We have seen that economics is, on the one side, a Science of Wealth; and, on the other, that part of the Social Science of man's action in society, which deals with his Efforts to satisfy his Wants, in so far as the efforts and wants are capable of being measured in terms of wealth, or its general representative, i.e., money." [2]

The third example of a definition of "economy" and "economic science:"

"The economy consists of the economic system of a country or region; labor, capital, and land resources; economic agents, which are socially involved in the production, exchange, distribution, and consumption of goods and services in that area or region. A given economy is the final result of progress, which includes technical evolution, its history and social organization, as well as its geography, natural resources, and ecology as major factors. These factors determine the context, content, and set of conditions and parameters under which the economy operates. The economy is an inseparable part of the history and structure of society, the origin of the word can be traced back to Ancient Greece, coming from the Greek οικονομία, "the person in charge of the household," a word derived from οικος, home, and νέμω, "distribute, rule." [3]

The fourth example of a definition of "economy" and "economic science:"

"Economy – a vast and multifaceted concept, which different people assign different meanings to. By opening any dictionary, both encyclopedic and economic, one can encounter a variety of interpretations of its

meaning. For some, economy is the business activity of people, while for others, it is the domestic or national property. We can talk about the economy of an industry, the economy of an enterprise, the economy of a country. In the broad sense of the word "economy" - the vitally important system of the state, which solves the tasks of production, distribution, and consumption of various goods and services needed to meet the needs of both the individual, as well as the needs of the collective, such as companies and the state. Humanity can only exist and develop based on the continuous revitalization and repetition of the production processes. Therefore, the economy is the foundation of any society. The economy emerges along with man, exists in one with and in the name of man.

The economy powerfully invades every person's life, and people aspire to know more about it. The study of economic theory allows for the formation of accurate ideas about market mechanisms, for the realization of personal entrepreneurial and work capabilities, and for economically educated decision-making. A modern individual cannot consider himself educated if he has not studied and understood the laws of social development, has not mastered economic knowledge.

Every science arises as a result of people's aspirations to solve certain problems of their life activities. This statement fully applies to economic science as well. Economic science – a branch of knowledge dedicated to the study of rules that allow for the rationalization of the behavior of the economic entity (person, company, state) in solving its economic problems.

Economics emerged as a science in the ancient civilizations and its emergence is associated with the names of scientists from ancient Greece and Rome. The origin of the word "economy" itself originates from the Greek "oikos," meaning home, farm, and "nomos," meaning rule, law. Initially, economics was seen as the science of household management.

With the development of economic theory as a science, the interpretation of its subject matter also changed. Economists are interested in a wide *range of problems, and at different stages of economic development, different groups of concepts are at the forefront of economics. Some economists argue that the purpose of study of economic disciplines is the matter of the material prosperity of society; others – the matters of social security and, above all, the diverse tasks related to the organization of consumption and bartering; a third group – the matters of creating and distributing wealth; a fourth group – the matters related to daily business operations. The purpose of modern economics has been gradually crystallized. Its modern definition is based on the claim that every society is affected by one major economic problem: society's resources are limited or scarce, and its material needs are boundless, and as a result, all economic problems are reduced to one: how to get the greatest benefit at the lowest cost. The focus of economic theory is the relationships that arise between people in the processes of production, distribution, exchange, and consumption of material goods and services in a world of limited resources. The aim of economic disciplines is to achieve the efficient use of limited economic resources to maximize the material needs of people."* [4]

The fifth example of a definition of "economy" and "economic science:"

"Every textbook and dictionary defines economics as a science.

The clear understanding of the subject matter of a science makes sense of its study, and the lack thereof makes its study meaningless. In other words, we must answer the question: what gap of knowledge does the science of "economics" fill, and what practical problems does knowing its principles solve?

The science of economics is the science of choice, human action and its consequences in a world of unlimited needs and limited resources. It deals with the decisions people make based on their needs and the available resources.

But in reality, we live in a world of limited resources. Even the richest people have a shortage of one resource – time. So, in pursuit of their goals *and of the need to meet their needs, each person must choose from a variety of possible solutions at any given time. Each decision has an expected result, but also a missed supposed effect of the alternatives. Most importantly, when we have to choose, we do not know for sure what awaits us with the various options. We can only guess based on our own assessment.*

By making a choice, one inevitably misses alternatives. By making a choice, we assess not only the likely effect of our decision, but also what we lose by not choosing the other alternatives. We often have to choose between a higher yield with a lower chance of success, or a lower yield with more security.

And perhaps the most agonizing dilemma is the choice between "now or later," i.e., the choice between instant consumption or saving for the future. In an enterprise, this dilemma could be exemplified by the decision of whether to reduce current sales in order to invest in machinery and equipment that would increase future profits or not. Considering the alternative cost of each decision, individuals must make a judgment call about the best choice in a given situation. The comparison of the effects of the different options is at the heart of the economic way of thinking.

Many define economy as the science of making optimal use of limited resources to meet boundless needs. ..., while each individual resource is limited, new ways of meeting needs are constantly being discovered, i.e., new things gain "utility," and therefore, become "resources." It is this process of changeable needs and the dynamic means to satisfy them that is the subject of study of economic science. Economics theorizes about the emergence of new ideas and new technologies for new products, about what is being sought at a given moment in time and in what quantity. If we know what and how much should be produced with the available resources and known technologies, then the other fields of science – chemistry, physics, *biology, engineering, and mathematics, will ensure that happens in the best way possible.*

Therefore, it is a good idea to bring some clarity to these concepts and terms. The description of events that have occurred in agriculture is the task of business history. The reason why to some, television is more interesting than theater (or vice versa) is a matter that should be left to psychoanalysts. The calculation of the cheapest way to produce certain goods with predetermined qualities, using available technologies and familiar materials should be a task for mathematicians, or more precisely, for management accountants. The creation of steel with precisely defined qualities for a specific purpose is a task for metallurgical engineers. Economy seeks and analyzes the principles and logical links that follow from individual choices among alternatives with unknown outcomes in the context of fluctuating preferences and limited but innumerable resources." [5]

After repeatedly reading the above text and other similar texts quite carefully, in order to attain a general understanding of the objective meanings of the concepts of "economy" and "economic science", one inevitably must conclude that they are all correctly defined by the initial phrases of the fourth and fifth example definitions, which state:

"Economy – a vast and multifaceted concept, which different people assign different meanings to. By opening any dictionary, both encyclopedic and economic, one can encounter a variety of interpretations of its meaning."

"Every textbook and dictionary defines economics as a science."

If these statements are accepted as true, this raises two hypotheses:

First hypothesis:

The concepts of "economy" and "economic science" <u>are</u> <u>not</u> directly related to the existence of categories of objects which are part of the real world. Therefore, this makes it pointless to make efforts to create, develop, and disseminate a scientific understanding of these terms, which may lead to clear and usable definitions of the objective meanings of these concepts.

Second hypothesis:

The concepts of "economy" and "economic science" are directly related to the existence of categories of objects, which are part of the real world; however, for one reason or another, the professional community of economists has failed to make purposefully organized efforts to create, develop, and disseminate a scientific understanding of these terms, which may lead to clear and usable definitions of the objective meanings of these concepts.

The first hypothesis must be rejected because it cannot be logically correct.

The second hypothesis, on the other hand, suggests that the huge investment of Western society – investments in the form of billions of man-hours and billions of euros per year – has not even resulted in the consistent understanding and precise definition of the two basic concepts upon which all economic science is built upon, and upon which all Western management staff relies.

It sounds scandalous, but it is a fact!

It turns out that it is not easy to obtain a clear understanding of the meaning of "economy" and "economic science", given the inability of the global multitude of "economics professionals" to derive **a unified theory and terminology of the economic science**.

However, we are certain that it is not impossible. In the following paragraphs, we will endeavor to produce clear and succinct definitions of these two concepts by approaching the problem as an engineering design process and by relying on our own investment of hundreds of hours of research into literary sources on the matter. Every engineer knows that an engineering design process requires accuracy and precision, which ought to reflect reality as closely as possible, and ought to utilize terminology that is familiar to all and concepts that are clearly defined because the more precise the content of the process is, the more accurately it can be understood by the people who handle it and use it.

To this end, we will introduce several terms which we believe make it much easier to comprehend the concepts "economy" and "economic science"; however, we will allow you to decide for yourself. Firstly, we will present the history of the use of these concepts.

The etymology of the word "economy" can be traced back through Latin languages all the way back to ancient Greek. It is composed of the roots "oikos"- home, property, and "nomos"- rule, law. The term "economics" came into use in the first half of the 16th century and is understood as *"laws and rules for home property management that ensure cost-effective and prudent use of resources."* Based on this concept, the concept of "polit-economy" emerged in the mid-17th century with reference to the wealth and resources of a country or governing state. The emergence of the term "polit-economy" marked the beginning of an academic discipline that studies production and trade within a nation and their influence on customs, laws, and governance, including the existing distribution of the national wealth. At the end of the 19th century, the term *"economics"* was introduced as an abbreviation of *"economic science"*. This term, then, replaced "polit-economy" as a concept.

In order to provide a clear meaning of our definition of "economy" and "economic science", we also need to clarify a phrase that is not common in the scientific literature: *a **"systemic object carrying systemic subjecthood."***

"Subjecthood" *is an essential property of observable objects, which are parts of the global environment for human existence. The characteristic "subjecthood" defines these objects as capable of knowing and transforming both the world around them and themselves. In other words: the concept of "subjecthood" characterizes objects that are capable of being active* *and independent, capable of analyzing the nature and meaning of their own existence, and based on that analysis, set and achieve strategic and enduring objectives through which to realize their essence and meaning in a specific way. All objects that bear the property of "subjecthood" are, by their physical, existential nature, systemic objects. These systemic objects can be one of two kinds, based on their origin:* ***"natural" and "artificial."*** *The only systemic objects of natural origin that bear the property of subjecthood are people. The subjecthood of an individual is unique and personal and entirely dependent on the unified and continuous function of the physiological systems of his body: neuropsychological, respiratory, cardiovascular, digestive, and others. According to Christian teachings, personal subjecthood is derived from an ideal object that inhabits every person's physical body from birth to death. This ideal object is of divine origin and is defined by the meaningfully unified concept "spirit and soul." The highest possible level of personal subjecthood is achieved through systemic modeling of personal existence in three spiritual aspects: (1) ambitions, (2) possibilities, and (3) reality.*

The characteristic "subjecthood" is also inherent to artificial systemic physical objects, which inevitably contain a multitude of human individuals that work together in a system. These humans, in their capacity as physically distinct sources of labor, ensure the synergy of the functional systems of these artificial systemic objects for the realization of their existential purpose. ***Through the systemic unification of the personal subjecthood of the human staff that services the various functional systems, such an artificial systemic object can understand and transform both itself and the world around it.*** *Thus, this object is bearer of the characteristic "systemic subjecthood." In practice, objects bearer of the characteristic subjecthood, regardless of whether it is personal or systemic subjecthood, are called* ***subjects.*** *Similar to* ***personal subjecthood,*** *the highest level of fully-functioning* ***systemic subjecthood*** *is achieved by modeling the existence of the* ***object,***

bearer of the characteristic systemic subjecthood, *in the same three aspects: (1) ambitions; (2) possibilities; and (3) reality*." [6]

From a global point of view, the multitude of artificial objects that can be characterized by "systemic subjecthood" is large and diverse, but within the human world, the most important are those that fall within the meaningful scope of the concept of "economy."

Therefore, we conclude that the concept of "economy" forms an idea of the process of manageable existence of artificial systemic objects, bearers of the characteristic systemic subjecthood, generally labeled as "economic units." In the modern world, the multitude of objects defined as "economic units" are divided into three types: (1) geopolitical economic unit, (2) industrial economic unit, and (3) household economic unit. "Geopolitical economic units" are (1) countries, (2) the politically administrative regions of a country, which are called provinces and states, and (3) the towns and villages with their suburban territories and rural lands. "Industrial economic units" are (1) individual enterprises of various types and sizes of activity, and (2) associations of enterprises in the form of corporations and holdings. "Household economic units" are (1) family households, different in terms of human relationships and property ownership, and (2) single-person households, considered special cases of family units.

The three aspects of the concept of "economic unit" give three aspects of the concept of "economy:" (1) geopolitical economy, (2) industrial economy, and (3) household economy. The term "geopolitical economy" has specific manifestations in three geopolitical aspects: (1) provincial, (2) national, and (3) international.

The national aspect of the geopolitical economy, referred to as the *"national economy,"* gives an idea of a nation as a territorially identifiable object, bearer of the characteristic subjecthood for its realization as a safe and just technological environment for the fulfillment of a variety of functioning household and industrial economies. These economies form the building blocks of the national economy and are linked to it and to each other through debit-credit relations.

The concept of *"industrial economy"* outlines the existence of an enterprise as a systemic object, bearer of the characteristic systemic subjecthood for its realization as a functional system of processes that works for the fulfillment of a number of family economies, of enterprises, and of the national economy – linked to them through debit-credit relations.

The concept of *"household economy"* outlines the existence of a family household as a systemic object, bearer of the characteristic systemic subjecthood for its realization as a functional system of processes that works for the continuation of the family. The family economy achieves this by participating in the process of fulfillment of the multitude of enterprises, family households, and the national economy - linked to them through debit-credit relations.

Thus defined, the meaning of the term "economy" leads to the conclusion that the political management of a country's economy is reduced to the management of its many enterprises as a means to secure the just and dignified future of its many family households. This means that the knowledge of an ontological model of an enterprise in its capacity as a systemic object, bearer of the characteristic systemic subjecthood for its existence as a building block of the geopolitical economy, is a fundamental knowledge of the managerial modeling of the economy in its three aspects: (1) geopolitical, (2) industrial, and (3) household.

Logically considered, the scientific knowledge that should form the understanding of the principle setup and way of functioning of such objects should be defined by the term "fundamental scientific knowledge of economy." That is to say, **the global educational and research community, which creates, develops, and expands professionally recognized knowledge for the managerial modeling of the economy – the national, industrial, and household – falls under the term "economic science."**

It is assumed that modern economic science has two strands: microeconomics and macroeconomics. The former provides scientific knowledge for the management of the industrial economy, and the latter – is for the geopolitical economy. Household economy is only considered peripherally and only in relation to the national economy, as it only marginally falls within the scope of modern economic science.

Thus, defined by us, the concepts of "economy" and "economic science" fully support our second hypothesis that the professional community of economists has failed to make purposefully organized efforts to create, develop, and disseminate a scientific understanding of these terms, which may lead to clear and usable definitions of the objective meanings of these concepts. A fact that many other engineers who have come before us have reached, a fact that will become evident in Chapter 3. Furthermore, based on these definitions, it becomes clear which classes of real-world objects economic science ought to study and analyze – the artificial systemic objects, bearers of the characteristic subjecthood, or in other words the economic units.

And now, based on our new understanding of the concept of "economy," we should move on to the next step in the search for scientific knowledge of an ontological model of the economy of the enterprise for machines; scientific knowledge that can be defined as "fundamental scientific knowledge of economy." To this end, we will draw a parallel with an already exceptionally well-developed science: medical science.

2.2. The parallel between economic science and medical science.

This unconventional comparison is inspired by the fact that based on their civil purpose, both medical and economic sciences are primarily tasked with establishing an *objective knowledge for the principle setup and way of functioning of systemic objects, bearers of the characteristic subjecthood.* In this paradigm, for medical science, this systemic object is the human body, and for economic science, in our opinion, the systemic object ought to be the enterprise for machines, in its role as a building block of the engineering industry, which as we have demonstrated in the previous chapter, is the ultimate leader in the development of all other industries.

But firstly, let us examine an excerpt from a medical encyclopedic dictionary in order to understand what is accepted as fundamental scientific knowledge of modern medicine:

"Medicine- this is a science that studies a person in a healthy and unhealthy state in order to strengthen his health, prevent illnesses, and treat said illnesses. In this sense, medical science's task is not only to treat the sick but also to strengthen the health of the healthy.

It is perfectly obvious that the tasks of medical science cannot be solved without the knowledge of how the human body is set up (i.e., anatomy) and how it functions (i.e., physiology). For this reason, medical science is based primarily on these two sciences – anatomy and physiology.

Human anatomy and physiology – these are closely related biological sciences, the focus of which is the human body. ...

Human anatomy (from the Greek "anatome"- slicing) - this is a science which studies the from, external and internal structure of the human body. Human physiology (from Greek "phisis" nature and "logos"- science) studies the vital processes and patterns of the function of the human organism, its separate systems, organs, tissues, and cells. Human anatomy and physiology are inseparable from medicine, they are its foundation.

...

When studying the construction and functions of the human organism, it is accepted to distinguish the interconnected structural and functional parts of the organism – organs and the systems created by them.

Organ – this is a distinct part of the body with a certain structure and position. An organ consists of different tissues, and one of these tissues is considered the main framework of the organ. All organs are supplied with *blood, lymphatic vessels, and nerves. ... Tissue – a collection of related cells and intercellular substances with a particular structure, location, and origin in the embryonic developmental process and which perform a specific function.*

Organ system – this is a set of united organs that perform a specific function and that are connected in their development. The human body consists of the following organ systems: (1) the musculoskeletal system, which consists of two parts – the skeletal (bone) system and muscular system; (2) nervous system; (3) endocrine system; (4) digestive system; (5) respiratory system; (6) cardiovascular system and (7) urinary-gender system.". [7] [8]

Reviewing this citation and other such materials – there are plenty of them on the internet - demonstrates that the anatomy and physiology of a normally developed, middle-aged human are accepted as the fundamental knowledge of modern medical science. In other words: the fundamental knowledge of modern medical science is the knowledge of an ontological model of the living human body - a systemic anatomical and physiological model that creates a complete and true understanding of the design and manner of existence of this type of object (the body of a living individual).

Similarly, modern economic science should be based on a systemic ontological model that gives a complete and true understanding of the principle setup and manner of existence of its object of study, namely the enterprise for machines.

To further demonstrate the validity of this comparison, two other analogies can be made: (1) an analogy between the term "human life" and the term "economy of an enterprise for machines"; and (2) an analogy between the term "human body" and the term "capital of the enterprise."

Anyone who has studied the disciplines called "enterprise economy" or "industrial economy" should know that at any given moment of its existence, an enterprise for machines is a purposefully aligned and systemically organized multitude of objects, governed by the enterprise in its role as a subject. Two questions naturally arise from this definition: (1) *What is the purposeful alignment of this multitude of objects?* and (2) *What is the systemic organization of this multitude of objects?*

To answer the first question, it can be said that any enterprise for machines (as a systemically organized variety of objects) exists to increase the potential of the geopolitical environment for all human existence. It achieves this objective by providing the geopolitical environment with products it manufactures or services for machines that it provides in return for payment. The public value of its existence is determined based on the "economic result" - when this result is positive, it is called "profit," and when it is negative - "loss." In the current practice of economic science, the set of objects that form the structure of the enterprise for machines as a purposefully aligned and systemically organized variety of objects, bearers of the characteristic artificial subjecthood, is defined by the term "the capital of the enterprise." The capital of the enterprise for machines justifies the purpose of its existence with consistent movement through the space-time continuum of the global world. Through this movement, the capital of the enterprise "lives." And through this movement, the capital of the enterprise realizes itself as a subject with a specific purpose – to increase the potential of the environment for human existence. If this movement ceases, the capital "dies." If the movement is not restored, the capital becomes irreversibly dead; it becomes a "corpse," which necessitates "a burial" called "liquidation." But let us return to its life through movement.

The movement of capital in each enterprise takes place through the unified function of five technological systems that are integral to it. [6] Four of these systems are well-known and recognized, while the fifth, which is the most complex and important, is still unidentified by modern economic science. At this point in the book, we shall not comment on the fifth, most important system (here, it is numbered as fifth, but in practice, it is essential to the enterprise and in primary position from a "life cycle" perspective). In this portion of the book, we will comment on the four well-known technological systems. They are the "sales" system, the "production" system, the "supply" system, and the "financing" system. These systems propel a process known as "capital turnover." Therefore, just as the unified function of the seven organ systems of the human body ensures its life and existence, these five technological systems are vital for the function of the economy of the enterprise.

The development and management of the capital are determined by the economy of the enterprise, just as the function of the human body depends on the sustenance, growth, and formation of ideas of the individual about his existence and the existence of the objects within his surroundings. The analogy between the term "human life" and the "economy of an enterprise" demonstrates the importance of a thorough understanding of each of these entities within these two sciences.

The conclusion that the comparison between medical science and economic science is more than reasonable has gradually emerged.

And thus, we have arrived at the key question: *"Is there scientific knowledge of the ontological model of the enterprise for machines?"* Because if there is such scientific knowledge, then this knowledge would be the fundamental scientific knowledge of economy, just as the knowledge of the anatomical and physiological model of the human body is the fundamental scientific knowledge of medicine.

2.3. Publicly accepted scientific knowledge of the ontological model of the economy of the enterprise for machines.

We assume that most of you have guessed that the current scientific knowledge of the ontological model of the economy of the enterprise for machines is the knowledge of its accounting model. The knowledge about this model is popular as "accounting," while the model itself is known as a "balance sheet and profit and loss statement." Here it should be added that "accounting" is applicable not only to the creation of a model of the economy of any enterprise for machines but also to the economies of all other enterprises. But is the knowledge of the accounting model of the enterprise for machines as applicable to the effective management of the economy of the enterprise as the knowledge of the anatomical and physiological model of the human body is to the effective management of human life? Is the accounting model sufficient for the systematic upgrade and development of the enterprise? We will look for the answer to these questions in the critical analysis at the end of this chapter, and to this end, we will provide a brief overview of the history of accounting.

An online source on the topic of "History of Accounting" states that the international emblem of accountants depicts the sun, scales, and the Bernoulli curve. The sun symbolizes financial accounting, the scales – a balance sheet, and the Bernoulli curve is a symbol that signifies that accounting, once established, will last forever. The motto is written as *"science, conscience, independence."* In the historical development of accounting, two stages clearly stand out: the first can be defined as simple (single entry) accounting and the second as complex (double-entry) accounting. The most ancient accounting artifacts date back several thousand years before the New Era, from the valley of the Nile (ancient Egypt) and the Tigris and Euphrates rivers, where Assyrian, Babylonian, and Sumerian civilizations flourished at the time. Agriculture was flourishing, and the trade industries for the production of goods and services were developing in the cities. There were even banks. In this era, governance was theocratic, and the rulers - messengers of God, controlled almost all of the available land and livestock. This, of course, required accounting activity. In the 23^{rd} century BC, a law was passed in Babylon according to which each sale of goods had to be accompanied by a written statement of the price of the transaction. Without such a written record, the transaction was deemed invalid. At that time, the role of the accountant was performed by a scribe. The scribe not only prepared a written record of the transaction on a clay tablet but also oversaw the appropriate enforcement of the law in the execution of the transaction. Thousands of scribes worked in temples, palaces, and even had private practices. Their profession was considered extremely prestigious. Accounting in ancient Egypt developed similarly to accounting in Mesopotamia; however, the significant difference was that instead of clay tablets, they used papyrus, which allowed the records to be much more detailed. A complex system of audits allowed for verification of the credibility of Egyptian accountants. They had to be as careful and honest as possible because violations were punished with fines, amputation of body parts, and even death. In ancient China, accounting was the main tool for assessing the effectiveness of government programs and the honesty of officials who implemented them. During the reign of the Zhao Dynasty (1122 - 256 BC), an accounting system was developed, which was utilized until the mid-19th century, when it was replaced by double-entry accounting. In ancient Rome, accounting was developed based on the records traditionally kept by the heads of families. The household income and expenses were recorded daily, summarized on a monthly basis, and then transferred to a special book for safekeeping. Such an accounting report was necessary because the citizenry had to provide regular information about their financial situation. This data was used for taxation on the basis of which civil rights (social class position) the citizen belonged to. In the Middle Ages, the tradition of Roman accounting continued. One of the main tasks of the feudal lord was to exercise control over the hired rulers by auditing of their accounts. However, in the Renaissance era, the simple notations of the Romans no longer met the growing needs of the trade industry. New forms of accounting and record keeping were emerging and were being implemented in banks. These new forms of accounting were first used by Italian merchants, as at the time, Italy was not only an intellectual epicenter but also a central hub of world trade. The transition to a new stage in the development of accounting gives rise to the idea of double-entry (debit-credit) bookkeeping of business operations. The idea of double-entry bookkeeping was developed in the Middle Ages, but its widespread dissemination and popular practical application only gained momentum after 1494. In 1494, the Italian Luca Pacioli, who had a Ph.D. in theology and was a Franciscan monk, published several scientific papers on mathematics in a book entitled "*Sūma de Arithmetica Geometria Proportioni & Proportionalita*" meaning "All about Arithmetic, Geometry, Proportions, and Proportionality." It was precisely in this book that Luca Pacioli summarized and systematized the double-entry (debit-credit) bookkeeping system of Italian merchants and became known throughout history as the "father of accounting." The book contains a separate chapter, "Treatise on Accounts and Records," which describes the Venetian accounting system (known today as double-entry accounting) for the very first time. Many accounting terms that are still in use today are defined, such as debit, credit, balance sheet, assets, capital, liabilities, turnover statement, etc. Additionally, instructions for accounting processes, such as year-end closing, are given. Topics such as ethical norms in the accounting profession and value calculation are addressed. Today, it is well-known that the first book describing the double-entry accounting method was Benedetto Cortula's book, titled "On Commerce and the Modern Merchant." This book was written by hand in 1458; however, it was not printed until 115 years later in 1573. For this reason, Luca Pacioli is recognized as having written the book which initiated a new stage of development in the accounting profession. Considering once more the great machine inventions that changed humanity, it can be concluded that one of the main culprits in the popularization of the modernized accounting methods was the great invention of the 15th century, called the printing press. The double-entry accounting system that originated in Italy began to spread: first in France and Germany, then in England and Scandinavia, then to the west in Spain, and finally across the Atlantic Ocean to America. To the east, its route passed through Poland, then through Russia (in the 18th century), to eventually reach China and Japan in the 19th century. The second half of the 19th century and the beginning of the 20th century was a time of rapid economic development, both in Europe and in North America, represented by the United States. This same time interval also led to the realization of the fact that double-entry bookkeeping was the only practical knowledge that could be used for modeling of the economy of the enterprise for machines, even though it could only be actioned at fairly large time intervals (monthly, quarterly, yearly), and what is more concerning is that it could only be done after the fact. The growing public and social importance of the double-entry accounting system – due to its greater application potential but also complexity compared to the single-entry accounting system – made it necessary to regulate how accounting information is created and used. Accounting legislation, which included the balance sheet and income statement, was developed in most European countries. Legislation in many countries obligates traders to publish their accounts in order to reduce the risk on the part of shareholders, investors, and other stakeholders.

2.4. Critical analysis

In order to answer the question, "*Are the knowledge of the accounting model of the enterprise for machines and the knowledge of the anatomical and physiological model of the human body comparable in terms of quality in their respective fields*?" we should recall two key accounting tools: the first is called "a balance sheet" and the second - "a turnover statement." In short, the balance sheet represents a model of the capital of the enterprise in the form of assets and financing at two moments in time. The turnover statement is a model that depicts the actual changes that led to this conversion of the state of the capital at the beginning moment in time to its state at the end moment in time. This aggregate object (called "capital") undergoes structural changes in the space and time of the real world.

These structural changes are dependent on the nature and basic structure of the enterprise and its purpose. These changes can be linguistically expressed through two phrases: "the process of existence of the enterprise," which is a colloquial expression for the "economy of the enterprise," which is a specialized scientific term. Critically speaking, knowledge of accounting modeling of the process of existence of the enterprise has two significant shortcomings in terms of management. Firstly, it does not provide a systemic understanding of the principle setup and way of functioning of the enterprise as an object and a subject, which immediately makes the knowledge of the accounting model inferior to the knowledge of anatomy and physiology of the human body; and secondly – it can only be applied to past events – what was the state of the enterprise's capital at the end of the month and what structural changes have led to this state, visible only 10 to 15 days of the following month. The long-standing head of the United States Federal Reserve, Alan Greenspan, made a persuasive analogy between the accounting model for management and driving by only using the rear-view mirror in his book "Age of Turbulence."

Despite these defects, knowledge of the accounting modeling of the enterprise is the only part of modern economic science that provides practical knowledge of modeling the existence of the enterprise within the national economy. Indirectly, evidence that supports this thesis is the fact that the application of the accounting modeling of the enterprise is regulated by law. Our research has shown that there are no other scientific disciplines that are regulated by special laws.

At the same time, the use of incomplete knowledge that is more than 500 years old to manage the economy of the enterprises for machines, which are far more complex than those for which the accounting model was created, further reinforces the thesis posed at the beginning of this chapter.

The inability of the professional community of economists to make purposefully organized efforts to (1) clearly define the object of study of economics and hence (2) create, develop and disseminate scientific understanding of the terms "economy" and "economic science," which may lead to clear and usable definitions of the objective meanings of these concepts, and subsequently (3) create a unified theory and terminology to explain the process of existence of objects studied by economics, is a fact. This fact is shocking, but the consequences can be disastrous. The magnitude of this crisis in economic science will become increasingly clear as this book progresses.

The gaps in knowledge of the accounting model, from the point of view of managing the efficiency of the industrial economy (mainly the efficiency of industrial labor), as well as a clear awareness of the fact that economists are unable to create a unified theory and terminology for the process of existence of the enterprise for machines, have led engineers working in those enterprises to create additional knowledge to compensate for these flaws. And that takes us to the next chapter.

Chapter 3: The third disregarded, evident fact

The history of the fundamental scientific knowledge of economy clearly shows three engineering waves of development, all having their origins in the USA.

In the previous chapter, we concluded that the knowledge of the accounting model of the economy of the enterprise for machines is the most effective method for managerial modeling in the field of economics to date. Therefore, it should be defined as a "fundamental scientific knowledge of economy." However, as we have already explained, the economy is a process of manageable existence of economic units, in other words, systemic objects characterized by subjecthood. The accounting model provides knowledge for analyzing past states of the economy of the enterprise, but throughout the years, especially during the Second Industrial Revolution, people managing and working in enterprises for machines have required real-time modeling or even future projections. This type of analysis requires knowledge about the management of the efficiency of the production process, the efficiency of the labor of individual workers, as well as an understanding of the modeling of separate operations within the enterprise. And this is precisely how the great American engineering minds intervened.

The First Industrial Revolution (1760 – 1840) launched the USA's transition from a country relying mainly on agriculture to the most robust industrial country in the world. After that came the Second Industrial Revolution (1870-1914), which was concurrent with the "Progressive Era," a period that marked the greatest economic development in the United States. The "Progressive Era" paved the way for many political reforms, as well as truly remarkable inventions and discoveries; however, what the American machine engineers achieved in the field of fundamental scientific knowledge of economy deserves a tremendous amount of respect. Starting at the end of the 19th century, they initiated three engineering waves in the development of the fundamental scientific knowledge of economy, which were key to the development of this knowledge of economy. Let us retrace history to understand how and why.

3.1. First engineering wave in the development of the fundamental scientific knowledge of economy

The first engineering wave in the development of the fundamental scientific knowledge of economy consisted of **the creation, development, and dissemination of the knowledge of operational modeling of processes in the enterprise**. It was associated with the American engineers **Henry Towne and Frederick Taylor.** At that time, Henry Towne was a well-known businessman and the director of a number of companies. He was also the president of the American Society of Mechanical Engineers (ASME) from 1889 to 1890, and as of 1921, he became an honorary member. Having had the idea that engineers ought to have a leading role in the field of economics as early as 1886, Henry Towne wrote a publication entitled "The Engineer as Economist." According to him:

"(Shop management) should come from those whose training and experience has given them an understanding of both sides (viz.: the mechanical and the clerical) of the important questions involved. It should originate, therefore, from those who are also engineers and, for the reasons indicated above, particularly from mechanical engineers. [9]

Henry Towne justifies this statement by the fact that engineering science has earned its place among the modern sciences and has made remarkable progress in its systematic development, but the science of enterprise management is no less important. Unfortunately, around the 19th century, it is precisely the field of enterprise management that lacks any systematic effort to create a foundational knowledge curriculum. Towne appealed for the establishment of a commission, which based on the accumulated publications and experience, would derive scientific, objective knowledge for the effective modeling of industrial enterprises. During the next few decades, Towne's appeal was echoed by the man he groomed as his successor as president of the American Society of Mechanical Engineers (ASME) - Frederick Taylor. Taylor's postulated that "scientific management" stood out as a significant advancement in the field.

Frederick Winslow Taylor was born in Philadelphia, the second largest city in the United States at the time. At the end of the 19th century and the beginning of the 20th century, Philadelphia was a leader in the industrial and machine engineering sectors. The engineering profession grew in popularity astonishingly quickly. Between 1880 and 1920, the number of professional engineers in Philadelphia rose from 7,000 to 136,000, a nearly 2000% increase. As an American machine engineer, Taylor became one of the first management consultants. He fully dedicated his professional life to devising methods for increasing production efficiency, thus becoming known as "the father of scientific management." More than 100 years ago, Taylor authored works that outline key knowledge in business management that remains valid today and is still applied in business consulting.

As a result of his years of work, he found solutions to various significant engineering and technological problems that he outlined in his publication "The Principles of Scientific Management." One of the developed procedures allowed 140 people to carry out the work that previously required more than 400 laborers. Taylor's approaches to solving management problems are based on the application of methods developed by engineers to solve technical problems. He seeks to prove that *"the best management is a true science, resting upon clearly defined laws, rules, and principles, as a foundation."* [10]. As Towne's successor, Taylor inherited the enlightened idea that imposing science is an indispensable means of improving society and its members. He advocated for the "**standardization of methods**" and the "**standardization of the terminology**," which became characteristic of this system towards the end of the century. In his own words, *"the fundamental principles of scientific management are applicable to all kinds of human activities, from our simplest individual acts to the work of our great corporations, which call for the most elaborate cooperation"* [10].

Scientific management, or the so-*called "Taylorism,"* refers to the rational restructuring of work practices and working conditions, as well as to changes in the management of the workforce in order to significantly increase labor productivity. According to Taylor, this is achieved by systematically studying and analyzing the work process, as well as by using accumulated knowledge to *"eliminate waste"* [10] in production — loss of labor, loss of talent, loss of material, loss of time. It is reasonable to state that Taylor was the inventor of "describing techniques in advance" (Standard Operating Procedures) in modern production.

The principles of Taylor's scientific management focus on optimizing the time spent performing work tasks by studying them, simplifying them, and breaking down complex operations into smaller tasks. Once simplified, the operations are assigned to workers, and they can easily be trained to deal with their specialized sequence of work operations, movements, and actions in the best possible way. According to Taylor, there is only one optimal way for every worker to work, and this optimal way must be discovered through scientific analysis and research of the labor:

"Nine-tenths of our trouble has been to "bring" those on the management's side to do their fair share of the work."

"The idea of peace must replace the old idea of war on both sides."

"Scientific management has for its very foundation the firm conviction that the true interests of the two are one and the same; that prosperity for the employer cannot exist through a long term of years unless it is accompanied by prosperity for the employee, and vice versa." [10]

These are some of the most significant claims of the *"father of the scientific management."*

Before Taylor developed his methods to increase productivity, the production process was in the hands of experienced craftsmen who had acquired their skills over many years of apprenticeship. These masters had autonomy in the work process and could decide how to distribute work and complete tasks. The scientific management method strips the masters of their autonomy and breaks down their complex crafts into a series of simplified actions that can easily be learned and carried out by far less experienced workers. These inexperienced workers receive easy and quick training instructions to handle much simpler tasks. In order to optimize work, Taylor also introduced the use of chronometers so that the time allocation for various tasks can be measured and the efficiency standards for each task can be strictly adhered to. By analyzing work behavior and using scientific methods, Frederick Taylor introduced revolutionary for its time principles to deal with "slacking off" and to increase productivity. Taylor's ideas regarding remuneration are also very important. He proved that high working wages result in cheap production costs. For this reason, he advises companies to establish a fair and reasonable minimum pay for each position and then to develop a system that stimulates and rewards those who work above the accepted minimum level of performance. During Taylor's time, these principles were applied in numerous factories in the United States, resulting in a more than three-fold increase in productivity. Taylor also attempted to popularize his concept of streamlining administrative work in a production plant. His idea was to divide administration between 8 middle-level managers, each of whom would be responsible for different types of activities.

Frederick Taylor confirms Henry Town's thesis that "Management" is a separate scientific discipline and should, therefore, be studied independently. He clearly understands that a weak and inefficient manager means ineffective management of the whole enterprise. Therefore, continuous training is essential for the prosperity of any company, whether large or small. Thus, scientific management ought to be studied and practiced.

In 1906, Taylor received significant public recognition — he was elected as the president of the American Society of Mechanical Engineers (ASME). In this capacity, he published his work: *"On the Art of Cutting Metals,"* designated by experts as a "masterpiece" in the field. To the members of the American Society of Mechanical Engineers (ASME), Taylor presented two influential reports - "A Piece-rate System" and "Shop Management." In 1911, Frederick Taylor published what may be his most important work, *"The Principles of Scientific Management."* The year of the publication of this book marks the birth of scientific management. It is believed that since 1911, Taylor's book has helped increase labor productivity more than 100 times and has served as an *"instrument to eradicate poverty"* in many parts of the world. In this way, scientific management was being implemented by engineers in mass production, which was subsequently used exceptionally successfully by Henry Ford in the automotive industry. During his career, Ford hired Taylor to help him achieve greater production efficiency. In this way, on the one hand, Ford achieved a combination of high-performance, large-scale, vertically integrated production and, on the other hand - high wages and low production costs.

Henry Ford's main achievement was that he turned the car into the primary mode of transportation for Americans. Furthermore, he also stimulated the wealth and welfare of the whole population by stimulating the development of many auxiliary automotive industries, such as road construction, oil and gas supply, etc. Historically, Henry Ford is known as one of the greatest industrial figures of the 20th century. By applying Taylor's scientific management, Ford became a major visionary in creating the conveyor system of mass production and developing the "product of products" of the 20th century – the automobile.

As a result of the first engineering wave in the development of fundamental scientific knowledge of economy and the multiplicatively increased capacity and quality of production, the United States became a geopolitical leader. A fact that is especially noticeable after each of the two world wars.

3.2. Second engineering wave in the development of the fundamental scientific knowledge of economy

The second engineering wave in the development of the fundamental scientific knowledge of economy consists of the creation, development, and dissemination of knowledge of production management focused on the quality of the manufactured products. The idea of quality control was not a new concept. It originated in ancient times through "fear of punishment." Hammurabi, a king of Babylon in the 18th century B.C., was the first official to formalize a quality control law in "Hammurabi's Code of Law." According to Hammurabi's legislature, a builder paid with his life for poor construction. [5] The idea of quality control management through the fear of punishment works to this day, but this method is very distant from the "second engineering wave." The second engineering wave involves the creation, development, and dissemination of an integrated system for managing the quality of manufactured products. The pioneers in this area of development were the American engineers Walter Shewhart, William Deming, and Joseph Juran.

Walter Shewhart was the first to use statistical methods in quality control. Due to his experience as an engineer, he understood the tremendous practical importance of purposefully and consistently eliminating the causes of unacceptable deviations that occur in the production process and the supply of engineering goods and services. Shewhart developed a method for controlling production and supply by successfully utilizing statistical control charts, which are now known worldwide as "Shewhart control charts." Walter Shewhart's methodology was further developed and enriched by William Deming. Deming took this concept to a new and much higher practical level. An important aspect of Deming's ideas is that quality is seen as a responsibility at each organizational level, including the highest organizational level – management. Deming expressed his views regarding the secret to the success of an industrial organization as follows: *"The basic problem anywhere is quality. Where is quality made? The answer is by the top management. The quality of the output of a company can not be better than the quality determined at the top."* [11]

This idea was not new. It was also formulated by Fredrick Taylor, who said, "Nine-tenths of our trouble has been to "bring" those on the management's side to do their fair share of the work." [10] In his organizational management model, Deming necessitates cooperation not only between all the employees but also between all the department units in the name of improved product quality. Moreover, he requires that staff undergo recurring training and retraining in order to focus them on achieving ever higher quality as a team. "Shewhart Cycle," which later became known as the "Deming Cycle" (Figure 3.1), was developed to illustrate this concept. The Deming Cycle is a flow diagram that highlights the cyclical process of learning and the continual improvement of a product or process.

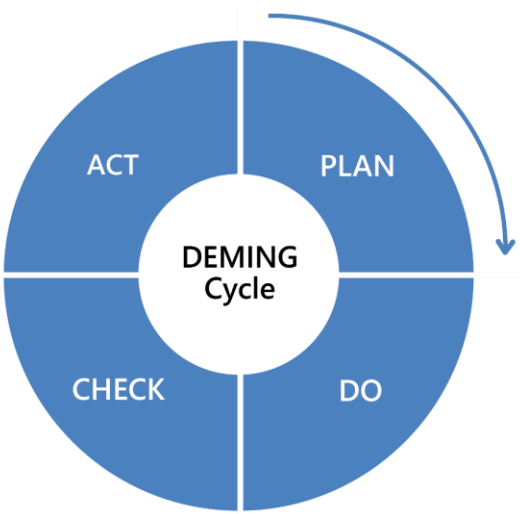

Figure 3.1. The Shewhart /Deming cycle

Eventually, Deming changed the term "Check" in the cycle and renamed it to "Study" because, in his opinion, the term "Check" prioritizes inspection over analysis of the operation.

Similar to the way the Deming cycle serves as a visual representation of the cyclical process of learning, Joseph Juran created a visual representation of the quality control method, which he named the "spiral of progress in quality." The "spiral of progress in quality" identifies the main stages of the continuous improvement of quality control management. These stages of quality control management in "Juran's spiral of progress in quality" (Figure 3.2) are as follows: (1) Market research; (2) Product Development; (3) Product Design; (4) Specification; (5) Purchasing; (6) Supplies; (7) Manufacturing Planning; (8) Production, Process Control; (9) Inspection, Test; (10) Marketing; (11) Wholesaling; (12) Retailing; (13) Use and Feedback; and (14) Market research.

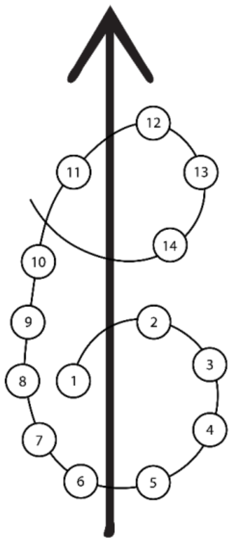

Figure 3.2. Juran's Spiral of Progress in Quality [12]

A careful analysis of "Juran's spiral of progress in quality" clearly demonstrates that personnel training protocols in a company (for example, a company that has decided to manage its product quality systemically) must always begin by training the highest-ranking staff members (the management elite) first, and then, the lower-level employees.

Building on the knowledge of systemic quality management (developed by American engineers Deming and Juran), Japan — an enemy of the USA during World War II — made a massive leap in its economic development. William Deming is credited with making huge contributions to this economic leap, popularly known as the "Japanese economic miracle." In 1960, the Prime Minister of Japan (Nobusuke Kishi), acting on behalf of Emperor Hirohito, awarded Deming Japan's Order of the Sacred Treasure, Second Class, an award equated with the title of "the hero of Japan."

In 1960, when Deming received the Order of the Sacred Treasure, fourteen years had already passed since his first visit to this distant and, until recently, hostile country. In early 1947, Deming was sent by the United States Department of the Army to assist the Japanese administration in planning and organizing the 1951 census of the Japanese population. The Japanese Union of Scientists and Engineers used Deming's temporary stay in Japan to invite him to hold a series of lectures on "*Improving Quality and Productivity in the Japanese Industry.*" He accepted the invitation and reaped unprecedented success in his first few lectures. Within a few months, he gained immense respect and popularity among Japan's industrial elite, and lecturing became one of his main responsibilities over the next few years. At the core of each of his lectures was "a visual representation of the production enterprise considered as a system." Deming called this relatively simple chart a "Flow diagram" (Figure 3.3).

