Scalability and Sustainability of Business Models in Circular, Sharing and Networked Economies

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Edited by

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INTRODUCTION

The mechanisms of the functioning of the present economy are diametrically different than they were a few years ago. New technologies and total digital transformation have opened up new spaces, not only for the development of companies, but many sectors of the economy as well. It determines the new spaces and dimensions of modern business. Being on the boundary of the real and virtual worlds, companies have begun to search for the best possible solutions to achieve a high level of effectiveness, in particular in the digital business ecosystem. The new shape and image of technology brought about by the next generation of Industry 4.0 set out a new path, not only to achieving competitive advantages, but also mutual exchange and cooperation. New economies have emerged in this environment. The network economy based on the network paradigm has become particularly important, mainly due to the ever-stronger position and role of network societies. This is where companies began to search for efficiency and effectiveness in business. The consequence of such strategic thinking was that companies strove to obtain results related to the network effect. At the same time, the pursuit of dynamic growth and ownership of large resources has ceased to matter. The borderless business world increasingly began to realise that good business is a scalable business that is configured in such a way as to ensure business continuity, regardless of the prevailing conditions, through proper adjustment and adaptation to market opportunities around it. Hence, the ability of a company to scale and survive on the market through the permanent management of its interfaces towards the optimal income generation logic - with the simultaneous presentation of an interesting, innovative proposition of many values - became crucial. Such design thinking of companies embedded in the network began to bring measurable results, especially in relation to access to resources in the networks. The approach to defining and managing the value chain also changed. Due to digitalisation of the economy, classic value chains began to change, becoming significantly shorter. Everything became SMART, especially due to the impact of the new DNA of digitalisation, from SMART INDUSTRY to SMART people. At the same time, new design thinking resulted in the joint implementation of traditional and digital thinking by business architects. It triggered the so-called circular economy where the management of repeatable cycles of resources and the generation of

emerging new resources in an effective life cycle became particularly important.

It is also worth noting that the implementation of business processes in networks has changed the approach to defining and implementing the main strategic goals of companies. Social goals have started to play a significant role against a background of economic goals, which, to a large extent, affected the sustainability of companies in business. This was also influenced by the strong impact of the concept of sharing, which began to open new spaces and perspectives for the development of companies, especially in the era of servitisation. Such strategic changes have led to the need for scientific search and investigation in the area of strategic directions related to key ontological beings of companies such as business models, strategies, business processes and strategic projects. Among these four beings that create a kind of strategic hybrid, the concept of business models is definitely highlighted. This concept has even caused a storm in management sciences, especially in the context of the existing subversive era of economics.

Business models which convert payments into profits during the period of building space for their monetisation have become the determinant of the modern success of many organisations. Business models that are a configuration of many unique resources, or have access to them, have become a platform for market victory measured by the sustainability of companies and their ability to be continuously scalable, among other factors. A constructive comparison between the three key factors has emerged in this cognitive perspective. The first factors include management mechanisms going towards the conceptualisation and operationalisation of the business models of companies. The second group of factors includes the search for the organisation's main goals in today's business world based on scaling and survival. Finally, the third factor is the functioning of companies in new economies, which include the sharing economy, the circular economy and the networked economy. From this perspective, the scientific problem described in this monograph, which is worth solving, has come to the forefront - namely the scalability and sustainability of business models in the sharing, circular and networked economies.

This issue can be solved, among others, by defining related key resources, key success factors and new value drivers. This is where the research question arises: How to conceptualise and operationalise scalable business models which ensure the survival of companies functioning in the sharing, circular and networked economies? The monograph and its individual chapters attempt to answer this research question, which is crucial for management sciences.