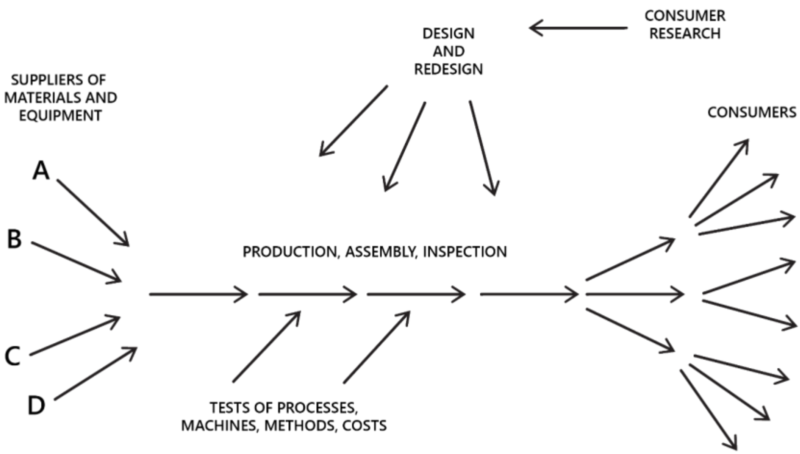

Figure 3.3. Flow diagram [11]

The following excerpt is from Deming's book "The New Economics," published in the United States in 1992:

"... What ignited Japan? The flow diagram (shown in Figure 6) was the spark that, in 1950 and onward, turned Japan around. It displayed to top management and to engineers a system of production. The Japanese had knowledge, great knowledge, but it was in bits and pieces, uncoordinated. This flow diagram directed their knowledge and efforts into a system of production, geared to the market- namely, prediction of needs of customers. The whole world knows about the results. This simple flow diagram was on the blackboard at every conference with top management in 1950 and onward. It was on the blackboard in the teaching of engineers. Action began to take place when top management and engineers saw how to use their knowledge." [11]

The enthusiasm generated by Deming's lectures is also evident in another fact. In 1951, the Japanese Union of Scientists and Engineers established a prize named after Deming, awarded annually to the best Japanese companies in quality management. Notable for the successful implementation and development of Deming's ideas, as well as directly related to Japan's economic growth, is Toyota's "just in time" system, which was launched in 1954. The company's managing director at the time, Shoichiro Toyoda, who was heavily influenced by Deming's ideas, then began to implement a comprehensive quality management program in all aspects of the company. In 1965, Toyota was awarded the Deming Prize for introducing this new production system. An excellent example of the practical understanding and implementation of the ideas derived from the "flow diagram" is the SMED (Single-Minute Exchange of Die) system developed and implemented by Toyota. The SMED system is a systemic engineering knowledge with universal application in manufacturing for the quick and efficient operational transition from the production of one product to another.

It all started with the car body press machines. In the Toyota operational procedure, as in all other car manufacturing companies, it used to take 4 to 6 hours for the car body press machines to be recalibrated (i.e., machine downtime) for an average production time of 30 minutes per batch. By introducing minor changes in the recalibration process of the machine presses and describing in detail each movement that the workers need to make (a process known as "Quick Die Change"), Toyota reduced the recalibration time from 5 hours down to 3 to 5 minutes. The "Quick Die Change" process allowed Toyota to multiply the capacity and diversification of its production. Other Japanese carmakers quickly adopted the Toyota methods and began to dominate the markets all around the world. In 1962, Japan ranked 6th in the number of cars produced, bested by the United States, Germany, England, France, and Italy. Five years later, in 1967, Japan ranked second, and in 1980, it managed to overtake even the United States - the biggest competitor in this industry. Effective and efficient management at companies such as Toyota, Honda, and Mazda led to high-quality production at a relatively low price, making the Japanese car industry one of the largest in the world in the 1990s. It is precisely because of the efficient management of its enterprises for machines that Japan aggressively entered not only the world automobile market but also many other markets, such as the market for home appliances, office equipment, warehouse equipment, construction machinery, metallurgical equipment, and many others. It may seem paradoxical, but at the heart of the "Japanese economic miracle" is a universal "scheme of the production plant seen as a system." The scheme created by William Deming, "the flow diagram."

The first and second engineering waves in the development of the fundamental scientific knowledge of economy are systematically linked – the first engineering wave should be seen as a necessary prerequisite for the occurrence of the second and vice versa — the second engineering wave can be considered a natural consequence of the first. The general essence of the first and second engineering waves in the development of fundamental scientific knowledge of economy finds a synthesized expression in the concluding statements of one of Frederick Taylor's publications:

"... Now, in its essence, scientific management involves a complete mental revolution on the part of the workingman engaged in any particular establishment or industry - a complete mental revolution on the part of these men as to their duties toward their work, toward their fellow men and toward their employers. And it involves the equally complete mental revolution on the part of those on the management's side—the foreman, the superintendent, the owner of the business, the board of directors - a complete mental revolution on their part as to their duties toward their fellow workers in the management, toward their workmen, and toward all of their daily problems. And without this complete mental revolution on both sides scientific management does not exist." [10]

Similar sentiments are expressed in the publications of Deming and Juran, except instead of referring to "scientific management of production," their texts refer to "systemic quality management."

3.3. Third engineering wave in the development of the fundamental scientific knowledge of economy

The third engineering wave began in the second half of the 20th century. The widespread use of increasingly affordable computers in the mid-1950s marked the beginning of a new era of information processing in an enterprise regarding production operations, which profoundly impacted how each distinct operation is conducted. Perhaps this impact is felt most significantly in the field of production logistics, i.e., inventory management and production planning. Until the advent of the computer, it was precisely these processes that were chronic, even impossible to solve for the management of every company engaged in the production of singular objects, which go through many stages of conversion from raw materials to a final product. The solutions available up to that point were imperfect, fragmented, and generally unsatisfactory from the point of view of managing the economy of an enterprise. The first computer applications in the field of enterprise inventory management appeared around 1960 and marked the beginning of solving this problem. The existence of computers capable of processing information at volumes and speeds that were previously considered impossible removed all restrictions on the processing of copious data and simultaneously led to the sudden obsolescence of previous methods and techniques. Those traditional inventory management methods could not go beyond the limitations imposed by the data processing tools available at the time. That is why almost all of the traditional approaches and techniques are characterized by defects; however, that was the achievable maximum with the resources available at that time. Those approaches were attempts to summarize and shorten operations and represented methods for estimating data. They were based on weak and rather unrealistic assumptions and thus imposed impractical concepts on reality in order to make the use of a specific technique possible. The breakthrough occurred after the computer became available, and the use of such defective methods and systems was no longer mandatory. It was possible to rearrange, revise, or delete the old methods altogether and to introduce new ones that had hitherto been impractical or impossible to implement. It was found that among the manufacturing companies - pioneers in the creation of computer applications for inventory management in the 60's - the most significant results were achieved by those who undertook a fundamental overhaul of their systems, in contrast to those who chose only to improve or accelerate existing processes. The result was the abandonment of techniques that had proven unsatisfactory and their replacement by new, radically different approaches, made possible by the advent of computers. [13]. No one was better able to deal with this challenge than the two American machine engineers, Joseph Orlicky and Oliver Wight. They were colleagues at the American technology giant IBM, and together they set the stage for the third engineering wave in the development of the fundamental scientific knowledge of economy. The third engineering wave involves the generation, development, and dissemination of knowledge of computer-integrated modeling of the sales, production, and supply processes. This knowledge is defined by the terms "MRP I" ("Material Requirements Planning") and "MRP II" ("Manufacturing Resource Planning").

"MRP" is a control system for production planning and inventory planning. MRP systems are designed to fulfill three main objectives:

(1) To ensure timely supply of production materials and timely sale of the products.

(2) To maintain the lowest possible levels of production materials and products for sale.

(3) To plan the production processes, the deliveries of materials, and the deliveries of products for sale.

According to the American Production and Inventory Control Society (APICS), MRP II is defined as a method for the efficient planning of all the resources of a production plant. MRP II systems, in addition to all the functionalities of MRP I systems, also include the following novel functionalities: production capacity planning, demand planning, quality control, and general accounting. The system consists of three main parts: (1) Long-term planning, (2) Interim planning, and (3) Short-term planning.

The emergence of this type of system is the "response" to the Japanese systems for rapid recalibration and quality management. A response, which the American industry for machines desperately needed, since, in the 1970s and 1980s, it began to suffer due to the competition from the Japanese industry for machines which had already undergone its "economic miracle," ironically thanks to the American machine engineer

William Deming. According to the U.S. Bureau of Work Statistics, productivity increased by 23.6 % between 1968-1978, while in Japan, over the same period, it increased by 89.1 %. Due to the lack of effective planning and rapid recalibration systems, Americans spew huge quantities of manufactured goods while periodically needing to "cut inventories." [14]. These practices result in prices that cannot compete with the prices of the Japanese products and thus enormous losses for producers. MRP algorithms provided an effective solution to this massive problem. U.S. industrialists recognize the potential of MRP systems. The American Manufacturing and Inventory Control Society (APICS) funds national programs in which managers and engineers are trained in this new and invaluable knowledge of integrated computer modeling in sales, production, and supply processes. Furthermore, they fund a multitude of professional circles to promote and popularize the use of these systems.

In fact, this is the commonality between the first, second, and third engineering waves: all three are aimed primarily at managers, the people who run the enterprises for machines. Oliver Wight defined the MRP II system as "a set of management tools" [14].

What is remarkable about all three engineering waves is the systematic work of American engineers with the purpose of developing a high-standard, fundamental scientific knowledge of economy based on the enterprise for machines. Systematic work that was based on the conscious knowledge that the US could become a global economic leader, which it consequently did become, thanks to the advances of its industry for machines.

A fact also evidenced in Oliver Wight's 1981 words:

"Production is the primary source of wealth. It is our factories and our farms (and our farms would not be what they are without our factories), it is construction, and it is mining, that creates the wealth. It is not created by banks, insurance companies, schools, stock brokers, politicians, or any other service functions. Some say, "But better than half the gross national

product is in services now, not in production." That may be. But ask anybody in a town like Youngstown where the manufacturing companies are shutting down about that. The dry-cleaners aren't too busy and the people who service swimming pools are wondering what other businesses to get into. This is not to say that these services are not important - nor that some of them are not essential in the support of production - but they themselves create no wealth. Wealth is created by the "producers." Without them, there wouldn't be any funds to pay for education or any of the other important services that we consider the necessities of life today. Manufacturing is "the goose that laid the golden egg." But where do we stand in American manufacturing today? It is no secret. We're slipping badly." [14]

These astounding individuals – Henry Towne, Frederick Taylor, William Deming, Joseph Juran, Walter Shewhart, Joseph Orlicky, and Oliver Wight – already understood the primary importance of the industry for machines for the development of all other industries and also realized that there was a lack of knowledge of how to manage and model the processes in an enterprise for machines. A lack of knowledge that economic science has not overcome to this day, more than 100 years later. This fact is evident in two speeches, more than 100 years apart. The first speech, spoken by Henry Towne in 1886, states: ***"(Management of works as a science) is unorganized, is almost without literature, has no organ or medium for the interchange of experience, and is without association or organization of any kind."*** [9] The second, spoken by Oliver Wight in 1981, states: ***"We have colleges of finance and marketing and engineering; but where in our manufacturing economy is a school on how to run a manufacturing business in all of its facets? What about the subject of manufacturing itself? ... There is not even a well-defined body of practical knowledge on the subject. There are virtually no college textbooks that address the subject from a practical viewpoint."*** [14].

All three engineering waves aimed to address these problems, and although they provided extremely useful and practical solutions, there was still no consolidated knowledge with unified theory and technology about the principle setup and way of functioning of the enterprise for machines. Perhaps Oliver Wight could have succeeded because, according to him: *"It's about time we recognized that every function in a manufacturing business is important and interdependent, as well as recognizing the tremendous responsibility we have in managing our manufacturing businesses more effectively. There are few activities in our society that have more impact on more people than managing a manufacturing enterprise. Consider a company in trouble, like Chrysler. Workers lost their jobs, management people lost their pay, independent businessmen who had automobile dealerships with all their money tied up in them went out of business. Customers ran the risk of losing part of their investment by buying a potentially "orphan" car. Even the taxpayers had to bear some of the risk by underwriting loans to try to keep Chrysler in business."* [14] He believed that "MRP" could evolve into a tool for the overall effective management of the economy of the enterprise for machines: *"MRP" is about managing production, purchasing, inventories, cash flow, and return on investment. It is about tying marketing planning, manufacturing planning, and financial planning into a company plan that can be executed and monitored. It's about improving the effectiveness of engineering and marketing and delivery performance. It's about having more reliable financial numbers and preventing surprise inventory shrinkages. It's about productivity, better teamwork, reducing the adversary relationship between management and labour, and improving the quality of life in a manufacturing company."* [14] Furthermore, he believed that a sufficiently well-developed system that can be successfully implemented in an enterprise for machines could then be implemented in a wide range of industrial enterprises.

He made this statement in his 1981 book "Manufacturing Resource Planning: MRP II – Unlocking America's Manufacturing Potential." Unfortunately, Oliver Wight left this world in 1983. His work and dreams, combined with the advent of more powerful and affordable computers, are the seeds from which an entirely new market developed - the market for digital products for managerial modeling of the economy of enterprises.

3.4. Digital products for managing modeling of the economy of the enterprise for machines

If we look at an enterprise for machines in its entirety and at the same time make a general overview of modern digital systems that are functionally focused on modeling the economy of the enterprise for machines, we could rank the digital products of this type in a hierarchical structure. At the lowest level, we should place CNC/DNC systems, at the middle level would be the CAD/ CAM/ CAE systems, and at the highest level would be the ERP systems.

In general terms, the CNC/DNC systems are characterized as follows:

(1) CNC stands for *Computer Numerical Control*. It is a computer system (software and hardware) for program control of the runtime mode of a variety of machines. The diversity of these systems is huge, but the most well-known by name and the one that gives this type of system its functional characteristic is applied in the programming of metallurgy machines and industrial robots.

(2) DNC stands for *Direct Numerical Control*. It is a computer system (software and hardware) for the direct control of the runtime mode of a variety of CNC machines.

CAD/CAM/CAE systems are:

(1) CAD stands for Computer-Aided Design. CAD systems are used to generate two-dimensional and three-dimensional graphic representations of a variety of objects.

(2) CAM stands for Computer-Aided Manufacturing. CAM systems are used to create programs for CNC machines based on the three-dimensional graphic models created by the CAD systems.

(3) CAE stands for Computer-Aided Engineering. CAE systems are used to make engineering calculations based on the three-dimensional graphic model created by the CAD system.

Now let us look at the successor to the MRP systems: the ERP software.

Building on Oliver Wight's vision, in 1991, the American consultancy company "Gartner" coined the term "ERP" — "Enterprise Resource Planning." These systems should be the product of the cumulative achievements of the three preceding engineering waves in the development of fundamental scientific knowledge of economy. At their core, they must encompass all the functionalities of the "MRP" systems, but also, through additional modules, they must offer capabilities to manage sales, accounting, and all the other major processes in the enterprise. This more comprehensive approach leads to the change of the letter "M" with "E," i.e., from a "Manufacturing Resource Planning" tool, they grow into an "Enterprise-wide Resource Planning" tool. Conceptually, "ERP" systems are a combined set of modules that share a common database and user interface and can perform the multitude of functions used in the different divisions of the company.

Therefore, based on the aforementioned information, CNC/DNC systems can be categorized as the lowest level of digital products for managerial modeling of the economy of the enterprise for machines because they only control the work of individual machines and groups of machines. CAD/CAM/CAE systems rank as the mid-level system for managerial modeling because they allow for the design of the complete production process of a given object. ERP systems rank at the highest level. Similar to the way in which CAD/CAM/CAE systems nowadays build complete functional and production process models of objects before they are produced, the ERP system's purpose is to create a comprehensive, integrated, and functional model of the enterprise as well as the related processes.

The last decade of the 20th century and the early decades of the 21st century have been a time of development and widespread distribution of the ERP software. In 2016, the sales of ERP software amounted to $270 billion, and the sales of services in the form of management consulting related to the practical application of this type of software exceeded $250 billion a year. But the remarkable market success (over $500 billion per year) of modern ERP software is sullied by a significant distancing from the cognitive universalism underpinning the functional constructs of any pure, application-free MRP system. Any analysis of the functional design of this type of software - including the most reputable brands that generate billions of dollars in annual revenue – would show that there is no such software on the market whose functional construct offers a comprehensive picture of the company as a systemic object, characterized by systemic subjecthood which allows the enterprise to manage its own existence. This significant departure of modern ERP systems from the cognitive universality of the pure MRP system makes them unsuitable for their inherent purpose – to serve as a tool for building a comprehensive, integrated, and functional model of the enterprise, which was Oliver Wight's dream.

What caused this departure of the ERP systems from their inherent purpose?

The global community of "professional economists" is aware of the huge financial potential of the widespread distribution of the MRP software; however, the software itself remains largely foreign to them. As we learned in the previous chapter, fundamental scientific knowledge of economy is the knowledge of accounting modeling. Although it has many flaws when applied to industrial enterprises, all financiers, accountants, and, above all, economists have accepted it to be the main form of managerial modeling of industrial economy. For this reason, they actively intervene in the creation of the so-called ERP systems, which ought to upgrade MRP systems. The main goal of this global community of "professional economists" is not the thorough functionality of the production chain at all levels. In fact, ERP systems offer extremely basic functionality in all areas, except for one: finance and controlling, which has the most in-depth level of development. Cited as a main advantage is the fact that all operations are immediately transcribed in accounting since all modules share this common database. And this, in turn, "makes life and work much easier" for managers. [15] In other words, it can be argued that the ERP system is based on the accounting model and that, in fact, it is nothing more than a high-level accounting system. And as such, it has inherited all the defects intrinsic to the accounting model. The very name "*Enterprise Resource Planning*" does not accurately reflect reality. As we know, the accounting model reflects the past, and because of this fact, ERP systems are practically devoid of the necessary functionality to carry out actual planning and are rather systems for recording transactions. They are suitable for recording completed sales, recording completed deliveries, and subsequently linking each transaction to the financial statements. In fact, ERP systems are the complete opposite of planning. [15] Realizing these flaws, consumers have to look for additional, external solutions. External vendors are creating a huge number of modules to bridge the gap of the limited capabilities of the ERP planning system, such as B.I. (Business Intelligence), CRM (Client Relationship Management), SCM (Supply Chain Management), PDM (Product Data) Management), PLM (Product Lifecycle Management), and many others. This vast array of modules, which are not connected to each other by common theory or terminology, cause real chaos in the field of digital systems for the managerial modeling of the economy of the enterprise for machines—chaos, which results in huge losses for companies, and sometimes even bankruptcy.

3.5. Critical analysis

The three engineering waves in the development of the fundamental scientific knowledge of economy have led to an unprecedented increase in the efficiency of enterprises for machines and, as a consequence, to the phenomenal development of the world industry for machines in the 20th century. The development and widespread dissemination of new knowledge for the managerial modeling of the economy of the enterprise for machines, termed "scientific management, in its essence constitutes the first engineering wave in the development of fundamental scientific knowledge of economics. Historically observed, the first engineering wave was a major factor in the U.S.'s rise as the undisputed industrial and technological leader of the world after the two world wars. The second engineering wave was the main determinant of Japan's reindustrialization and reinstatement as a global economic power. The third engineering wave allowed the United States to catch up to Japan and helped reinvigorate their "stagnant" manufacturing industry in the 1980s. Thus, we are justified in stating that the three engineering waves in the development of fundamental scientific knowledge of economy had a hugely positive effect on the economies of the countries that decided to be "on the crest of the wave."

In the last chapter, we arrived at the conclusion that the knowledge of accounting modeling of the enterprise is the part of modern scientific knowledge of economy that has greater societal significance than all its other components combined. In this chapter, we can add that next in significance are the knowledge of operational management, the knowledge of quality control management, the knowledge of production efficiency management, and the knowledge of the management of production materials using the MRP algorithm.

However, the main takeaway of this chapter is a paradoxical fact, which has not been resolved for more than 100 years. A fact that is reflected in the statements of Henry Towne and Oliver Wight, namely that there is no systematic effort to develop systemic knowledge of the science of management of the enterprise for machines - systematized knowledge that would provide a clear, usable, and comprehensive understanding of the principle setup and way of functioning of the enterprise for machines. The fact is that all three engineering waves were pushing towards the formation of such knowledge. Oliver Wight even imagined a digital system that would be based on knowledge of the principle setup and way of functioning of the enterprise for machines. Although the development of the science for management of the economy of the enterprise for machines ought to be the responsibility of economic science, it is no surprise that the active intervention of "professional economists" resulted in total chaos in the so-called ERP systems. As we established in the previous chapter, these are people who have not made systematic efforts even to define the key concepts "economy" and "economic science." It is baffling why, after more than 100 years of efforts, American machine engineers suddenly withdrew from the pursuit of systemic knowledge of enterprise management. It is baffling why, after making extraordinary efforts to form such knowledge within the three engineering waves, they gave way to "professional economists" to advance and upgrade the knowledge they created. Why did engineers not initiate a fourth engineering wave in the development of fundamental scientific knowledge of economy, which would have led to the completion of the work of the American engineers Henry Towne, Frederick Taylor, and all the other American engineers who devoted their lives to the previous three waves in the development of this knowledge? The fourth engineering wave, which we (as engineers deeply inspired by the work of the participants in the three waves) believe consists of the creation and development - both in theory and in practice – of a new generation of digital technologies for managerial modeling of the economy of the enterprise for machines. The functional construct of this new generation of digital technologies is based on an embedded knowledge of an ontological model of the economy of these fundamental enterprises - a model that describes their principle setup and way of functioning as a systemic object and subject.

There is an urgent need for a fourth engineering wave that would elevate the fundamental scientific knowledge of economy to an equivalent level of systemic understanding as the fundamental scientific knowledge of medical science. Unfortunately, to date, all indications are that the fundamental scientific knowledge of economy at a medieval level of historical development. And that leads us to the next disregarded evident fact.

Chapter 4: The fourth disregarded, evident fact

Compared to the fundamental scientific knowledge of medicine, the fundamental scientific knowledge of economy is still at a "medieval" level; and therefore, it still has major functional flaws.

Based on the objective definition of the concept of "economics," which we formulated in Chapter 2 as **the process of manageable existence of artificial systemic objects that are bearer of systemic subjecthood**, it is logical to expect that the fundamental scientific knowledge of economy ought to provide a clear understanding of the principle setup and way of functioning of the enterprise for machines, a systemic object bearer of systemic subjecthood. It is logical because the management of an enterprise as a **systemic object** comes down to managing the many trajectories of objects passing through the enterprise (*e.g., operations that convert raw materials into a final product*). The management of an enterprise, as a **systemic subject**, comes down to managing the cognitive abilities needed to design and implement the trajectories of the multitude of objects (e.g., the applied knowledge of how to convert a piece of fabric into a dress shirt).

The defined cognitive abilities necessary for managing the objects in an enterprise form the collective and, therefore, the individual professional responsibility for the existence of the enterprise.

Meaning, that if we do not have the knowledge necessary to answer the question "How is an enterprise built?" - as a set of objects in space that is undergoing changes in their quantitative and qualitative characteristics, as well as a specific knowledge needed to understand these changes – then we have no idea what is really going on in this enterprise.

If the text that defines the Fourth disregarded evident fact is closely examined, two substantive parts become clearly evident, as well as a causal link between them.

The first substantive part states, "*Compared to the fundamental scientific knowledge of medicine, the fundamental scientific knowledge of economy is still at a "medieval" level...*"

The second substantive part states that "*and therefore, it still has major functional flaws.*"

The second content part states that "*... fundamental scientific knowledge of economy as such (from the position of its medieval level of development) has significant functional flaws.*"

The causal link between them is that the fundamental scientific knowledge of economy is at the medieval level of historical development relative to fundamental scientific knowledge of medicine because economic science (since its inception to this day, for one reason or another) has not yet put systematic effort into overcoming its two major functional flaws, which are:

First major flaw:

The fundamental scientific knowledge of economy does not provide a comprehensive and clear understanding of the principle setup and way of functioning of the enterprise as a systemic *object*. [16]

In other words — compared to the level of development of modern medical science — the level of development of today's economic science should be defined as medieval. Just as medieval medical science was once unable to explain the anatomy and physiology of the human body as a system, so modern economic science is unable to systemically explain the "anatomy and physiology" of the enterprise for machines.

Second major flaw:

The fundamental scientific knowledge of economy does not provide an understanding of the principle setup and way of functioning of the enterprise for machines as a systemic *subject*. [16]

In other words, economic science does not provide any systemic knowledge of the nature and meaning of collective, and therefore, of individual professional responsibility for sustaining the operation of an enterprise for machines as a main building block of the national and global economy.

In this chapter, we will examine whether this is the case.

It should be clarified that overcoming the first major flaw of the fundamental scientific knowledge of economy is an absolutely necessary prerequisite for overcoming the second major flaw because if we do not have an understanding of the principle setup and way of interaction of the objects that make up the enterprise, there can be no question about projecting their changing trajectories and the knowledge needed to accomplish this task.

For this reason, we should focus our attention entirely on the first major flaw of the fundamental scientific knowledge of economy, and consequently, a comparison of the historical development of the two sciences (economic and medical) can be made. For that same reason, we will not dwell on the second major flaw in this chapter and will examine its (and the first major flaw's) resolution in Chapter 6.

As we have already established, it is well known that the modern fundamental scientific knowledge of medicine consists of scientific knowledge of the ontological anatomical and physiological model of the living human body. This model creates a complete and true understanding of its systemic design and way of function. However, the understanding of the "systemic anatomical and physiological model of the human body" is indisputably established as the fundamental knowledge of medicine in the second half of the 19th century. Up until the end of the Middle Ages (which was given rise by the invention of book printing), the fundamental knowledge of medicine was completely different from what it is today.

And this prompts the following questions: What was the fundamental scientific knowledge of medicine in the Middle Ages? Did it have any fundamental flaws, like today's fundamental scientific knowledge of economy?

The following material provides the answer to these questions.

4.1. A brief overview of the historical development of the fundamental scientific knowledge of medicine

4.1.1. The fundamental scientific knowledge of medicine in the Middle Ages

The first institutions for higher education in Western Europe were established in Italy. The oldest of them is the medical school in Salerno. It is said that it was founded in the 9th century and was famous as the "heir of the best medical traditions of the ancient world ."This fame also led to the popularization of another name for the city of Salerno: "civitas Hippocratica," in other words, "the city of Hippocrates ."By order of the Emperor of the Holy Roman Empire, Friedrich II (1212-1250), only this school was given the right to accredit the title of a "doctor." Practicing medicine without accreditation from this school was forbidden. The training in Salerno lasted for five years, followed by a compulsory one-year practicum. In 1213, this higher-education institution was transformed into a university. In the Middle Ages, people from the working class, such as merchants and various craftsmen, were called "universitas" (Latin "*collective*"). By analogy, the groups of teachers and scholars were then called "*universitas magistrorurn et scolarium* ."That is how the term "university" came to be. In medieval Western Europe, the establishment of universities was closely related to the growth of cities, the emergence of new cities, and the creation of the existing labor associations (i.e. companies, before the term "company" was legalized).

The Law School in Bologna, Italy, is the first school to be classified as a university. After that, schools in Oxford and Cambridge obtained this status (Britain, 1209); Salerno (Italy, 1213); Paris (France, 1215); Salamanca (Spain, 1218); Padua (Italy, 1222); Naples (Italy, 1224); Montpellier (France, 1289); Lisbon (Portugal, 1290); Prague (the Czech Republic, 1348); Krakow (Poland 1364); Vienna (Austria, 1365); Heidelberg (Germany, 1386); Cologne (Germany, 1388); Leipzig (Germany, 1409), etc. As a rule, medieval universities had four faculties: one preparatory faculty and three main faculties. The term "*faculty*" (from the Latin *"facultas"* - ability, skill, talent) was introduced by Pope Gregory IX to denote the various specialties in the church founded by the University of Paris. The preparatory faculty (or artistic, from the Latin "*artes*" - arts) was compulsory for all students, where the seven liberal arts were taught in two parts: "*trivium*" (meaning grammar, rhetoric, dialectic) and "*quadrivium*" (meaning arithmetic, geometry, astronomy and music theory). After passing the "*trivium*" program and taking the appropriate exams, the medieval student (scholar) was awarded a Bachelor of Arts degree. Then, after completing the "*quadrivium*" program,The medieval scholar was awarded a Master of Arts degree and the right to continue their education in one of the three main faculties: law, theology, or medicine. After graduating from one of these faculties, the scholar was awarded a Doctorate Degree.

"Doctor of Law," "Doctor of Theology," or "Doctor of Medicine" - these were the titles of the most educated and well-read people of medieval Europe. This is understandable – books were very rare and expensive during the Middle Ages. To get an idea of just how rare books were in the Middle Ages, it would suffice to note that in the middle of the 15th century – a few decades before book printing spread across Europe with an unparalleled speed for that era – the Faculty of Medicine of the University of Paris possessed only 12 books, which were chained to the lecterns and library desks. The liberal arts programs of *trivium* and *quadrivium,* the foundation of medieval university education, were mostly devoid of physical labor, labor performed by working with the hands. That is how they were distinguished from the "manual arts," which was how surgery was classified. This was cause for a distinction between doctors who had graduated from the faculty of medicine in a university, and the surgeons who were considered craftsmen (tradesmen) and had their own professional collectives and associations with strict hierarchies.

The highest positions in these hierarchies were those of the "long-apron surgeons." Their garments distinguished them as qualified to perform the most complex surgeries – at that time, the most complex surgeries were procedures to remove kidney stones and hernia surgeries. The next category in the hierarchy was the "short-apron surgeons," most of whom were barbers and performed "small surgical procedures," such as tooth extraction and bloodletting. The lowest category in the hierarchy were the masseurs in public bath houses, who performed the most straightforward procedures, such as cutting off calluses. A popular English publication from the end of the 16th century, entitled A Treatise on the Perfect Gentleman, stated that in addition to lawyers, doctors could also be perfect gentlemen, with the exception of surgeons and obstetricians. Furthermore, at the beginning of the 19th century, in England, surgeons and dentists were not allowed in high society because they worked with their hands and, therefore, were considered to be craftsmen (tradesmen). The case for dentists was complicated by the fact that sometimes criminals were punished with tooth extractions, and in the eyes of the public, dentists were a type of punisher.

Professional medicine in the Middle Ages, represented by doctors who graduated from the faculty of medicine of an official university, is now termed "scholastic medicine" because it constituted reading, memorizing, and interpreting old texts written by authors who laid the foundations of historically recognized professional schools. The most recognized names among those authors are Hippocrates, Galen, and Avicenna. Their texts provide the groundwork for lecturing, debating, and essay writing. From these texts, medieval doctors formed the "scientific" idea that the human body is made up of four "humoral substances," that there are four temperaments, and that bloodletting is a treatment for all kinds of ailments.

A book by Ian McNeely and Lisa Wolverton, entitled "Reinventing Knowledge: From Alexandria to the Internet," contains interesting descriptions of the level of development of medieval medical science and medical practice. Next, we will present some excerpts from this book:

"... It is easy to mock Greco-Arabic medicine for its pseudo-scientific rigor: its four humoral substances (blood, phlegm, black bile, and yellow bile), the four temperaments their circulation creates in each person (hot, wet, cold, dry), and the like. But to medieval scholastics, such theoretical schemas raised medicine from an 'ars,' a skill, a bundle of empirical therapies and rules of thumb, into a true scientia, a form of abstract knowledge recorded in written treatises. The surgeon Henri de Mondeville (1260–1320), who taught at both Montpellier and Paris, argued that scientific medicine placed its practitioners a cut above the "illiterate barbers, fortune tellers, alchemists, old women, converted Jews, and Saracens" (Arabs) with whom they had to compete..."

"... Laypeople, not scholars, took the initiative in establishing the superiority of Christian university physicians over rival healers. Kings hired court doctors and often consulted them on political affairs; towns hired their own physicians; criminal courts relied on them for forensic testimony; church officials needed them to certify impotence in petitions for marital annulment. Much like preachers and lawyers, but even more so, medical doctors rose to influence in a world dominated by illiterate but otherwise

powerful and intelligent courtiers, parishioners, clients, and patients. In each of their roles, academic physicians had been trained through the scholastic method of ceaseless verbal questioning to think on their feet and impress laymen with their knowledge..."

"...Viva voce learning, pedagogy through the "living voice," was standard medical practice, as in every field. After the dictation of introductory texts in lectures, the real heart of teaching was the disputation, a staged debate between master and master, student and student, or master and student. In the so-called "quodlibet" ("whatever you want"), a question was posed, and a master took on all comers. A master might even dispute himself, in person or in a written treatise or commentary. These virtuoso performances were like knights' tournaments for scholars.

Debating questions may seem quite ill-suited to medical diagnosis, therapy, and hands-on practice, even if it makes perfect sense for theology and law, whose practitioners lived and breathed the written word. But it was precisely because scientia founded its superiority to ars on the disputation of texts that the scholastic method triumphed even in medicine, the most applied field of university endeavor. Indeed, it was by borrowing from the dialectical methods of nearby theology and law faculties that new medical schools at Paris and Bologna managed to rival and eventually surpasses Salerno and Montpellier ..."

"... In an epoch when medicine had very little power to cure and to heal, merely the ability to diagnose and to explain disease exerted a palliative effect, and this is precisely what scientia offered doctors and their patients..." [17]

The above quotations are more than enough to defend the idea that the level of development of medieval medical science was quite different from the level of development of modern medical science. Medieval medical science was characterized by a scholastic approach. This approach does not require proof of knowledge of the "systemic anatomical and physiological model of the human body." For this approach, it is sufficient to know and accurately interpret the written texts of officially recognized authorities on the subject, even though these texts regarding the structure and function of the human body are not only fragmented but also a significant portion of them are either far removed from reality, or there are contradictions between them. And this is where an important question arises: the question about the historical conditions that marked the beginning of the transition of medical science from the medieval level of development to the modern level of development, a level of development with a clearly defined fundamental knowledge of human health management in the form of universally accepted "systemic anatomical and physiological **model** of the human body," which is in agreement with a "systemic anatomical and physiological **approach**" for the development and dissemination of this knowledge.

4.1.2. The beginning of the transition of the medical science from a medieval to the modern level of development

The man who initiated the transition of medical science from a

scholastic (medieval) level of development to a contemporary (systemic) level of development was Andreas Vesalius (1514-1564). In 1543, Vesalius published his seminal work "*On the structure of the human body*" in seven parts. In this work, which was based on his own research, Vesalius not only summarized the achievements in the field of anatomy over the past centuries but also corrected more than 200 mistakes made by Galen, an indisputable authority in this field at that time. Most importantly, however, Vesalius organized the understanding of the structure of the human body **into a system**, thereby redirecting the development of the field of anatomy onto a new path. This path did not please many of the then-professional authorities. Vesalius's teacher at the University of Paris, Jacobus Sylvius (1478-1555), called his student a "madman" in his publication entitled "A Refutation of a Certain Madman's Calumnies Against the Anatomy of

Hippocrates and Galen" When faced with the irrefutable facts, the scholastic professors were more willing to accept that there had been a change in man's anatomy over the centuries rather than admitting that the great Galen could have made mistakes.

Andreas Vesalius's work initiated a "golden age" in the history of anatomy. In 1545, Charles Etienne published a beautifully illustrated textbook, "*De dissectione partium corporis humani libri tres*" (meaning "The Dissection of the Human Body"). In 1553, the Spanish philosopher, theologist, and physician Michael Servetus described the pulmonary circuit of blood circulation in his book. After Servetus, Vesalius' successor, Realdo Colombo, studied the movement of blood in the lungs and described his observations in the work "*De Re Anatomica*" (meaning "On anatomizing") in 15 books. Anatomy research at that time was not limited to the study of blood circulation. Other human systems were also researched. For example, in 1563, Bartolomeo Eustachi (1510-1574) provided a detailed description of the human auditory organs (the auditory tube bears his name). Gabriel Fallopian (1523 - 1562) studied the structure of the reproductive organs, the development of the human embryo, and was the first to describe the structure and functions of the fallopian tubes. Fallopius' pupil, Hieronymus Fabricius (1533-1619), was the first to demonstrate the function of the venous valve; therefore, displaying that blood flow in the veins was unidirectional – towards the heart. Hieronymus Fabricius, in turn, taught William Harvey (1578-1657), who developed a coherent theory of blood circulation and proved that blood flows in two distinct circuits: the pulmonary circuit and the systemic circuit. After many experiments, Harvey proposed his theory in a seminal work entitled "*De Motu Cordis*" (Anatomical Account of the Motion of the Heart and Blood).

The publication of this book in 1628 marks the inception of the science of physiology, which marks the end of the first stage of the transition of medical science from a scholastic (medieval) level of development to a modern (systemic) level of development. This transition continued for the next two centuries despite the strong resistance of the influential individuals who belonged to the scientific and ruling elite at the time.

4.2. A brief overview of several widely popular scientific fields in the fundamental scientific knowledge of economy

In order to evaluate the current level of the historical development of economic science compared to the historical development of medical science, it is necessary to make an overview of the existing scientific knowledge for managerial modeling of the economy of the enterprise for machines. This overview would allow us to determine whether there is or there is not a systemic knowledge of the "anatomy and physiology" of this type of enterprise, akin to that of the human body in medicine.

Any conscientious overview of today's existing scientific knowledge for managerial modeling of the economy of the enterprise for machines would conclude that this knowledge consists of many various components, which differ in their conceptual purpose. From a historical perspective, the first to come along was the **scientific knowledge of the accounting model**, which is undoubtedly the leading model of enterprise management from a practical point of view. Then came the **scientific knowledge of operational management** and, finally,the **scientific knowledge of quality management**. To summarize the previous chapters, the first model was the work of the Christian church, while the second and the third models were developed by American engineers. Almost all other models of management are the work of modern professional economists.

Among all those other types of fundamental scientific knowledge of economy that have been developed by modern professional economists, the most popular are (1) the **scientific knowledge of "business planning,"** (2) the **scientific knowledge of "controlling,"** and (3) the **scientific knowledge of "business model ontology**."

4.2.1. Scientific knowledge of "business planning"

In one form or another, the internet gives an unambiguous answer to the question *"What is this business planning?"* - it is "*the purposeful activity of multiple subjects with the goal of preparing a business plan.*"

However, the answer to the question *"What is this business plan?"* is not so unambiguous. The same source (the internet) offers different definitions in terms of content. Here are a few examples.

The first example of a definition of the term "business plan":

A method for closing a market transaction, a system of measures used in entrepreneurship aimed at obtaining a profit. When drawing up a business plan, all possible obstacles to its implementation must be taken into account. The main purpose of preparing a business plan is to clearly define the project's goals and objectives and evaluate the possibility of its implementation realistically. A business plan is prepared either by the entrepreneur themselves or with the help of a specialized firm. [18]

The second example of a definition of the term "business plan":

A written document that describes in detail how a business—usually a start-up—defines its objectives and how it is to go about achieving its goals. A business plan lays out a written roadmap for the firm from marketing, financial, and operational standpoints. [19]

The third example of a definition of the term "business plan":

A program for the enterprise's activities; a plan of specific measures taken to achieve specific company objectives; includes an assessment of the expected costs and revenues. It is developed based on market research. [20]

The fourth example of a definition of the term "Business plan":

A written document describing the nature of the business, the sales and marketing strategy, and the financial background, and containing a projected profit and loss statement. [21]

The fifth example of a definition of the term "Business plan":

A document on the basis of which the planning of the entrepreneurial activity is carried out. Depending on the reason for the development of the business plan, the structure, composition, size, and content of its sections may differ. A business plan may be developed to justify a new project; organize a new business; attract investors; justify the advantage and benefit of investing funds in the expansion of a business; restore the financial stability and solvency of an existing enterprise; to plan the operation of a functioning enterprise, etc. [22]

Historically, the concept of "business planning" started in the 1950s in the United States as an addendum to the budgeting process; however, it only began gaining popularity in the 1990s along with the popularization of the so-called "venture capitalism" and "risk investments." Venture capitalists insisted on familiarizing themselves with the business plan of a possible venture opportunity before investing in it. Research shows that around the world, there are many different standards for the structure and content of a "business plan."

The following chart is an overview of four types of such standards expected by world-renowned organizations: United Nations Industrial Development, a division of the United Nations; European Bank for Reconstruction and Development; "KPMG" and "Ernst & Young" - two of the companies of the "Big Four" accounting firms. (Figure 4.1).

What is evident is that the lack of consistency in the definitions of the term "business plan" is echoed in the form of a lack of consistency in the necessary components of the various "business plan" standards. Furthermore, upon closer examination of the content required within each section, it becomes evident that despite the shared section headings, each of the different "schools" has a different understanding of the content requirements within each section. An understanding which is indisputably different from the understanding of others. An in-depth analysis of the concept of a "business plan" leads to the conclusion that through business planning, we must be able "*to justify a new project, to organize a new business, and to plan the operation of a functioning enterprise.*" Therefore, the ability to make a business plan should give us a complete and clear understanding of the principle setup and way of functioning of the enterprise as a systemic object because otherwise, the reasonable implementation of these activities would be impossible. An in-depth analysis of the business planning process leads to the conclusion that this process is evidence of the first major flaw of the fundamental scientific knowledge of economy.

Standard / Components	United Nations Industrial Development Organization	European Bank for Reconstruction and Development	KPMG	Ernst&Young
1	Summary	Executive summary	Summary	Executive summary
2	Description of industry and enterprise	Project details	Products and services	Market analysis
3	Description of goods and services	Strategy	Market and industry analysis	Company description
4	Marketing and sales of products and services	Responsibility assignment matrix	Target markets	Marketing and Sales activities
5	Production plan	Market analysis	Strategies for advertising and promotion	Products and services
6	Organizational structure and management	End user analisys	Management	Operations
7	Financial plan	Financial analysis	Financial analysis	Management and Ownership
8	Orientation and economic efficiency of the project	Roadmap	Annexes	Funds required and their uses
9	Risks and guarantees	Planning		Financial data
10	Applications	Risks and mitigation		Appendices or Exhibits

Figure 4.1 An overview of four types of business planning standards

4.2.2 Scientific knowledge of "controlling"

The first example of a definition of "controlling":

The term "control" is derived from the English verb "to control" and has different meanings. In economic terms, it means "manage" and "monitor." However, since effective management and monitoring are impossible without setting goals in advance and anticipating the actions needed to achieve them, it follows that "controlling" requires the execution of tasks related to planning, regulation, and observation. According to modern approaches, "controlling" can be interpreted as the process of providing the information needed for the management of results-oriented enterprises. Therefore, the task of "controlling" involves the preparation and presentation of necessary administrative information that would guide the decision-making activities of the management team. It can be argued that the main purpose of "controlling" is to support the management of enterprises. Furthermore, if the "controller" is, for example, a member of the management team or the board of directors and/or is the head of the "controlling" department, then the "controller" may perform the primary central functions of management. By its very nature, "controlling" is one of the most important functions of management and is vital to the stability of management. ... The goals of "controlling" are derived from the goals of the enterprise. The ultimate goal is the maintenance and successful long-term development of the enterprise. In order to achieve this goal, the company produces goods and provides services that optimize its financial outcomes while taking into account the company's societal goals. "Controlling" helps achieve the enterprise's main (financial) value goal: the optimization of financial outcomes by maximizing the income, maximizing the net worth, and ensuring the enterprise's liquidity. Furthermore, the process of "control" is a means to coordinate the achievement of market goals and societal objectives and the activities and resources necessary to achieve those goals and objectives. Thus, the main objective of "controlling" is the *optimization of the enterprise's financial performance whileensuring its liquidity."* [23]

The second example of a definition of "controlling":

The concept of "control" is most often associated with management and monitoring. Management generally means setting goals and regulating their implementation. "Controlling" can be understood as a set of all management tasks that coordinate the planning and control of an enterprise, as well as the provision of information. The process of "controlling" is a dynamic system that assists in the decision-making process of choosing the optimal way to realize a set of goals. It can be considered to be a management technique that comprehensively encompasses the management process. There are three main approaches to "controlling": (1) the "controlling" tasks are limited by the management of the enterprise's value indicators; (2) the conceptual framework is expanded by emphasizing the information focus of the process of "controlling"; (3) emphasis is placed on the coordinating role of "controlling" in the management process. [24]

The third example of a definition of "controlling":

In order to solve the problems of the enterprise, problems influenced by internal and external factors, it is necessary to adopt and apply new methods of planning, reporting and control, and analysis of business activities. Insufficient information about the current state of the company's affairs and the company's future prospects requires the adoption of new management approaches and tools for their implementation, such as:

(a) clarification of economic problems;

(b) providing timely notifications in the case of inadequate management measures;

(c) providing real-time information necessary for the management of the company towards its objectives;

(d) overcoming bottlenecks and determining the direction of progress.

The process of "controlling" is a tool to solve these problems for the enterprise. It is a modern way of managing the enterprise by connecting economic analysis, planning, management accounting, and management.

"Controlling" raises the process of management to a new level by integrating, coordinating, and directing the activities of different departments and divisions of the enterprise in order to achieve operational and strategic goals. Its primary objective is to support the processes of the management-adopted decisions.

In an economic context, the term "control" is used to mean "management" and "monitoring." There are various opinions on the interpretation of this term. Some consider the process of control to signify internal control, while others associate it with auditing and, as such, define it as management accounting. Modern economic dictionaries give the following definition.

"Controlling" is:

1) *A tool for planning, accounting, and analysis of the condition of the enterprise, used to make decisions based on a computerized database and information processing.*
2) *Determining the departmental organization of the company.*
3) *A system for the continuous assessment of various aspects of the company's activities, its departments, and its managers and associates responsible for accounting and analysis; controlling as an integral function of the company.*

"Controlling" is also defined as "a system for effective management of the organization, focused on securing the long-term operation of the organization through the practical implementation of modern management methods." It brings together two components — "controlling" as a philosophy and "controlling" as a tool:

a) "controlling" as a philosophy is a representation of managers' thought processes, focused on utilizing resources efficiently and ensuring the long-term development of the organization.

b) "controlling" as a tool is utilized to achieve the organization's objectives through an integrated information system that the managers can rely upon in the process of planning, control, analysis, and adoption of management decisions in all functional areas of the organization's activities.

One of the main reasons for the emergence and implementation of the concept of "control" is the need for a system of integration and coordination of the various aspects of the management of the organization's business processes. [25]

Those responsible for carrying out the "controlling" tasks are called "controllers." Controllers were first employed in government positions in the USA and England. The term "counter-roullour" was introduced in English in 1292 and came from the French word "contre-rôle." As early as the 15th century in the English Royal Court, a "Count-roller" made records of incoming and outgoing money and goods. Since 1778 in the USA, the "Comptroller" has balanced the state budget when spending government funds. Its other historical roots are the positions of the "Comptroller of the Currency" (the administrator of the federal banking system since 1863) and the Comptroller General (Head of the Government Accountability Office (GAO) since 1911) in the United States.

Accounting and control remain important responsibilities of the "comptroller" to date. In 1880 the transport company *Atchison, Topeka* & *Santa Fe Railway System* was the first transportation authority to appoint a controller, the so-called "comptroller." Then, in 1892, *General Electric Company* was the first industrial enterprise to create a controller post. The position of "controller" spread throughout the United States after the Great Depression. In 1931, the "Controller's Institute of America" was established in the USA, which was later renamed the "Financial Executive Institute

(FEI)." The FEI contributed to defining the controller's tasks and distinguishing them from other related positions in financial management (for example, "Treasurer" - treasurer/financial manager). The position of "controller" was first introduced to Europe within the subsidiaries of American companies. The first advertisement for a controller in Germany was in 1954. The position of "controller" is introduced in large German companies in the 1960s and 1970s. By the 21st century, 90% of companies have a "controller" on staff. Furthermore, in 85% of the enterprises for machines within the electrical and automotive industries, the controller was also a member of the company's board of directors.

A thorough analysis leads to the conclusion that "controlling" as a concept can be defined as a set of goals, tasks, tools, entities, and organizational structures. Its main function is to support and assist the management of the enterprise in order to make optimal management decisions. The purpose of the enterprise's existence is defined as the achievement of maximum results on the Discounted Cash Flows - which is in complete contrast with how we define the purpose of an enterprise in Chapter 1. In order to achieve the meaning defined by the above sources, "controlling" encompasses complex tasks of planning, regulation, and monitoring the activity of the enterprise in order to achieve the predetermined objectives. Furthermore, it is the task of the "controller" to make ongoing changes and adjustments, eliminate interferences, and ensure the continuous flow of information to the management team. In addition, the process of "controlling" should serve as the basis for building an information technology system that supports the management of the enterprise, or more precisely, it should serve as the basis for the digital technology for managerial modeling of the economy of the enterprise for machines.

The fact that the controller is in charge of all these activities gives this position supreme authority over the enterprise. In essence, the controller becomes the "actual leader" of the economy of an enterprise.

The widespread distribution of knowledge of "controlling" reveals the root cause for the existence of consulting firms. The roots of Management Accounting, which is the main method for "controlling," also become apparent. The notion that the purpose of the enterprise for machines is to "increase the value of its capital" is imposed, and financial markets are placed upon a high pedestal.

Everything presented thus far indicates that knowledge of "controlling" should provide a complete and clear understanding of the principle setup and way of functioning of the enterprise as a systemic object because otherwise, the reasonable performance of the "*primary management functions*" would be impossible. However, an in-depth analysis of the knowledge "controlling" leads to the conclusion that this knowledge supports the first major flaw of the fundamental scientific knowledge of economy. It must also be concluded that "controlling" is the "heart" of the Western, accounting-driven model of managerial modeling of the enterprise. It includes everything – philosophy and ideology, methods, and administration, as well as accompanying software (an example leading product is "SAP").

4.2.3. Scientific knowledge of the "business model ontology"

To respond to the question "What is business model ontology?" we will present two answers. The first answer is based on the meaning assigned by the person who introduced the term "business model ontology" in the scientific knowledge of economy. The second answer is based on a thorough analysis of the written texts related to "business model ontology" and clarifies the objective meaning of this concept.

This thorough analysis is conducted in order to provide a concise definition to a concept that is precise in its nature, but as we will expose by the end of this section, has yet again been convoluted by the vague descriptions and interpretations of modern economics.

Thus, first we present the definition assigned to this term by the man who coined the phrase "business model ontology":

"A business model is a representation of how a company buys and sells goods and services and earns money.

In general, the purpose of creating a model is to help understand, describe, or predict how things work in the real world by exploring a simplified representation of a particular entity or phenomenon. Thus, in the case of a business model, the model (i.e., representation) shall help understand, describe and predict the "activity of buying and selling goods and services" and "earning money" of a particular company. But as the notion of buying and selling seems too narrow, I try to extend it. So differently put, the business model is an abstract representation of the business logic of a company. And under business logic, I understand an abstract comprehension of the way a company makes money, in other words, what it offers, to whom it offers this, and how it can accomplish this. [...]

In a nutshell, I describe a business model:

- as an abstract conceptual model that represents the business and money-earning logic of a company.

- as a business layer (acting as a sort of glue) between business strategy and processes."

In order to get a better understanding of the business model and its role, it is important to explain how it is situated in the company. As mentioned in the previous section, the business model is a conceptualization of the money-earning logic of a firm. As such, it can function as a conceptual link, forming a triangle between strategy, business organization, and ICT (Information and Communications Technology). Because there is often quite a substantial understanding gap between these three "worlds," the business model concept could serve as a unifier or glue.

Business model research is a rather young research domain and still has to prove its relevance. But as addressed above, yet relatively little concepts *and tools exist to help managers capture, understand, communicate, design, analyze and change the business logic of their firm. In my opinion and the opinion of many other researchers in this domain, the business model concept can fill some of this gap and can eventually gain an important position in managing under uncertainty.*

In the following sections, I will outline some of the roles the business model concept (i.e., the use of a specification of a conceptualization of business models) can play in business management and, particularly in regard to e-business issues. I have identified five categories of functions, which are understanding & sharing, analyzing, managing prospects and patenting of business models. Furthermore, an ontological approach to business models is indispensable for building software-based tools that help fulfill these five functions.

I describe these categories to give an outlook on what could be done with the help of the business model concept, particularly on the base of the business model ontology. The scope of this dissertation, however, is the design of a business model ontology.

The first area in which business models can contribute is in understanding and sharing the business logic of a firm. Concretely, business models help to capture, visualize, understand, communicate and share the business logic. […]

The second area in which the business model concept can contribute is in analyzing the business logic of a company. Concretely, they can improve measuring, observing and comparing the business logic of a company. […]

The third area of contribution of business models is in improving the management of the business logic of the firm. The business model concept helps ameliorating the design, planning, changing and implementation of business models. Additionally, with a business model approach companies can react faster to changes in the business environment. Finally, the *business model concept improves the alignment of strategy, business organization and technology. [...]*

The fourth area of contribution of business models refers to the possible futures of a company. I believe that the business model concept can help foster innovation and increase readiness for the future through business model portfolios and simulation. [...]

A last but fundamental area of contribution of business models is in building the foundation for a set of new computer-assisted management tools. Management literature is famous for producing concepts and models. Yet, little of these concepts have been translated into software-based tools, although, in my opinion, this could bring enormous value to management. For instance, some of the business model functions mentioned above principally make sense in a digitized version. Visualizing, designing and comparing business models can be done quickly, once software-based tools have been developed. More complex tasks, such as simulation, are simply impossible without the help of computers. But in order to be able to use computer assistance as outlined above, an ontology of the business model domain has to be provided. And this is exactly one of the aims of this dissertation. Once the elements and relationships of the business model concept have been defined, one can start building a set of software-based tools to simplify the life of managers.

To tackle this question, I design and propose a rigorous conceptual model of business models, which I subsequently call an ontology. Gruber (1993) defines ontology as an explicit specification of a conceptualization. It can be understood as a description (like a formal specification of a program) of the concepts and relationships in a specific domain. ... Current application areas of ontologies are also disparate, including enterprise integration, natural language translation, medicine, mechanical engineering, standardization of product knowledge, electronic commerce, geographic information systems, legal information systems2, biological information *systems (Guarino 1998). This seems to suit the business model ontology quite well, as it aims at defining the concepts and their relationships in the business model domain."* [26]

The term "business model ontology" was first introduced in the dissertation of the Swiss economist Alexander Osterwalder. His dissertation was completed at the end of 2004 and published under the title "The business model ontology - a proposition in a design science approach."

After a thorough analysis of the above quotations, it can be concluded that "business model ontology" describes the principle of operation of the industrial enterprise, *which is created and then advanced for the purpose of making a profit.*

As part of Alexander Osterwalder's dissertation, not only was the term "business model ontology" born, but also a scientifically recognized version of the first business model ontology. Six years later, in the book "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers," the first commercial version of this model was published. It later gained widespread popularity under the name "business model canvas." (Figure 4.2)

The structure of the "business model canvas," was presented at the very beginning of the aforementioned book. According to this book, the model, viewed as the bearer of scientific knowledge about the principle of operation of the industrial enterprise, has nine building blocks.

<table>
<tr><td colspan="2" rowspan="2">8. Key partners</td><td colspan="2">7. Key activities</td><td colspan="2" rowspan="2">2. Value propositions</td><td colspan="2">4. Customer Relationships</td><td colspan="2" rowspan="2">1. Customer segments</td></tr>
<tr><td colspan="2">6. Key resources</td><td colspan="2">3. Sales channels</td></tr>
<tr><td colspan="5">9. Cost structure</td><td colspan="5">5. Revenue streams</td></tr>
</table>

Figure 4.2. Business model ontology

The first building block is called "Customer Segments." It identifies five groups of customers that an enterprise could benefit from: (1) mass market, (2) niche market, (3) segmented, (4) diversified enterprises, and (5) multi-sided platforms, also known as multi-sided markets.

The second building block is called "Value Propositions." It forms representations of the possible manifestations of the value resulting from the consumption of the multitude of products (goods or services) that the multitude of industrial enterprises provides to all customer segments. In short, this block answers the question, *"What are the main reasons customers are willing to pay for certain types or other types of products offered on the market?"* According to the authors of the book (without claiming to be exhaustive), the main reasons are eleven and are described as follows: (1) newness; (2) performance; (3) customization; (4) "getting the job done"; (5) design; (6) brand/status; (7) price; (8) cost reduction; (9) risk reduction; (10) accessibility; (11) convenience/ usability.

The third building block is called the "Sales Channels" and answers the question of how (in what ways and by what means) the multitude of industrial enterprises provide the products it produces to the relevant customer segments. In the book, the sales channels are described as having two aspects. In the first aspect, sales channels are seen as direct and indirect ones, and in the second aspect, sales channels can be owned or partnered. The relevant channels then pass through five types of sales actions: (1) awareness, (2) evaluation, (3) purchase, (4) delivery, and (5) after-sale service.

The fourth building block is called "Customer Relationships" and defines the types of relationships that various industrial enterprises create and maintain with their customer segments. In this sense, six types of relationships are presented: (1) personal assistance, (2) self-service, (3) dedicated personal assistance, (4) automated service, (5) Communities, and (6) co-creation of value (joint work).

The fifth building block is called "Revenue Streams." It represents the different types of sources of income that the multitude of industrial enterprises receives from their customer segments — here, the authors of the book specify that in order to obtain the net profit, the costs necessary to obtain the corresponding income must be deducted. Seven sources of revenue streams are presented: (1) assets sale, (2) usage fee, (3) subscription fee, (4) lending/renting/leasing, (5) licensing, (6) brokerage fees, (7) advertising.

The sixth building block is called "Key Resources" and describes the most important types of assets needed to realize each possible business model. According to the authors of the book, these resources can be categorized as follows: (1) material resources, (2) intellectual property resources, (3) human resources, and (4) financial resources.

The seventh building block is called "Key Activities." It describes the most important types of activities that an industrial enterprise has to carry out so that its business model can work in practice. According to the authors of the book, these activities can be categorized as follows: (1) production, (2) problem solving, and (3) creating and maintaining platforms/networks.

The eighth building block is called "Key Partners" and describes the network of suppliers and partners who implement the business model. According to the authors of the book, there are four types of partnership: (1) strategic cooperation between non-competing companies, (2) strategic partnership between competitors, (3) joint ventures for the implementation of new business projects, (4) links between manufacturer and suppliers to obtain quality components. Three motivations to create a partnership should be distinguished: (1) optimization and economy of scale, (2) reduction of risk and uncertainty, and (3) Acquisition of particular resources and activities.

The ninth building block is called "Cost Structure" and describes all the necessary costs for operating the business model. According to the authors of the book, costs of the enterprise should be considered within the following four categories: fixed costs, (2) variable costs, (3) economies of scale, and (4) economies of scope.

Through his dissertation and from the position of a professional economist, Osterwalder draws attention to a really big problem in the development of the human capital of the world. This problem is described in the following text:

"... every manager and entrepreneur does have an intuitive understanding of how his business works and how value is created. In other words, he does have an intuitive understanding of the company's business model, but even though this business model influences all important decisions, in many cases, she or he is rarely able to communicate it in a clear and simple way (Linder and Cantrell 2000). And how can one decide on a particular business issue or change it, if it is not clearly understood by the parties involved?..." [26]

The above excerpt reveals one great truth – the fact that there is not a single entrepreneur or manager in the whole world who has a clear and conscious understanding of the principle setup and way of functioning of the industrial enterprise. Rather, the understanding of each entrepreneur and manager is on an intuitive level and is strictly personal, making it very difficult to form a collective consensus and, therefore, to act in cohesion when managing the real economy.

In light of what has been presented thus far, another excerpt from Osterwalder's dissertation is worth noting, which reads:

"... people have different mental models they will not automatically understand the same thing under a business model. Thus, a generic framework (i.e., an ontology) for describing business models becomes necessary. Such a framework can be understood as a common language between stakeholders to get the ideas out of their heads in order to formulate them in a way that everybody understands..." [26]

This text does not only confirm Osterwalder's idea that there is a global deficit of scientific knowledge, which explains the principle of operation of the industrial enterprise that is created and then advanced for the purpose of making a profit. Within his dissertation, the author defines a means to overcome the problem he discovered (in the form of a scientific task). He defined this tool as the "business model ontology," and assigned it one fundamental function, which should cover the most important operational functions for management practice. This is a suitable opportunity to summarize that the fundamental function of the business model ontology considered as a description of the principle of operation of the industrial enterprise, comes down to its role as a theoretical basis for the creation of a new generation of software.

All this means that knowledge of the business model ontology should give us a comprehensive and clear understanding of the principal setup and way of functioning of the enterprise as a systemic object because otherwise, it would be impossible to construct such software in a logical manner. However, an in-depth analysis of the knowledge of the "business model ontology" in the form of a "business model canvas" once again leads to the conclusion that this knowledge supports the first major flaw of the fundamental scientific knowledge of economy.

And yet, in our opinion A. Osterwalder, intuitively rather than purposefully, introduced a concept that could serve as scientific knowledge of a new level and quality and thus, could replace accounting in its role as the fundamental scientific knowledge of economy. However, for this purpose, it is necessary to invest more time and effort to further clarify the concept of "business model ontology".

Such a clarification is presented in an analysis of the concept of "business model ontology" from an engineering perspective, which was part of a Master's Degree thesis defended in 2022 at Tsinghua University in China under the title *"New business model ontology, examined as a bearer of cognitive potential for a historical change in the development of the global human capital."* [27]

The second definition clarifying the term "Business Model Ontology" states:

"...after careful examination (of the attempt to provide a definition of the concept "business model ontology"), I came to the conclusion that this term was far from being clearly defined and the reason lies within the

adopted methodology for deriving the definition. The author, A. Osterwalder, approached the task of deriving an objective definition for this term by breaking it down into two stages:

The first stage answers the question "What is a Business Model?" and the second stage answers the question "what is a Business Model Ontology?"

Based on thorough research, I propose another possible approach, which also breaks down the task into two stages:

The first stage gives an answer to the question "what is a Model Ontology?", and then the second stage gives an answer to the question "what is a Business Model Ontology?"

In response to the first question "What is a Model Ontology?", the research provides a thorough explanation, based on engineering logic, and leads to the conclusion that:

"A Model Ontology is a ***schematic and formulated description of the principle of operation of a class of systemic objects.****"*

In response to the second question, "What is a Business Model Ontology?", the research explains the scientific significance of this term for economic science after which provides the conclusive definition that:

"A (Holistic) Business Model Ontology is a ***schematic and formulated description of the principle of operation of the enterprise for machines examined as a systemic object bearer of the characteristic subjecthood.****"*

Here we can draw a parallel between the primary proposal for the meaning of the term "business model ontology" and the second clarifying proposal:

The first definition – Business Model Ontology means "*an abstract, conceptual model that represents the business and money-earning logic of a company.*"

The second definition – Business Model Ontology means "*a schematic and formulated description of the principle of operation of the enterprise* *for machines examined as a systemic object bearer of the characteristic subjecthood."*

In the Critical analysis section of the current chapter, we will examine the effects of the dissemination of the "business model ontology" as defined by A. Osterwalder in the form of a "business model canvas. Then in Chapter 6 we will present a knowledge of business model ontology developed in accordance with the second clarifying definition. Finally, we will draw a parallel between the two types of knowledge developed from the two distinct definitions.

4.3. The signs of a crisis in the development of today's economic science

Your head is probably spinning from all these different definitions and directions outlined by modern economic science. Similar to the definitions of the concepts "economy" and "economic science," here, too, we observe a huge number of varying understandings of otherwise identical concepts and terms. The lack of common terminology makes it impossible for professional economists from different schools of economics to find common ground and reach mutual understanding. At least for us, the similarity between the level of historical development of the fundamental scientific knowledge of economy and that of medical science in the Middle Ages is more than obvious. Different schools of economics, from their position of authority, impose scientific knowledge that is accepted as "true" after being discussed or debated, regardless of whether or not that knowledge can be applied in practice. Moreover, similar to the doctors of the Middle Ages, modern economic "scholastics" are senior advisers to the "royal courts," which in the modern world are the management teams of large corporations and also the political leaders of nations. Although it is logical that economic science ought to be the leading science for the management of the geopolitical and industrial economy, and although it claims to be just that, the fact is that it is at a medieval level of development. But what exactly does that mean? It means that there is a serious crisis in the development of this science!

But before we proceed to the critical analysis, in which we will elaborate on the comparison between the two sciences, let us examine if other people have noticed this crisis in the development of modern economic science. Are we the only ones, or are there other, much more authoritative individuals, who share our view, and if so, what has been the reaction of the ruling elites of the Western world to these signs?

4.3.1. Various signs of a crisis in the development of economic science

Surfing the internet for 10 – 15 hours would be sufficient to recognize that there are many different signs of a crisis in modern economic science. Of particular interest among all these signs are those from recognized, professional authorities in the field of economic science. There are numerous such signals, and more significantly, they are not recent.

1997, Russia — "A Crisis in the Development of Modern Economic Science" — this is the main topic of the report of Russian academic Victor Meerovich Polterovich. The report, entitled "Crisis of Economic Theory," was read at a seminar at the Central Economics and Mathematics Institute of the Russian Academy of Sciences in January 1997. The introduction states:

"... I proclaim the state of a theory to be in crisis if it is proven or if it is quite obvious that the main tasks set before it cannot be solved by the methods accepted by the theory. The present work presents arguments that demonstrate that modern economic theory, regardless of its impressive progress, is in deep crisis. This crisis is evident not only in the fact that this theory could not find effective solutions to the current problems of economic reform policy, but it is also evident in a section deep within the

core of the theory: there is an accumulation of facts that testify to the fundamental limitations of the theory's methodology.

Firstly, I would like to limit my task. The term "economic theory" is utilized too broadly to have any practical application at all. How can we talk about a unified theory with such a variety of views and research approaches that we observe today?

After five decades of intensive mathematization of economic theory, it is possible to analyze how the complexity of the object is reflected in the structure of economic knowledge. It turns out that economics theory sets limits on itself, just like mathematical logic and physics. These limits are not always set consciously; the results are then imposed on various sections of the theory, and as far as I know, the theory as a whole has never been subjected to systematic analysis. The main part of this statement has been devoted to an attempt at such an analysis. Although I cannot see any clear resolutions to this crisis, I hope this discussion will be an opportunity to find some possible resolutions. For me, this hope is the main argument in favor of the topic "the crisis of economic theory."

There is another aspect of the matter, a moral obligation. A professional is obligated to care for the prestige of his profession, and discussion about the crisis of economic theory does not contribute to the prestige of economic science. On the contrary, they can turn young talents away from the field of economics. This is a significant counter-argument, and I suspect that the reluctance to violate corporate ethics has restrained public discussion of this problem among those who are professionally involved in the development of this science. Economics textbooks and the entire educational process are designed to give students the impression that they are studying a discipline that is fundamentally no different from the natural sciences. This belief is facilitated by a complex mathematical foundation, an abundance of formal proofs, and a great deal of attention paid to the methods used to create models. This belief is further spread into society *and consequently creates inflated expectations that economic science cannot meet. This puts economists in a position of fault and requires an explanation. This is my second argument in favor of discussing "the crisis of economic theory."*

At first glance, there have been reasons to talk about a crisis for more than ten years now. However, all of the main facts that I will refer to have been known since the mid-eighties, and most of them have been known for 20 years now. It turns out that as time progresses, the methodological problems of economic theory deepen, regardless of the unprecedented scale and pace of research and progress in certain areas - such as the theory of financial markets. In addition, events took place in the world that particularly brightly illuminated the limited capabilities of economic theory. I am referring to the radical reforms in Eastern European countries. Economic theory proved to be incapable of not only solving but even predicting the problems of the transitional economy. [28]

2000, France - Students of the most prestigious master's program in economics in the French university system, "Grand Ecole," write in an open letter:

"Economic theory is hopelessly untenable, mired in its own private model of reality...

We want to get out of the imaginary worlds!...

These scientific inconsistencies, this disregard for concrete realities, represent a huge problem for those who would like to be valuable economic and social participants in society." [29]

2009, USA - Paul Krugman, a 2008 Nobel Prize laureate in economics, published a lengthy article in the early fall of 2009 entitled "How did economics get it so wrong?" In this article, Krugman harshly criticizes the ideological failure of the theory of financial markets, a theory that

Polterovich's report (see the first example) defines as the greatest achievement of economic science in the second half of the 20th century. Two and a half years later, Paul Krugman published a book titled "End this depression now!" in which he expresses his view that the whole chain of phrases that citizens have frequently heard in recent years is nothing more than a handful of falsehoods uttered by politicians and economists, who are fully aware that in many cases, they are lying. They lie because to admit that there are alternative solutions to the crisis other than their own would mean to admit that their political and economic ideas may be wrong. Because the problem did not begin in 2008, but in the 80s with the policies initiated by Ronald Regan in the United States and Margaret Thatcher in the UK, which were later transferred to the rest of Europe. [30]

2010, France - Thousands of French economists signed the "Manifesto of Terrified Economists." The manifesto contains a list of "10 false evidences" imposed by modern economic science. Cited below are the false evidences they listed:

False evidence #1: The financial markets are efficient.

False evidence #2: Financial markets favor economic growth.

False evidence #3: The markets are good judges of the solvency of states.

False evidence #4: The excessive rise in public debt is the consequence of excess spending.

False evidence #5: Expenses must be cut to reduce public debt.

False evidence #6: The public debt transfers the price of our excesses to our grandchildren.

False evidence #7: Financial markets must be reassured in order to finance public debt.

False evidence #8: The European Union defends the European social model.

False evidence #9: The euro is a shield against the crisis.

False evidence #10: The Greek crisis has finally made it possible to move towards an economic government and true European solidarity.

In conclusion, they come to the conclusion that established economic policy should be debated and discussed and that the European Unition ought to be re-established anew. [31]

2012, USA — Joseph Stiglitz, a 2001 Nobel Prize laureate in economics, published a book titled "The Price of Inequality," in which he put forth the idea of an analogy between the development of modern economic science and the development of medieval medical science:

"The failures in politics and economics are related, and they reinforce each other.

Like the doctors of the Middle Ages who believed in bloodletting, but when the patient didn't get better, argued that what they really needed was another round, the bloodletters of twenty-first-century economics will not waver. They will demand ever more austerity, and they will find myriad excuses for why the first dosage didn't work as predicted..." [32]

4.3.2. The behavior of the Western world in regard to the signs of a crisis in the development of economic science

We asked ourselves*, "What is the reaction of the Western government elites to the numerous signs of a crisis in economic science?"* Since our world has gone through more than one crisis, be it a financial crisis, health crisis, or a crisis of another kind, there is a derived knowledge of crisis management, a knowledge that government elites can refer to in order to manage various crises effectively. But the existing theoretical knowledge that ought to provide an answer to the question *"What should be the rational behavior of the Western world in regard to the signs of crisis in the* *development of its economic science?"* is the product of that same science in crisis.

Among the various subfields within economic science, there is one that creates, develops, and disseminates "knowledge of crisis management." Often, this subfield utilizes negative labels, such as "knowledge of anti-crisis management" or "knowledge of anti-crisis governance." Regardless of the label used, this knowledge is recognized as part of the core curriculum in economics courses in both secondary schools and university programs. The following excerpt is an example of relatively easily digestible lecture material on the topic of "crisis management":

My grandfather used to say: "Everything can be resolved as long as there is no war." Over the years, I realized that war, too, is a way to get out of a crisis, but it is an extremely cruel and damaging way. The goal of crisis management is to take actions that avoid war and instead build a culture of change in the population in a peaceful, delicate, and balanced way. The established negative attitudes must be skilfully altered, and relationships of a new type must be built. Instead of going to extremes, a few simple steps should be taken to neutralize those same negative emotions. The action plan should be underpinned with care and responsibility.

How to react in a crisis or in a situation that may cause the emergence of a crisis:

1. Calm down. As strange and impossible as it may sound, this is one of the most important things. We can't think right if we're under stress and pressure.

2. Assess the situation and create a crisis headquarters. Create a crisis action plan. (Experts are not always admitted to the crisis headquarters. The crisis response team can involve friends, like-minded people, and people who support and trust you.) Mobilize the crisis team for a rapid and coordinated implementation of the adopted crisis plan, including an analysis of *actions to be taken and actions not to be taken during the crisis, using all available resources. Locate the damage.*

3. Identify. Manage the crisis process by starting with the identification of the root cause of the problem and the risk elements. Begin the process of eliminating the problem with extreme care. You may need to change the previously agreed-upon plan of action. Don't be afraid and be flexible.

4. Talk to the people. Go out and speak to the affected community and stakeholders and tell them the reality of the situation. You can always say, "Yes, I made a mistake, but it was in the name of the cause, in order to improve the lives or prosperity of certain groups of people." Don't be arrogant, but rather show humility.

5. Get some help. If you do not have a solution to the problem, seek support and assistance from experts and create a circle of affected parties to brainstorm with you.

6. Build an appropriate PR strategy, so there is a periodic flow of information to the stakeholders. These periodic messages can be supported by information about the usefulness and positivity of your activity. At such a time, reactions can be extremely unpredictable. Do not be discouraged by negative comments or attitudes. Go out and defend your position openly. Don't forget to apologize. I reiterate: it's not shameful to admit that you've made a mistake and take responsibility.

7. Justice. Try to compensate the affected parties fairly.

8. Think about the future. Look for a solution that suggests minimal future risks and risk situations.

9. Think of the big picture. Create conditions that prevent the same or similar situations from arising in the future. Don't forget to describe the measures taken, and don't underestimate the simmering elements of discontent.

10. Have foresight. Insert yourself within the dissatisfied groups and try to secure a critical mass for attitude modification. Go down to the level of the people and talk to them. Everyone wants to be heard.

And finally ... The faster you react at the start of the crisis, the more likely you are to save the organization. Don't be afraid! Crises are not the elements that destroy organizations. If we properly manage the process during a crisis, we can not only stabilize the company but can also create lasting partnerships, partnerships that are underpinned by loyalty, trust, and optimism. [33]

On a general, cognitive level, the content of this material corresponds to many other widely available materials about the scientific knowledge of "crisis management," and it cannot be denied that at its core, all of this sounds reasonable. This means that the Western world has some scientific knowledge of crisis management. Since there is such knowledge, it follows that the signs of a crisis in the development of the economic sciences ought to be responded to by establishing anti-crisis management procedures and by ensuring their operation. In reality, the Western world has somewhat successfully assimilated this kind of knowledge. In the event of a health crisis (such as COVID 19) or an event that threatens national security (such as a terrorist attack), crisis headquarters are immediately formed. However, every examination of the available information confirms that no such measures are being taken to deal with the crisis in economic science, and there is absolute passivity in response to the signs of such a crisis.

This fact has only one plausible explanation - the governing elites of the nations of the Western world do not realize the price of passivity in response to the signs of a crisis in the development of economic science.

4.4. Critical analysis

In the first part of this chapter, we asked ourselves, *"What was the fundamental scientific knowledge of medicine in the Middle Ages? Did it have* *any fundamental flaws, like today's fundamental scientific knowledge of economy?"*

From the materials presented, it can be observed that throughout the history of the Western world, from the creation of the first universities in Europe in the 13th and 14th centuries to the present day, there have been two phases of historical development of medical science, as well as a transition between them.

The first level of the historical development of medical science is defined as medieval and scholastic because it is characterized by a scholastic approach. This approach does not require knowledge of a "systemic anatomical and physiological mode of the human body." During this first level of development the knowledge of medical science was fragmented, described by vague concepts, and the majority of it was unsuccessful at depicting reality. However, solely because this knowledge was contained within the written records of verbally proclaimed authorities in the field, it was considered sufficiently justified and thus studied, interpreted, and asserted as truth.

The second phase of the historical development of medical science is defined as modern and systemic because it is characterized by a systemic approach. This approach imposes a definite requirement to master the knowledge of a "systemic anatomical and physiological model of the human body," described with clear and unambiguous concepts. This knowledge is defined as the fundamental scientific knowledge of medicine – thus, without such knowledge, studying for and completing a medical degree is unfathomable.

Nowadays, it is hard to imagine visiting a medical doctor who treats us with bloodletting by using leeches or drilling a hole in our skull to relieve a headache, right? Imagine two surgeons at an operating table: one surgeon refers to what we know today as a "kidney" by one term, and the other refers to it by another term. How will these surgeons understand each other, and how are they to perform the most rapid and appropriate treatment possible if they cannot communicate with each other?

In order to reach a shared understanding of an object and to distinguish it from its surroundings, we assign this object a set of sensory-cognitive parameters that characterize it. These sensory-cognitive parameters allow us to differentiate and control it. Naming an object is precisely one of those sensory-cognitive parameters. When an individual wants to spread knowledge about an object to a multitude of people, he does so by passing on the knowledge of the object's particular set of parameters to the next person. Each subsequent person then steps upon this terminological foundation and may potentially begin to build upon it.

It turns out that the transition of medical science from the medieval, scholastic phase of development to the modern, systemic phase would have been impossible without the creation of a unified theory and a set of terms based on that unified theory.

The formation of the systemic anatomical and physiological model of the human body is precisely such a process. Its detailed development and mass dissemination allow all medical students to have a thorough, and above all, a unified understanding of the object they are treating, namely the human body.

Now, let us compare the level of historical development of the fundamental scientific knowledge of medicine with the level of historical development of the fundamental scientific knowledge of economy. In the previous chapter, we determined that the most important parts of the fundamental scientific knowledge of economy are **scientific knowledge of the accounting model**, **scientific knowledge of operational management**, and **scientific knowledge of quality management**. The first model was the work of the Christian church, while the second and the third models were developed by American engineers. Then, in this chapter, we examined the developments made by modern, professional economists: **scientific**

knowledge of "business planning," scientific knowledge of "controlling," and the most recent addition – the **scientific knowledge of "business model ontology."**

If we return to the topic of the clear definitions of these concepts, it is more than obvious that the problem with establishing universal definitions of the objective meaning of the concepts "economy" and "economic science" (which we considered in Chapter 2), is "inherited" here as well. This is not surprising; it's even logical.

Unfortunately, just like medieval medical science, modern economic science is being developed by the work of numerous individuals whose authority is derived from their status in the field of economics, and who are representatives of different, influential schools of economics. These schools of economics – Austrian, Chicago, Neoclassical, etc. - have their own views about what the phenomenon of "economy" actually is, and often, they even contradict each other. This is also the reason why we see such diverse meanings of the concepts of "economy" and "economic science", as well as the approaches and methods within them, such as "business planning".

In the absence of a unified understanding of the objective meaning of the term "economy," it is extremely difficult to develop a high-quality fundamental scientific knowledge of economy.

We defined "economy" as **an idea of the process of manageable existence of artificial systemic objects, which are bearer of systemic subjecthood, generally labeled as "economic units**." This lack of a clear understanding of the objective meaning of the concept of "economy" is directly related to the First major flaw inherent in the fundamental scientific knowledge of economy that is currently being disseminated, namely that it does not provide a comprehensive and clear understanding of the principle setup and way of functioning of the enterprise as a systemic **object**. Just as medieval medical science was once unable to explain the anatomy and physiology of the human body as a system, so modern economic science is unable to systemically explain the "anatomy and physiology" of the enterprise for machines, and not just of the enterprise for machines.

It can be said that the development of "modern" economic science is even worse off in comparison to medieval medical science since the professional economist community fervently argues that the principle setup of engineering enterprises are more different than alike. In other words, they claim that it is impossible to derive knowledge of a ontological model of the economy of the enterprise for machines as a systemic object.

However, the need for such knowledge in the real, industrial world remains.

The scientific knowledge of accounting modeling reflects the past, but it is inadequate for managing the operational activity and planning the enterprise's future. The scientific knowledge of operational management and the scientific knowledge of quality management are primarily "necessary patches" in the field of operational management. This is also the reason for the emergence of all these various kinds of knowledge – business planning, controlling, and business model ontology. If we analyze the definitions of all these concepts carefully, we can confidently assert that they all have the same purpose – to explain the principle setup and way of functioning of the enterprise as a systemic object and, on this foundation, to provide guidelines for the progressive management of the enterprise.

And with the same level of confidence, we can also conclude that all of these concepts, without exception, fail at this task.

Let us analyze the very emergence of the knowledge for creating a business model of an enterprise that the Swiss national Alexander Osterwalder postulated. In his 2010 book "Building Business Models," the author claims to provide "knowledge for building an enterprise's business model." That is, he claims to provide a methodology for describing the process by which an enterprise creates added value. Moreover, he claims that it is possible to create a new generation of management software based on this knowledge. We can boldly assert that in order to properly build a model that describes this process for creating added value, one must have a crystal-clear idea of the principle setup and way of functioning of the enterprise in question. Only then will we be able to determine the causes for loss, the strengths of the enterprise, and where to direct investments. Using a true (proven to be practically applicable), ontological model of the economy of the enterprise for machines, it is possible to assess what is causing the actual losses while when using the accounting model it is very difficult to decipher what lies beneath the numbers. The question is whether Osterwalder's model is practically applicable, and universal for the enterprise for machines.

Before we can answer that question, we must note the phenomenal market success of Osterwalder's book (1 million copies sold in 4 years and translations into 40 languages) which leads to the conclusion that people in the industry have a great need for such knowledge since all the theories preceding it (knowledge of business planning and knowledge of controlling) have proven to be insufficient for the explanation of the principle setup and way of functioning of the enterprise. We must credit Osterwalder for recognizing that there is a global deficit of scientific knowledge that explains the principle of operation of the industrial enterprise. Perhaps that is why his "business model ontology" is so successful. From his position of authority, he declared that the current knowledge of economy does not provide a comprehensive and clear understanding of the principle of operation of the enterprise, but that the knowledge he offers would fill this gap.

However, after a thorough analysis of the texts describing the knowledge of business model ontology that he developed, we are still unable to find the answer to the question, " *What is the principle setup and way of functioning of the enterprise for machines?*" In other words, the nine-block schematic description of the principle of operation of the enterprise for machines proposed by the Swiss does not give a clear and empirically-adequate idea of the process by which the enterprise makes a profit, and for this reason, this nine-block schematic cannot be expressed with formulas. The business model canvas not only does not provide a comprehensive explanation of the process by which an enterprise makes a profit, but it also does not provide any explanation of the principle setup and way of functioning of the enterprise for machines, which in turn means, that this model does not correspond to the definition of the term "business model ontology" and due to this fact it could be deemed to be a "fragmented business model ontology".

And yet, that is far from the most significant issue that arose from the creation and popularization of the fragmented business model ontology. Today, at the very beginning of the third decade of the 21st century and ten years after it was first presented to the general public as a book, the fragmented business model ontology has already found a place in the curricula of business faculties of all universities around the world.

In Bulgaria, this fragmented model is not only studied in universities but also in elementary, primary, and secondary schools. Considering the fact that Bulgaria is a member of the European Union and that the educational programs are synchronized, we are certain that Osterwalder's fragmented business model ontology has found a similar place in the educational systems of all European countries.

And this is a massive problem because those who study Osterwalder's fragmented business model ontology get the false idea that this model represents the highest-quality scientific knowledge of the principle of operation of the enterprise for machines, when in fact, that is not the case at all.

In our opinion, it would have been much better for the educational system to provide no scientific knowledge of the principle of operation of the enterprise for machines than to provide knowledge of such questionable quality. That is because the quality of the scientific knowledge of "business model ontology" is as crucial for the development of human capital in the field of economy as the quality of scientific knowledge of the anatomy and physiology of the human body (its model ontology) is for the development of the human capital in the field of medicine.

So, why have all these theories failed at the task of providing high-quality knowledge for a business model ontology? We will allow ourselves to reiterate a quote from Viktor Polterovich:

"The term "economic theory" is utilized too broadly to have any practical application at all. How can we talk about a unified theory with such a variety of views and research approaches that we observe today?" [28]

The lack of unified theory and terminology makes it impossible for any of this knowledge to have serious success in practice. The lack of a unified basis for mutual understanding is detrimental to the further development of modern economic science by the community of professional economists.

In fact, Osterwalder himself had reached the same conclusion. However, instead of taking on the task of developing a theory and terminology of a new level and instead of committing himself to extensive practical work that can lead him to derive an ontological model of the economy of the enterprise for machines as a systemic object and subject, he proposed a superficial solution called "business model canvas." His theory lacks any attempt to derive new terminology that adequately reflects the real world. His attempt to explain how an enterprise for machines operates through the nine blocks is frivolous, to say the least, and wreaks havoc on the minds of those studying this model rather than contributing to building a universal understanding of how an enterprise really creates value.

In Chapter 6, we will demonstrate that the creation of an ontological model of the economy of the enterprise for machines is not only possible but is already a reality. This ontological model can also be appropriately described as a holistic business model ontology. Furthermore, we will make a direct comparison between the fragmented business model ontology and the holistic business model ontology.

However, we are not trying to attribute all the blame for the crisis in economic science to Alexander Osterwalder alone. His work, chaotic as it is, attempts to fill a huge knowledge deficit. The role of the community of professional economists is precisely to subject the knowledge of "business model canvas" to critical analysis. But such a critical analysis never took place, and without any scrutiny, the fragmented business model ontology has been accepted into and widely disseminated throughout the scientific and educational systems of the Western world.

The outright reluctance of the entire community of professional economists to acknowledge the simple fact that to reach this new type and level of knowledge of the ontological model of the enterprise for machines, a knowledge that is characterized by a unified theory and standardized terminology, it is necessary to conduct real-world studies and practice. This reluctance makes the transition of economic science from a medieval level of development to a systemic level of development impossible. A type of transition that medical science proved to be possible more than 400 years ago.

To our (and the entire Western world's) great regret, economic science has another significant similarity with medieval medical science, namely: *"...Kings hired court doctors and often consulted them on political affairs; towns hired their own physicians; criminal courts relied on them for forensic testimony; church officials needed them to certify impotence in petitions for marital annulment. Much like preachers and lawyers but even more so, medical doctors rose to influence in a world dominated by illiterate but otherwise powerful and intelligent courtiers, parishioners, clients, and patients."* [17]

Today, economic science has gained public recognition as the science that can and must create, develop and disseminate knowledge of systemic understanding and, therefore, systemic management of the development of industrial capital (including human capital) within the space-time continuum of the global world. In this respect, economic science has gained an absolute monopoly, and from this position, it bears key cognitive responsibility for achieving a dignified and just future for the nations of the world.

Due to this publicly recognized position of authority over the industrial capital, the community of professional economists has acquired extraordinary influence in management circles. This influence greatly exceeds that of lawyers, engineers, doctors, military personnel, etc. Economists are present at every level of management of the geopolitical and industrial economy and, from their position of authority, impose their corrupted views on all aspects of our lives.

Alas, this is not the time to comment on the motivations of this community, whose deeds can be adequately described by Pieter the Elder BRUEGEL "The Parable of the Blind Leading the Blind," where a blind man leads the blind to the precipice. The analysis of the motivations of this community of professional economists we leave for Chapter 7.

This is, however, the appropriate place to declare that the acceptance of all these unsound theories in the field of the fundamental scientific knowledge of economy without any scrutiny from the professional economist community has had detrimental consequences for the Western world; consequences that may also lead to a Third World War.

Chapter 5: The fifth disregarded, evident fact

The flaws of the fundamental scientific knowledge of economy lead to an unfavorable development of the human capital in the Western world.

After proving our claims that economic science has significant flaws, and especially after providing evidence of the long-standing signs of a crisis in the development of economic science, any open-minded reader would be convinced that the state of modern economic science is dreadful. And yet, all the while, somewhere in the back of your mind, there is likely a looming question: *"Perhaps it is true that modern economic science is fundamentally flawed and in crisis, but so what – what consequences does this fact lead to in a personal, professional, and global respect?"*

In our view, the most substantial damage that modern economic science inflicts is upon the development of the human capital of the Western world, which due to its significant central place for any economy transcends to all other aspects of the modern world. But how does this happen?

Throughout the last two decades in the publicly available online spaces, there have been some indications (not many, but sufficiently worrisome ones) of the lagging development of the human capital of the Western nations compared to the development of the human capital of East Asian nations, especially that of China.

5.1. Signals of an unfavorable development of the human capital of the Western world compared to that of China

2010, Germany.

An influential German media source published an article that reads:

"Is it possible that today, half a millennium later, we are experiencing the end of Western dominance?

Unprecedented economic growth!

The Western world can only watch and admire Beijing's response to the collapse of the export industry caused by the U.S. credit crisis, a collapse that was expected to have a devastating effect on Asia. But while the developed world teetered on the brink of a second Great Depression, China experienced a slight downturn in economic growth – thanks to the government's highly effective economic stimulus program and massive credit expansion.

Of course, it would be naïve to think that the coming decades do not hide issues for China's economic rise. However, the fact remains that in the wake of the financial crisis, Asia's most recent and greatest industrial revolution has only paused to catch its breath.

The financial crisis called into question in a fundamental way the legitimacy of "The American Way" - what Francis Fukuyama and others called liberal capitalism or capitalist democracy in 1989. I have just returned from China, where I frequently heard phrases, such as: "You can no longer tell us that your system is the best. And you can forget all about this so-called democracy. Look at where it has led you." In the course of the current crises, we have lost an important power: the power to admonish and be listened to."[34]

2011, USA.

An influential American media source published an article reading the concern that the American industry is reducing its costs and increasing its profit by exporting the production of its highly innovative products. However, with these actions, it loses its innovation experience, loses its technological talents, and thus also loses its scientific research talents.

"In the long term, then, an economy that lacks an infrastructure for advanced process engineering and manufacturing will lose its ability to innovate.

Industries that are "already lost" to the USA:

- *compact fluorescent lighting;*
- *LCDs for monitors,*
- *T.V.s and handheld devices like mobile phones;*
- *crystalline and polycrystalline silicon solar cells,*
- *inverters and power semiconductors for solar panels;*
- *advanced composite used in sporting goods and other consumer gear;*
- *advanced ceramics and integrated circuit packaging.*

Their list of industries "at risk" is even longer and more worrisome." [35]

2016, USA.

An influential American media source published an article that read:

"Chinese leader Xi Jinping knows something Barack Obama doesn't: America is finished. The U.S. economy is an ocean liner holed below the waterline. In the stateroom, the band plays on – but, on the bridge, the outcome is clear.

With the arguable exception of the late-era Soviet Union, America is sinking faster than any Great Power in history.

As a proportion of national output, America's foreign debts are already larger than those of any Great Power since the rotten-to-the-core Ottoman empire a century ago. For those who need reminding, the Ottoman empire, which had flourished for more than six centuries, was then within a decade of final collapse.

As Xi Jiping knows only too well, this is a matter of technology. As soon as American corporations come up with a more efficient new production technology, they ship it to China or elsewhere overseas, where it will boost the productivity of foreign workers. Any corporation that wants to sell in China must not only manufacture there but bring its best technology. Then it is expected to export back to the United States. All this means that the American economy has passed the tipping point. It is now simply too *hollowed out to make a recovery. Even apparently solid U.S. manufacturers like Boeing, Caterpillar, and Corning Glass have long since sourced many of their most advanced components and materials from Japan, Korea, Germany, and other manufacturing-focused nations. (Much of Boeing's most valuable technology has long since been transferred to East Asia, not least its avionics and its incomparable wing technology.)*

In proceeding full steam ahead towards national bankruptcy, the United States is world history's ultimate example of the triumph of ideology over commonsense. Beginning in the Eisenhower era, succeeding Washington administrations have bet the farm on ever-freer trade.

There is a one-way valve here. Key production technologies leak out of the United States: they don't leak in. Other nations have industrial policies to make sure that their most productive technologies stay at home. By contrast, in a latter-day America, corporations have no national loyalty, and they have every reason to transfer their technologies abroad.

No nation has understood the stupidity of America's trade policy more clearly than post-Mao China. On the one hand, American leaders have thrown the U.S. market wide open to Chinese exports. On the other, they have ignored Beijing's in-your-face blocking of virtually all advanced American exports to China. The United States has been by far the most serious victim of Chinese protectionism.

Even South Korea, with just one-seventh of America's population, is a bigger exporter to China than the United States. On a per-capita basis, South Korea's China exports are eight times larger than America's. Korea's exports moreover consist almost entirely of leading First World goods such as highly miniaturized electronic components, whereas the main things America sells to China are Third World-ish items such as iron ore, coal, and wheat.

This is not to suggest that American brands are absent from China. Actually, they are everywhere. But virtually all American-brand goods sold in

China are made there -- using American production knowhow that, in some cases, has taken the American nation generations to build up. In an egregious sell-out of the American national interest, U.S. corporations now almost reflexively comply with China's technology demands.

As Chinese leaders know better than anyone, the ultimate issue is American corruption. Washington is actually far more corrupt than Beijing. If you want to get something done in Washington, you do what you do in Jakarta: just slip some money to the right people. The point was made as far back as a generation ago by the prominent Japanese commentator and author Shintaro Ishihara. From an East Asian point of view, the United States is already, in its political dynamics, a Third World country."[36]

The above texts are excerpts from a Forbes article titled "Obama In China: Taking Candy From A Baby," and they remind the readers of two events from 2016. In the spring of that year, Barack Obama published an article in the "Washington Post" in which he stated:

"America should write the rules (of global economy). America should call the shots. Other countries should play by the rules that America and our partners set, and not the other way around.

The world has changed. The rules are changing with it. The United States, not countries like China, should write them."[37]

Only a few months later, at the G20 summit in China, the president of the United States of America – Barack Obama – was greeted by the hosts in a scandalously insulting manner compared to the welcome that other country leaders received. As it turned out, he was the only leader who was not provided with a ladder for an official disembarkment from the airplane, and thus, he was forced to use the emergency exit. These two events embody the perspective of the Western academic community of economists, who claim that the USA has reached the highest stage of socio-economic development (a stage called "knowledge economy," which we will address later), as well as the perspective of East-Asian academic and political elites, who reject the USA's claims to be a mentor to other nations and insistence on dictating the global future because the U.S. economy is based upon faulty theories that turn them into a "paper tiger."

The East-Asian view that the Western world has no grounds for pretenses based on the accolades of its economic science is candidly articulated by Ha-Joon Chang (South Korea) in his book "23 Things They Don't Tell You About Capitalism." The following texts are excerpts from that book:

"Economic miracle without economists

The East Asian economies of Japan, Taiwan, South Korea, Singapore, Hong Kong, and China are often called 'miracle' economies. This is, of course, hyperbole, but as far as hyperboles go, it is not too outlandish.

During their Industrial 'Revolution' in the nineteenth century, per capita income in the economies of Western Europe and its offshoots (North America, Australia, and New Zealand) grew between 1 percent and 1.5 percent per year (the exact number depending on the exact time period and the country you look at). During the so-called 'Golden Age' of capitalism between the early 1950s and the mid-1970s, per capita income in Western Europe and its offshoots grew at around 3.5–4 percent per year. In contrast, during their miracle years, roughly between the 1950s and the mid-1990s (and between the 1980s and today in the case of China), per capita incomes grew at something like 6–7 percent per year in the East Asian economies mentioned above. If growth rates of 1–1.5 percent describe a 'revolution' and 3.5–4 percent a 'golden age,' 6–7 percent deserves to be called a 'miracle.'

Given these economic records, one would naturally surmise that these countries must have had a lot of good economists. In the same way in which Germany excels in engineering because of the quality of its engineers and France leads the world in designer goods because of the talents of its *designers, it seems obvious the East Asian countries must have achieved economic miracles because of the capability of their economists. Especially in Japan, Taiwan, South Korea, and China – countries in which the government played a very active role during the miracle years – there must have been many first-rate economists working for the government, one would reason.*

Not so. Economists were, in fact, conspicuous by their absence in the governments of the East Asian miracle economies. Japanese economic bureaucrats were mostly lawyers by training. In Taiwan, most key economic officials were engineers and scientists, rather than economists, as is the case in China today. Korea also had a high proportion of lawyers in its economic bureaucracy, especially before the 1980s. Oh Won-Chul, the brains behind the country's heavy and chemical industrialization programme in the 1970s – which transformed its economy from an efficient exporter of low-grade manufacturing products into a world-class player in electronics, steel, and shipbuilding – was an engineer by training.

If we don't need economists to have good economic performance, as in the East Asian cases, what use is economics? Have the IMF, the World Bank, and other international organizations been wasting money when they provided economics training courses for developing-country government officials and scholarships for bright young things from those countries to study in American or British universities renowned for their excellence in economics?

A possible explanation of the East Asian experience is that what is needed in those who are running economic policy is general intelligence, rather than specialist knowledge in economics. It may be that the economics taught in university classrooms is too detached from reality to be of practical use." [38]

Interestingly, in 2020 the ratio of bachelor of engineering graduates in the USA to that of bachelor of engineering graduates in China was an impressive 1:7 – 202,000 to 1,362,380 in favor of China.

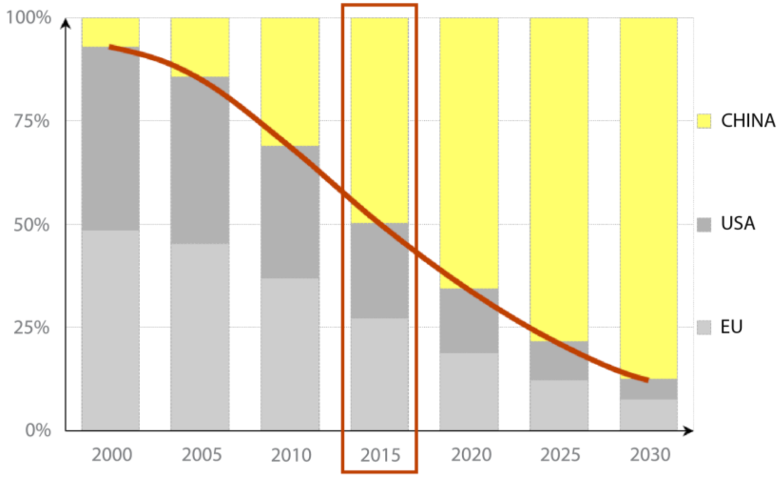

Figure 5.1. The trend of development of Western and Chinese technological elite

Research that we conducted in 2021 shows that in the first fifteen years of the 21st century, the country that produced the greatest number of engineers per 1 million citizens was South Korea. Japan comes in second place, falling short of South Korea's numbers by about 15%, and in third place is China. In the last decade of the 20th century and the first decade of the 21st century, China has continuously expanded its production of engineering personnel, and in the last five years, it has already overtaken Japan. India is also following in China's footsteps, but with some delay. The technological labor force parity between the West and China in 2015, as shown in figure 5.1, might have been slightly exaggerated; however, the West certainly had the upper hand. The truth is that in regard to the workforce potential in the field of machine engineering, China is already ahead of the Western world, which for more than two decades has recklessly been cutting back the human capital in the field of engineering. This reduction, however, is leading to a boom in bachelor of economics and business graduates. In the United States alone, the bachelor graduation rate in these fields is over 2:1 relative to the bachelor of engineering graduates.

5.2. Economic science as the dominant science for the development of human capital in the Western world

At the end of the last chapter, we established that the governing elites of the nations of the Western world do not realize the price of passivity in response to the signs of a crisis in the development of economic science. So, what is that price?

In recent decades, the human capital of the entire Western world has undergone a substantial and extremely ill-advised distortion of its most strategically valuable human resources. A distortion that has led to the alarmingly low level of practical efficiency of the workforce to contribute to the advancement and progression of the Western economy.

This unfavorable trend has been growing indiscriminately in the Western world for several decades now and has resulted in a huge imbalance in comparison with China's human capital, which in turn has followed a radically different strategy for socio-economic and political ascent, an imbalance that could even lead to a world war. This is the hidden price of the Western world's passivity in response to the signs of a crisis in the development of economic science.

This distortion of the Western world's most strategically valuable human resources is caused by the educational system, led by the academic field tasked with disseminating scientific knowledge of managerial modeling of the industrial economy within the schools and universities.

Actively supported by the media industry, this distortion is a result of the fact that the fundamental scientific knowledge of economy is still at a medieval, scholastic level of development.

A knowledge which, as we have seen, has two major flaws:

The first major flaw – the fundamental scientific knowledge of economy does not provide a comprehensive and clear view of the principle setup and way of functioning of the enterprise as a systemic object.

The second major flaw – the fundamental scientific knowledge of economy does not provide a comprehensive and clear view of the principle setup and way of functioning of the enterprise as a systemic subject.

But why does this unfavorable trend, visible in figure 5.1, only start at the beginning of the 21st century? One of the reasons is that economic science was not taken seriously until the beginning of the 1980s, and it only began to gain popularity in the last two decades of the 20th century. Even more damaging is the fact that there is a parallel and ongoing phenomenon of mass relinquishment and dismissal of historically proven, traditional, Christian morals and ideals that Western peoples have adhered to for centuries; ideals based upon the belief that Man's very nature is to be a Maker and a Creator in the image and after the likeness of God, that human virtue is the primary cause of economic activity, and that it is the unity of human labor which is the foundation of economic efficacy.

The accumulation of all these disregarded, evident facts creates a foundation for the function of the Western educational system as a machine for intellectual and moral distortion of its most valuable human resources.

This fact is catastrophic and even dangerous for the social structure, especially in the last decades of the 20th century, when the Western educational system was reorganized and adjusted to attract the youth with the highest potential to enroll in economics programs, producing professional economists in excessive numbers. Meanwhile, twice as few engineers are being recruited at the expense of this abundance of professional economists. Despite that, it should be noted that under the conditions of this defective fundamental scientific knowledge of economy, it is precisely the professional class of machine engineers that is capable and can be relied upon to generate and develop a systematic scientific knowledge of economy and thus create a technological leadership. The professional class of economists is entirely unfit to achieve this task under the same conditions. Why is that? In the last chapter, we demonstrated how economic science is at a medieval level of development since it was developed by different schools of thought, each with its own understanding of the phenomenon called "economics ."Furthermore, they develop this science from their position of authority, through numerous discussions and debates, not through practical experimentation in order to derive a unified theory and universal terminology. That is, the use of a systematic, scientific approach, and hence the necessary systematic development of a science, is not inherent to the field of economics and the professional class of economists.

Thus, it turns out that the primary reason for the metamorphosis of the Western educational system into a means for intellectual and moral distortion of its most valuable human resources is the collective inability of the elite professional economists to elevate the scientific knowledge for managing the industrial economy from a scholastic to a systemic level of development. However, this lack of ability does not only harm the scientific and educational systems of the West. It also gives rise to another disturbing phenomenon – the cognitive impotence on the part of the political and socio-scientific elites of the Western nations to ensure the development and implementation of highly reliable strategies for the socio-economic development and the national security of each nation. Once again, it is precisely economic science that ought to provide clear and practical scientific knowledge needed to draft documents of the highest order, which define the vision and general objectives of the public administration policies.

For the most part, the substantive framework and top-level goals of various national programs are indeed worthy of respect, but the specific targets and activities needed to achieve them in practice are described extremely scantly and thoughtlessly, sometimes to a crisis-inducing degree.

The long-term strategic plans of a given country, which define the vision for the future of that nation and the collective goals and policies for the development of all sectors of the state's administration, are characterized by a systemic problem. This systemic problem is a consequence of a lack of practical knowledge of the systemic management of the economy of both an individual enterprise and, by extension, of the entire nation.

This, in turn, means that there is a frightening deficit of valuable scientific knowledge about strategic management among the people who are involved in the strategic planning of nations. What is worse is the fact that this deficit of scientific knowledge is observed among the persons and institutions responsible for the approval and oversight of the successful implementation of the established goals.

These problems would not be so pernicious if the rest of the officials responsible for the governance of a country and the media outlets dealing with the coverage of major and significant events did not "suffer" from civic duty blindness. This brings us to an even more serious problem - among the many politicians engaged in the management of the Western nations, no one paid serious attention to this huge deficit of valuable scientific knowledge but only noted its consequences.

The thesis that the political officials of the Western world are plagued by cognitive impotence that renders them incapable of devising and enacting reliable strategies for the socio-economic development and national security of their nations finds strong support in a statement by the president of Russia, Vladimir Putin, made at the end of October 2016. This was a closing statement made during a Valdai Discussion Club event entitled "The

Future in Progress: Shaping the World of Tomorrow." In his closing remarks, the President of Russia stated:

"... But it is very clear that there is a lack of strategy and ideas for the future. This creates a climate of uncertainty that has a direct impact on the public mood.

Sociological studies conducted around the world show that people in different countries and on different continents tend to see the future as murky and bleak. This is sad. The future does not entice them but frightens them. At the same time, people see no real opportunities or means for changing anything, influencing events and shaping policy." [39]

This is the public statement of a man who is the undisputed leader of a geopolitically influential country and who, in this capacity, for more than 15 years, has made an extraordinary personal effort to build a mechanism for responsible national governance through the implementation of a system in two parts: (1) a national security strategy, and (2) a socio-economic development strategy.

The above-quoted words of President Vladimir Putin can be interpreted as an unfair reproach of world economic science that, in the course of its historical development, it has not yet created a sufficiently effective set of political ideologies to manage the development of economy. A set from which one or more political ideologies can be chosen, but rather than being an end in themselves, the practical application of these strategies would lead to a continuous increase in the probability of peace, security, and just economic development, both for singular national economies and for the collective development of the world economy.

Each and every professionally unbiased, politically impartial, and in-depth survey of today's existing political ideologies of economic development, which have been created by economic science in the course of its historical development, would lead to the conclusion that the president of Russia is not unfair and has the full moral right to express his concern publicly. Conducting such a survey of the political ideologies of economic development to date leads to the conclusion that there are two types of ideologies, which can be aptly defined as "economic theism" and "economic atheism."

"Economic theism" seeks and finds support in texts from the sacred books of historically successful nations and, more specifically, from the substantively identical systematic ideas about the economic nature of Man arising from these texts. Some of these ideas, stated in the most simplistic way, boil down to the following:

(1) In his fundamental nature, Man is a Maker and a Creator;
(2) The primary causes of economic activity are Man's virtues;
(3) The foundation of Man's economic efficacy is the social unity of labor.

These ideas once nurtured common sense, culturally traditional, and Christian moral ideals; however, today, societies are shifting towards "economic atheism." Economic atheism seeks and finds support in the texts of professionally recognized social scientists, who propose ideas about the economic essence of Man that are in direct opposition to "economic theism." Ideas that:

(1) In his fundamental nature, Man is a Consumer;
(2) The primary causes of economic activity are Man's sins – greed, lust, and glory;
(3) The foundation for Man's economic efficacy is the social division of labor.

The founder of "scientific-economic atheism" is Adam Smith - "the father of economics." In 1776 he published a book entitled "An Inquiry into the Nature and Causes of the Wealth of Nations," which later became popular under the title "The Wealth of Nations." In this book, Smith first introduced the ideas that the primary basis of Man's economic efficiency is the social division of labor, and the primary causes of his economic activity are the deadly sins that play the role of the "invisible hand" of the market. This phrase is only used once in Smith's book, but that was sufficient to make this term widely popular and accepted even today; to make it a justification for any drastic change in the economy that the community of professional economists cannot explain. To a large extent, modern economic science resembles ancient polytheistic religions, where every inexplicable phenomenon was interpreted as a "sign from the gods." There are no specific texts within the book that explicitly and directly reject the idea of "Man as a Maker and a Creator" and impose the idea of "Man - a Consumer," but the book's general tone is such, and it is implied between the lines.

The broad ideology of "economic atheism" then spawns a host of "political ideologies."

According to our understanding, "political ideology" means the authoritative scientific knowledge for the selection and evaluation (and therefore planned and purposeful management) of the historical development of national economies and the economies of international unions and alliances – a development analyzed through the understanding of distinct historical stages that are characterized by specific criteria.

Based upon our research and criteria, currently, there are three existing political ideologies for economic development – the first is popularly known as "Marxism," the second is known as "knowledge economy," and the third is commonly known as "Industry 4.0". All three of these political ideologies for economic development represent "economic atheism."

We acknowledge that thus presented, the three "main political ideologies" do not align with a fairly widespread view that the three main political ideologies are: "liberalism" the focus of which is to prevent the intervention of the government in the economy, "socialism" the focus of which is on the fair distribution of economic outcome, and "conservatism" the focus of which is the adherence to management traditions.

In our opinion, the above-cited concepts are "political approaches" and not "political ideologies" for the purposeful management of national economies because they are not characterized by distinct, criterion-specific stages of historical development.

This "tangent" was necessary in order to move on to the next part of this chapter. In response to the words of V. Putin: *"... But it is very clear that there is a lack of strategy and ideas for the future. This creates a climate of uncertainty that has a direct impact on the public mood.",* it follows that we ought to make a general overview of the multitude of existing political ideologies. All of them are based upon the common ideology of "economic atheism" and the existing fundamental scientific knowledge of economy. From this position, their authors are responsible for the development of the human capital of the world. Let us begin with the first ideology in chronological order.

5.2.1. The political ideology of economic development popularly known as "Marxism"

"Marxism" is a theory of strategic modeling for the political management of the socio-economic development of society. According to this theory, socio-economic development passes through 5 distinct, criterion-specific stages of historical development: (1) primitive-societal stage, (2) slavery-owning stage, (3) feudal stage called *feudalism*, (4) capitalist stage called *capitalism*, and (5) a communist stage called *communism*, which is defined as the last and most evolved historical stage of socio-economic development of a society.

According to this theory, capitalism and communism are only possible and can only exist as a result of "industrialization." In both of these types of economies, there are two clearly distinguishable sectors: "sector A" and "sector B." In "sector A" the means of production are created, the most important of which are machines, and in "sector B" - products for consumption are created. The development of "sector A" determines the development of "sector B." Capitalism means extensive and intensive industrialization based on private ownership of enterprises. Communism also means such extensive and intensive industrialization but based on public ownership of enterprises. According to the Marxist theory, public ownership of enterprises results in a much fairer distribution of economic outcomes and hence a much faster and more sustainable process of development of the economy based on innovation.

In the course of history, Marxism has been practiced in two applied forms. One can be defined as "soft" - in this applied form of Marxism, it is assumed that industrial enterprises can be managed effectively regardless of the form of ownership: private, state, or mixed. This form of Marxism currently functions as a tool of political governance in China. The other applied form of Marxism can be defined as "hard" because it is much closer to the original theory - it assumes that industrial enterprises can only be managed effectively under state ownership or cooperative ownership.

The "hard" form of Marxism first became an instrument for political management in Soviet Russia, and after the end of the Second World War, the Eastern European block and the USSR. In the 50s and 60s of the 20th century, the economy of the European East marked world achievements in the fields of atomic energy and space research, but at the end of the 80s, without much effort for mitigation, the "hard" form of Marxism ceased to be used as an applied form of political management as it resulted in bankruptcy. Its strategies for socio-economic development had proven ineffective, with the notable exceptions of a few areas, such as education and healthcare.

Up until the end of the last decade of the 20^{th} century, Marxism was the only officially accepted political ideology for socio-economic management.

However, the beginning of the 21st century marked a significant change in this regard.

In the year 2000, the theory of "post-industrial society" (also known as the "knowledge economy" ideology) was officially adopted as the scientific basis of the Lisbon Strategy. Based on the Lisbon Strategy, the European Union was tasked with developing a world-class "knowledge economy" by the end of 2010. The acceptance and implementation of this ideology immensely contributed to the unfavorable development of the human capital of the Western world.

5.2.2. The political ideology of economic development popularly known as the "Knowledge Economy"

Broadly speaking, "Knowledge Economy" is a theory of strategic modeling for the political management of the socio-economic development of society. According to this theory, socio-economic development passes through 3 distinct, criterion-specific stages of historical development: (1) a pre-industrial stage called *pre-industrial society*, (2) an industrial stage called *industrial society*, and (3) a post-industrial stage called *post-industrial society*, which is defined as the last and most evolved historical stage of socio-economic development of a society.

According to this theory, in any economy, regardless of whether it is pre-industrial, industrial, or post-industrial, there are three clearly distinguishable sectors: the 'primary sector', the 'secondary sector', and the 'tertiary sector'. The 'primary sector' is comprised of the extractive industries and agriculture, the 'secondary sector' is comprised of the manufacturing industry, and the 'tertiary sector' is comprised of the service industry. The economy of a "pre-industrial" society is dominated by the 'primary sector', the economy of an "industrial society" is dominated by the 'secondary sector', and the economy of a "post-industrial society" is dominated by the 'tertiary sector'.

The "post-industrial" society has several stages of socio-economic development, the last and most evolved of which is the "knowledge economy."

The "theory of a post-industrial society" gives relevance to the concept of "globalization" and introduces a positive connotation to the concept of "de-industrialization" as the main prerequisite for all stages of the "post-industrial society." According to this theory, achieving the "knowledge economy" stage would be impossible without "de-industrialization."

In the context of the "theory of the post-industrial society," "de-industrialization" is a process whereby the national economy eliminates outdated resource-intensive industries and modernizes the remaining industrial enterprises through innovative transformations and further development of the personnel by upgrading their skills and expanding their knowledge base. In this way, old production processes are either modernized or transferred to counties where the transition to a post-industrial economy has not yet occurred. All of this leads to new technologies, new types of activity, and the advancement of small- and medium-sized businesses. It also leads to the service industry gaining a bigger portion of the national economy, with financial services, legal services, and management consulting services being particularly important.

After the political disintegration of Eastern Europe, which began in the mid-1980s but came to an end between 1989 and 1991, the legitimacy of "Marxism" reached a historical minimum, and at its expense, the legitimacy of the political ideology of the "post-industrial society" steadily increased. In 2000, this political ideology of economy was officially accepted as the scientific basis for the Lisbon Strategy. The Lisbon Strategy tasked the European Union with developing an exemplary "knowledge economy" by the end of 2010. In the pursuit of this task, the European Union would be in competition and simultaneous cooperation with the USA and Japan, which were also developing their "knowledge economies" in parallel by "de-industrializing" in accordance with the scientific theory. At a later stage, the effects of the USA's and the E.U.'s strict adherence to the "de-industrialization" process in comparison to Japan would become apparent.

"Information technology," "human capital," and "de-industrialization" are the three key concepts to express the economic content of the "knowledge economy" political strategy.

Faith in the idea of a "knowledge economy" provided ideological comfort to the West (led by the USA) until nearly the end of the first decade of this century, but in the early years of the second decade, this faith was put to the test. It was tested by the great financial and economic crisis of the West in 2008 and 2009 and by opening the eyes of the West to the economic success of China, which despite the West's lecturing and preaching, has continued to adhere to the Marxist ideology, only modifying it and adapting it to fit its political needs.

These two phenomena, the financial crisis and China's rapid economic development, call into question the validity of one of the main pillars of the "knowledge economy" idea - namely, the concept of "de-industrialization." Gradually it becomes apparent that the savings incurred by not maintaining one's own production industry and the transfer of all "dirty" production to developing countries is a "double-edged sword." Although, in the short term, Western companies accumulated huge profits from this decision, it becomes obvious how in the long term, due to the drastically reduced potential for innovation, these companies would be displaced by competitors, and some will even perish. The European Union acknowledges this fact and initiates the discussion and development of "re-industrialization" concepts.

The idea of "re-industrialization" of Europe became the goal of the chairman of the European Economic and Social Committee (EESC), Henry Malosse, who became head of the Committee in April 2013. When he took office, Malosse expressed the view that, given Europe's financial crisis at the time, European citizens had a growing lack of understanding of the E.U.

decision-making processes. In his opinion, the Committee's role is, on behalf of the citizens who make up European society, to draw the attention of the European institutions to their own strategies and hold them accountable. Only then would the citizens regain their trust in these institutions. Thus, the goal of the Committee became to strengthen its capacity to anticipate and prevent crises, provide transparency into its activities, and monitor European policies closely.

In this spirit, during his visit to Bulgaria in December 2013 for a debate on the topic of "The re-industrialization of Europe - myth or reality: The challenges facing the Bulgarian economy" organized by the "Bulgarian Industrial Capital Association" (BICA) and the "Bulgarian Association of Electrical Engineering and Electronics" (BASEL), Henri Malosse stated:

"The question is, is re-industrialization a myth? I think it is not re-industrialization that is the myth. For the past 10 – 20 years, we have been living according to three myths that have done a disservice to Europe. First the myth that the "knowledge economy" would make Europe the most competitive continent in the world. This was the claim in the year 2000, and we have seen that 13 years later, by following this strategy, the nations in the European Union have become that part of the world that has lost the most in terms of economic competitiveness. So, the Lisbon Strategy was a mistake because "knowledge economy" has no meaning. Since the dawn of time, the economy has been the process of production, maintenance and service of the production process, and the sale of the products that were produced. That is what generates "knowledge."

...

The second myth we have been living according to for the past 20 years is that of a single market. It was thought that by opening the borders, and by increasing trade, we could create wealth. It was a good idea in the eighties, but not anymore. Because we all know that today's market is a global market.

...

There is also a third myth called the "myth of miracles." Over the weekend, I visited Troyan and the surrounding area. The city's mayor asked me if there was anything I could do to cause a miracle, the miracle of a venture capitalist investing in Troyan. I responded that we could each light a candle in the Troyan church and pray for a miracle, but in general, miracles do not happen in economy.

...

Re-industrialization must become a top priority. Market competition must change. Rather than spying on industrialists, industrial cooperation should be supported and encouraged. European industry has had only one great success since the forties. It is "Airbus." And "Airbus" became successful precisely because of the political support of political leaders in France, Spain, England, Germany, and other European countries, which funded it with public tax subsidies. Thus, "Airbus" became the first manufacturer and producer of aircraft in the world. But if we were to attempt to re-create Airbus today, Europe would not agree. That is the absurdity!

...

We have to be more realistic and more pragmatic and invest in research in significant scientific developments.

I can only speak of my own country. The policy of my country, France, to support scientific research activity has absolutely no significance. The program has 3210 priorities, each of which receives 50 – 100 thousand euros per year. What could possibly be achieved this way?

We must revert back to local production, support small- and medium-sized enterprises, develop extremely simple things, rely on common sense and rational decision-making.

...

We have suffered too much from these ideological myths – the knowledge economy myth, the single market myth, and the myth of the *miracle of foreign investment. We need to get back to reality; we need to get back to common sense. Re-industrialization is common sense. Thank you!"*[40]

We fully agree with Henri Malosse's view that the "knowledge economy" is indeed a myth, but only due to the major flaws of the fundamental scientific knowledge of economy. The "knowledge economy" would not be a myth if a new scientific knowledge of a higher quality, devoid of such flaws was created for the managerial modeling of the economy of enterprises for machines. Without this scientific knowledge of a higher quality, at the end of the second decade of the 21st century and dominated by an economic science at a medieval level of scientific development, the generally reasonable political idea of a "knowledge economy" is not only a "myth," but even a "utopia." How can a "knowledge economy" be achieved without an understanding of economics?

During the time period between 2011 and 2015, the public information space became saturated with more than enough statements and publications, which questioned the strategic validity of the political ideology of "post-industrial society" and its last and most evolved stage - "knowledge economy." This accumulation of doubt had a destructive effect upon the authority of the most influential ideological institution in the field of economic management: The World Economic Forum.

Founded under the name "European Management Forum" (EMF) in 1971 by Klaus Schwab, this forum aimed to spread good American management practices to European industry. After the very first EMF conference, this forum began to gain enormous popularity. Frequent participants of the forum's conferences over the years are all the most prestigious representatives of the world's political, business, media, and science elites. By 1987, the European Management Forum had gained such influence and prestige that it became the World Economic Forum. The influence and prestige are not accidental. With the progress and development of the industry and commerce, the world begins to suffer more frequent from the problems caused by the unidentified deficit of quality knowledge for managerial modeling of the industrial economy. Moreover, given the prestige of economic science, the representatives of the political and business elites wholeheartedly trust the community of professional economists to provide adequate guidelines and tools for dealing with the incessant crises; a community which, however, until 1971 had no acknowledged institution that would stand at the helm and lead the community of professional economists. And this is how Klaus Schwab managed to elevate himself and the institution he created as the leader and face of the community of professional economists. It was from this position as a supreme leader of the economic science that WEF actively spread the ideology of the "knowledge economy." However, with the growing doubt about the strategic viability of that political ideology, Klaus Schwab and WEF were faced with an unavoidable choice: either to focus attention and declare the failure of the idea of a "knowledge economy" or to avert this attention by inventing and proposing a new ideology.

The latter option was chosen.

The book "The Fourth Industrial Revolution" was published at the beginning of 2016 for the very first time. The book is authored by Klaus Schwab, in his capacity as the founder and chairman of the World Economic Forum. This book laid the foundations of a new political ideology for economic development, known today as "Industry 4.0."

5.2.3. The political ideology of economic development popularly known as "Industry 4.0"

The clearest and most accurate definition of the ideological foundations of the political ideology of economic development, popularly known as "Industry 4.0," can be found in the "Historical Context" section (Chapter 1, Part 1) of the book "The Fourth Industrial Revolution."

The following are passages of this part of the book:

"The word "revolution" denotes abrupt and radical change. Revolutions have occurred throughout history when new technologies and novel ways of perceiving the world trigger a profound change in economic systems and social structures. Given that history is used as a frame of reference, the abruptness of these changes may take years to unfold.

The first profound shift in our way of living – the transition from foraging to farming – happened around 10,000 years ago and was made possible by the domestication of animals. The agrarian revolution combined the efforts of animals with those of humans for the purpose of production, transportation, and communication. Little by little, food production improved, spurring population growth and enabling larger human settlements. This eventually led to urbanization and the rise of cities.

The agrarian revolution was followed by a series of industrial revolutions that began in the second half of the 18th century. These marked the transition from muscle power to mechanical power, evolving to where today, with the fourth industrial revolution, enhanced cognitive power is augmenting human production.

The first industrial revolution spanned from about 1760 to around 1840. Triggered by the construction of railroads and the invention of the steam engine, it ushered in mechanical production. The second industrial revolution, which started in the late 19th century and into the early 20th century, made mass production possible, fostered by the advent of electricity and the assembly line. The third industrial revolution began in the 1960s. It is usually called the computer or digital revolution because it was catalyzed by the development of semiconductors, mainframe computing (1960s), personal computing (1970s and 80s), and the internet (1990s).

Mindful of the various definitions and academic arguments used to describe the first three industrial revolutions, I believe that today we are at the beginning of a fourth industrial revolution. It began at the turn of this *century and builds on the digital revolution. It is characterized by a much more ubiquitous and mobile internet, smaller and more powerful sensors that have become cheaper, and artificial intelligence and machine learning.*

Digital technologies that have computer hardware, software, and networks at their core are not new, but in a break with the third industrial revolution, they are becoming more sophisticated and integrated and are, as a result, transforming societies and the global economy. This is why Massachusetts Institute of Technology (MIT) Professors Erik Brynjolfsson and Andrew McAfee have famously referred to this period as "the second machine age"...

In Germany, there are discussions about "Industry 4.0", a term coined at the Hannover Fair in 2011 to describe how this will revolutionize the organization of global value chains. By enabling "smart factories," the fourth industrial revolution creates a world in which virtual and physical systems of manufacturing globally cooperate with each other in a flexible way. This enables the absolute customization of products and the creation of new operating models." [41]

The continuation of this section of the book is an expression of confidence that the Fourth Industrial Revolution will be as powerful and historically significant as the first three industrial revolutions combined. However, the conclusion of that same part of the book has a different tone.

The conclusion is an expression of concern that the economic potential embedded in digital technology will not be fully realized and will not be utilized for the common good. The reason cited for this concern is the fact that the ruling elites do not understand the need to rethink and change the existing economic systems by using digital technologies that store information, and thus knowledge, about these systems. This understanding "is inadequate at best and, at worst, absent altogether." [41]

5.3. Critical analysis

Throughout this chapter, we have presented a variety of examples of signals and evidence that support the thesis that the flaws of the fundamental scientific knowledge of economy have led to the unfavorable development of the industrial human capital of the Western world compared to that of China. It should not be overlooked and forgotten that the political ideology of a "knowledge economy," which was adopted indiscriminately and with considerable enthusiasm, is the leading cause of the unfavorable trend in the development of the technological elite of the Western nations compared to those of East Asia, with China at the lead. And this, in our opinion, is extremely reckless. For more than two decades now, in accordance with the theory of the "knowledge economy" and its inherent idea of de-industrialization, the Western world has been purposefully discouraging the development of the human capital in the field of engineering. At the same time, the Western world has been mass-producing a range of social workers, social science professionals, and above all others, professional economists. And this is even more reckless because some of the finest young people of the West are becoming professional economists. After four, five, or more years of study at leading universities, these people can write brilliant theoretical essays on the topic of economy, but none of them can actually give a decent explanation of the objective meaning of the term "economy." They are even less capable of explaining a perfectly clear construct – the universal principle setup and way of functioning of the enterprise for machines in its capacity as an object and a subject.

It turns out that the Western educational system has been turned into a machine for intellectual and professional distortion of its most valuable human resources – us and our future generations. It sounds absurd, but this is a fact. A fact that presents a grave issue for the future of the Western world.

It also should not be overlooked and forgotten that the World Economic Forum has played a significant role in the blind and indiscriminate acceptance of the political ideology of a "Knowledge Economy" by the Western governing elites. In its role as the leading institution responsible for the development of economic science, it should have established a crisis headquarters to deal with this serious problem. However, there is no such headquarters, and there is no record that there ever was. Moreover, the fact that the World Economic Forum does not address the evidence that modern economic science is at a medieval level of development represents a serious part of how this organization has contributed to the negative trend of the development of the human capital of the Western world, which we have outlined thus far. And this strategy may be entirely deliberate, as will be made clear in Chapter 7.

However, as it has already been established, the political idea of a "Knowledge Economy" has lost practical relevance and has been replaced by that of "Industry 4.0". What lies ahead for the Western world on the road of this ideology is also further examined in Chapter 7.

Within this Critical Analysis, we will consider the consequences of the negative trend of the development of the managerial human capital of the Western world from a current and indicative example: the crisis protocol of the Western world, led by the USA, and the crisis protocol of East Asia, led by China, in response to the "Spanish flu" and the COVID 19 pandemics. Currently, our world has almost overcome an extremely severe health crisis - the COVID-19 pandemic. According to numerous historians and medical professionals, this is the worst health crisis our world has faced since the "Spanish Flu" crisis (1918-1920). According to statistics, the total number of individuals infected with COVID-19 worldwide is about 760 million, of which more than 6.8 million people have died. In comparison, the Spanish flu pandemic infected about 500 million and killed between 25 and 50 million people. Since we are not virologists or health experts, we refrain from comparing which of the pandemics is more contagious or making statements about polarizing topics like the efficiency of the introduced vaccines. Rather what interests us is how different world leaders managed these crises and the different approaches that were adopted to deal with the pandemics.

We will begin our analysis with COVID-19 as a more recent example in human history and, thus, in human consciousness. It is a well-established fact that the first cases of COVID-19 were first recorded in China at the beginning of 2020. After that, the pandemic began to spread exponentially across the rest of the world. However, the spread of the disease in China, one of the world's most densely populated countries, and the spread throughout the rest of the world was radically different in the months and years that followed.

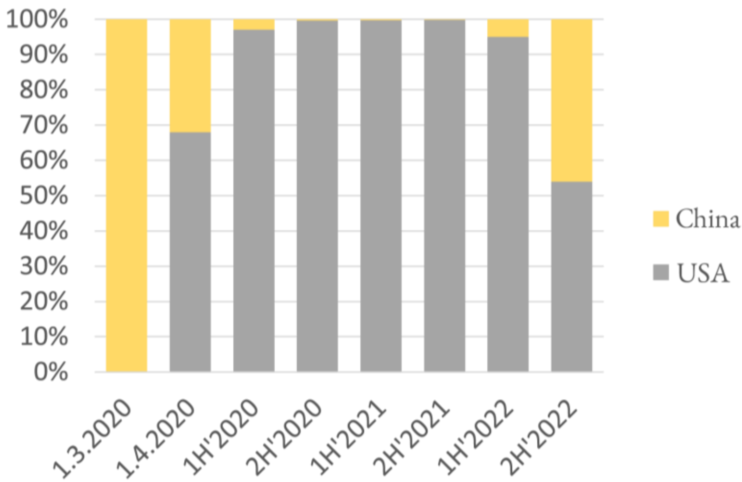

Figure 5.2. Comparison of the number of infected by the COVID-19 virus in China and the USA

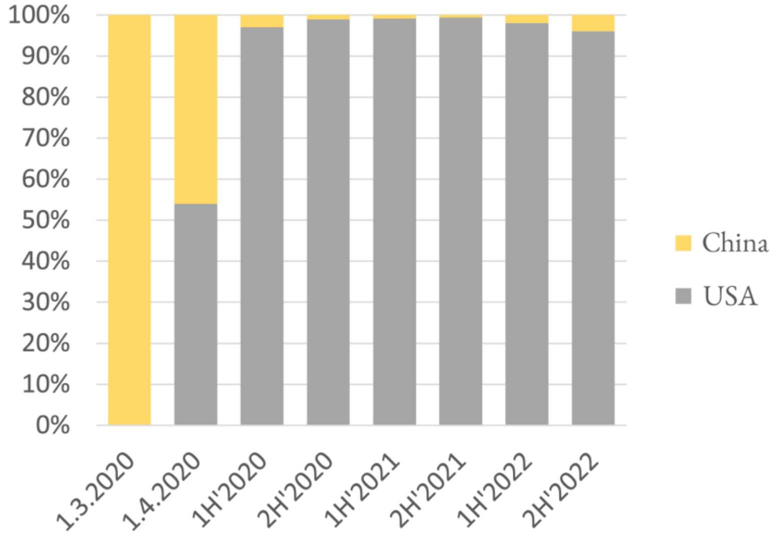

Figure 5.3. Comparison of the number of deaths by the COVID-19 virus in China and the USA

Figure 5.2 and 5.3 reflects the reality we have all witnessed by utilizing statistics provided by WHO about China and the USA – the two economic leaders of the Eastern and Western world, respectively. The two figures show how all the newly infected and all the deaths occur in China. The state authorities of China immediately imposed restricting measures to contain and manage the pandemic. Then, only one month later, the USA passed China in both those indicators. Amid the pandemic when the virus was the deadliest (from the mid of 2020 to the beginning of 2022), the restrictive measures taken by the USA seemed to have no effect, resulting in many deaths. In comparison, during that period, the spread of Covid 19 in China was minimal. Only after the middle of 2022, when the population is vaccinated and the global lethality of Covid 19 has decreased, China gradually eased its restrictive measures, leading to a massive increase in new infections but with a minimal mortality rate.

Therefore, it could be concluded that while in China, the people successfully managed processes to put the calamity under control and handled the virus to the most of their ability, in the USA, the calamity managed the people. It is evident that China has implemented an approach to handle a crisis of such a scale with great understanding, and the positive results are indisputable, while the USA has disregarded the engineering thinking and knowledge for management of processes leading to negative results and a high mortality rate. This raises the question: "Why has China dealt with the COVID-19 crisis so much more successfully than the USA?"

There are numerous and various attempts to answer this question in the accessible information forums, but more often than not, they are vague and convoluted, which obscures a simple truth. The truth is that the multitude of "economic leaders" within the societal system responsible for dealing with a crisis, such as COVID-19, in China is much better prepared and capable of doing so than the corresponding multitude of "economic leaders" within the USA.

In other words, the approach utilized by the ruling elites of China in dealing with the COVID-19 crisis, a "systemic engineering" approach, is much more effective and of a higher quality than the "scholastic economic" approach utilized by the ruling elites of the USA to deal with the same problem.

The reason for this fact is best expressed by Hajun Zhang, whose words we quoted at the beginning of this chapter:

"Economists were, in fact, conspicuous by their absence in the governments of the East Asian miracle economies. Japanese economic bureaucrats were mostly lawyers by training. In Taiwan, most key economic officials were engineers and scientists, rather than economists, as is the case in China

today. Korea also had a high proportion of lawyers in its economic bureaucracy, especially before the 1980s. Oh Won-Chul, the brains behind the country's heavy and chemical industrialization programme in the 1970s – which transformed its economy from an efficient exporter of low-grade manufacturing products into a world-class player in electronics, steel, and shipbuilding – was an engineer by training." [38]

A huge proportion of East Asia's "economic leaders" are precisely engineers. Both in East Asia and in the Western world, the level of development of economic science is identical, however, while in the West, we mainly rely on the community of professional economists to lead us through yet another crisis, be it of a financial, health, or other nature, in the East economic science is considered irrelevant, due to an established lack of systemic and sound foundational knowledge base unlike in engineering science. Engineering knowledge, in comparison, is based upon systemic thinking, and by utilizing the engineering approach, China managed to contain the spread of COVID-19 significantly more successfully than the USA.

The systemic approach to solving problems that is inherent in the engineering approach sharply contrasts that of the chaotic and fragmented approach inherent in the modern economics approach. This difference is a consequence of the scholastic level of development of economic science. The lack of systematized and organized knowledge in this science was noted as early as the 19th century by Henry Towne in his work "The Engineers as an Economist":

"Engineering has long been conceded a place as one of the modern arts, and has become a well-defined science, with a large and growing literature of its own, and of late years has subdivided itself into numerous and distinct divisions, one of which is that of mechanical engineering. It will probably not be disputed that the matter of shop management is of equal importance with that of engineering, as affecting the successful conduct of most, if not all, of our great industrial establishments, and that the

management of works has become a matter of such great and far-reaching importance as perhaps to justify its classification also as one of the modern arts. The one is a well-defined science, with a distinct literature, with numerous journals and with many associations for the interchange of experience; the other is unorganized, is almost without literature, has no organ or medium for the interchange of experience, and is without association or organization of any kind." [9]

By taking a systemic and organized approach to dealing with such a health crisis as COVID-19, China managed to limit the spread of the infection and protect its population. By 2023, China has recorded 87 million cases of infection since the start of the pandemic and 48 thousand deaths, which is about 0.003% of the population.

In comparison, although the U.S. has a four times smaller population size and is four times sparser than China, there have been 100 million cases of infection and nearly 1.1 million, which is about 0.32% of the population.

In the biased Western society, China is often accused of manipulating data, censorship, and other such accusations of limiting freedom of speech. Whether it is so or not, we cannot say. But it is evident that the actions of the managing elite of China have saved millions of human lives.

But let's see how other East Asia countries have handled the crisis of Covid-19. Countries that have not been accused of restricting human rights, as has been the case with China.

Internet research yields result that the other leading countries in East Asia (South Korea and Japan), who are broadly speaking allies of the USA but also rely upon the engineering approach to management, are dealing with the pandemic much more successfully than the leading Western countries (such as the U.S., Germany and the whole of Europe) with a mortality rate of 0.066% of the population for South Korea and 0.058% - for Japan. For comparison, the European countries have a mortality rate average of 0.29% of their population, with the leading country being Bulgaria, with a rate of 0.56%.

It could be argued that the East Asian countries have managed to limit the mortality rate by an order of magnitude better, which could be considered as having an order of magnitude higher ability to save the lives of their population.

But is it possible that the difference in success in managing a crisis of this nature is based on the difference in cultural mentality of Western populations and East Asian populations?

Examining the crisis management approaches during the "Spanish flu" provides an important insight. The "Spanish flu" pandemic broke out between 1918 and 1920, and it should be added that the Western world was particularly vulnerable and weakened at the time as a consequence of WWI, which had just ended. Examining the data related to the "Spanish flu," it is evident that Western countries dealt with that pandemic far more successfully, especially compared to East Asian countries.

In the USA, the rise of the "Spanish flu" coincides with the end of their so-called "Progressive Era." As we have learned in previous chapters, it was during this period of time that the U.S. became the most technologically advanced nation in the world and had entire armies of engineers helping the rest of the world recover from each of the two world wars. During this time, Western nations were still following "economic theism" and placed great emphasis on developing engineering professionals as a significant part of the human capital of their nation.

In a complete role reversal of the current pandemic, the "Spanish flu" pandemic started in the USA in 1918 and spread exponentially across the rest of the world. Due to the lack of modern testing and means for data processing in the early 20th century, it is difficult to determine the number of infections in each country, but various sources provide estimates for the number of deaths per country during the pandemic.

In the USA, which in 1920 had a population of about 100 million people, the number of deceased was between 500 and 650 thousand people or approximately 0.5 - 0.6 % of the population.

In China, which in 1920 had a population of about 400 million people, the number of deceased was about 5 million people or approximately 1.25% of the population.

It is clear that at the beginning of the 20th century, with incomparably poorer methods of mass communication, with incomparably poorer medical technology, and with the compounding factor that the "Spanish flu" pandemic started in the United States itself, the Americans managed the crisis much more successfully, and not only in comparison to China. In fact, the USA had done a better job of managing the "Spanish flu" crisis better than any other major country in the world at the time.

We conclude Chapter 5 with this historical and geographical comparison of crisis management. Throughout the chapter, we attempted to demonstrate the detrimental effect of the flawed fundamental scientific knowledge of economy upon the development of the Western world's human capital, especially compared to that of China. It is clear that when American society followed common sense and the historically proven, culturally traditional, and Christian moral ideals, it rose to become a world leader in a political, technological, and cultural regard. In short - to become the center of the Western world.

But in complete contrast, today, the governing elite of the Western world, actively guided by their economic advisers, sees the world from a new, cognitively different point of view from which it seems that "*the meaning of human life consists of the continuous pursuit of happiness through the satisfaction of the unknowable and infinitely growing human consumption needs. Unfortunately, the physical form of human life exists in a world with limited and depleting natural resources. Fortunately, there is something called the "invisible hand of the market" that organizes people* *into communities called industrial enterprises.*" And these enterprises, fighting for existence, achieve the seemingly impossible: "*maximum satisfaction of human consumption needs under the condition of limited, depleting resources.*" Unfortunately, the "invisible hand of the market" has a boundless need to "perfect" the legal and regulatory conditions in the country so that the "hand" can be effective at achieving maximum consumption under the condition of dwindling natural resources. Yet, fortunately, there is a community of professionals called "economists" who incessantly and tirelessly study the legal and regulatory conditions that the "invisible hand of the market" requires and then advise the governing body on what changes are necessary in order to motivate it and stimulate it.

The problem is that while everyone is looking at the world from the cognitive point of view of today's professional economists, they fail to see that the rules created to motivate and please the "invisible hand of the market" are conveniently leading to the increasing number of economists and the professions that support them. This consistent increase of economists happens at the expense of and by diverting talent away from the engineering professions of the Western populations. In this way, the "invisible hand of the market" is about to perform a suicide by depleting the quality human capital needed to develop efficient industrial enterprises, which in turn build the foundation of this market that the "invisible hand" belongs to; a foundation called "industrial economy."

Chapter 6: The Sixth disregarded, evident fact

The problem with the unfavorable development of human capital in the Western world has only one reasonable SOLUTION: the development and widespread study of a new type of ERP system – holistic ERP system.

In the preceding chapters, we traced the historical development of the fundamental scientific knowledge of economy: the work of the Christian Church, the American engineers, and professional economists. We have concluded that the most useful concepts from a practical standpoint have been knowledge of the accounting model, knowledge of operational management, and knowledge of quality management, as well as knowledge of inventory management and production planning. Furthermore, we deduced the substantially disregarded fact that the fundamental scientific knowledge of economy has two major flaws that are worth reviewing:

First major flaw:

The fundamental knowledge of economy does not provide a comprehensive and clear understanding of the principle setup and way of functioning of the enterprise as a systemic **object**.

Second major flaw:

The fundamental scientific knowledge of economy does not provide an understanding of the principle setup and way of functioning of the enterprise for machines as a systemic **subject**.

The result of the analysis thus far is that modern economic science (since its inception to this day, for one reason or another) has not yet put systematic effort into overcoming these two major flaws. Moreover, these major flaws of the fundamental scientific knowledge of economy have negatively impacted the development of the human capital of the Western world.

This negative impact is also causing the West to fall behind the East in terms of technological innovation. The compound effect of these two factors could result in a Third World War.

In the public information space, the signs of a crisis in the development of the human capital of the Western world are encountered almost daily: a shortage of medical workers, a shortage of engineering professionals, a shortage of truck drivers, and many, many more. On the other hand, there is an extraordinary abundance of all kinds of social science professionals and, above all others, professional economists. The Western world is already experiencing the consequences of this irresponsible waste of our most valuable human resources and is becoming a victim of and a witness to the avalanche of crises that have resulted from the negative impact on the development of the human capital – shortage of electricity, shortage of basic necessities, shortage of medical supplies, disrupted logistics chains, drastic inflation of fuel prices and as a consequence of all products and services, an inability to deal with the COVID-19 crisis and many others. And although this situation has not yet resulted in war, perhaps the most catastrophic consequence possible, there are no signs that the Western world is awakening and acknowledging the problem or that any efforts are being made to resolve it. Even though all leading institutions report the consequences of the problem, there are currently no adequate proposals for solving them. This is because the real problem remains in the shadows, namely, the medieval level of development of economic science.

The most influential institution that should be reporting this problem and sounding the alarm, the World Economic Forum, is currently choosing not to. And so, our Western world is teetering on the edge of a precipice, and if it tips off the edge, there may be no climbing back up. Meanwhile, none of the leading institutions acknowledge the existence of a problem, a fact proven by the lack of any measures being actioned to deal with the crisis in economic science.

We, the authors of this book, as representatives of the foundation that we created, "Information Technology and the Future of Economic Science," refuse to sit idly by as the Western world perishes! Especially since we are capable of identifying the root cause of the problem which has thus far eluded all others, and what is more, by the will of God, Fate, or Chance, in the course of our tenure in the Bulgarian engineering sector, we were given the opportunity to be enlightened with knowledge that could become the basis of a vital transformation of economic science. Knowledge that was created and developed by Bulgarian engineers united in an informal, little-known technology park called IDEUM Base. These Bulgarian engineers successfully defined the major flaws of the fundamental scientific knowledge of economy and then, for 20 years, developed knowledge to eliminate them. Subsequently, this knowledge was embedded in the functional design of a new type of ERP software for managerial modeling of the economy of the enterprise for machines; software that can be described as a full-fledged successor to Oliver Wight's dream.

We are some of the very few who have had the opportunity to study this knowledge in depth through the use of the developed ERP system and have then successfully applied the "knowledge-software" combination in practice. Having applied this "knowledge-software" combination in practice, we, the authors of this book, have complete confidence and faith that this new fundamental scientific knowledge of economics of a higher quality can resolve the catastrophic status of the human capital of the Western world. Acting upon this confidence and faith, we have mapped out a new road for future development, and if the Western world moves in this proposed direction quickly and decisively, it can resolve the crisis. We called this road to a new future the *"Digital Transformation of Economic Science."*; a transformation that entails the creation, development, and dissemination – both in theory and in practice – of the functional programming constructs of a new generation of digital technologies for managerial modeling of the economy of enterprises for machines. We define these digital technologies as "holistic ERP systems." The most important factor is that these ERP systems incorporate knowledge about managerial modeling of the professional development of people who can comprehend the enterprise as a systemic object and subject and, therefore, can bear the responsibility for introducing innovative changes to its development. Incorporating such knowledge would turn this new type of ERP system into the most effective, feasible solution to the conundrum of the current negative trend in the development of the human capital in the Western world. This is true due to the fact that several months of study, both theoretical and applied, of the functional construct of such a digital system would result in knowledge about the economy of the enterprise for machines that is much more valid and applicable than the knowledge that can be formed after several years of diligent study of microeconomics at the most prestigious, specialized universities.

The proposed solution poses three essential questions:

1. How should this new fundamental scientific knowledge of economy of a higher quality be developed to form the "holistic ERP systems"? Knowledge that would constitute an ontological model of the economy of the enterprise for machines by describing the principle setup and way of functioning of the enterprise as a systemic object and subject. Knowledge that would be devoid of the major flaws that plague the current concepts and theories of economic science.
2. Why exactly are "holistic ERP systems" so crucial?
3. What would be the consequences of the mass dissemination of holistic ERP" systems?

We begin with the first question.

As mentioned, such knowledge already exists, and it serves as proof that its development is possible. Before we proceed to presenting the main parts of the first question, we must answer another preceding question: *"How* *should a fundamental scientific knowledge of economy that constitutes an ontological model of the economy of the enterprise be developed, since many schools and technology parks are working precisely on developing such a knowledge?"* As we established in the previous chapters, the development of fundamental scientific knowledge of economy to a new level is not a simple task. To date, it appears to be an insurmountable task for the community of professional economists. In their stead, the people who have successfully developed practically useful knowledge for the management of an industrial enterprise have been the American engineers. These engineers realized three engineering waves in the development of the fundamental scientific knowledge of economy. So, the question, then, is: Why were the engineers successful where the economists failed?

6.1. The two main approaches to the development of fundamental scientific knowledge of economy

As we established in Chapter 4, modern economic science resembles medieval medical science in that it is developed and advanced through the writings of authorities that are recognized and respected by the community of economics professionals. These texts are not subjected to testing and verification in practice and are accepted as adequate only because they were written by a particular recognized school or individual. This approach in the development of a science is defined as "philological." In contrast, engineers utilize the other possible approach for the development of a science - the "laboratory" approach, where the value of a theory and its validity is assessed through testing in practice. In order to determine which approach would be more useful in the development of the new fundamental scientific knowledge of economy of a higher quality, we will conduct a brief analysis.

6.1.1 Brief overview of the philological approach

The philological method originated in the 1880s in Halle, Germany, where philology was established as a university discipline with the founding of the "Philological Seminary" of Friedrich Wolff. The philological method arose as a secular version of the theological method, but with two essential differences:

1. It is distanced from theological texts and instead is based upon the texts recognized by the elites of the scientific and humanitarian communities as classic examples of European literature and culture.
2. The strict hierarchy of theological disputation is replaced by a roundtable discussion approach in which the debate participants are accepted as equals.

This democratization of philological debate allows participants to take on the role of "mentors for a day" to gain experience by emulating and competing with their actual mentors. The participants in the debate are required to present original thematic theses on the content of the studied texts. Very often, not the mentors, but they themselves choose the topics. The belief that an individual's talent and diligence can elevate them through the ranks becomes central to their ideology.

One of Friedrich Wolf's first and most loyal disciples, Wilhelm von Humboldt, made substantial contributions to the validation and dissemination of the philological approach. Wilhelm von Humboldt was a professor at the University of Göttingen, but in 1808 he left the University of Göttingen and began his public service at the Prussian Ministry of Culture. The Baron of Prussia tasked him to carry out a radical reform of the education system in order to transform it into the source of the German national spirit. At the heart of this reform is the "humanitarian high school." The "humanitarian high school" curriculum emphasized classical languages, ancient history and philosophy, and mathematics, while natural sciences and religion played a peripheral role in the education of the students. The goal of this curriculum was to establish an ideological foundation for the younger generation, the nation's future citizens. In 1810, a university that aimed to continue the idealistic education of the nation's future citizens opened its doors in Berlin. Later, in 1949, this university was renamed after Wilhelm von Humboldt - Humboldt University.

Humboldt's educational reform turned the high school into an incubator for socially adaptable young people with ambitions for a career in the public and private administrative hierarchy. Since, at the time, the basic requirement for admission to universities was mastery of the classical disciplines, the humanities education students received opened the doors to higher education institutions. Students with a solid philological foundation could specialize in the overarching field of philosophy, which was seen as a natural extension of their philological qualification. At the beginning of the 19th century, the privileged status of philosophy found expression in the new scientific title introduced in German universities - "Doctor of Philosophy," which to this day is considered the most prestigious professional certification. By virtue of its universities, Germany became the European center for "philosophy of science," and the University of Berlin became a model for higher education institutions in Western Europe. Its first rector, the philosopher Johann Gottlieb Fichte, became the main force behind linking German mass education with the awakening of German national aspirations for a united Germany.

From today's point of view, Wilhelm von Humboldt, Johann Fichte, and their colleagues, classic academics, were the first representatives of the scientific, humanitarian elite who assembled and successfully cooperated with the political elite in order to implement a major investment program for the reform of the mass education with the aim to enhance the development of the human capital of the nation. However, there were unforeseen consequences of the program, as there often are with major investment programs for reform. High school students, bachelor's and master's degree graduates, and doctors of philosophy who completed the reformed mass education did not harbor ambitions for a career in the applied fields of public administration and economics but rather aspired for a career in academics. Those who strategically combined teaching and frequent publication of articles in scientific journals were considered to be most successful and accomplished. Thus, these academics could define and impose new, more and more narrowly specialized scientific disciplines in the educational system.

Interestingly, the development of the philological approach coincides with the publication of a sacred for the economics community text: Adam Smith's book "The Wealth of Nations" (1776). This coincidence resulted in the emergence of a new scientific and educational industry. The primary purpose of this new scientific and educational industry, which is based upon a method that is uncharacteristic of the pure sciences, namely the philological approach, is the study of economic management and the publication of texts on the topic. Having been expanded to fit our modern, globalized world, this industry engages the productive efforts and intellectual focus of millions of intelligent individuals in our community, systematically eating up vast amounts of public resources that could otherwise be utilized in industries that would ensure the recovery and development of the industry for machines of the Western world. But we have already established that. [17]

6.1.2 Brief overview of the laboratory approach

Today's scientifically and technologically oriented laboratory approach was first manifested in France between 1765 – 1794. It was the work of Antoine Laurent Lavoisier, considered the "father of modern chemistry." In 1765, the 22-year-old Lavoisier presented his research to the Paris Academy of Sciences on "A Better Way to Light the Streets of the Big City." In this first research of his, the young scientist demonstrated his extraordinary dedication and thoroughness in achieving practical, socially useful goals through experimental research - virtues manifested in all his subsequent work. This first research of his was also awarded a gold medal and marked the beginning of his lifelong affiliation with the Academy.

In 1793, Lavoisier was accused by the National Convention of "conspiring with the enemies of France" to commit tax fraud; however, according to some historians, the accusation was fabricated by Lavoisier's influential ideological opponents, who viewed his laboratory approach as a "debasement" of academic science to a practical level. In response to a citizen's petition for a pardon for Lavoisier, given his great personal potential for future contributions to the development of science and the public economy, the president of the Revolutionary Tribunal declared: "France has no need of brilliant scientists." The sentence was carried out in May 1794. After the execution, Lagrange said: " "It took them only an instant to cut off that head, and a hundred years may not produce another like it."

Throughout his academic career, Lavoisier held the firm conviction that academic science, and chemistry, in particular, should serve the common good rather than serve as tools for enriching private companies. Based upon this conviction, he defined the following three requirements for the development of a socially useful science:

1. Theory
2. Terminology
3. Technology

The vocation of scholars is to refine and expand the content of these requirements and to ensure logical order, completeness, and consistency "within" and "between" them. Lavoisier turned these ideas into his life's work, and as a result, humanity received a system of concepts about the subject and development of chemical science. Additionally, humanity received systematized requirements for the terminological apparatus of chemical science: "... precisely formulated scientific language is not an arbitrary set of names and signs. Clear language and clear signs stimulate the development of analytical skills that obscure language would only demean. Just as Roman numerals gave way to Arabic ones because they were too "vague," so too subjectively varying terms must be replaced by precise and unambiguous scientific terminology." Lavoisier also proposed the first scientific terminological system based on the terms oxygen, hydrogen, nitrogen, oxidation, and the classification of chemical compounds within three main groups: bases, acids, and salts. Furthermore, he proposed principles for experimental research of the theoretical idea system and implementation models for the technological requirements of a laboratory setting. Every chemical laboratory became standardized with essential technical tools, such as weight scales, calorimeters, and gasometers.

Lavoisier was not fortunate enough to experience praise from the scientific community. Instead, his ideas are met with hostility, going so far as to conduct a "solemn burning" of his portrait. However, his ideas were rooted in Germany, where 30 years after the death of Lavoisier, Justus von Liebig created the first university chemistry laboratory, which became the nucleus of some of the world's largest chemical corporations. The scientific-technological nature of Liebig's laboratory scandalized the humanities professorship. It led to the ultimate demand that "... the university must offer basic theoretical knowledge in chemistry, including to students from other faculties, but without any practical orientation." Pressed by the academic leadership, Liebig was forced to seek the support of the government authorities, convincing them that the exact sciences were just as worthy of respect as classical philology, philosophy, and history. In one of his "apolitical," well-received letters to the Prussian government, he sharply criticized the humanists' reverence for texts and directly accused "traditional academics" of denying the cognitive value of the laboratory approach, even though it met the highest philosophical criteria.

This crusade for the recognition of the high social significance of scientific knowledge obtained through a laboratory approach was initiated by Lavoisier and continued by Liebig. But another, more radical scientist achieved a great but historically short-lived victory for the cause. Louis Pasteur publicizes the definitive divergence between knowledge created and developed through critical-discursive analysis of texts and knowledge created and developed through laboratory research. Pasteur assigned greater social value to scientific laboratory research as a reference point for carrying out various economic activities.

The laboratory approach was first applied in the field of industrial management by Frederick Taylor. In 1911, he wrote: "In the past, the man has been first; in the future, the system must be first." Taylor broke down production routes into their constituent process operations and each operation into its constituent steps, which he then analyzed to maximize efficiency. The invention of this method earned him the nickname "Father of Scientific Management." Among the first "Taylorists" were Frank and Lilian Gilbreth. They further developed Taylor's methodology by adding the use of photography. Once again, they confirmed the social-scientific principle that simply observing people changes their behavior, resulting in increased productivity. The inception of "Taylorism" and its subsequent development in derivative forms such as "systems engineering," "quality control management," etc. turned the USA not only into the world leader for "scientific management" but also into an industrial superpower by the end of the 20th century. [17]

Based upon these texts, we can provide an answer to the first question, namely, how should this new fundamental scientific knowledge of economy of a higher quality be developed? For modern economic science to break away from its medieval development and transition to a systemic level, it must follow the example of medical science and many other sciences that have made a similar transition. This means the development of a new fundamental scientific knowledge of economy of a higher quality in the form of an ontological model of the economy of the enterprise for machines, which reflects its principle setup and way of functioning as a systemic object and systemic subject. Just as Andreas Vesalius derived a universal anatomical model of the human body through a multitude of empirical tests, so this model of the "anatomy" and "physiology" of the enterprise for machines must be derived from empirical tests, from practice.

Since the development of this new knowledge of a higher quality rests upon the empirical verification of data, it categorically necessitates the use of the laboratory approach. This, in turn, is fundamentally opposed to the philological approach used by the community of professional economists in the development of modern economic science.

Another fact confirms the need for a radical change of approach. In the preceding chapters, we concluded that the most significant, from a practical point of view, parts of the scientific knowledge for managing the industrial economy are the scientific knowledge of the accounting model, the knowledge of operational management and quality management, and knowledge of inventory management and production planning. Except for the first model, developed by a Christian monk, the other models were developed by American engineers. Furthermore, in the preceding chapters, we also outlined how the "MRP" algorithm, which was also developed by engineers, made it possible to effectively plan the "Sales," "Production," and "Supply" processes. All of these accomplishments of the American engineers in the development of the scientific knowledge of economy were achieved precisely through the use of the laboratory approach.

Now, let us move on to the second question: Why exactly are "holistic ERP systems" so crucial?

As we learned in Chapter 3, digital information technology exists today that purports to incorporate the processes of an enterprise as a whole and thereby enables synchronized management of all processes in real-time.

Not only that, but this digital information technology purports to enable the planning of the future states of the enterprise. This is the ERP (Enterprise Resource Planning) technology. Based upon these claims of functionality, the ERP systems have been established as the best digital product for managerial modeling of the economy of the enterprise. Therefore, all individuals working in an enterprise have to work with an ERP system to varying degrees. Upper management and the mid-level management of an enterprise should monitor and manage all processes at the macro level, and all employees below the managerial level should manage the individual processes at the micro level. Yet everyone, from upper management to entry-level employees, has individual professional responsibility, which becomes part of the collective responsibility of the enterprise.

Therefore, wouldn't it be much easier if such a system were part of the university curriculum, as an in-depth study and analysis of its functions would prepare every future employee to manage processes in an enterprise for machines on both a micro level and a macro level.

Such knowledge is imperative for all students who aspire to be in charge of or own an enterprise for machines.

But to truly incorporate all the processes of an enterprise means that at the core of such a digital system is knowledge of the ontological model of the enterprise (whether it is an enterprise for machines or not) as a systemic object and systemic subject.

Today's digital information technology market offers a wide range of different ERP systems. Alongside these, a similarly wide range of technology parks is engaged in designing and developing these ERP systems.

The process of designing and developing ERP systems involves the employees acquiring specific, as well as general, knowledge of the systemic setup and way of functioning of various types of enterprises, including enterprises for machines. Through this process, every employee possessing the intellectual capacity to generate such knowledge independently would inevitably be able to describe the nature of an enterprise for machines using the following three common projections. Listed below are the projections derived by the employees of the IDEUM Base technology park.

First common projection:
Every enterprise for machines is a subject that, in turn, belongs to a set of subjects, all of which – in their capacity as customers and/or suppliers of machine engineering products and/or services – collectively make up a logical fragment of the global industry for machines.

Second common projection:
Every enterprise for machines is a systemic object which comprises a set of objects defined as capital assets, some of which are owned, others - borrowed.

Third common projection:
Every enterprise for machines exists in its capacity as a systemically and continuously realized object by retaining and re-allocating (altering) its capital assets through the coordinated operation of five technological systems:
(1) Technological system for Sales;
(2) Technological system for Production;
(3) Technological system for Supplies;
(4) Technological system for Financing;
(5) Technological system for Implementation of the Technological Environment of the enterprise. [6]

While writing this book, and even prior to that, we conducted extensive research in search of an ERP system whose functional structure contained these five technological systems. That is, we have been looking for and continue to look for an ERP system that has embedded within it a new level of fundamental scientific knowledge of economy.

Our research concludes that there is no evidence that anyone, anywhere, at any time, has succeeded in developing a new fundamental scientific knowledge of economy of a higher quality based on the laboratory approach. And since there is no such knowledge anywhere in the world, there is also no ERP system based on such knowledge. With one notable exception.

6.2. An illustrative example of the application of the laboratory approach to the development of fundamental scientific knowledge of economy

This notable exception is found in Bulgaria. Here, there has been ongoing engineering research and creative activity for the past 20 years in a little-known technology park called "IDEUM Base." IDEUM is the Bulgarian acronym for the phrase Industrial Soul-unifying Managerial Modeling („Индустриално Духовно Единяващо Управленско Моделиране"). The foundations of "IDEUM Base," as a Bulgarian technology park for strategic innovations in the field of "fundamental scientific knowledge of economy," were laid at the beginning of 1998.

The founder, Peter Bachvarov, is a machine engineer with extensive experience in management positions supervising production in large Bulgarian enterprises. In the course of his tenure as a director of an enterprise for machines in the 1980s, he noticed an inadequate understanding of how to define job descriptions. This fact piqued his interest and caused him to delve extremely deep into the field of economics in order to study and analyze the foundations of the fundamental scientific knowledge of economy. From his experience as a director of many enterprises, he observed that contrary to modern economics dogma, the principle set up and way of functioning of these enterprises were much more alike than they were different. Having discovered these inconsistencies between modern economic theory and actual industrial practice, he defined the two major flaws of modern fundamental scientific knowledge of economy, which then became the foundations of the "IDEUM Base." The ideology of this technology park is formed by two worldview ideas, born in the conditions of the massive privatization of Bulgaria in the mid-1990s, which led to the bankruptcy of a considerable part of the Bulgarian industry for machines:

First worldview idea - *"The Bulgarian economy is crippled because the scientific knowledge about its management has two major flaws."*

A second worldview idea - *"The well-being of the Bulgarian economy can be strengthened through constructive reengineering of its enterprises. This constructive reengineering can be accomplished using an IT product that would consist of universal knowledge about the principle setup and way of functioning of every enterprise as a systemic object and subject that can and must generate added value. Thus, this IT product must be the bearer of a new fundamental scientific knowledge of economy of a higher quality; knowledge that would explain, replace, and complement all modern scientific knowledge about the management of enterprises for machines as the building blocks of a well-developed national economy."* [6]

This ideology predetermines the purpose of the 20-year activity of the "IDEUM Base," namely the creation of a prototype of a complete (holistic) IT product for managerial modeling of the economy of the enterprise for machines. Such an IT product can be defined as a "holistic ERP system." All commercially available ERP systems between 1998 and 2008 are fragmentary (scholastic). The only reason for this is that there is no unified theory and terminology of a complete (holistic) scientific knowledge of a ontological model of the economy of the enterprise for machines considered first as a systemic object and then as a systemic subject. This fact, combined with the great ambition of the founders of IDEUM Base to create a complete (holistic) ERP system, confronts the employees of the technology park with the obvious need to initiate significant efforts to create a new, unified theory and terminology.

The "theoretical foundations" created by IDEUM Base define a system of basic concepts, which form the basis of meaningful "terminology." That is, the theory defines the relationship between the basic concepts and acts as a kind of skeleton for the terminology needed to describe those interconnected concepts. This system of basic concepts has four structural levels and a predetermined requirement that each concept (regardless of its structural level) must be defined as a holistic business model ontology or, in other words, as an ontological model of the economy of the enterprise for machines.

The first structural level consists of the concepts "object," "subject," "space," "time," and "environment for the existence of an object." The second level of terminology is based upon the concepts from the first level. The third level is based upon the second. Further development of this new knowledge is based upon this key base of concepts. Because if we look at an object (for example, a book), it has an external environment, boundaries, and an internal environment with a corresponding structure and content, both in terms of physical configuration and as a carrier of information. Then, we can suppose how the internal environment, limited by these external boundaries, exists in the external world. It is not a coincidence that the concepts of "space" and "time" are involved. If we look at the concept of "space" in practical terms, we can structure it on three levels - macrocosm, microcosm, and everyday cosmos, or what we experience as the world on a day-to-day basis. The day-to-day world is what happens on the earth's surface, what can be seen with human eyes, and what can be touched with human hands. Physics deals with the microcosm and the macrocosm. Physics also studies the physical laws of the day-to-day world we experience.

If we consider a human being as an internal environment with external boundaries, logically, everything outside the human body is the external environment. The various processes that occur throughout time, both in his internal environment and the external environment surrounding him, coupled with his own movement in space, can be described by the continuum of space-time parameters. Management of the changes in the space-time parameters of the human body is the task of medical science. Management of the changes in the space-time parameters of the machine enterprise is the task of economic science. However, in modern economic science, we find linear concepts simply thrown around, as there is no fundamental knowledge capable of taking the role of basis of reference. In contrast, in the terminology derived by "IDEUM Base," the concepts are part of one structure - a system derived from the theoretical foundations. Thus, the system these concepts are part of defines the logical relationships between them. A unified cognitive system has been created in the form of an ontological model of the economy of the enterprise for machines, and the concepts are the components of this system.

By applying the "laboratory" approach to their labor, the IDEUM Base research team made several discoveries, two of which are particularly important. By our estimation, the significance of their discoveries for modern economic science would be equivalent to the importance of Andrea Vasaulius' discovery, the systemic anatomical model of the human body, had for medical science. The two Bulgarians who made these discoveries and formulated them into written texts are Peter Bachvarov – machine engineer founder of "IDEUM Base," and Anna Videva, who studied mathematics. They define their discoveries as "engineering cognitive platforms" for understanding and making sense of any enterprise for machines as a systemic object and a systemic subject simultaneously.

The first cognitive platform provides knowledge for understanding and making sense of each enterprise for machines as a systemic object that exists as a result of the coordinated operation of five functional systems. The second cognitive platform provides knowledge for understanding and making sense of each enterprise for machines as a systemic subject, characterized by an inherent, hierarchical system of five types of knowledge.

All of this is described in detail in a unified theory of the "Engineering Model of the Economy of the Fundamental Enterprise," and on its basis, completely new terminology was derived. Thus, in 2011, two books were published. The first is titled "Ideological Pillars of the Engineering-Dominant Management Model of the Business Unit," and the second is "Some Concepts of the Unified System of the Engineering-Dominant Management Model of the Business Unit." The authors of these fundamental works are also Peter Bachvarov and Anna Videva.

After providing summaries of the different types of knowledge that form the modern fundamental scientific knowledge of economy in Chapters 3 and 4, it follows that we ought to make a general summary of the knowledge developed by the "IDEUM Base." Subsequently, we will make a comparison with the knowledge that is currently accepted as the highest quality knowledge for managerial modeling of the economy of the enterprise for machines, namely the knowledge of the fragmented business model ontology – Canvas. We will conduct this comparison in order to evaluate which knowledge has a higher practical utility for modeling the enterprise as a systemic object and subject simultaneously and which ought to serve as the basis for the development of a new class of ERP systems, holistic ERPsystems.

6.2.1. First cognitive platform

According to the first cognitive platform, every enterprise for machines - in its capacity as a systemic object - exists as a result of the coordinated operation of five functional systems: (1) "Sales" system, (2) "Production" system, (3) "Supply" system, (4) a "Financing" system and (5) a system for the "Implementation of the Technological Environment of the enterprise." The visual representation of the first cognitive platform has the shape of a cross and is called the "Cross of the Industrial Enterprise" or simply the "Industrial Cross" (Figure 6.1).

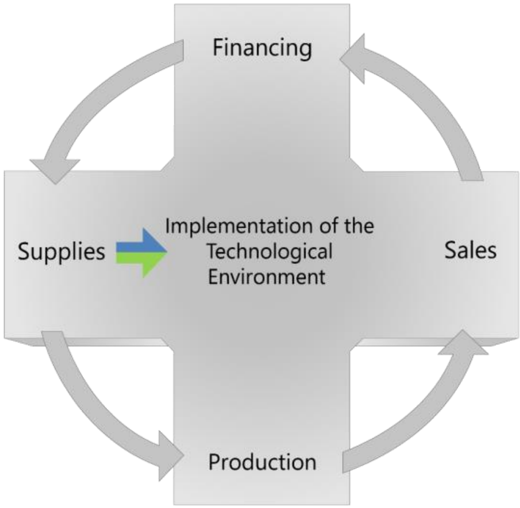

Figure 6.1 The Industrial Cross

The five functional systems of the enterprise for machines manage the assets which are under its control: both its own assets, as well as attracted, i.e., borrowed, assets. Examined in a time interval manner, as well as from a technologically systemic point of view, this management of assets can be presented as two object flows. One of these object flows is depicted as a circular, four-tier flow. It is formed and driven by the synergy of the four functional systems for Sales, Production, Supplies, and Financing. It is commonly referred to as the Working Capital Flow. (Figure 6.2)

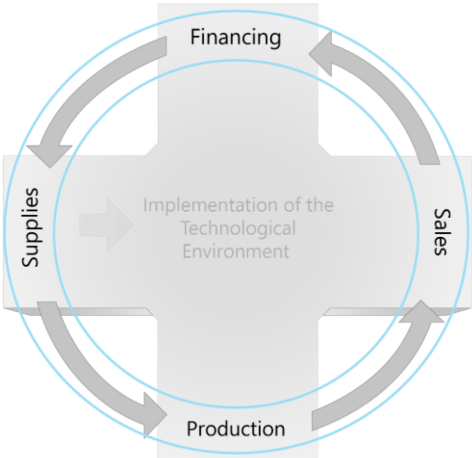

Figure 6.2 Working Capital Flow

The other object flow is central and two-tier. It is intended to ensure the functioning of the enterprise's technological environment. This flow is driven by the functional systems for Supply and Implementation of the Technological Environment. (Figure 6.3)

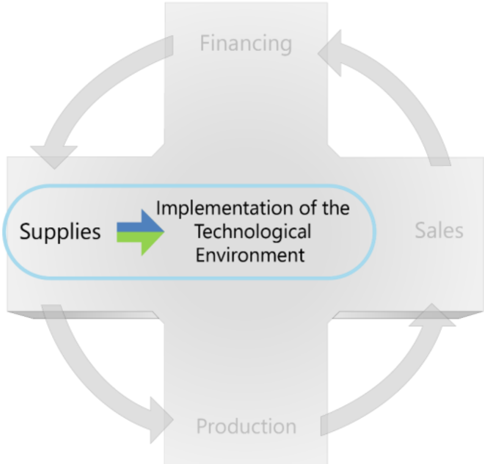

Figure 6.3 Expenses and Investment Flow

The central, two-sectioned flow has two parts: (1) Expenses flow and (2) Investment flow. The expenses flow: these are all the "objects" provided by the "Supply" and "Implementation of the Technological Environment" systems that the enterprise for machines uses (or spends) in order to maintain the ongoing functional suitability of its technological environment. The investment flow: these are all the "objects" provided by the systems for "Supply" and "Implementation of the Technological Environment" systems, which the enterprise for machines uses (or invests) in order to introduce qualitative changes to its technological environment. The investment flow is also comprised of two parts: (1) the recovery part and (2) the development part. The first ensures the recovery and restoration of the technological environment in order to counteract depreciation, and the second ensures development and progress through attracted investments.

Unlike other systems (for "Sales," "Production," "Delivery," and "Financing"), the functional system for "Implementation of the Technological Environment" of the enterprise for machines is, in fact, a meta-system. On the one hand, it ensures the formation, maintenance, and strategical development of the technological environment for the other four fundamental functional systems, and on the other, it ensures the same for its own operation.

The establishment of every enterprise starts with the formation and development of its system for Implementation of the Technological Environment. The technological environment of the enterprise consists of two components: (1) technical environment and (2) organizational environment.

The main foundational and operational element of the technical environment of any enterprise can be aptly defined by the concept of an "operational place" (OpP). Further elaboration on the essence and meaning of the term operational place, as part of an objectively more precise and more accurate terminology for describing the modern enterprise for machines, would over-complicate this summary. Thus, for the sake of simplicity, it can be said that the concept of an operational place is partially synonymous with the colloquial term "workplace."

The multitude of operational places of the enterprise for machines forms the physical basis for the formation of its multitude of operational technological fields. The concept of operational technological field is a descriptive term for the main building component of each of the five functional systems of the enterprise. In addition to the operational place in its role as the physical component, the operational technological field has two other inherent aspects that can be described as "organizational." These are: (1) an array of documented knowledge (in different types and forms) about the operational technological field lifecycle management in accordance with its intended systemic purpose; and (2) a multitude of appointed workers from specific parts of the human resources of the enterprise, who are assigned with responsibilities concerning the existence of the respective operational field. On the basis of one physical operational place, there may be various operational technological fields created, which are required for establishing the functional systems of the enterprise. These include the systems for Sales, Production, Supplies, Financing, and Implementation of the Technological Environment. The multitude of organizational components, which are structurally inherent in the multitude of operational technological fields, form the organizational environment of the enterprise as an indispensable component of its technological environment.

In conclusion, the Industrial Cross illustrates the principle setup and way of functioning of the technological environment of the enterprise for machines as a synergy of five technological systems. At least in our opinion, there is no technological system that is not incorporated within the Industrial Cross. We have pondered this topic hundreds, perhaps thousands, of times, and thus far, we have not found a contradiction.

What is more, based on the logic of the Industrial Cross, we can provide clear and understandable answers to the questions "What is profit or loss?" and also "What is a commodity or service?" These two questions pose huge difficulty for the contemporary community of "professional economists." The second question can be concisely answered as follows:

Commodity: sale of a material object, where the enterprise is the owner of the substance (materials used to make the final product). The customer is not interested in the substance but is rather only interested in the final product.

Service: sale of the effect of a process, where the enterprise does not own the substance, but rather the customer is responsible for providing it. The customer is interested in both the initial object state of the substance and the final object state of the substance.

The logic behind the Industrial Cross and the terminology of the "engineering model" also provide an answer to the first question. The industrial result of the economic activity of the enterprise, indicated by the symbols $ER[t_1, t_2]$ in the time interval $[t_1, t_2]$ should be calculated according to the formula:

$$ER[t_1, t_2] = \sum MOC[t_1, t_2] - \sum InV_1\{MOC[t_1, t_2]\} - \sum ExFl[t_1, t_2]$$

Where:

$\sum MOC[t_1, t_2]$ is the total value of monetary obligations on the part of the Customer (*Monetary Obligations of Clients*), incurred at time $[t_1, t_2]$ in exchange for the Products provided to the Customer at the same time in the form of engineering goods and services.

$\sum InV_1\{MOC[t_1, t_2]\}$ denotes the invested value of supplies of the components making up the structure of the Products sold during the time interval $[t_1, t_2]$.

$\sum ExFl[t_1, t_2]$ means the value of the multitude of Elements of the Enterprise's Own Assets invested in its Technological Environment to ensure its functioning in a regular (non-investment) mode in time $[t_1, t_2]$. In the "Industrial Cross" terminology, this set of Elements is defined by the concept of "Expenses flow."

Using this extremely simple and clear formula, we can accurately and clearly determine the profit or loss of the enterprise.

In our opinion, what differentiates the Industrial Cross from all the other currently disseminated visualizations of the business model ontology of the enterprise is the presence of the technological system "Implementation of the Technological Environment." The systems of the so-called "Working capital flow" - Supply, Production, Sales, and Financing – are present in other theories, but what has remained in the shadows thus far is precisely the system reflecting the technological environment of the enterprise and perhaps most of all its "organizational" component. We know that every enterprise, regardless of whether it is an enterprise for machines or not, is made up of many objects – be it machines, tools, furniture, or other material objects. All this information can be found in the so-called "inventory book," which is an accounting register for recording the fixed assets of an enterprise. All of these elements, recorded in the inventory book, form the Technological Environment of the enterprise. Nowadays, the Technical Environment and its development are given a lot of attention. However, the other constituent part of the Technological environment of the enterprise remains somewhat neglected even though it is no less important. On the contrary, in our opinion, it is the primary one, namely the Organizational environment. The Organizational environment of the enterprise consists of many organizing elements: knowledge of the enterprise, objectified in the form of documents, instructions, methodological guidelines, etc., along with the system for their organization, as well as the multitude of appointed workers who possess willpower, ideas, learned skills and knowledge, and who make the connection between knowledge and technical means in order to achieve the goals set by the industrial organization. The definition of the Operational Technological Field, which is a combination of two components, "technological" and "organizational," as constituents of a single operational place in the enterprise, can also, in itself, be defined as a fundamental discovery. This is so because, firstly, every single enterprise - a company, an organization, be it a corporation with thousands of employees or a car repair shop with one employee - carries out an activity with the goal of creation. This activity takes place at a specific location (operational place), which can be either fixed or mobile. Consider, for example, the technological system of Supplies in a car repair shop. The operational place is a desk with a computer and a printer. The employee uses a certain set of technological elements, such as machines, tools, pens, etc., and a certain set of organizational elements, such as knowledge and "knowhow" needed to achieve a final state of the object on which he performs his activity (the delivery of a set of tires for a given car, for example). It is the combination of these two types of elements that form the Operational Technology Field. Moreover, at this same Operational Place, but using a different set of technological and organizational components, this same employee can perform an "invoicing a customer" operation within the Sales Technology System. Thus another Operational Technology Field has been created at the same Operational Place. A multitude of Operational Technology Fields within the five technological systems forms the activity of an entire department, workshop, etc., where employees perform necessary activities related to a particular technological system. Therefore, we can state that the Operational Technology Field is the building block of every enterprise for machines.

Furthermore, which is also quite surprising that this building block has not been identified or defined by modern economic science until now.

Based on this logic, the Industrial Cross, which comprises five technological systems consisting of numerous "Operational technological fields," represents clear and understandable knowledge for the enterprise for machines as a systemic object.

6.2.2. Second cognitive platform

The realization of the enterprise for machines as a systemic subject is achieved by the sum of all of the employees assuming collective responsibility for the acquisition, application, and development of the knowledge necessary for its realization as a systemic object, depicted above as the Industrial Cross. The cognitive understanding required to realize any enterprise for machines as a systemic subject can be visually represented as a tree called Tree of Industrial Cognitions. (Figure 6.4)

The realization of the enterprise for machines as a systemic subject is achieved by the sum of all of the employees assuming collective responsibility for the acquisition, application, and development of the knowledge necessary for its realization as a systemic object, depicted above as the Industrial Cross. The cognitive understanding required to realize any enterprise for machines as a systemic subject can be visually represented as a tree called Tree of Industrial Cognitions. (Figure 6.4)

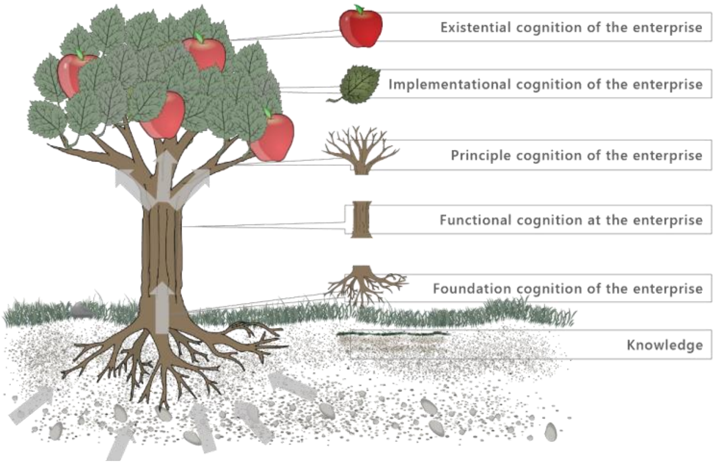

Figure 6.4 Tree of Industrial Cognitions

The cognitive understanding of the Tree of Industrial Cognitions is more difficult to conceptualize because, although likened to a physical tree, its building blocks are the various types of "cognition." It is difficult for every individual to envision each type of cognition as a combination of knowledge and guidance. For this reason, the different tiers of cognition of the enterprise for machines, which together comprise the "Tree of Industrial Knowledge," have been likened to (1) fruit, (2) leaves, (3) branches, (4) stem, and (5) roots.

The "fruits" of the Tree of Industrial Cognitions are a symbolic representation of the existential cognition of the enterprise in its capacity as a systemic subject. This is the knowledge about the past changes over time and, more importantly, about the future changes over time in the value of its capital assets (i.e., the economic result). These changes are colloquially referred to as profit or loss. The ability of the enterprise to model the prospective variants of its economic result with a sufficient level of accuracy, as well as to realize them successfully, is of strategic importance as it predetermines its ability to model its trajectory in the spiritual aspects: (1)

ambitions, (2) possibilities, and (3) reality. Furthermore, obtaining quality information about the future economic performance of a given enterprise is of great interest to the multitude of investors, owners, and other stakeholders interested in its prosperity. The condition and development of the "fruits" of the Tree of Industrial Cognitions, symbolizing the existential cognition of the enterprise, are directly dependent on the condition and development of its "leaves," "branches," "stem," and "roots."

The "leaves" of the Tree of Industrial Cognitions are a symbolic representation of the implementational cognition of the enterprise in its capacity as a systemic subject. In other words, this is the current knowledge of its employees about the specific activity, here and now, in the realization of the systemically necessary time-space trajectories of the set of objects that collectively form the current capital assets of the enterprise: both its own assets, as well as attracted, i.e., borrowed assets. In short, this is the knowledge of what to do here and now in accordance with the logic of the Industrial Cross. The implementational cognition, referring to a specific object, which is part of the capital assets of the enterprise, can be most accurately defined by the phrase "implementational time-interval models of the multiple responsibilities over the trajectory of an element." Those responsibilities should be taken on by the operational technological fields of the enterprise and, more specifically, by the appointed workers in charge of the functioning of those fields, who are thus an indispensable part of them. Broadly speaking, the "leaves" of the tree are the set of knowledge and skills necessary to carry out a specific activity in reality. For example, the knowledge and skills necessary to operate a sewing machine in order to produce a men's dress shirt. The condition and development of the "leaves" of the Tree of Industrial Cognitions, symbolizing implementational cognitions for achieving an economic result by the enterprise, are directly dependent on the condition and development of the "branches" of this tree.

The "branches" of the Tree of Industrial Cognitions are a symbolic representation of the principle cognition of the enterprise in its capacity as a systemic subject. In other words, this is the current knowledge of its employees about its specific activity in creating a principle basis for the implementational cognition. Principle cognition, as referring to a specific object, which is part of the capital assets of the enterprise, can be most accurately defined by the phrase "principle time-interval models of the multiple responsibilities over the trajectory of an element." The principle cognition is the basis for the creation of implementational cognition, but unlike the implementational cognition, where managerial responsibilities are assigned along the real-time axis, the principle cognition assigns responsibilities according to a principle time axis, i.e., by principle time steps and intervals. Consequently, an infinite number of implementational cognitions can be generated on the basis of one principle cognition. Broadly speaking, the "branches" of the tree are a set of principle scenarios for realizing the trajectory of a given object, for example, designing various patterns for a men's dress shirt. The condition and development of the "branches" of the Tree of Industrial Cognitions, symbolizing the principle cognition that forms the basis for creating implementational cognitions, are directly dependent on the condition and development of the "trunk" of this tree.

The "trunk" of the Tree of Industrial Cognitions is a symbolic representation of the functional cognition of the enterprise in its capacity as a systemic subject. Functional cognition indicates the ways of creating principle cognition and its respective outcomes, as well as the ways for creating implementational cognitions through the application of principle cognitions, with the aim of achieving an economic result. Some examples of functional cognition are knowledge of how the objects are operated, how technological operations are conducted, how the environment is utilized and maintained, how dialogues and contracts with partners are handled, and many others.

The essence of the functional cognitions of the enterprise for machines can be understood by comprehending the objective meaning of the "SIS of EM" (the Subjecthood Implementation System of the Enterprise for Machines). "SIS of EM" (the Subjecthood Implementation System of the enterprise for machines) provides meaningfully organized information about everything that the human capital of the enterprise should do in order to ensure that the enterprise justifies the essential purpose of its existence. In other words, and stated succinctly, "SIS of EM" is a concept of the vitally necessary knowledge required to objectively define the job descriptions of the employees that form the human capital of the enterprise. Broadly speaking, it can be said that the " SIS of EM" defines the Cognition and Responsibilities necessary for the management of the enterprise for machines. This system provides answers to the questions "what" should be done and "how" it should be done, as well as "what" constitutes an acceptable result of the work.

The condition and development of the "trunk" of the Tree of Industrial Cognitions, symbolizing the functional cognition base for creating principle cognition and then implementational cognition for the achievement of an economic result by the enterprise, is directly dependent on the condition and development of the "roots" of this tree.

The "roots" of the Tree of Industrial Cognitions are a symbolic representation of the foundational cognition of the enterprise in its capacity as a systemic subject. Examples of foundational cognitions of the industrial enterprise are the applications of various natural sciences, such as knowledge of Physics, Biology, Chemistry, Mathematics, Engineering, etc. The knowledge for an ontological systemic model of the enterprise for machines, symbolically represented by the Industrial Cross and the Tree of Industrial Cognitions, are also examples of foundational cognitions.

The Tree of Industrial Cognitions in its entirety is a visual representation of the second cognitive platform for understanding and making sense of each enterprise for machines as a systemic subject.

In summary, we can conclude that the Tree of Industrial Cognitions represents a comprehensive cognition system that outlines the responsibilities vital for the existence of the enterprise as a systemic subject. The Tree of Industrial Cognitions symbolizes the hierarchical construction of the Objectified Cognitive Environment, which contains the necessary and sufficient cognition to achieve the purpose of the existence of the enterprise for machines - to increase the potential of the environment for human existence.

These two cognitive platforms are part of the previously mentioned unified theory and terminology "Engineering Model of the Economy of the Enterprise for Machines." Anyone interested could research the topic further since the two books that we mentioned above are publicly available at the Bulgarian National Library "St. St. Cyril and Methodius" in Sofia.

An in-depth, exhaustive readthrough of these texts leads to the conclusion that the knowledge developed by IDEUM Base provides an extremely detailed terminological basis for the mutual understanding of employees working in a certain enterprise for machines. Furthermore, it can become the basis for mutual understanding of all the "systemic subjects" (economic units) that form the global industrial economy. The content of the "engineering model" is conveyed predominantly through everyday language supplemented by content that clarifies the meaning of the concepts. The use of the concept terminology is very strict, so much so that it is comparable to the use of formulas. It is these characteristics of the discoveries made by IDEUM Base that make them a suitable basis for a "Digital Transformation of Economic Science." Through the development of clear and accurate terminology, they successfully organize and bring under control the multitude of objects and processes that occur in all enterprises for machines on a daily basis. Thus, they have proven that the creation of a unified theory and terminology is quite possible.

But is this knowledge about the principle setup and way of functioning of the enterprise for machines better than the publicly recognized as the highest quality such knowledge - the fragmentary business model ontology called business model "Canvas"?

6.3. A comparative analysis between the business model ontology and the engineering model of the enterprise for machines

In order to answer this question, we must juxtapose the two models against each other. By positioning the two models in direct competition with one another, we can test which model provides more precise answers to the following questions:

1. What is the principle setup and way of functioning of the enterprise for machines as a systemic Object?
2. What is the principle setup and way of functioning of the enterprise for machines as a systemic Subject?

These questions will test which of the two models actually resolves the two major flaws of the fundamental scientific knowledge of economy that is disseminated today.

Before we begin, we will briefly recall the concepts of "business model ontology" and "Industrial Cross":

"Business Model Ontology" - this is a graphical representation of how a company functions. This graphical representation can serve as the basis for modeling the mechanisms by which the company creates added value.

"Industrial Cross" - this is the first cognitive platform of the engineering model of the economy of the enterprise for machines that presents a graphical description of the principle of operation of the enterprise for machines as a systemic object.

Now each reader should compare the business model Canvas (Figure 6.5) to the Industrial Cross (Figure 6.6) in an attempt to answer the first question:

What is the principle setup and way of functioning of the enterprise for machines as a systemic Object?

In addition, each reader should try to discern the answer to the two questions we presented when we introduced the Industrial Cross:

"What is profit or loss?" and "What is a good or service?"

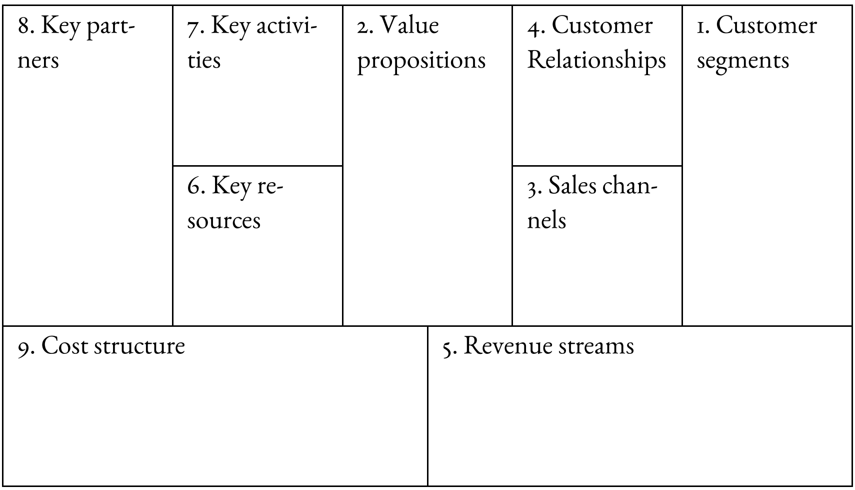

Figure 6.5 Business Model Canvas

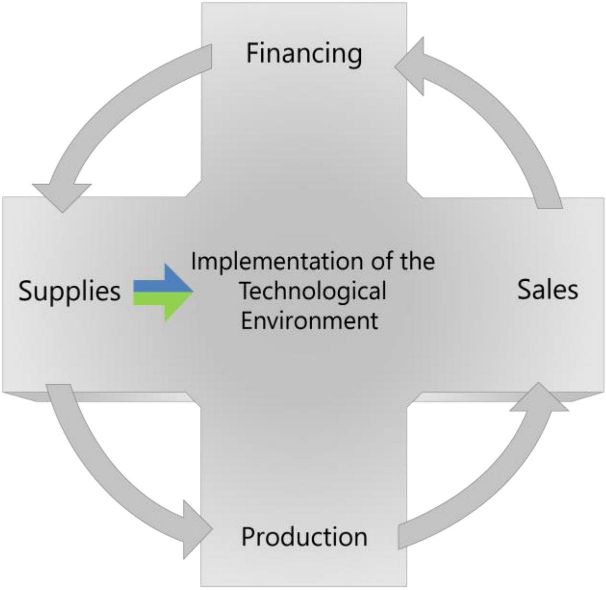

Figure 6.6 The Industrial Cross

From an analysis of the two images, we can draw the following conclusion:

The business model Canvas and all other similar visual representations have one serious shortcoming. None of them provide an understanding of how the enterprise functions and how it creates added value – which is how the knowledge of the Industrial Cross differs from the rest. We have repeatedly established this inability of other graphic representations of the economy of the enterprise to symbolize the way of functioning of the enterprise, and in fact, we have done so with the participation of representatives of the community of professional economists. None of the experts relying on the schematic of the business model Canvas is able to provide a single decent explanation of how an enterprise for machines functions in reality. Stated explicitly, the Business Model Ontology schematic does not fulfill its definition: to serve as a visual representation of the mechanisms through which an enterprise makes a profit.

In our opinion, the Industrial Cross is the only graphic representation available in the world, which provides a clear understanding of the principle setup and way of functioning of the enterprise for machines as a systemic Object.

We have explained the Industrial Cross to a relatively select group of workers in an enterprise for machines (6 groups of 20 people) with the aim of increasing work motivation based on a general but conscious understanding of the principle setup and the way of functioning of the engineering company. The training sessions consisted of a 40-minute explanation of the Industrial Cross followed by questions and feedback.

After an initial explanation of the Industrial Cross (similar to the one we have presented here), followed by a question-and-answer period and brief comparisons with the systems of the human body, the workers themselves reached the conclusion that major crises in the economy of the enterprise resemble major crises in the human body, such as "cancer" and a "heart attack." Furthermore, almost everyone arrived at the conclusion that the "Industrial Cross" is cognitively valid not only for the industry for machines but also for enterprises from a wide range of other industries.

As far as we are concerned, a comparison between the business model Canvas and the Tree of Industrial Cognitions, which rests firmly upon the Industrial Cross, in regard to the second question (namely, what is the principle setup and way of function of the enterprise for machines as a systemic subject?) is impossible. After all, in order to provide an adequate answer to this question, a theory must first resolve the first major flaw of the fundamental scientific knowledge of economy, which the business model Canvas, as well as all other models preceding it, have failed to do.

If we examine the application of the two models in real industrial practice, we will determine that the business model Canvas is applied solely for the purpose of forming a general understanding of its nine building blocks: Customer Segments; Value Propositions; Channels; Customer Relationships; Revenue Streams; Key Resources; Key activities; Key Partnerships; Cost structure. All of these building blocks are slapped on the canvas without any logical or systemic connection between them. The author's instructions for filling out these blocks are compiled into 20 short pages, accompanied by numerous illustrations, and the official recommendation for how to fill in the individual cells is with the highly innovative method of using sticky notes. Furthermore, the Business Model Ontology proposed by Osterwalder does not provide a unified theory and terminology on the basis of which a truly ontological model of the economy of the enterprise for machines as a systemic object and subject can be developed. Due to this fundamental limitation, the "business model ontology" cannot serve as a basis for the development of a digital product for managerial modeling of the economy of the enterprise, despite the author's claims in this regard. Indicative of this fact is that to this day, more than 11 years after the "business model ontology" was first introduced in the public sphere, there is still no digital product for managerial modeling of the economy based on it.

By comparison, the formation of the engineering model of the economy of the enterprise for machines begins with the formation of a unified theory and terminology, which reflect the principle setup and way of functioning of the enterprise as a systemic object and subject. This unified theory and terminology serve as a stable foundation for the creation of a holistic ERP system, which allows the modeling of the economy of a given enterprise in three distinct aspects. Allow us to refresh your memory; in terms of "personal subjecthood," these are the spiritual aspects of "Ambitions," "Possibilities," and "Reality." In terms of "systemic subjecthood," these aspects are Strategic, Tactical, and Operational. Furthermore, the prototype of this holistic ERP system has been tested in practice in several enterprises for machines in Bulgaria and culminated in significant results.

As a conclusion of the comparison between the "business model canvas" and the engineering model of the economy of the enterprise, we should conclude that the better model, which fills with meaning the concept of "business model ontology," is precisely the model created in Bulgaria by "IDEUM Base. " So, from now on, we will call the "engineering model" - "holistic business model ontology."

At the beginning of this chapter, we mentioned that while writing this book, and even prior to that, we conducted extensive research in search of an ERP system whose functional structure contained these five technological systems that are part of the "Industrial Cross." Our research concludes that there is no evidence that anyone, anywhere, ever on a global scale has succeeded in developing a new fundamental scientific knowledge of economy of a higher quality based on the laboratory approach. And since there is no such knowledge anywhere in the world, there is also no ERP system based on such knowledge. With one notable exception, namely the working prototype of a holistic ERP system created by "IDEUM Base."

Next, we will briefly present the results of this research of ours.

6.4. Comparative analysis of fragmented ERP systems and the holistic ERP system

6.4.1. Fragmented ERP systems

The professional ERP systems available on the market today, produced by companies like SAP, Oracle, and the like, are created in several steps. First, the theory and terminology are selected or developed. Second, a functional construct (user interface), which is based on a thorough knowledge of the theory and terminology, is created. Third, based on the functional design, the program architecture of the digital product is developed. Fourth, based on the functional design and the program architecture of the digital product, the entire digital program is created. The fifth step is testing. The ERP system designed by SAP is structured on the basis of the theory and terminology proposed by the German Dietger Hahn in his publication "Planung und Kontrolle," which is one of the leading publications on the knowledge of controlling, which we examined in Chapter 4.

However, since the modern fundamental scientific knowledge of economy is fragmented, the current ERP systems that use this knowledge as a foundation inherit these same flaws. For example, the knowledge of controlling does not provide a complete and clear understanding of the principle setup and way of functioning of the enterprise for machines; therefore, the SAP product, which is designed based on this knowledge, is characterized by the same defect. In order to compensate for this shortcoming, many modules are subsequently added to provide functionality for the missing aspects of the fundamental scientific knowledge; however, these add-on modules are not conceptually or systemically connected to each other. Some examples of the missing aspects are knowledge of accounting, knowledge of planning and control, and knowledge of human resource management, etc. These various types of knowledge do not share common theory or terminology. Thus, various software vendors design a multitude of modules to "patch up" the fragmented ERP, which leads to organizational chaos and many failed implementations (according to data from "Gartner," a leading consulting firm in the field of ERP systems, between 55% and 75% of ERP implementation projects fail).

We will continue with an overview of the basic functional construct of the world leader in the field of ERP systems - SAP.

Founded in 1972 in Germany by five former IBM engineers, the company was initially in the business of developing accounting software. Subsequently, the software's functionality was expanded with the addition of materials management modules and, eventually, the MRP algorithm. Two years after Gartner came up with the term ERP system, SAP introduced

"SAP R/3" - "*The ERP system that will take over the world.*" This digital system is based precisely on the scientific knowledge of controlling. Accordingly, there are four main modules of the SAP ERP system:

- Sales and distribution;
- Materials management;
- Production planning;
- Finance and controlling.

Next, we provide an overview of the basic functional construct of the second most widespread ERP system, which is developed by the company Oracle. Their product - "Oracle Enterprise Resource Planning" consists of the following main modules:

- Finances;
- Accounting;
- Procurement;
- Project management;
- Risk Management;
- Enterprise Performance Management;
- Supply chain management.

These are only the main modules of the leading ERP manufacturers - SAP and Oracle. The functionality of these modules is extremely basic, which necessitates the additional "installation" of numerous other modules to supplement and expand the functionality of these digital products. According to our data, SAP offers more than 60 supplementary modules. And that's just the number of modules produced by SAP themselves. It would be difficult to determine the total number of modules offered by third-party software vendors, but it is safe to say that it is well over a thousand. An interesting observation is that after the implementation of a fragmented ERP system in a given enterprise, in most cases, a complete "dismantling" of the system begins, as it becomes evident that a large part of the advertised functionalities are not good enough and a new search for external solutions commences.

We believe that the compromised foundation of the fragmented ERP systems (the flawed fundamental scientific knowledge of economy that they are based upon), is the reason why neither the customers nor even the software vendors understands exactly what an ERP system ought to do. Because of this fact, sales consultants set unrealistic expectations for their clients that these will practically manage the enterprise for them. This is also the reason why ERP manufacturers try to cover every single possible process in the enterprise by creating a module for it.

The chaos caused by the lack of a unified theory and terminology, the confusing functional construct, the slow communication between the multitude of modules, and above all, the inability to reflect the technological environment of the enterprise (as it really is) leads to extreme confusion among the manufacturers, vendors, and users of the ERP systems. To express the problem more clearly, let us draw an analogy with medieval medical science: in the absence of the anatomical and physiological model of the human body (an ontological model of the economy of the enterprise for machines), doctors (the ERP manufacturers and implementations consultants) could not carry out empirically based treatment plans (holistic ERP solutions) of diseases (business challenge) that plagued patients (users).

The executive director of SAP, Christian Klein, made an interesting statement in this regard in an interview in May of 2020 acknowledging SAP's own deficit in knowledge to develop holistic solutions: "*We overcomplicate things, and we are not offering good enough holistic solutions for the customer. When you are coming only with pieces and fragments, then it's hard for the customer to figure out, how do we solve my business challenge?*" [42]

6.4.2. The holistic ERP system

Let us review: holistic ERP systems, in contrast to fragmented ones, are built on the basis of a unified theory and terminology derived from practice and, therefore, provide universally applicable knowledge of the principle setup and way of functioning of the enterprise for machines. And this knowledge can be defined as a holistic business model ontology.

Due to the fact that the holistic ERP system is based on such unified and universally applicable knowledge, the core of the holistic system is complete (not fragmented) and encompasses all of the functional processes that take place within the enterprise for machines. At the highest level, these processes form five technological systems: Sales, Production, Supplies, Financing, and Implementation for the Technological Environment of the Enterprise.

Having this knowledge embedded within the holistic ERP system allows for the management of the entire multitude of objects in an enterprise, and not only that, but it also allows for the management of the multitude of subjects, such as employees and partners, in combination with the multitude of cognitions necessary for the operation of the enterprise, even in real-time.

But perhaps the most important and valuable benefit is that when we have a system with a completed core based on a unified theory and terminology, which reflects the enterprise as a whole, it allows for the mutual understanding of all of the employees working in the enterprise, and from there for consensus and motivated collaboration.

The prototype of the holistic ERP system created by IDEUM Base has gone through 3 versions of development, with each subsequent version being based on the further development of the "engineering cognitive platform." It is important to note that we are not referring to modules, such as those characteristic of the fragmented ERP systems. By designing a holistic system based on the "Engineering Model of the Economy of the Fundamental Enterprise," the processes are truly and fully incorporated and work in sync with each other. That is, they are not separate modules that work with a common database but can be considered as functional subsystems that together form the holistic ERP system.

And thus, today, this working prototype of the IDEUM Base holistic ERP system has the following seven functional subsystems:

1) Functional subsystem "Subjects";
2) Functional subsystem "Objects";
3) Functional subsystem "Implementation of the technological environment";
4) Functional subsystem "Sales";
5) Functional subsystem "Production";
6) Functional subsystem "Supplies";
7) Functional subsystem "Finances."

By analyzing the basic functional structures of the fragmented ERP and the holistic ERP systems presented in this way, it is clear that the holistic ERP system covers all the technological systems that make up the principle setup of the enterprise for machines. In contrast, the fragmented ERP systems mostly cover the systems of the "Working capital flow" - Supply, Production, Sales, and Financing – but none of them take into consideration the technological environment of the enterprise. A technological environment, which consists of two components: organizational environment and technological environment. And in fact, if we are not managing the technological environment, then we are not actually managing our enterprise at all. Our studies lead to the paradoxical conclusion that none of these fragmented systems has identified and defined the building block of each enterprise – the "operational technological field," including its organizational and technological components of the enterprise's environment.

Thus, since the fragmented systems lack the capability to reflect the enterprise's object environment, it becomes, quite logically, impossible to define the organizational component or the cognition necessary for the operation of a given workplace. Moreover, the lack of a clear understanding of the enterprise's technological environment makes it impossible to model its future states, which in turn, means it makes it impossible to perform true, strategic management of the enterprise's economy. This inevitably leads to endless organizational chaos.

In order to compensate for the lack of integral functional subsystems, when implementing the fragmented ERP systems in a given enterprise, the software consultants who perform this task utilize a number of modules based on the so-called "best practices" (in other words, what they believe works in other businesses in the same sector). Furthermore, some of the basic functional constructs of a given ERP manufacturer are better than the alternatives of another manufacturer, which leads to the paradoxical use of two separate ERP systems in the so-called "two-tier ERP." The paradox lies in the fact that the top management of the enterprise uses one type of ERP system from a certain manufacturer, which is very well suited and specifically tailored to their enterprise, while the lower-level employees use a different type of ERP system, produced by the same manufacturer or even a different manufacturer, which is better suited to the lower levels of the enterprise. Subsequently, the two ERP systems must be connected, and a link must be established to automatically transfer the data from the low level to the high level.

Accordingly, you can imagine (and perhaps you have been unfortunate enough to experience this in your own place of employment) the difficulty and the amount of time and energy that the employees of these industrial enterprises waste while trying to manage the processes in their enterprise by using two systems, which are based on different concepts and methodologies.

And yet, every fragmented ERP system is advertised as "the one system to unite them all" and the system which "provides exceptional automation" and which would "save the enterprise a great deal of man-hours." However, the reality is very different: about 70% of ERP implementation projects fail, and for over 90% of successful implementations, there is no data or evidence of any optimization expressed in terms of decreased man-hours or higher revenue as a consequence of the implementation.

The reason for all this is that the fragmented ERP systems are compromised from the very beginning. Their original design is flawed due to the lack of a clear, ontological model of the principle setup and way of functioning of the enterprise for machines as a systemic object and systemic subject.

As a direct consequence of the questionable scientific foundation on which fragmented ERP systems are based, another considerable problem occurs – the "conceptual jungle" that has "sprung up" within. Built on different fragments of the scholastic fundamental scientific knowledge of economy, the multitude of modules, disconnected theoretically and conceptually from each other, bring chaos, and thus fragmented ERP systems do not help to build a unified language in the enterprise. During an official presentation of one of the world's leading ERP systems, the consultants admitted that when creating a localized Bulgarian version of the ERP system, one term is translated in several ways in several different modules, and they "do not see any problem in that."

Opposing this "conceptual jungle" and the thousands of modules on the market, IDEUM Base achieves truly indisputable results after subjecting the holistic ERP system to testing.

Based on the knowledge of the holistic business model ontology and by using the holistic ERP system as an aid, was successfully carried out an enterprise engineering project consisting of the creation of an entirely new enterprise for machines, which to produce a highly innovative products (axial-piston hydraulic pumps and motors).

Based on the knowledge of the holistic business model ontology and by using the holistic ERP system as an aid, an entirely new enterprise for machines, which produces a highly innovative product (axial-piston hydraulic pumps and motors), was successfully engineered (designed) and created from scratch (i.e., enterprise engineering project).

In addition, based on the knowledge of the holistic business model ontology and by using the holistic ERP system as an aid, a complete reengineering of a large enterprise for machines was carried out in order to achieve a significant improvement in the economic result (i.e., enterprise reengineering project). By reengineering, we mean the pre-planned and complete radical restructuring of an enterprise (considered as a technological environment). The entire reengineering campaign consisted of restructuring and relocation of more than 70 % of all workplaces of a large enterprise comprised of more than 500 employees, while the whole campaign was conducted in a highly expeditious manner, without any delay or suspension of industrial processes.

It is precisely these capabilities of the holistic ERP system for modeling the technological environment that allow the effective modeling of the economy of the enterprise in a strategic aspect that makes these systems an extremely powerful and attractive tool for all investors and shareholders.

With a clear understanding of the technological environment and the cost of its maintenance, this type of systems are capable of performing principle modeling of the multitude of trajectories of the objects in the enterprise in time-interval models. That is, it makes it possible to simulate the future states of the enterprise by modeling the flows passing through the technological systems for Supply, Production, Sales, and Financing, in combination with the expenses and investment flows, which ensures the robust functioning of the technological environment depending on a variety of external economic factors. This is made possible by deriving multiple "time-interval models" of its future revenues and expenses much more accurately than those computed by the fragmented ERP systems. The data is presented in a convenient and easy-to-assimilate infographic.

But the most significant benefit of combining the knowledge of the holistic business model ontology and the use of the holistic ERP system is the achievement of true labor motivation among the employees. By learning about the holistic business model ontology, working in a unified environment, and relying on a unified theory, in the shape of the holistic ERP system, all employees gain a detailed understanding of the principle setup and way of functioning of the enterprise in which they work. This allows them to see how each employee's effort contributes to the goals of the enterprise, resulting in greater fulfillment in their job. Thus, it can be argued that through the understanding of the holistic business model ontology, it is possible to inspire total consensus among the personnel (from the top tier of management to the entry-level positions), which is, in fact, a mandatory prerequisite for cooperation.

These indisputable facts have convinced us that embedding a new fundamental scientific knowledge of economy of a higher quality into the new kind of ERP system (which we call holistic) and the subsequent wide dissemination of both the theory and the digital product in educational institutions will lead to the transition of scientific knowledge of economy from a medieval (scholastic) to a modern (systemic) level of qualitative development, or in other words, to *Digital Transformation of Economic Science.*

Based on these two comparative analyses, we can draw the following conclusions. Firstly, through their research, IDEUM Base has proved our thesis: a new fundamental knowledge of a higher quality for managing the economy of the enterprise for machines can be created. It is knowledge that gives a clear understanding of the principle setup and way of functioning of the enterprise for machines as a systemic object and subject. Secondly, IDEUM Base has also proven that a new class of ERP systems can be developed based on this new fundamental knowledge, a class of systems we deservedly define as holistic ERP systems.

Of course, we cannot rule out the possibility that elsewhere in the world, a new fundamental scientific knowledge of economy of a higher quality is also being developed, or has already been developed, and that a new class of ERP systems has already been designed based on its theory. We, the representatives of Foundation ITFES, conduct continuous research on this topic and have yet to find another such theory or knowledge. And yet, Bulgaria's success in this direction is sufficiently indicative that such knowledge can be created and then developed.

If this new class of holistic ERP systems, which are bearers of a new fundamental scientific knowledge of economy of a higher quality, are widely disseminated and studied, then we are convinced that the negative trend in the development of the human capital of the Western world will gradually be resolved. But why are we so convinced?

It is time to answer the third big question posed in this chapter: *What would be the consequences of the mass dissemination of the holistic ERP systems?*

6.5. Critical analysis

As part of the critical analysis, we will consider what the effect would be if engineering students began to learn theoretical and practical knowledge about the programmed functional constructs of the new class of holistic ERP systems. At the end, we will also consider what the effect would be if economics students undertook that same course of study.

It is our view that the people who should study this knowledge with increasing priority are engineers, or, more precisely, machine engineers – the real professionals creating, developing, and managing the industry for machines. This view of ours fully overlaps the concept of "The Engineer as

Economist" – an idea born in the late 19th century that led to the three engineering waves in the development of the fundamental scientific knowledge of economy but remained incomplete to this day. Let us review. The author of this idea is Henry Towne, one of the vice-presidents of the "American Society of Mechanical Engineers" and later its eighth president. His idea was then practically applied by Frederick Taylor, the twenty-fifth president of the "American Society of Mechanical Engineers" and known worldwide as the "Father of Scientific Management." The creation and widespread dissemination of this new, at the time, knowledge about managerial modeling of the economy of the enterprise called "scientific management" represents the first engineering wave in the development of the fundamental scientific knowledge of economy. The second and third engineering waves in the development of this knowledge are also the work of American engineers, and in our opinion, these three waves of development were a major factor in the evolution of the USA into an undisputed industrial and technological global leader throughout the twentieth century. The USA's industrial leadership continued into the first two decades of the twenty-first century, albeit much less decisively; however, all signs point to the fact that in the third decade and the decades thereafter, China will be leading the global industrial and technological market.

The only viable chance for a dignified and righteous development of the Western world, in order to reduce its technological lag in comparison to China, is through the realization of a Fourth engineering wave in the development of the fundamental scientific knowledge of economy and which would lead to the finalization of the work of the American engineers Henry Towne and Frederick Taylor. A finalization, crowned with the emergence of a new generation of machine engineers, which we call Systemic Economic Engineers.

A Systemic Economic Engineer is any professional machine engineer who, as a result of purposeful education, in addition to having acquired fundamental and specialized engineering knowledge in a certain field of machine engineering, has also acquired theoretical and practical knowledge of the programmed functional constructions of a new class of ERP systems called "holistic ERP systems." These are holistic digital technologies for managerial modeling of the economy of the enterprise for machines that are based on knowledge of an ontological model of the enterprise for machines in its capacity as a systemic object and subject.

For a more accurate and in-depth understanding of the composite concept Systemic Economic Engineer, we will proceed by defining the terms "engineer" and "machine engineer."

Engineer – a person who practices engineering. Engineering (from the Latin word "ingenium," meaning ingenuity, intelligence, knowledge, and skill) — a field of intellectual human activity, discipline, and profession, which is tasked with applying science and technology, understanding the universal natural laws, and using natural resources to solve mankind's problems and achieve the goals and objectives of humanity. According to the American Engineers' Council for Professional Development (ECPD), engineering is *"a creative application of scientific principles to design or develop structures, machines, devices, production processes, or work on their use separately or in combination; constructing or driving them with full knowledge of their design; predicting their behavior under certain regimes."*

Machine engineer – a person who practices machine engineering. Machine engineering is a unifying term that includes the entire body of engineers dealing with machines, independently mechanical, electrical, hydraulic, etc. Machine engineering requires understanding the fundamental areas, including mechanics, dynamics, thermodynamics, materials science, structural analysis, and electricity. It is the branch of engineering that involves the design, manufacture, and operation of any machinery.

Systemic Economic Engineer - as a result of several months of theoretical and practical study of the functional construction of the holistic ERPsystem - forms a cognitive potential for managerial modeling of the economy of the enterprise for machines, which greatly surpasses that of the most pretentious professional industrial economists. Economists who have studied the numerous scholastic (systemically unrelated) schools of the modern scientific knowledge of the management of the industrial economy in order to acquire public recognition as an authority in this field compared to those who have not invested years into this scholastic field.

The most notable superiorities of the Systemic Economic Engineer are listed and explained below:

The System Economic Engineer has the ability to thoroughly understand and then, based on the knowledge of the programmed functional constructs of a holistic ERP system:

(1) To clearly explain the principle setup and way of functioning of the engineering enterprise as a **systemic object** as a result of the continuous, coordinated operation of its five functional systems. This explanation must provide clear answers to five questions: (1.1) What is "**the capital of an enterprise** for the production and sale of engineering products in the form of goods and/or services?"; (1.2) What is "**the economy of an enterprise** for the production and sale of engineering products in the form of goods and/or services?"; (1.3) What is "**the economic result of an enterprise** for the production and sale of engineering products in the form of goods and/or services?"; (1.4) What is "**the manufacture and sale of machine engineering products in the form of goods?**"; (1.5) What is "**the manufacturing and sale of machine engineering products as services?**"

All of the studies we have conducted thus far unequivocally show that among the multitude of professional industrial economists, none can explain the principle setup and way of functioning of the enterprise for machines as a systemic object. There are also none who can provide a clear and unambiguous answer to any of the above questions. They are unable to answer these questions in a way that provides the average person with a clear, practical understanding of the meaning of these concepts. [43]

(2) to clearly explain the principle setup and way of functioning of the engineering enterprise as a **systemic subject** as a result of the operation of its "subjecthood implementation system." This explanation must provide clear answers to five questions: (2.1) What is "**existential cognition of an enterprise** for the production and sale of engineering products, considered as a systemic object and subject simultaneously?"; (2.2) What is "**implementational cognition of an enterprise** for the production and sale of engineering products, considered as a systemic object and subject simultaneously?"; (2.3) What is "**principle cognition of an enterprise** for the production and sale of engineering products, considered as a systemic object and subject simultaneously?"; (2.4) What is "**functional cognition of an enterprise** for the production and sale of engineering products, considered as a systemic object and subject simultaneously?"; (2.5) What is "**foundational cognition of an enterprise** for the production and sale of engineering products, considered as a systemic object and subject simultaneously?"

All of the studies we have conducted thus far unequivocally show that among the multitude of professional industrial economists, none can explain the principle setup and way of functioning of an enterprise for machines as a systemic subject. There are also none who can provide a clear and unambiguous answer to any of the above questions. They are unable to answer these questions in a way that provides the average person with a clear, practical understanding of the meaning of these concepts. [44]

(3) Forms practical knowledge for the development of highly effective strategies for the future economic development of an enterprise for machines with a focus on the anticipatory development of its innovation potential. This knowledge enables the Systemic Economic Engineer to personally lead or at least participate in the development of such strategies.

(4) Forms practical knowledge for the development of highly effective programs for the training, retraining, and motivation of the employees of an enterprise for machines; programs that aim to realize the strategies for the future economic development of an enterprise for machines.

(5) Forms practical knowledge for the planning and management of projects for the installation and further development of information systems for managerial modeling of the economy of an enterprise for machines.

All of the studies we have conducted thus far show that among the many professional industrial economists, there are those who have some practical knowledge for the planning and management projects for the installation and further development of information systems for managerial modeling of the economy of the enterprise for machines, but that this knowledge of theirs is inferior to the knowledge of a Systemic Economic Engineer. [44]

(6) Forms practical knowledge for the planning and management of projects for the implementation of a quality management system for the goods and services sold by an enterprise for machines.

(7) Forms practical knowledge for auditing an enterprise for machines in order to assess the current status and the future development of its economy and in order to generate ideas for increasing the efficiency of this development.

(8) Forms conceptual knowledge for the creation and development of a truly effective accounting model of the economy of the enterprise for machines.

(9) Clearly explains the possibilities for managing the cost and quality of the goods and services sold by an enterprise for machines. Based on this understanding and with the help of a holistic ERP system, the Systemic Economic Engineer can perform a technological analysis (in terms of product cost and quality) of the process for the creation of those goods and services while offering technological trajectory variants.

(10) Forms practical knowledge for the planning and management of projects for the implementation of systems for lean manufacturing (Single-Minute Exchange of Die – SMED) of goods and services sold by the enterprise for machines.

All of the studies we have conducted thus far show that among the many professional industrial economists, there are those who have some practical knowledge for the planning and management of projects for the implementation of systems for lean manufacturing, but that this knowledge of theirs is fragmented and of lower quality to the knowledge of a Systemic Economic Engineer. [45]

(11) On the basis of the knowledge of the programmed functional constructs of a holistic ERP system, the Systemic Economic Engineer forms practical knowledge for the planning and management of the re-engineering of enterprises for machines or large parts of them.

All of the studies we have conducted thus far show that among the multitude of professional industrial economists, there are none who can develop plans and systematically lead the re-engineering of enterprises for machines or large parts of them. In this respect, their collective knowledge approaches "zero." [45]

(12) On the basis of the knowledge of the programmed functional constructs of a holistic ERP system, the Systemic Economic Engineer forms practical knowledge for the planning and management of the engineering of enterprises for machines or large parts of them.

All of the studies we have conducted thus far show that among the multitude of professional industrial economists, there are none who can develop plans and systematically lead the re-engineering of enterprises for machines or large parts of them. In this respect, their collective knowledge approaches "zero." [45]

The possible superiority of the new generation of Systemic Economic Engineers over the scholastic industrial economists in the field of managerial modeling of the economy of the enterprise for machines begs the question: "How would studying the programmed functional constructs of the holistic ERP system affect the scholastic industrial economists?" The facts are that in today's Western world, there is a huge number of people who are currently studying or have already graduated with an economics major. These are people who are naturally proactive and intelligent, and they bear no blame for the fact that the subjects they study are based on a fundamental scientific knowledge of economy that is at a medieval level of development. Precisely because of their many positive attributes, these people deserve to get practically useful knowledge about the managerial modeling of the industrial economy, which will serve them in their professional life.

Next, we offer our opinion about what could be the possible social effect of the mass study, both in theory and in practice, of the programmed functional constructs of a new class of digital technologies for managerial modeling of the economy of the enterprise for machines (holistic ERP systems) by modern industrial economists.

This social effect would manifest itself in the formation of a second new professional class, which we call Holistic Industrial Economists.

A Holistic Industrial Economist is any industrial economist who, as a result of purposeful education, has acquired theoretical and practical knowledge of the programmed functional constructs of holistic ERP systems. For a more accurate and in-depth understanding of the composite concept of Holistic Industrial Economist, we will proceed by defining the terms "economist" and "industrial economist."

Economist - a person who has made a significant investment of time, effort, and money to acquire a set of authoritative documents certifying that he possesses theoretical and applied knowledge of managerial modeling of the economy in one or both of its dimensions - macroeconomics and microeconomics.

Industrial economist - an economist who has focused his investment in the field of microeconomics and, more precisely, on acquiring theoretical and applied knowledge for managerial modeling of the economy of the enterprise for machines and, therefore, by extension of other industrial enterprises.

The Holistic Industrial Economist - as a result of the in-depth theoretical and practical study of a holistic ERP system, theoretically, terminologically, and practically familiarizing himself with the digital technology of the ERP system, achieves cognitive superiority in the field of managerial modeling of the industrial economy over any scholastic economist who relies on the medieval fundamental scientific knowledge of economy. Due to their lack of knowledge in the specific engineering fields, Holistic Industrial Economists could not have cognitive superiority in the field of managerial modeling of the economy of an enterprise for machines over a Systemic Economic Engineer, but they would achieve significant cognitive superiority over scholastic economists in the fields of accounting, finance and insurance, and as well as marketing and sales. As a result of acquiring knowledge about the principle setup and way of functioning of the enterprise for machines, they will have a more realistic and thorough idea of how an industrial enterprise operates and, therefore, will be able to provide much higher quality services in the aforementioned areas.

So, in conclusion, it should be reiterated that the greatest opportunity to stabilize the precarious position of the Western world as a global leader rests upon the initiation and indoctrination of a fourth engineering wave in the development of the fundamental scientific knowledge of economy. A wave that would lead to the finalization of the work of all the American engineers who devoted their lives to the previous three waves in the development of this knowledge. A finalization, crowned with the emergence of a new generation of machine engineers that we call Systemic Economic Engineers.

All of these advantages of the Systemic Economic Engineers will gain enormous prestige for the engineering profession, which will naturally begin to attract young people who want a career in industrial management and who have thus far been enrolling in economics majors in order to pursue such ambitions. The emergence of the class of Systems Economic Engineers and the redirection of the human capital of the Western world back to the engineering specialties as a natural environment for creating quality management personnel for the industry for machines will return our Western world back to its formative foundations of the early and mid-20th century.

We can define the emergence of the new class of engineers - "system economic engineers" - as the ultimate goal that must be achieved in order to begin solving the problem of the negative trend in the development of human capital of the Western world. The road that leads to the emergence of this key professional class and beyond is called the "Digital Transformation of Economic Science."

That is, to implement the creation, development, widespread dissemination, and mass study, both in theory and in practice, of the programmed functional constructs of a new class of digital technologies for managerial modeling of the economy of the enterprise for machines - holistic ERP systems.

In the final chapter of this book, we will look at two possible roads for future development of global human capital: the one laid out for us today by the political ideology of "Industry 4.0" and the new road that we propose, that of the "Digital Transformation of Economic Science."

Chapter 7: Two possible roads for future development of the global human capital of the West

In this final chapter, we will present two possible roads for the future development of global human capital. One of the two roads is being charted by the community of professional economists led by the World Economic Forum. This road would be an extension of the road our world has followed for the past 30 years. The other road is the one we propose, "Digital Transformation of Economic Science." This road aims to return the Western world to its formative foundations of the early and mid-20th century.

Unlike in the other chapters, in this chapter, the critical analysis is in the middle since, from our position, we can only analyze the first road. The other road, called "Digital Transformation of Economic Science," should be critically analyzed by the readers of this book.

7.1. The first possible road for the future development of the global human capital

In Chapter 5, we presented the leading political ideologies the Western world has followed or is currently following. Once again, according to our understanding, "political ideology" means the authoritative scientific knowledge for the selection and evaluation (and therefore planned and purposeful management) of the historical development of national economies and the economies of international unions and alliances – a development analyzed through the understanding of distinct historical stages that are characterized by specific criteria.

The first Western ideology is the so-called "knowledge economy." Adopted in 2000 as the Lisbon Strategy, this is the main political ideology the Western world currently follows. To review: knowledge economy is an ideology of historical development of a geopolitical economy, according to which the socio-economic development of society passes through 3 distinct, criterion-specific stages: (1) a pre-industrial stage called "pre-industrial society," (2) an industrial stage called " industrial society," and the last and most evolved stage - (3) the post-industrial stage called "post-industrial society," which is reached by going through a process called "de-industrialization." Through this process, outdated and dirty industries are transferred to developing countries that have not yet reached the status of a "post-industrial society." The only industries that remain in the most highly developed countries are the service industry and the industry for the development of innovative technologies.

Faith in the idea of a "knowledge economy" provided ideological comfort to the West (led by the USA) until nearly the end of the first decade of this century, but in the early years of the second decade, this faith was put to the test. It was tested by the great financial and economic crisis of the West in 2008 and 2009 and by opening the eyes of the West to the economic success of China.

These two phenomena, the financial crisis and China's rapid economic development call into question the validity of one of the main pillars of the "knowledge economy" idea - namely, the concept of "de-industrialization." This fact is best summed up in the words of Henri Mallos:

"For the past 10 – 20 years, we have been living according to three myths that have done a disservice to Europe. First the myth that the "knowledge economy" would make Europe the most competitive continent in the world. This was the claim in the year 2000, and we have seen that 13 years later, by following this strategy, the nations in the European Union have become that part of the world that has lost the most in terms of economic competitiveness. So, the Lisbon Strategy was a mistake because "knowledge economy" has no meaning. Since the dawn of time, the economy has been the process of production, maintenance and service of the

production process, and the sale of the products that were produced. That is what generates "knowledge." [40]

And also, in the following quote: *"In the long term, then, an economy that lacks an infrastructure for advanced process engineering and manufacturing will lose its ability to innovate."* [35]

The result of the "knowledge economy" is the West's drastic lag behind China in an economic aspect, but most significantly, it is expressed in a crisis in the development of the human capital of the Western world. The engineering profession and all of the engineering-specific specializations are losing their prestige as a consequence of the claim that the West *"does not need an industry for machines"* and instead is investing in the cultivation of an extraordinary abundance of all kinds of social science professionals and, above all others, professional economists.

After the Western world actively "de-industrialized" for 16 years, 2016 brought a drastic change in directionality. The top management levels of the European Union initiated the development and discussion of concepts for possible "re-industrialization." This is how the new political ideology of "Industry 4.0" was conceived.

According to the ideology of the Fourth Industrial Revolution, the historical development of a geopolitical economy passes through five historical stages, defined as "revolutions." The first "revolution" is defined as "agrarian" and the subsequent four as "industrial." We are currently in the "Fourth Industrial Revolution," also known as the "Second Machine Age" and more frequently called "Industry 4.0". This current ideological philosophy of the Western world is intriguingly annexed after the onset of the COVID-19 crisis. On June 3, 2020, at a video conference organized by the World Economic Forum, the so-called "Great Reset" was announced. The manner in which it was announced in the publicly available online spaces gives every reason to define this "reset" as a political ideology because: firstly, it represents the most authoritative scientific knowledge possible for strategic management of the historical development of the economy in all its dimensions, and secondly, it structures this development in criterion-specific historical stages, in fact, it organizes them in two distinct levels. The first level is the transition from the period before the initial mass infection with COVID-19 to the period after the initial mass infection. The second level is the transition from "shareholder capitalism" to "stakeholder capitalism," i.e., a transition from capitalism that serves the interests of company owners to capitalism that serves the interests of all persons associated with the company - partners, owners, employees, etc. The Great Reset is the road that the leaders of the World Economic Forum are guiding us on. Given the subject matter of this chapter, we will present some quotations from Professor Klaus Schwab's statements made during the conference on June 3, 2020:

"The COVID-19 crisis has shown us that our old systems are not fit any more for the 21st century. It has laid bare the fundamental lack of social cohesion, fairness, inclusion, and equality.

Now is a historical moment in time, not only to fight the real virus but to shape the system for the post-corona era.

We have a choice: to remain passive, which would lead to the amplification of many of the trends we see today — polarisation, nationalism, racism, and ultimately increased social unrest and conflicts.

However, we have another choice: we can build a new social contract, particularly integrating the next generation. We can change our behavior to be in harmony with nature again. And we can ensure that the technologies of the fourth industrial revolution are best utilized to provide us with better lives.

In short, we need a Great Reset.

We have to mobilize all constituents of our global society to work together. We must not miss this unique window of opportunity.

I think the most important issue is to change our minds, and instead of focusing on the short-term as we did in the past, we have to keep in mind the long-term perspectives and the long-term prosperity.

This leads me, for example, to the need, and the World Economic Forum is very much engaged to elaborate a comprehensive system of ESG – environmental, social, and good governance criteria for companies.

It should be a must for companies to report not only on financial success but how they contribute to our environmental, health, to social cohesion, and exercise good government." [46]

A few weeks after the video conference that announced the Great Reset initiative, the World Economic posted a so-called "Transformation map" of its initiatives to implement this great reset on its webpage.

This "Transformation map" claims to reflect the commitment of the World Economic Forum to create and develop a comprehensive system of uniform criteria for companies: firstly, criteria for environmental sustainability; secondly, criteria for socially responsible practices; and thirdly, criteria for optimized governance.

In reality, the idea of such criteria is not new. It was introduced at the beginning of the 21st century by the United Nations, but it only began to gain momentum in the last few years of the second decade of this century, thanks to increased interest in green energy and environmental protection. There have been many such criteria proposed up until now, but the goal of the WEF is to form a single system that would become the standard practice in the management of the economy (both the geopolitical economy and the industrial economy).

At this point, it ought to be explicitly clarified that the creation, development, dissemination, and then the implementation of such a targeted system of criteria in the real industrial economy is all that the Great Reset actually is, an obvious conclusion after a careful, substantive analysis of Professor Klaus Schwab's statements from June 3, 2020.

Next, we will present the "Transformation map" of the Great Reset. We must note that during the video conference in June of 2020, or any other events organized by the WEF, there has been no mention or discussion of the negative trend in the development of the human capital of the Western world, which we have defined. However, judging by the general ideological positions of the Industry 4.0 philosophy and by subsequent statements by Prof. Schwab that the Great Reset requires the retraining of one billion workers and professionals so that they can acquire skills needed for the realization of the Fourth Industrial Revolution (40% of whom must acquire engineering skills), we can come to the following conclusion:

This "Transformation map" should depict clear and usable (at a common-sense level) roads and paths that lead to a significant and accelerated strategic increase in the innovation efficiency of industrial capital.

And as for us, the representatives of Foundation ITFES, we believe that this Transformation map should provide roads and paths that if the Western industrial sector follows at a brisk pace and with the intention to overtake the East Asian industrial sector, especially those of South Korea and China, will lead the Western industry to eventually melting the lead that East Asia has gained in this respect. The "Transformation map" is depicted as a web of semantic terms at the center of which is the phrase the "Great Reset." We urge anyone reading the following lines to try to answer the question, "Can you see clear and rational (at a common-sense level) roads or paths that directly lead to a strategic plan for the significant increase of the innovation efficiency of the industrial human capital, specifically in the field of machine engineering, anywhere on this map?

According to the World Economic Forum, the Great Reset Transformation Map (Figure 7.1) contains seven nodes:

- the first node is called "Harnessing the Fourth Industrial Revolution";
- the second node is named "Strengthening Regional Development";
- the third node is called "Revitalizing Global Cooperation";

- the fourth node is called "Developing Sustainable Business Models";
- the fifth node is called "Restoring the Health of the Environment";
- The sixth node is called "Redesigning Social Contracts, Skills and Jobs";
- The seventh node is called "Shaping the Economic Recovery."

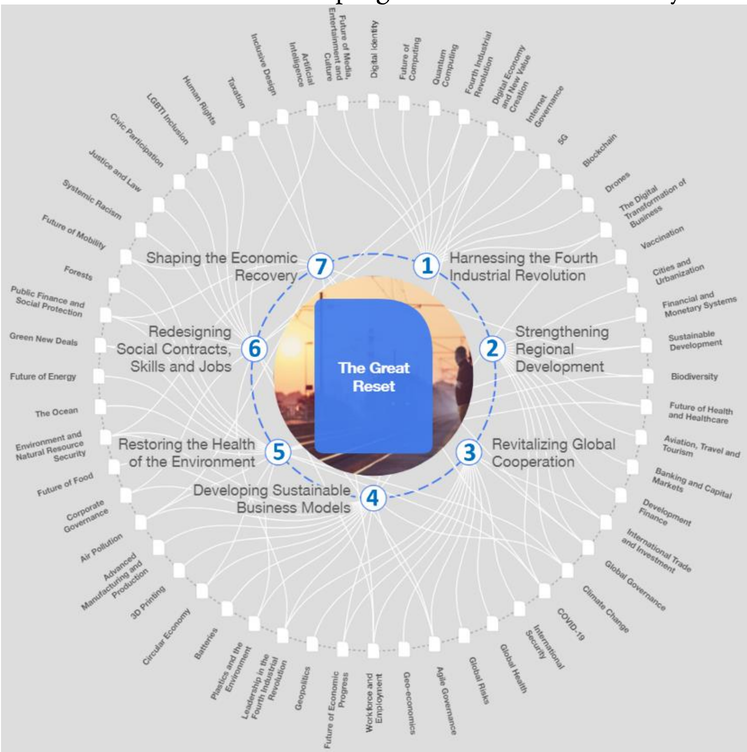

Figure 7.1 The Great Reset Transformation Map. [47]

The first node, called "Harnessing the Fourth Industrial Revolution," leads to Artificial Intelligence and Robotics; Future of Media; Entertainment and Culture; Digital Identity; Future of Computing; Quantum computing; The Fourth Industrial Revolution; Digital Economy and New Value Creation; Internet Governance; 5G technologies; Blockchain technologies; Drone technologies; Digital Transformation of Business; Vaccination.

The second node, called "Strengthening Regional Development," leads to Cities and Urbanization; Financial and Monetary Systems; Sustainable Development; Biodiversity; Future of Health and Healthcare; Aviation, Travel, and Tourism; Banking and Capital Markets; Development Finance; International Trade and Investment; Global Governance; Climate Change; COVID-19.

The third node, called "Revitalizing Global Cooperation," leads to International Trade and Investment; Global Governance; Climate Change; COVID-19; International Security; Global Health; Global Risks; Agile Governance; Geo-economics; Workforce and Employment; Future of Economic Progress; Geopolitics; Fourth Industrial Revolution.

The fourth node, called "Developing Sustainable Business Models," leads to Digital Economy and New Value Creation; Digital Transformation of Business; Climate Change; Agile Governance; Workforce and Employment; Future of Economic Progress; Fourth Industrial Revolution; Plastics and the Environment; Batteries; Circular Economy; 3D Printing; Advanced Manufacturing and Production; Air Pollution; Corporate Governance; Future of Food; Environment and Natural Resource Security.

The fifth node, called "Restoring the Health of the Environment," leads to Sustainable Development; Biodiversity; Future of Health and Healthcare; Climate Change; COVID-19; Plastics and the Environment; Circular Economy; Air Pollution; Environment and Natural Resource Security; The Ocean; Future of Energy; Green New Deals; Public Finance and Social Protection, Forests, Future of Mobility.

The sixth node, called "Redesigning Social Contracts, Skills and Jobs," leads to LGBTI Inclusion; Human Rights; Artificial Intelligence; Civic Participation; Justice and Law; Systemic Racism; Fourth Industrial Revolution; Digital Economy and New Value Creation; Workforce and

Employment; Agile Governance; Corporate Governance; Green New Deals; Public Finance and Social Protection.

The seventh node, called "Shaping the Economic Recovery," leads to Inclusive Design; Taxation; Public Finance and Social Protection; Environment and Natural Resource Security; Sustainable Development; Air Pollution; Global Governance; COVID-19; Workforce and Employment; Future of Mobility.

Every single node and each final destination have additional explanations and descriptions, which are available to all interested parties on the internet.

At the beginning of 2021, Klaus Schwab published a book entitled "Stakeholders' Capitalism," expressing his vision for realizing this historical stage in the development of national economies and the economies of international unions and alliances. In order to achieve this new and better kind of capitalism, it must be ensured that:

- All stakeholders get a seat at the negotiation table when discussing decisions that affect them.
- An appropriate measurement system is put in place that evaluates each stakeholder's contribution to the creation or destruction of value, not only in financial terms, but also in terms of the environmental, social, and governance goals and standards of the company; and
- A system of checks and balances is put in place that ensures each stakeholder compensates society for his/her consumption. That is, each stakeholder receives a proportional share of the benefits relative to his/her contributions, both locally and globally.

Companies wishing to participate in this "stakeholder capitalism" must expand their horizons beyond income and expense accounts and achieve their particular "Universal Purpose of the Company within the Fourth Industrial Revolution." Next, we present a quotation from the book:

"A) The purpose of a company is to engage all its stakeholders in shared and sustained value creation.

B) A company is more than an economic unit generating wealth; it fulfills human and societal aspirations as part of the broader social system. Performance must be measured not only on the return to shareholders but also on how it achieves its environmental, social, and good governance objectives. Executive remuneration should reflect stakeholder responsibility.

C) A company with an international scope of activities not only serves all those directly engaged stakeholders but acts itself as a stakeholder—together with governments and civil society—of our global future." [48]

From the thus presented materials, it is evident how following The Great Reset Transformation Map, we will change our world to achieve "stakeholder capitalism" and will recover from the COVID-19 pandemic. Changing our world will be possible through the creation, development, dissemination, and implementation in the real industrial economy of a system of criteria for companies: firstly, criteria for environmental sustainability; secondly, criteria for socially responsible practices; and thirdly, criteria for optimized governance.

This concludes the presentation of the first possible road for the future development of global human capital. A road charted by the World Economic Forum, which is called "The Great Reset."

7.2. Critical analysis

Thus far, we have presented the road on which the World Economic Forum is guiding us. We should critically analyze this road to determine if there are reasonable grounds to believe that the negative trend in human capital development in the Western world will be reversed if we follow it. (Figure 7.2)

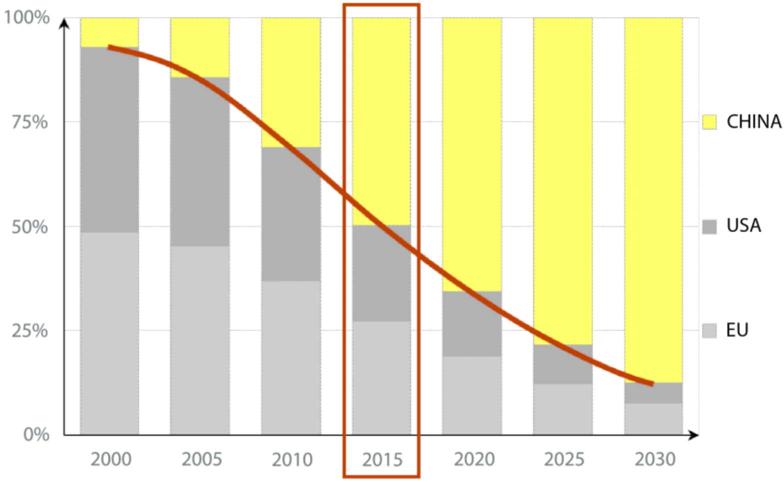

Figure 7.2 The trend of development of Western and Chinese technological elites

As we presented the Great Reset Transformation Map, we posed a question that we are keenly interested in: "*Does the Great Reset Transformation Map provide roads and paths that if the Western industrial sector follows at a brisk pace and with the intention to overtake the East Asian industrial sector, would lead to the reversal of the negative trend in the development of its technological elites compared to those of East Asia, especially those of South Korea and China?*"

It may not sound politically correct, but we (the authors of this book) perceive ourselves as an indivisible part of the Bulgarian people and, consequently, as an indivisible part of the nations of the Western world, both Europe and the USA. Therefore, in order for the political ideology of the Great Reset to be of high value to us (the people of the Western world), it must contain convincingly reasonable grounds for belief and hope that its realization can lead to a reversal of the cited negative trend.

It should not be overlooked and forgotten that the political ideology of a "knowledge economy," which was adopted indiscriminately and with considerable enthusiasm, is the leading cause of the negative trend in the development of the technological elites of the Western nations compared to those of East Asia, with China at the lead.

It also should not be overlooked and forgotten that the World Economic Forum has played a significant role in the blind and indiscriminate acceptance of the political ideology of a "Knowledge Economy" by the Western governing elites. The fact that the World Economic Forum remains silent about the evidence that modern economic science is at a medieval level of development represents a part of how this organization has enabled the development of the negative trend we have cited.

But as we already established, the "knowledge economy" political ideology has already lost practical relevance and has been replaced by "Industry 4.0". And most recently, in the middle of 2020, the new ideology of the "Great Reset" was introduced, and it is not yet entirely clear if it replaces "Industry 4.0" or simply complements it.

This frenetic transition between the different ideologies ("knowledge economy" - adopted for no more than 12 to 15 years; "Industry 4.0" - adopted for about four years; and "the Great Reset" - just introduced in 2020) is more characteristic of the changing fashion trends in the fashion industry than of serious political ideologies with great public value. Furthermore, this frequent change in direction by such highly influential institutions as the WEF brings extreme chaos to the national economies that have chosen the WEF as their economic guide and advisor.

This has not gone unnoticed by the public and the World Economic Forum employees themselves. Reading through their own analysis and opinions of their work at the WEF is quite interesting. A considerable part of employees (former and current) does not understand the frequent change in strategies and ideologies. Some of them even insinuate that these strategies are changed every six months, which they categorize as "excessive" One of these opinions (likely inspired by Ayn Rand's essay "The New Intellectual") caught our attention with its originality and has tempted us to present it briefly, even though it constitutes a deviation from the main topic.

In his opinion, this now former WEF employee compared the organization's scientific developments to Hans Christian Andersen's story "The Emperor's New Clothes." In order to understand why exactly this criticism of the destructive role of the World Economic Forum in the development of the Western economy has captivated our attention, we will summarize the fairy tale.

The story tells of an emperor who liked to impress his people with his modern dressing style. He hired weavers who promised to make him magical clothes, which would remain invisible to people who were unworthy or unfit for their position. So, the Emperor gave them a lot of money, and they began pretending to weave. The Emperor would send his courtiers to inspect the work of the weavers, and though none of them could see any clothes for fear of being labeled as unfit, each one reported that the clothes were beautiful. Finally, it was time for the Emperor himself to examine the clothes. Although he, like the others, could not see any clothing for fear of being unfit to be Emperor, he too said that the clothes were beautiful. And so, it came time to present the Emperor's new attire to the public. The Emperor stood before the gathered crowd buck naked, but since everyone knew about the clothes' supposed magical property, everyone pretended to see them. Finally, a small child shouted, "Look, look, the emperor is naked."

The tale contains four analogies to the current state of affairs.

The role of the child is played by the former employee of the World Economic Forum, who disclosed the naked truth that the WEF has a destructive effect on the development of the Western economy.

The role of the Emperor, who is so desperate to impress the people with his fashion sense, is played by the Western political elite, who are desperate to gain or retain power by pleasing the people of their nations with their ideas on how to manage the national economy.

The Emperor's new clothes are represented by the various strategies for management of the economy proposed by the World Economic Forum. Those who do not understand or disagree with them are either stupid or unfit for their positions.

And the role of the weavers is played by none other than the World Economic Forum itself.

And now an intriguing question presents itself: What do the weavers in this analogy (the World Economic Forum) gain in their coin purses for sewing the Emperor's new clothes?

For weaving clothes in the "knowledge economy" style, the annual sales revenue averages 200 million euros.

For weaving cloths in the "Industry 4.0" style, the annual sales revenue amounts to an average of 300 million euros.

And for weaving clothes in the "Great Reset" style, the annual sales revenue of 350 - 400 million euros seems little compared to the huge amount of work ahead on the roads and paths of the elaborately developed Transformation map.

These numbers are sourced from the official financial reports of the World Economic Forum over the years.

Naturally, there is also a huge amount of support for the political ideology of the Great Reset, but the vast majority of the opinions in support of this ideology originate in the Western world and are typical in nature because they originate in very similar starting points: A strong personal conviction that the way the economy of the Western world has been managed needs to be decisively changed and the unconditional faith in the capabilities of the World Economic Forum as the highest organ of authority that knows what needs to be done and how it needs to be done, can do it, and is ready to do it almost selflessly.

However, the detailed presentation of the political ideology of the Great Reset presents a conflict.

The criteria for the historical stages in the development of the economy according to the "Great Reset" are in intellectual disharmony with such criteria in the other three political ideologies, which we defined as "Marxism," "Knowledge economy," and "Industry 4.0".

In fact, the greatest disharmony in the criteria for the historical stages in the development of the economy is between the two political ideologies developed by the WEF: "Industry 4.0" and "The Great Reset."

We remind you that "*according to "Industry 4.0" there are five historical stages in the development of the economy and they are defined as revolutions. The first revolution was "agrarian," followed by four industrial revolutions. We are currently living in the "fourth industrial revolution," also known as "the second machine age," and most often called "Industry 4.0*".

According to the "Great Reset," "*there are two historical stages in the development of the economy: before and after COVID-19 and the transition from "shareholder capitalism" to "stakeholder capitalism*."

If the "Great Reset" had replaced "Industry 4.0", due to a failure to provide a cognitive understanding of the development of the economy through the historical stages, it would have saved a lot of mental exertion for all those who want to understand what exactly the World Economic Forum is teaching humanity.

But that's not the case. The Transformation Map for the Great Reset shows that the conflicting ideas about the historical development of the world economy embedded in the two respective ideologies must somehow be reconciled over time.

We will also remind you that one of the nodes on the Transformation Map for The Great Reset was called "Harnessing the Fourth Industrial Revolution."

As we have already mentioned several times, the "Fourth Industrial Revolution," also known as the "Second Machine Age" or "Industry 4.0", represents the fifth and, so far, the last known stage of the historical development of the phenomenon called economy. This stage began at the end of the 20^{th} and the beginning of the 21^{st} century. It also continues for an unknown period of time, as there are no specific criteria that will signify that the transition has been completed. Therefore, the "Fourth Industrial Revolution" is a process with a huge spatial and temporal scope. The Transformation map itself contains elements that represent very small parts of this process: Artificial Intelligence; the Fourth Industrial Revolution; Digital Economy and New Value Creation; etc.

Moreover, although "The Great Reset" is written in the center of the roadmap, WEF defines it as a process fragment that is a part of "Industry 4.0".

If these two ideologies, both proposed by the World Economic Forum, are examined carefully from a common-sense perspective and with a thorough understanding of the objective meaning of the concept of "economy," it turns out that the historical time of "Industry 4.0" contains and is divided by the time of "the Great Reset" in three parts:

The first period of time of "Industry 4.0" represents the time when the real industry is managed based on systems of old criteria for a company's responsibilities.

The third period of time of "Industry 4.0" represents the time when the real industry is managed based on systems of new criteria for a company's responsibilities.

Between the first and the third period of time of "Industry 4.0" is the time of "the Great Reset" - a time during which the aforementioned system of new criteria for a company's responsibilities is developed and implemented in the management of real industry.

Based on such an interpretation of the two ideologies, conducted carefully from a common-sense perspective and with a thorough understanding of the objective meaning of the concept of "economy," the logical structure of the first level of the Transformation Map of the Great Reset should, in our opinion, look like the schematic in Figure 7.3.

Figure 7.3. The logical structure of the Transformation Map of the Great Reset

In writing this book, we invested a lot of time and effort into the meaningful analysis of the two ideologies proposed by the World Economic Forum, an analysis we have attempted to present to you in the most abbreviated form possible.

As a result of these analyses, we have reached three conclusions:

The first conclusion is that the "Great Reset" should be seen as a complementary part of the content of the political ideology proposed in 2016 known as "Industry 4.0". Thus supplemented, it can be labeled as "Industry 4.0(+)".

The second conclusion is that the "Great Reset" is nothing more than the development and widespread dissemination of systems of new criteria for the standards companies must adhere to: firstly, environmental; secondly, social; and thirdly, governance responsibilities.

The third conclusion is that the political ideology of "Industry 4.0", or more specifically "Industry 4.0(+)", seems to replace the ideology of the "knowledge economy" that preceded it and that the practical implementation of "Industry 4.0(+)" should reverse the negative trend in the development of the technological elites of the US and the EU comparative to the development of their counterparts in China; a trend resulting from the political ideology of the "knowledge economy."

We would like to dwell on the second conclusion in more detail. The second conclusion is crucially important, because the only tangible, practical part of all the writings about changing our world and transitioning to a "stakeholder capitalism" is precisely the implementation of a new system of criteria for the political responsibilities of companies. Criteria that will be used to evaluate each company and which will be the basis upon which management bonuses will be calculated.

Perhaps some of the readers have noticed that the loud proclamation of the "Industry 4.0(+)" ideology, and more precisely of the "Great Reset," in fact, veils a process to take control of the world market of knowledge for managerial modeling of the industrial economy by a cartel led by the World Economic Forum. Its partners are "Bank of America" and "the big four accounting companies" - "Ernst&Young," "PricewaterhouseCoopers," "Deloitte" and "KPMG" with combined revenue of over $150 billion/year.

Under the auspices of the World Economic Forum, this cartel has already developed and thus has secured its leading position in the process of global implementation of a unified system of criteria, namely the "ESG" criteria (Environmental, Social, Governance Criteria) under the published paper "*Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation*" [49] By introducing the "unified" system of criteria, the "big four" financial consulting companies stand at the forefront of a large market, which is further popularized for them by the WEF via the "Great Reset." Thus, it is they, from their position of authority and responsibility as authors of the "unified system of criteria," who will lead the charge for realizing the process of the "Great Reset." And, of course, they will be generously rewarded for this effort. According to unofficial data, the total value of assets covered by these criteria is close to $30 trillion. This unofficial alliance of the big four financial consulting companies has, in our opinion, uncertain intentions regarding the future of the Western world (including the future of Bulgaria): it may have positive or negative effects on the future of the West.

For us, the main indicator for whether this unofficial alliance is having a positive or negative impact on the economy of the West is the direction of change of the current negative trend in the development of the engineering human capital in the Western world compared to that of China. What is the direction of the change in the trend of human capital development as a result of the introduction of the new system of criteria for environmental, social, and governance responsibilities of companies? Let us analyze the two potential possibilities: the new system of criteria has a positive effect on the trend of human capital development, or it has a negative effect.

First potential possibility:

Figure 7.4 (illustrated by the green line, which starts as a branch of the red line in 2020 and ends well above it in 2030) depicts ten years of restorative future development of the engineering human capital of the Western world relative to that of China.

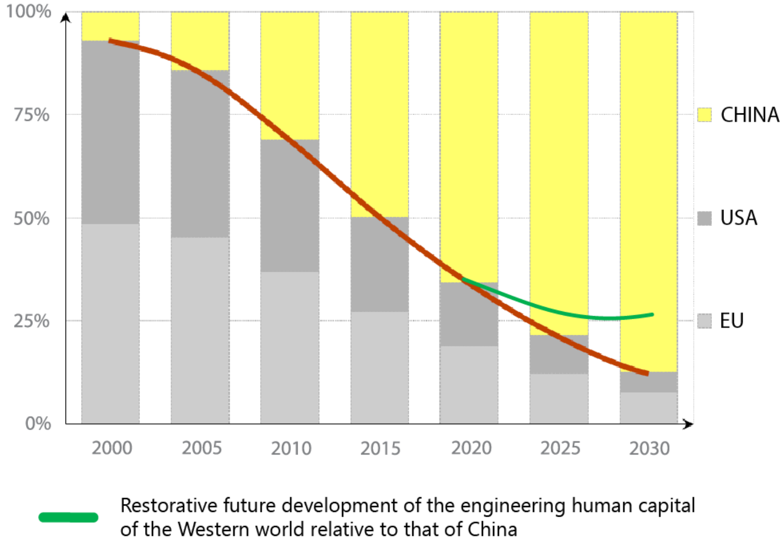

Figure 7.4

The main credit for this restorative development would be attributed to those members of the "Great Reset" cartel headed by the World Economic Forum, who would have managed to develop new fundamental knowledge of economy of a higher quality. Based on this new knowledge, they would be able to develop short and understandable systems of criteria for environmental, social, and governance responsibility of companies. These criteria would then act as the carriers and distributors of this new quality of fundamental scientific knowledge of economy through their implementation in the industrial practice.

A key indicator of whether the members of this cartel are bearers of the necessary knowledge would be their ability to give practical, clear, and understandable explanations using plain, everyday language of two things: the first necessary explanation describes the principle setup and way of functioning of the enterprise for machines as a systemic object, and the second – principle setup and way of functioning of the enterprise for machines as a systemic subject.

Second potential possibility:

Figure 7.5 (illustrated by the black line, which starts as a branch of the red line in 2020 and ends well below it in 2030) depicts ten years of the development of the Western world's engineering human capital falling even further behind the development of the engineering human capital of China.

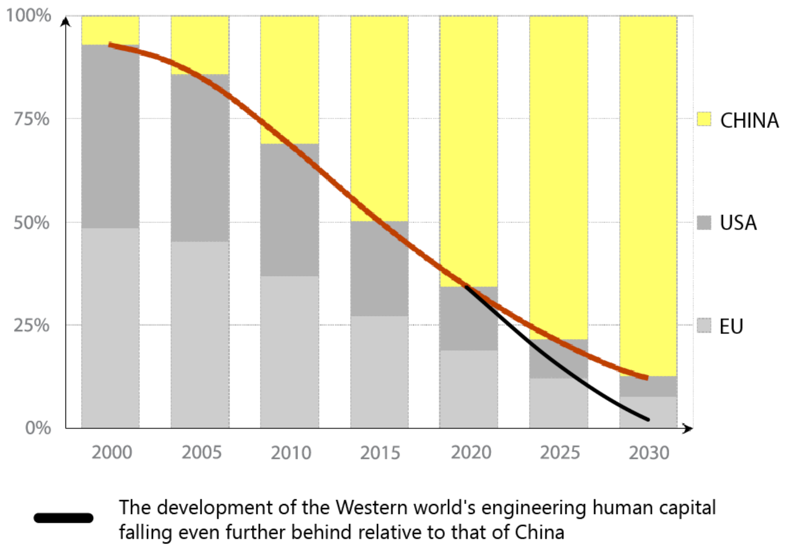

Figure 7.5

The main blame for this deleterious trend would be attributed to those members of the "Great Reset" cartel headed by the World Economic Forum, who would have continued to demonstrate total ignorance of the fact that economic science is at a medieval level of development and disregard for the need to form a new fundamental scientific knowledge of a higher quality. Despite the deficit of such a fundamental knowledge of economy, they would have introduced extensive and incomprehensible systems of criteria for environmental, social, and governance responsibility of companies. These criteria would then act as carriers and distributors of management chaos and confusion through their implementation in the industrial practice.

We are fully aware that for any individual who is not directly involved in industrial management and economics, any outsider in this field, the second potential possibility seems unrealistic. It would be extremely difficult for such a person to imagine that the most respected professionals in the field of economics suffer from significant cognitive lapses in in their knowledge of fundamental knowledge of economy. To such a person, this assumption would sound just as absurd as the assumption that the most respected medical professionals have no systemic knowledge of the anatomy and physiology of the human body.

But for us, it is hard to imagine the exact opposite. It is difficult for us to imagine that the individuals taking up key posts in the "big four financial consulting companies" have managed to fill their knowledge gap regarding principle setup and way of functioning of the enterprise as a systemic object and systemic subject. According to the results of direct, paid surveys conducted by IDEUM Base in 2012, the representatives of the big four ("PWC," "Deloitte," and "KPMG") had an absolute lack of knowledge in that regard. Further studies that we conducted at the beginning of 2020 also support the results of IDEUM Base from 2012; however, we consider them to be indirect evidence, as they were not the result of a series of direct, paid surveys with the representatives of the "big four."

However, since the direct studies were conducted more than eight years ago, and our own studies were indirect evidence, then faith and hope remain that during that more-than-8-year time period, the leading experts of the "big four" (as one with the World Economic Forum) have invested time and effort to fill their knowledge gap in terms of the fundamental knowledge of economy.

But does this cartel actually take into account the negative trend in the development of the human capital of the Western world at all, or does it rather want to gain the maximum benefit (in purely financial terms) of the Western world's difficulty in managing the COVID 19 pandemic, and thereby even intensify the cited negative trend?

In order to answer this question, there is no place for "potential possibilities, faith, and hope," which are not even supported by tangible evidence from the current state of affairs.

In considering the two potential possibilities of the intentions and actions of the unofficial alliance of the "Great Reset" cartel regarding the negative trend in the development of the engineering capital of the Western world compared to that of China, two important factual circumstances should be noted and their inevitable consequences.

The first factual circumstance is that the World Economic Forum remains entirely silent about the second factual circumstance – namely the fact that modern economics knowledge is at a medieval level of development. But that's not the most concerning fact. The most concerning fact is that the Western governing elites (compared to the East Asian governing elites) are fully trusting of the community of scholastic economists and apply this knowledge to the strategic management of the real economy uncritically and indiscriminately. This blind faith on the part of the political elites leads to harmful effects for the Western world in the development of its competitive technological ability compared to that of the East Asian world. The leaders of the Western world, which WEF undoubtedly is a part of, have made a decision and are implementing said decision (consciously or unconsciously) to greatly diminish the development of their engineering human capital (in comparison to East Asian countries), as a direct consequence of the "knowledge economy" political ideology.

This unpleasant fact can have only one possible explanation. The quality of the multitude of "economic leaders" within our Western societal system, represented by the WEF and the community of Western economics scholastics, who are directly and indirectly responsible for the development of the engineering human capital of our (Western) world through their advice, guidance, and direct actions, is at a much lower level than the quality of their counterparts in East Asian countries. If we look carefully at the first bar of the graph in Figure 7.5, we will come to two more conclusions in this regard.

The first conclusion is that even at the very beginning of the 21st century, the quality of the multitude of "economic leaders" of our societal system had already deteriorated because otherwise, the "sinister," in our opinion, negative trend in the development of the engineering human capital of the Western world would have never started.

The second conclusion is that up until almost the end of the 20th century, the quality of the multitude of "economic leaders" of our societal system was higher than that of the East Asian economic leaders because if it were not so, the first bar of the graph would not show such a significant dominance of the West over the East. The first bar of the graph is a visual representation that at the beginning of the 21st century, the machine engineering human capital of the West totally surpassed that of East Asia. It surpassed it with as much as East Asia's engineering human capital will surpass the West's engineering human capital by the end of the third decade of this century, which is only ten years from now.

If we think more carefully about these two conclusions, it turns out that during the "first machine age," during which the first three industrial revolutions took place and which spanned from the beginning of the 19th century to the end of the 20th century, the quality of the multitude of "economic leaders" of the Western societal system (which up until the mid-70s did not pay much attention to the achievements of economic science), was of wholly superior in terms of quality to the respective multitude of leaders of East Asian countries.

However, in Figure 7.5, it is evident that something has changed radically in the last three to four decades, and today, it is not superior. Today, it is the exact opposite.

All of the information presented thus far directs our thoughts to a very important question: What has happened in the last three to four decades that has led to such drastic degradation of the ruling elites of the Western world as compared to the ruling elites of the East Asian world?

We believe that the above question is most accurately and most comprehensively answered by a combination of two words that are not typically used in everyday language – the words "quasi-rational indoctrination."

If we use the definition of the concept of "indoctrination" provided by Princeton University's Laboratory called "WorldNet 2.0" as a basis for the definition of the above word combination, then "quasi-rational indoctrination" represents "a process of uncritical acceptance of a quasi-rational approach created and proclaimed by professional authorities (more "teaching," "theory") to solve a socially significant task" [50]. A "quasi-rational" approach, on the other hand," is an approach that appears to be rational in nature, but upon closer inspection and analysis is determined that it is not.

In this line of thought, a definition sourced from "The Henry Wise Wood High School" website sparked a particular interest. There, the concept of "indoctrination" is only considered as a harmful process. That is, according to this definition, all indoctrination is "quasi-rational indoctrination."

The definition reads: "indoctrination is the systematic study and imposition of controversial (in terms of validity) ideas." [51]

"Quasi-rational indoctrination" is well expressed with two illustrative examples.

Let us begin with the first illustrative example.

One of the most widespread doctrines of modern economic science is the "division of labor" as a natural and most important approach for implementing effective economic activity in each of its three dimensions: household, industrial, and geopolitical.

An analysis using many simple but common work situations demonstrates that this idea lacks real-life validity and applicability.

Let us take, for example, the transfer of a work desk from one floor to another. This is a job for two people; one is not enough, and three are too many, as they will get in each other's way.

Any rational person who has participated in this work situation, or at least observed it, would say that the two individuals are working in unity, i.e., "unity of labor."

The analysis of this and countless other work situations give rational grounds to reformulate the above-mentioned doctrinal idea in general terms but much more accurately in relation to reality by phrasing it as such: *"the unity of labor – of people with different natural talents, and then culturally and educationally nurtured abilities – appears to be a natural and most important approach for the implementation of effective economic activity in each of its three dimensions: household, industrial, and geopolitical."*

The fact that the second definition, which is obviously valid, is tendentiously disregarded in favor of the first definition, which is obviously invalid, within the Western educational system is aptly expressed through the words "quasi-rational indoctrination."

Another telling example of "quasi-rational indoctrination" is the mass study, without any prior critical analysis, of the "business model canvas," which we presented in Chapter 4. Anyone who might conduct critical analysis, as we did in Chapter 4, will determine a total conceptual incompatibility between the task and the proposed solution in this model. This conceptual incompatibility between a set scientific task and a proposed scientific solution without any critical analysis of the matter gives us reason to define the study of the "business model canvas" as an example of "quasi-rational indoctrination."

Naturally, a critical question arises: "Who is the source of the mass quasi-rational indoctrination of Western societies and, most importantly, of the quasi-rational indoctrination of the ruling and governing elites of Western nations?"

The answer to this question is relatively simple.

The source of mass quasi-rational indoctrination of Western societies and, most importantly, of the ruling and governing elites of the Western nations is the multitude of institutions that contrive and sell the faulty fundamental knowledge of economics. Within this multitude, a special place is occupied by the World Economic Forum and the informal alliance of the "Great Reset" cartel since their role is particularly destructive. In no other field of industrial economy is the assimilation of products without any critical analysis acceptable or possible as it is in the field of managerial modeling of the industrial economy. For comparison, if products of this quality were assimilated into the engineering industry, we – as in mankind – would still be in the "Middle Ages."

Leaving the outlier exceptions aside, the effect of quasi-rational indoctrination through the production and sale of faulty fundamental knowledge of economy upon society has two main manifestations: (1) a sharp decline in critical thinking abilities of individual members of society, and thus (2) an even greater decline of an individual's ability to engage in highly effective creative thinking and constructive action in the three dimensions of the economy.

So, what are the above-mentioned outlier exceptions?

The outlier exceptions should be considered from a national perspective. They represent the multitude of people in a country gifted with a rare combination of natural intelligence and creative will, by God, Fate, or Chance, to become leaders and the driving force behind the real economy. This rare combination of talents and abilities allows them to sift (more intuitively rather than purposefully) the "conceptual grain" from the "conceptual chaff" produced and sold by a growing number of professional scientific "economics scholastics." Scholastics, unlike the outliers, enjoy the special attention and patronage of the governments of the Western world. It is rather expected that this status quo would cause the multitudes of scholastics to grow, and at their expense, the multitudes of outliers, which are the true driving forces in the development of the economy, to diminish.

But these multitudes of professional scientific "economics scholastics" only enjoy the special attention and patronage of the Western governments. In contrast, as we have already noted, professional "economics scholastics" are not highly regarded by the East Asian governments. Faithful to the most important worldview foundations of their cultural tradition, the nations of the East Asian world are creating multimillion-dollar armies of engineers. As we have already mentioned, South Korea and China lead the world in the number of annual engineering graduates per million people of the population.

In contrast, the nations of the Western world (moving ever further away from the leading worldview foundation of their cultural tradition, Christianity) are creating multi-million armies of professional "economics scholastics." Scholastics among whom, paradoxically enough, there is not a single one who could draw a diagram of the principle setup and way of functioning of the enterprise for machines, and based on this diagram give clear and understandable answers to the questions: "What is a good or service?"; "What is profit or loss?"; "What is economy of the enterprise?"

This absurd professional inadequacy of our modern "economics scholastics" is the cause of a continual and drastic decline in the quality of the multitude of "economic leaders" in our Western societal system compared to the quality of the respective "economic leaders" of the East Asian societal system. This, in turn, is driving the Western world towards total ineptitude of the human capital to maintain and develop competitive economic activity in the age of digital technology and machines. Reaching such total ineptitude is not something that will happen in the distant future but rather in the next ten to fifteen years. Unless, of course, this process does not lead to a destructive Apocalypse first.

The inevitable consequences of all these factual circumstances are the crisis in the development of the human capital of the Western world, as well as the inability of the Western world to deal with the COVID-19 pandemic. There is also a third inevitable consequence of the factual circumstances we have referred to. The third inevitable consequence is that these circumstances act as a kind of guarantee that a "Great Reset" will occur; however, this great reset will be the continued decline in the development of the engineering human capital of the Western world leading to the complete superiority of the engineering human capital of China in the global economy. And this, for us, as people of the Western world, is unacceptable.

The only viable possibility of neutralizing the anticipated influence of the "Great Reset" as an amplifier of the negative trend in the development of the engineering human capital of the Western world relative to that of China, which is so alarming to us, consists of the immediate launch and unwavering implementation of the Digital Transformation of Economic Science.

7.3. The second possible road for future development of the global human capital

After all the information presented thus far, any unbiased reader has concluded that the road that today's "economic leaders" of the Western world are leading us on is veiled in beautiful words. However, realistically, there is no reason to believe and hope that it will lead our nations through the human capital crisis that the Western world is facing compared to China. On the contrary. It seems that we have every reason to believe that this road will intensify this negative trend and will thus bring the Western world even closer to a fatal end.

And yet, this is not the first time in history that Western civilization has been brought to the brink of disaster. Thus far, Western civilization has somehow always been able to "come back from the dead" and has even managed to reclaim its position as the world leader each and every time. Thus far, there has always been a light at the end of the tunnel that has helped Western civilization step off the road to catastrophe and back onto the road of prosperity.

We, the authors of this book, are engineering graduates pursuing careers as professional engineers. Technically speaking, we are no different from many of our colleagues, some of whom certainly have superior knowledge and experience in many technical fields. What distinguishes us is that we are among the few who have had the opportunity to study the new knowledge of a higher quality and have had the chance to realize its importance. Knowledge that by design is as superior to the existing knowledge of managerial modeling of the industrial economy as the knowledge of the anatomical and physiological model of the human body was superior to the "medieval" understanding of the human body. This knowledge is the holistic business model ontology of the economy of an enterprise for machines, the work of "IDEUM Base." Why do we make this claim with such confidence? Throughout our work experience in the engineering industry, we have had the opportunity to apply this knowledge in engineering (designing) and establishing new enterprises and re-engineering existing ones. Having completed these practical experiments successfully, we asked ourselves, "Is this knowledge truly so unique, or is this type of task not really something that extraordinary if even mid-level engineers like ourselves can manage it?" However, after hundreds and perhaps thousands of man-hours spent analyzing the existing knowledge of managerial modeling of the economy of the enterprise for machines, and even undertaking formal education at the Bulgarian economic universities, we are greatly shocked and at the same time outraged by the mass study and application of scientific knowledge (accepted without any critical analysis) which for the most part is absolutely impossible to apply in practice. We have even reached confusing situations of being told how a business model works successfully because it is built on the basis of another company's "best practices," but with the clarification that no attempts should be made to replicate these same "best practices" because they are strictly unique and particular for the said company, and that there is no guarantee that what has worked for one company will work for another. What is even more disturbing is that the mass dissemination of such untenable theories reaches even children in the 2nd grade.

Subsequently, hundreds of thousands of young people in the Western world enroll to study economic specialties in universities, believing that after five years of diligent study, they will have the skills and knowledge to be active participants in the process of increasing the economic prosperity of their countries. However, the hundreds of thousands of young people from societies in a demographic crisis who, after those five years of study, acquire skills and knowledge of managerial modeling of the industrial economy that is equal to - or in most cases even worse than - their "intuitive" skills from before they enrolled in the university program.

It is outrageous because the authorities of the community of "economics scholastics" who spread and impose this knowledge cannot even give a decent explanation of the objective meaning of the concept "economy." Furthermore, when these "economics scholastics" are asked the question, "*What is the principle setup and way of functioning of an enterprise as a systemic object and subject*?" the answer is always a lecture of at least 30 minutes, which inevitably concludes with the fact that "*it is impossible to provide an unequivocal answer to this question*."

Meanwhile, in Bulgaria – a small country by today's economic indicators but a country that has contributed a lot to Western civilization throughout history – exists a unique type of knowledge developed by an inconspicuous technology park named "IDEUM Base." This unique knowledge provides the means for all kinds of enterprises for machines to be successfully managed, and most importantly, the study of this knowledge has real, applied value for anyone who has invested the necessary time and effort for acquiring it.

Thus, we arrive at the present-day state of affairs, when we are able to successfully define a problem - common for the past, abnormal for the present 21st century, and devastating for our future and the future of our descendants – that even the World Economic Forum cannot or will not define. Namely, that economic science is at a medieval level of development compared to the level of development of medical science.

However, we are confident that this knowledge can, and should, transition to a systemic level of development. We are confident that now, more than ever before, this transition is possible because we possess the legacy of the Bulgarian technology park IDEUM Base - the new fundamental scientific knowledge of economy of a higher quality. Furthermore, since *knowledge is power and freedom*, it is up to all of us to secure a better future for ourselves and our descendants.

We define ourselves as patriotic Bulgarians and engineers. As such, we consider ourselves a part of the Western world and thus heirs of the knowledge bestowed by the great engineering minds who have come before us and made it possible for the engineering industry to be what it is today.

We refuse to accept the dark days looming ahead for our world, especially since we know we have a solution to the problem. We are obligated to do our utmost for the world we live in and the world we will bequeath to our children.

For this reason, in 2019, we established the Foundation "Information Technologies and the Future of Economic Science," which is purposed to be the organizational hub for a possible change of the future of our civilization. We also built a strategy for creating and developing a global discussion forum, the primary purpose of which is to spread our message in the form of a defined *problem,* its *source*, and its potential *solution*.

Furthermore, the forum will become an environment of partnership and cooperation with the political, business, scientific, and media elites who want to restore the Western world to its formative foundations. A journey along a road, following the engineering approach, that we have mapped out in detail and which we want to offer to all people of the Western world. A road, that we called the "Digital Transformation of Economic Science."

"Digital Transformation of Economic Science" is a new concept coined by us, the authors of this book, which means the process of creation, development, widespread dissemination, and mass study, both in theory and in practice, of the programmed functional constructs of a new class of digital technologies for managerial modeling of the economy of the enterprise for machines, thus forming among the society a new knowledge of a higher quality about the management of the economy of enterprises and corporations for machines; a knowledge that is much more valid and applicable for real industrial management than the knowledge formed as a result of five years of undergraduate study in the world's most prestigious universities. The idea of the "Digital Transformation of Economic Science" stems from the six disregarded evident facts that we presented in detail and the one little-known fact of the remarkable discoveries and achievements of the IDEUM Base technology park. The "Digital Transformation of Economic Science" is not a political ideology. It can be defined as an engineering enlightenment because, essentially, it represents the Fourth engineering wave in the development of the fundamental scientific knowledge of economy. Such a wave is a natural and crucial progression of the current state of the historical development of the global economy and represents the essence of the defined by the chairman of the World Economic Forum "Fourth Industrial Revolution." In this sense, the "Fourth engineering wave" in the development of the fundamental scientific knowledge of economy is historically inevitable.

In other words, in the time of the Fourth Industrial Revolution, which is characterized by information technology, the natural human intelligence is faced with the challenge of advancing the fundamental scientific knowledge of economy from a medieval to a modern level of development. The same level of development that the human intelligence achieved for the fundamental scientific knowledge of medicine way back when we invented and developed the process of book printing. The "Fourth engineering wave" in the development of the fundamental scientific knowledge of economy will bring the people of the world and the elites of their societies to a new qualitative level of economic enlightenment. An enlightenment that is based on the scientific understanding of the objective meaning of the concept of "economy," and on the knowledge of the universal principle setup of every enterprise for machines in its capacity as a systemic object and subject.

The Digital Transformation of Economic Science will finalize the work of the American engineers Henry Towne and Frederick Taylor, and at the same time, it will also set a new beginning for the Western industrial economy marked by the emergence of a new generation of mechanical engineers called "*Systemic Economic Engineers*." Why are we focusing on the creation of a new class of engineers and not on the creation of a new class of economists?

Historically, it is precisely the engineering industry that has played the most significant role in the transformation of the Western world into a global leader. This industry, in turn, was built up through the efforts of a huge number of engineers, but not only in the process of manufacturing products. It is indeed the engineers who have contributed the most to the systemization of the knowledge necessary for the practical management of the industrial enterprise through the three engineering waves in the development of the fundamental scientific knowledge of economy. The nearly 100 years of efforts towards this cause must be crowned with a final – fourth – engineering wave, which must be specifically designed to upgrade the skills and knowledge of the practicing engineers – the true driving force behind the engineering industry. The establishment of a new, unified theory and terminology of a higher quality will lead to the development of a unified cognitive understanding of the ontological model of the economy of the enterprise for machines. This unified cognitive understanding among engineers on a global level will lead to large-scale cooperation and, thus, economic growth of the countries that have chosen to join this movement.

As a real-life process, the Digital Transformation of Economic Science (DRES) also entails establishing and maintaining a "*World Network for Systemic Economic Engineering*." In essence, this is an educational and scientific research system that develops, disseminates, and provides to the end-user a new, better-quality knowledge for managerial modeling of the economy of the enterprise for machines, which is expressed as a unified theory and terminology in the form of holistic business model ontology and holistic ERP technology.

A key part of this new, better-quality knowledge is precisely the knowledge for development, evaluation, and certification of holistic products in the areas of business software, business consulting, business auditing, industrial engineering, and industrial re-engineering. This is a key part of the new knowledge because inevitably, there will be a surge of products marketed as bearers of the new ontological model of the enterprise for machines, and thus there must be an established method for certifying such claims. A practice that does not currently exist in modern economic science.

The implementation of the "Digital Transformation of Economic Science" consists of the establishment of a comprehensive system that unites the real industry with the educational and research systems in one "well-oiled" mechanism. The goal of this mechanism will be the mass distribution of the new, better-quality knowledge for managerial modeling of the economy of the enterprise for machines both among practicing professionals and among those who are yet to enter the labor market – the students. Furthermore, this system must be subject to constant quality control so that blind acceptance of flawed theories is no longer possible.

And now, we will present our vision (as a visualization of the overall plan) for the functional construct of the "*World Network for Systemic Economic Engineering*" by the end of 2032 (Figure 7.6). In designing the vision for this system, we followed the well established engineering approach. Because of this, our design of the vision is not represented as a semantic web but rather as three gears working in tandem within a system.

When examined as a working system, the functional construct of the World Network for Systemic Economic Engineering consists of two subsystems: (1) an implementing subsystem and (2) an initiating subsystem.

The initiating subsystem consists of two mechanisms: (1) a primary initiating mechanism and (2) a secondary initiating mechanism. These mechanisms, part of the initiating subsystem, work towards the successful formation of the implementing subsystem and hence towards the World Network for Systemic Economic Engineering reaching an operational state.

We will introduce each part of the World Network for Systemic Economic Engineering in turn, starting from the implementing subsystem, as the final objective, and continuing back towards the initiating subsystem. The initiating subsystem consists of a primary initiating mechanism and secondary initiating mechanism, purposed for the successful formation of the implementing subsystem.

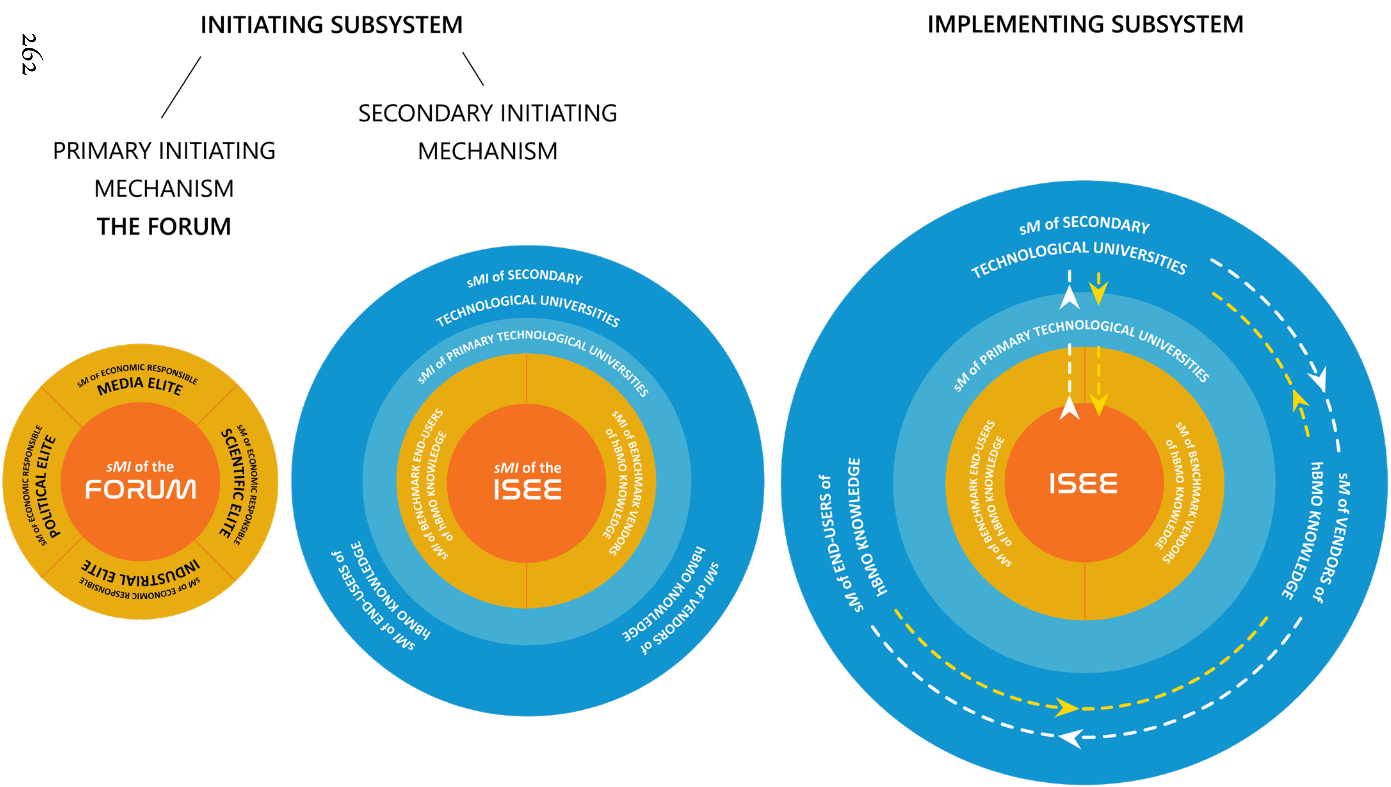

Figure 7.6 World Network for Systemic Economic Engineering

7.3.1. Implementing subsystem of the World Network for "Systemic Economic Engineering"

For the purpose of describing the implementing subsystem of the World Network for Systemic Economic Engineering WNSEE (Figure 7.7), we have borrowed terminology that describes the internal structure of the Earth. Considering this internal structure, the implementing subsystem of WNSEE consists of:

(1) inner core, (2) outer core, (3) primary working mantle, and (4) secondary working mantle.

The internal parts of the implementing subsystem are as follows:

(1) **Inner core**: *consisting of ISEE – Institute for systemic economic engineering.*

(2) **Outer core**, *consisting of:*

(2.1) Benchmark Vendors,

(2.2) Benchmark End-Users.

(3) **Primary working mantle**, *consisting of Primary technological universities.*

(4) **Secondary working mantle**, *consisting of:*

(4.1) Secondary technological universities,

(4.2) Vendors,

(4.3) End-Users.

Each of the four internal parts (Inner core, Outer core, Primary working mantle and Secondary working mantle) of the implementing subsystem of WNSEE is formed by a multitude of artificial systemic subjects - economic units. Subsequently, each artificial subject (economic unit) is formed by a multitude of systematically organized natural subjects – people.

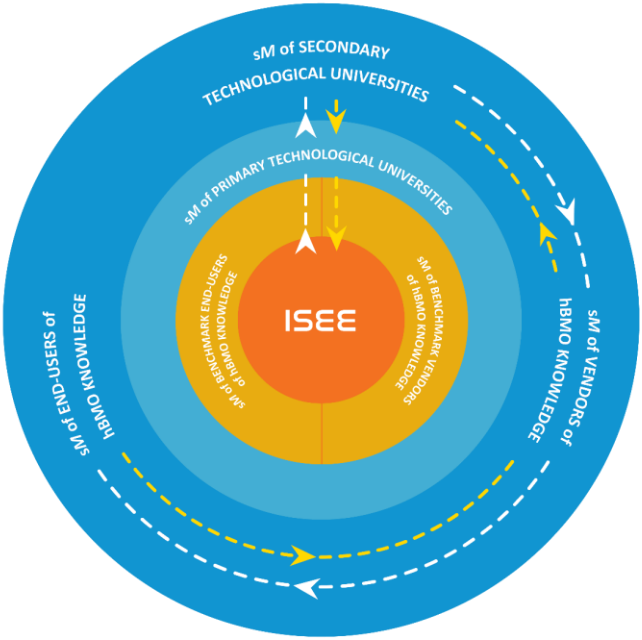

Figure 7.7. Implementing subsystem of the World Network

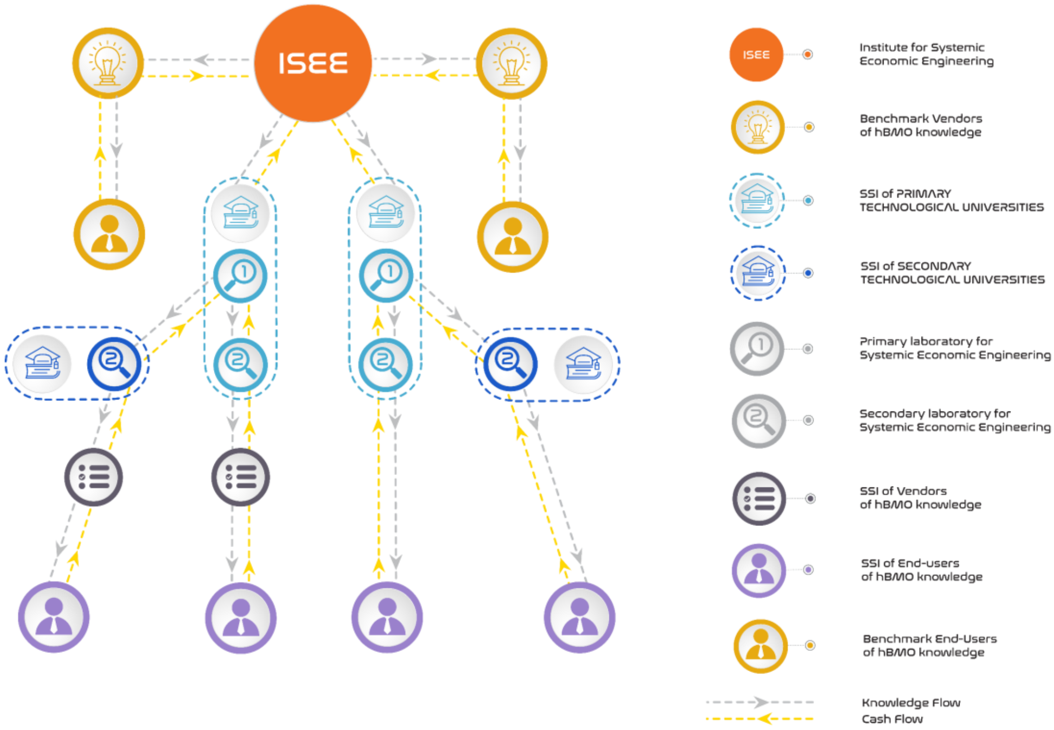

Figure 7.8. The inter-relationship between the distinct working elements of the subsystem of the World Network

The inner core of the implementing subsystem of WNSEE is a specialized enterprise called *Institute for Systemic Economic Engineering* (ISEE). This Institute will be the leading scientific research facility for creating and developing the new, better-quality fundamental scientific knowledge of economy – holistic business model ontology – and based on it developing prototype technology in the form of holistic ERP system. All research and developments of this Institute should be experimentally tested and verified in practice before proceeding to mass dissemination.

The technology park that has achieved the most remarkable success in creating and developing engineering knowledge for holistic business model ontology –in the form of theory, terminology and prototype technology – holistic ERP system – should play the part of this inner core institute. Although we currently have no data of any other organization having developed such knowledge, the achievements of the Bulgarian institute IDEUM Base is sufficiently indicative that such knowledge can be created and then advanced. Moreover, with sufficient interest and involvement of the Bulgarian and Western influential elites, the core of IDEUM Base can be transformed into an institute. For this reason, in 2021, we, Foundation ITFES, initiated the beginning of this process by transforming the core of IDEUM Base by officially renaming it to the "Institute for Systemic Economic Engineering" while forming a team that will actively work towards achieving the Institute's purpose. In this way, we have created the foundation that, in the case of interest on behalf of the aforementioned influential elites, can be developed into the full-fledged inner core of the implementing subsystem.

The outer core of the implementing subsystem of WNSEE will be working closely with ISEE to assimilate all new developments of the holistic business model ontology knowledge so that they can be tested in practice and receive the status of "practically applicable." The Outer core consists of two systemic sets: (1) systemic set of Benchmark End-Users of holistic business model ontology (hBMO) knowledge and (2) system set of Benchmark Vendors of hBMO knowledge. Vendors are pilot business software and business consulting companies. Users are the multitude of enterprises for machines, which are benchmarks for effective management of the development of their innovation potential based on the new quality knowledge and technology.

The establishment of a R&D testing system, comprising of the Institute for Systemic Economic Engineering, as a site for development of new knowledge of higher quality, along with the two types of benchmark enterprises, as sites for experimental research, would form the much-needed laboratory system for applied testing of all of the new developments of the Institute for Systemic Economic Engineering. Such a laboratory system would serve as a site where the numerous research scientists and educators would be able to stay in touch with the experimental environment in which holistic ERP systems are tested and implemented.

The primary working mantle of the implementing subsystem of WNSEE consists of a set of Primary Technological Universities that disseminate the hBMO knowledge. These are some of the most influential Technical Universities in the world that will be responsible for disseminating the hBMO knowledge among their students and people working in business as well as among other Technical Universities.

The Primary Technological University represents a technical university that by working in close cooperation with ISEE has established and develops a new faculty of management of a higher quality. This new type of Faculty of Management is called "*primary faculty for systemic economic engineering*." The most important part of the "primary faculty of systemic economic engineering" would be its two-component laboratory system for systemic economic engineering, consisting of: (1) a *primary laboratory* for systemic economic engineering and (2) a *secondary laboratory* for systemic economic engineering.

The primary laboratory for systemic economic engineering would have a simpler task: to work in inextricable cooperation with the inner core of the implementing subsystem (the ISEE) by establishing, advancing, and evaluating secondary laboratories for systemic economic engineering – first the one within its own university, and then the laboratories of other universities. The ISEE would lead the establishment of the primary laboratory for systemic economic engineering and later act as the advisor for and evaluator of its ongoing development.

The secondary laboratory for systemic economic engineering would have a more multifaceted task: (1) to establish and develop departments for systemic economic engineering education and (2) to advance and evaluate the multitude of companies that would distribute hBMO knowledge in the form of (2.1) holistic business software, (2.2) holistic business consulting, (2.3) holistic business auditing, and (2.4) holistic engineering and re-engineering, as well as a multitude of educational institutions in the form of: (2.5) universities, (2.6) schools and (2.7) academies for holistic managerial modeling of the industrial economy.

The Primary Technological University would lead the formation of the secondary working mantle of the implementing subsystem of the World Network for Systemic Economic Engineering.

The secondary working mantle of the implementing subsystem of WNSEE realizes mass dissemination of hBMO knowledge by creating a leading core of people – systemic economic engineers, who are the basis for the Digital Transformation of Economic Science.

The secondary working mantle consists of three systemic sets: (1) systemic set of Secondary Technological Universities, (2) systemic set of vendors of hBMO knowledge, and (3) systemic set of end-users of hBMO knowledge.

The systemic set of Secondary Technological Universities would be established upon a foundation of technical universities, where a new type of faculty of management would be established and advanced. This new type of Faculty of Management is the "*secondary faculty for systemic economic engineering.*"

The leading core of the secondary faculty for Systemic Economic Engineering is its "*secondary laboratory for Systemic Economic Engineering*".

The laboratory for systemic economic engineering of each Secondary Technological Universities would be established and developed under the direct supervision of a primary laboratory for systemic economic engineering of a selected Primary Technological University. This Primary Technological University would act as an advisor and evaluator of the ongoing development of the Secondary Technological Universities and, more specifically, of the activity and development of its secondary laboratory for systemic economic engineering. The Secondary Technological Universities, in turn, would fund its advisor and evaluator by providing it with a percentage of its income.

The systemic set of vendors of hBMO knowledge would consist of new business entities or transformed business entities that once distributed scholastic knowledge but have undergone a qualitative transition and begin to distribute hBMO knowledge for managerial modeling of the economic development of the enterprise for machines and other industrial enterprises. Knowledge incorporated in (1) business software, (2) business consulting, (3) business audits, (4) re-engineering, and (5) engineering. This knowledge would also be incorporated within the textbooks and curricula of (6) Tertiary Technological Universities, (7) independent universities, (8) secondary schools, and (9) specialized academies for training and retraining of management personnel.

The qualitative transition of the targeted products from carriers of scholastic knowledge to carriers of holistic knowledge and their subsequent development would be accomplished with the help of and under the control of a secondary laboratory for systemic economic engineering of a selected

Secondary Technological University. This laboratory would act as an advisor and evaluator of the ongoing development of the Subject – vendor of hBMO knowledge.

The systemic set of vendors of hBMO knowledge are an essential prerequisite for the establishment and development of the systemic set of end-users of hBMO knowledge.

The systemic set of end-users of hBMO knowledge would form the third and final component of the secondary mantle of the implementing subsystem of the World Network for Systemic Economic Engineering.

The systemic set would be established upon the foundation of pre-existing and newly established industrial enterprises that have begun to use new quality knowledge for managerial modeling of their economic development. As a result, the aggregate industrial efficiency – evaluated first and foremost in terms of "purpose" and then in terms of "productivity," "efficiency," "quality," and "timeliness" – of these enterprises would be much higher than the industrial efficiency of these same enterprises if they continued to use the current scholastic knowledge of managerial modeling of their economy.

7.3.2. Initiating subsystem of the World Network for Systemic Economic Engineering

As we have already stated, the functional construction of the World Network for Systemic Economic Engineering would consist of two subsystems: (1) the implementing subsystem, which we examined as a way of operation and potential for development towards the end of 2032, and (2) the initiating subsystem, which we will examine from the same point of view. The initiating subsystem consists of two mechanisms: (1) a primary initiating mechanism and (2) a secondary initiating mechanism (Figure 7.9). These mechanisms, part of the initiating subsystem, work towards the successful formation of the implementing subsystem and hence toward the World Network for Systemic Economic Engineering reaching an operational state.

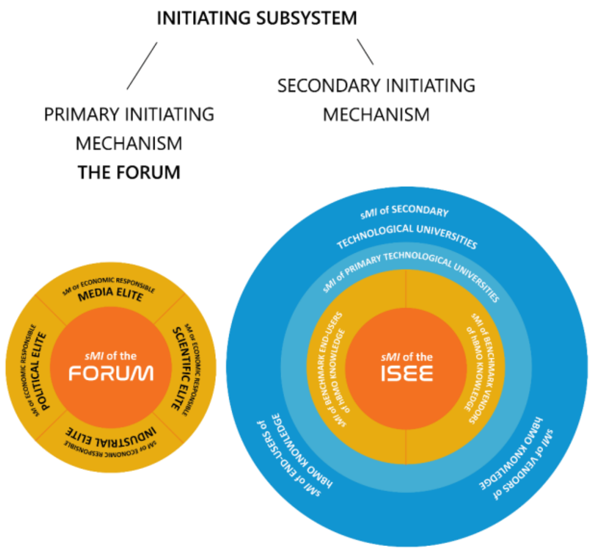

Figure 7.9 The Initiating subsystem of the network

The structure of the secondary initiating mechanism, purposed for the formation of the implementing subsystem, mirrors the structure of the implementing subsystem and also consists of an inner core, outer core, primary mantle, and secondary mantle.

The inner core of the secondary initiating mechanism consists of a systemic set of initiators (SSI) representing the individual people and organizations who would be the sources of knowledge, willpower, and financial means for the creation, development, and effective functioning of the Institute for Systemic Economic Engineering. These would be the many investors, owners, and employees of the Institute.

The outer core of the secondary initiating mechanism consists of two systemic sets of initiators (SSI). They ensure the strategic development of the two types of benchmark enterprises of the implementing subsystem: (1) benchmark vendors, and (2) benchmark end-users of hBMO knowledge for managerial modeling of the industrial economy. These would be the potential owners of the enterprises that make up the Outer Core of the implementing subsystem.

The primary mantle of the secondary initiating mechanism consists of the systemic set of initiators (SSI) that ensures the creation and strategic development of the systemic set of Primary Technological Universities. These are the universities that make up the primary mantle of the implementing subsystem. In general terms, these would be the people who would be responsible for the management of a given Primary Technological University (which includes, but is not limited to, the rectorate, the representatives of the state administration, the representatives of the private sector, etc.)

The secondary mantle of the secondary initiating mechanism consists of three systemic sets of initiators (SSI). The first would ensure the creation and strategic development of Secondary Technological Universities, the second would ensure the creation and strategic development of vendors of hBMO knowledge for managerial modeling of the economy, and the third would ensure the creation and strategic development of end-users of such knowledge.

However, this mechanism for secondary initiation of the implementing subsystem cannot initiate itself. It is necessary for this whole multitude of people to be activated and familiarized with the benefits of creating the World Network of Systemic Economic Engineering.

Therefore, a "*primary initiating mechanism*" is needed; a mechanism that ensures the creation and development of the "secondary initiating mechanism" and, through it, the creation and development of the "implementing subsystem" in its capacity as the final working part of the World Network of Systemic Economic Engineering.

To date, the primary initiating mechanism exists only at a concept level. The actual creation and development of this mechanism is the responsibility of the elites concerned about the future of the Western world. This primary initiating mechanism represents a global discussion forum committed to restoring the formative foundation of the Western world.

As a primary initiating mechanism, this Forum consists of two main parts: an inner and an outer core.

The inner core is represented by initiators for creating the global discussion forum. These are representatives of the Western elites who have the capabilities, the reach, and are ready to take on the responsibility to lead the Western world back on the path of creativity and unity.

By the end of 2032, the inner core consists of a complex organizational structure and a multitude of employees capable of developing the Forum's outer core as a foundation for building and developing the secondary initiating mechanism.

The outer core of the Forum is represented by four systemic multitudes comprised of thousands of responsible representatives of the ruling elite: economist elite, political elite, scientific elite, and media elite. These elites are familiar with and aware of the need for the proliferating emergence of systemic economic engineers as a prerequisite for a dignified and competitive development of the West compared to the East.

Anyone who has deeply thought about these matters would conclude that at present, the task of creating systemic multitudes comprised of thousands of responsible representatives of the ruling elite is a task that is impossible to accomplish within a few years since the concept of systemic economic engineers is completely new. It would require time, effort, and financial resources to educate the public about it and disseminate its relevance.

We would like to emphasize that we are not talking about today. We are not even taking about one year from now, or three years from now, which are the time frames of the longest projects financed by the Euro funds.

We talk about ten years from now, which is both a lot of time but also not so much.

In our opinion, the thus-presented vision for a new road in the history of the future, called "Digital Transformation of Economic Science," is the only logical and realistically option for our Western world to reverse the negative trend in the development of its technological elites in comparison to the respective East Asian technological elites. We argue that this is the only possible option because it is based on a successfully formed new fundamental scientific knowledge of economy of a higher quality. This new knowledge provides practical, clear, and understandable necessary explanations of two things: the first necessary explanation describes the principle setup and way of functioning of the enterprise for machines as a systemic object, and the second necessary explanation describes the principle setup and way of functioning of the enterprise for machines as a systemic subject.

Despite our extensive research, we couldn't find anywhere else in the world a successfully developed hBMO knowledge and a designed on its basis hERP system. However, Bulgaria's achievements are indicative that such knowledge can be created and then advanced. This gives us faith and hope that the World Network for Systemic Economic Engineering can be built and that the knowledge of the ontological model of the economy of the enterprise for machines can be widely distributed. The successful construction of this world network would lead to four progressive aftereffects and no adverse ones.

First aftereffect: The emergence of holistic ERP systems based upon the hBMO knowledge will cause restructuring of the markets for business software, business consulting and auditing, and engineering and re-engineering projects. This is because holistic ERP systems are a disruptive technology to existing ERP systems, and the knowledge of an ontological model is disruptive to the currently existing medieval fundamental scientific knowledge of economy. Historically speaking, the emergence of disruptive technologies causes an inevitable restructuring of the associated markets. For reference, in 2020, the markets for business software, business consulting and auditing, and engineering and re-engineering projects were estimated to be worth $2 trillion annually.

Second aftereffect: a new generation of machine engineers called "systemic economic engineers" will emerge. Having acquired knowledge of a higher quality of the economy of the enterprise for machines and by relying on their already characteristic technical knowledge, this new generation of engineers will be able to create new, higher-functioning enterprises for machines and will be able to successfully advance already existing ones.

Third aftereffect: The prestige associated with management positions will undoubtedly be transferred to the "systemic economic engineers" due to their superior knowledge and abilities. This prestige will begin to attract the bright and intelligent young people of the next generation to choose to study precisely this specialty, as opposed to pursuing social science disciplines. This will initiate the reversal of the negative trend in the development of the human capital of the Western world compared to that of China.

Fourth aftereffect: By relying on the new fundamental scientific knowledge of economy of higher quality, the Western political elites will begin to develop and implement truly effective strategies for achieving national security (social and economic growth) through a constructive and morally responsible development of the potential of the workforce of their nations.

Anyone who has managed to understand the content of this and the previous chapter can come to the following two conclusions regarding the "Digital Transformation of Economic Science."

The first conclusion is that objectively speaking, the "Digital Transformation of Economic Science" represents the highest-order moral benefit of worldwide importance. Its future world economic benefit, measured financially, amounts to trillions of dollars per year. But more importantly, this transformation will greatly reduce the ever-increasing political tension between the countries of the East and the countries of the West. Currently, this increasing tension, combined with the continuous deterioration (due to quasi-rational indoctrination) of the quality of the "economic leaders" of our (Western) nations, is driving the world towards a destructive Apocalypse.

The second conclusion is that objectively speaking, the "Institute for Systemic Economic Engineering" is an absolutely necessary means for realizing such a transformation, and in its role as such, it is the bearer of this same highest-order moral benefit of worldwide importance.

After everything that has been presented thus far, all of us, as concerned individuals, part of our global world, have one last question to ask ourselves.

What is to be done?

What is to be done?

Everything written in this book is an exposé of the facts that, for one reason or another, have not been proclaimed, or even worse, have not been identified thus far and are still beyond the scope of public attention in its four dimensions: business, political, scientific, and media.

The listed facts and the critical analysis identify the existence of a major problem and its source. Identifying this problem that threatens our future and the future of the next generation is the first "50% of the solution of the equation." The remaining 50% of the equation is also known – the presented solution for this large-scale problem. Therefore, the Western world has significant potential to solve this "equation." However, significant intellectual and financial resources are needed for this purpose, which would lay the foundation for building the special institutional structure charged with resolving this historical problem – the World Network for Systemic Economic Engineering.

So, what are the steps that each of us must take?

Within Chapter 7, we presented two possible roads for the development of the human capital of the Western world, a development that will inevitably affect the overall cultural, economic, and overall future development of Western civilization. One road is called "The Great Reset," and the other road, the "Digital Transformation of Economic Science."

Until now, the societies of the Western world and their ruling elites have lived in a state of absolute cognitive blindness regarding an absolutely vital matter. That the fundamental scientific knowledge of economy is at a medieval level of development. Like an avalanche effect, this leads to the next catastrophic matter. Namely, that all political ideologies based on defective knowledge are compromised from their formative phase.

Finding ourselves in a scenario similar to the painting by the Flemish artist Pieter the Elder BRUEGEL, "The Parable of the Blind," where a blind man leads the blind to the precipice, almost every modern "economic leader" blindly accepts the theories and strategies for future economic development offered by the authorities within the community of "professional economists" without any critical analysis or scrutiny.

However, after reading this book, any unbiased reader should have already "seen," with his eyes, with his mind, and with his heart, and be able to reach one final, personal decision:

EITHER

- YES, I will continue to trust my future, and the future of my children, to "surgeons" who have no understanding of the "anatomy and physiology of the human body" but claim to offer society a "panacea," a cure for all treatment and all diseases.

OR

- NO, this vicious cycle must stop, and I will do everything possible, for the sake of my future and my children's future, to participate in the resolution of this huge problem!

If you have made the latter choice and chose to continue with us on this journey of enlightenment, then you have already answered the call to action of the "Digital Transformation of Economic Science" as a new road in the history of the future. A call to unite the efforts of all engineers who consider themselves part of the Western world and realize the importance of the testament of Henry Towne, Frederick Taylor, William Deming, Joseph Juran, Joseph Orlicky, and Oliver Wight: a testament of three engineering waves in the development of the fundamental scientific knowledge of economy, that allowed the industry for machines (a leading industry of paramount importance for the development of all other industries) to become a foundational unit and building block not only for the Western world but for the entire global economy. It is time for their long-standing efforts to be completed through the realization of the Fourth Engineering Wave in the development of this knowledge. A fourth engineering wave that will create a new generation of "systemic economic engineers" and that will lay the foundation of the road of salvation leading back to the formative foundations of the Western world.

This book is a call to action to all engineering organizations: from the American Society of Mechanical Engineers (ASME), through to the Institute of Electrical and Electronics Engineers (IEEE), the International Electrotechnical Commission (IEC) and the European Society for Engineering Education (SEFI) all the way to the individual national engineering organizations of the Western world.

It is time to complete the dream and vision of the engineering giants who have left this remarkable foundation in the form of knowledge for management of the global industry for machines. Now more than ever, after more than 100 years of efforts by our colleagues, we must join forces to reclaim the prestige of the engineering profession and reverse the negative trend in the development of the industrial human capital of our (Western) nations compared to that of East Asian nations.

This book is also an appeal to all solicitous people of the world, all those who are cognizant of the current state of affairs. It is an appeal to all people who realize that if timely measures are not taken, the future position of the Western world within the global economy and global world structure is in grave danger.

IDEUM Base's unique Bulgarian discovery in the form of hBMO knowledge for the creation and development of holistic ERP systems represents a tool for reversing the negative trend in the development of the human capital of the Western world. Thus, IDEUM Base's legacy to the

Bulgarian people, and through them to all Western nations, is all we need to overcome this historic challenge.

If, in the next three years, we initiate and united our efforts to lay the foundations for the World Network for Systemic Economic Engineering and then develop this network within the subsequent seven years , we will be able to realize the new road in the history of the future – the "Digital Transformation of Economic Science. "

Just imagine: all of the highly intelligent and bright people who study economics will get high-quality knowledge about managerial modeling of the industrial economy All management systems and management educational programs will have been established upon new management knowledge of a higher quality. New enterprises will be built, and new technologies will "pop out" every day. People will make new discoveries and inventions, and society will be excited by all this activity and will follow this progress intently. Unity, creation, and systematicity will be the pillars that our Western civilization will be based on. All of this would be possible because high-quality knowledge of managerial modeling would allow Man to live, create, control, and make optimal decisions both for his surrounding environment, as well as the enterprise where he earns his living, and even for the life he wants to lead.

This is the effect that a "Digital Transformation of Economic Science" would have on humanity.

This process of "Enlightenment" envisions the benefit of everyone, all around the world.

Therefore, through this book, we, the authors, appeal to those who are concerned about the future of their nations, all those who have the cognitive potential to make sense of the "Digital Transformation of Economic Science" and then to provide support for its realization, to unite and make tremendous efforts to build a global discussion forum dedicated to the salvation of the Western world.

Only through united efforts can we lay the foundation for the new road in the history of the future. A road that will increase the chance of the Western nations for a dignified economic, technological, and morally responsible future in the global world. A road that will lead the Western world away from destruction and back toward unity and creation.

It is your turn!

Acknowledgments

The inception of the idea of the "Digital Transformation of Economic Science," which is aimed at the dissemination of a new fundamental scientific knowledge of economy of a higher quality and the establishment of a new class of engineers called "systemic economic engineers," and which represents a new road to return the Western world to its formative foundations, is based upon the efforts and work of generations of machine engineers. As the authors of this book, we would like to express our heartfelt gratitude to all those who have left their engineering mark in history, and in particular to:

- Frederick Winslow Taylor and Henry Towne - who initiated the First Engineering Wave in the development of the fundamental scientific knowledge of economy and formed the knowledge of operational modeling of processes in the enterprise;
- William Deming, Joseph Juran, and Walter Schuhart – who initiated the Second Engineering Wave and formed the knowledge of quality control;
- Joseph Orlicky and Oliver Wight – who initiated the Third Engineering Wave and formed the knowledge of inventory management and production planning.

Without this historically significant foundation, all subsequent steps, both those that have already been taken and those that are yet to be taken by us and our fellow engineers, would not have been possible.

This is also the place to express our special thanks and appreciation to our compatriots Eng. Peter Bachvarov and Anna Videva, who formed the knowledge of the "engineering model of the economy of the enterprise for machines." A worthy knowledge that has enormous potential to become the foundation of the Fourth Engineering Wave in the development of the fundamental scientific knowledge of economy.

We are also grateful for the work of the entire team of the Bulgarian technology park "IDEUM Base," who, with their hard work and undeniable professionalism over the past 20 years, have successfully developed and experimentally tested a new generation of holistic ERP system, which is based on the "engineering model of the economy of the enterprise for machines."

We also express our gratitude to the team of the Foundation "Information Technologies and the Future of Economic Science", who are walking and building the road of the "Digital Transformation of Economic Science" alongside us.

But most of all, we would like to thank everyone who answers the call to action that is "Digital Transformation of Economic Science" and accepts it as a personal quest to join the efforts to build a new, more just, and fair road in the history of our future!

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Abstract

The purpose of this book is to direct the attention of the entire Western world to six disregarded evident facts that are halting economic science development and cause the negative trends that threaten the West. The book talks about the source of those problems, but above all, it introduces an engineered vision for resolving these negative trends that threaten the West.

By tracing key historical events to the present day, the authors emphasize on the significant social problem that economic science is at a medieval level of development compared to the level of development of medical science. A problem common for the past, abnormal for the present 21st century, and devastating for our future and the future of our descendants. The source of this problem in the face of public institutions and organizations responsible for perpetuating this problem is exposed and openly named. The attitude of these organizations not only obstructs the possible solution of the problem with economic science development but even contributes to intensifying its malignant historical influence over the already negative trend of development of the West. If swift measures are not taken to reverse the current negative trend in the development of the West, in the not so far future this malignant influence of those organizations may even lead us to a Third World War.

However, the most significant information presented in this book is the engineering-designed Vision for a new road in the history of the future of the Western World. This Vision combines the scientific testament of the prominent engineers Henry Towne, Frederick Taylor, Walter Schuhart, William Deming, Joseph Juran, Joseph Orlicky, Oliver White, and others and builds upon it with the latest engineering discoveries in the science of man-aging the economy of the enterprise for machines. The book introduces a missing to this point systemic knowledge that gives a clear, accessible, and comprehensive understanding of the principle setup and way of functioning of the enterprise for machines that completes the dream and vision of the engineering giants who have left this remarkable foundation of knowledge for management of the global industry for machines.

This book is also a call to action and an appeal to join forces and reverse the negative trend in the development of the industrial human capital of our (Western) nations in order to reduce the ever-increasing tensions and avoid a potentially apocalyptic clash.

The answer is "Digital Transformation of Economic Science."