The monograph consists of 12 logically related chapters constituting a certain substantive whole in the area of the scientific issues discussed. The structure itself has a systemic character that is supposed to lead the reader in thought disquisition through the meanders of management sciences in the context of the scalability and sustainability of business models. In chapter one, authored by Bogdan Nogalski and Arkadiusz Rokicki and titled "Technological progress and management studies", the authors point to key aspects of technology in modern business management. This chapter is a voice in a discussion on the role of technological progress in the development of management theory and studies. The advance of mechanisation in the organisational environment leads to a world where intelligent machines make decisions based on algorithms and machine learning. It can be expected that the role of technology will increase in an organisational context. The underlying thought of the chapter is that technological progress has determined the development of management studies. The aim of the chapter is to provide evidence to support that idea. Management theories will be divided into those with direct technological impact and those where technological influences can be observed indirectly. The reasoning will be supported by the concept of four industrial revolutions. The latter will be subsequently confronted with the management theory scheme as presented by S. Lachiewicz and M. Matejun (Lachiewicz, Matejun, 2012, p. 89). The chapter also indicates further research areas that might reveal the need to create new management approaches as organisations progressively achieve automation in many areas. Chapter two is titled "Network relationships in achieving the Sustainable Development Goals" and its authors are Joanna Dzieńdziora, Magdalena Wróbel and Dawid Żebrak. The aim of this chapter is to present network relationships in achieving the Sustainable Development Goals with special consideration given to the areas of activity of the 2030 Agenda. The 2030 Agenda for Sustainable Development is a framework plan for the world, setting global goals from the perspective of the year 2030. Its structure includes a set of 17 sustainable development goals adopted by 193 UN member states. The 2030 Agenda aims for the formation of a fair world, which is based on respect for law and rules which are conducive to social inclusion. In this study, the literary analysis was used as the main research method. This analysis allows the authors to conclude that the goals of the 2030 Agenda oblige various entities to build network relationships based on close cooperation aimed at promoting behaviours that allow for economic growth, social development and environmental protection. Its main idea is also the pursuit of development, which will guarantee a dignified life for all. In chapter three entitled

"Development of business models and their key components in the context of cyber-physical production systems in Industry 4.0", Bożena Gajdzik pays attention to the fact that the development of cyber-physical production systems (CPPS) is associated with the popularisation of the concept of Industry 4.0. The concept was publicised after the Hanover Fair (2011) as Industrie 4.0 (Zühlke, online). A large number of scientific publications and research reports are already available on Industry 4.0. There is no universal definition of Industry 4.0, and the scope of changes in individual publications describing Industry 4.0 is varied. It is assumed that Industry 4.0 is a product of the fourth industrial revolution with the vision of intelligent factories built of intelligent cyber-physical systems (Lasi et al., 2014). In chapter four, Wioletta Wereda and Jacek Woźniak address the issue of the maturity of relational sales and customer service in the sector of innovative enterprises: a basis for constructing a business model. Contemporary sales are significantly different from those from a few decades ago, which mainly consisted of making a purchase transaction. In the past, it was associated with sitting and waiting for the customer at the point of sale, while the new approach to sales is based on a more active approach and on building customer relationships. Meeting the expectations of customers, direct sales, sales based on identifying customer needs, and online sales are terms that should increasingly be the basis for the functioning of contemporary organisations. The main purpose of the purchase is to satisfy customers that they would gladly return to the enterprise in order to take advantage of commercial services once again. It should be emphasised that sales do not necessarily involve forcing the product to be purchased and should not be associated with intrusive activity on the part of the seller. Therefore, it must be a complex process; if these sales are initiated by learning about the needs of a potential client, there is a high probability of completing the transaction with great success. Chapter five is also important; it is written by Małgorzata Smolarek and Monika Sipa and titled "CSR - a direction for the sustainable development of small and medium-sized enterprises. Current research trends in light of selected literature". Expecting social acceptance for the ways and effects of their functioning, organisations extend their responsibility towards the environment. Entrepreneurs' greater awareness in terms of perceiving problems connected with their organisation's impact on the environment results in taking the environment, social interests and relations with various groups of stakeholders into account as early as at the stage of establishing the strategy. Taking such an approach is called the concept of corporate social responsibility (CSR), which is one of the most modern and promising business strategies on today's market. It is mainly large

enterprises that are interested in this type of activity, whereas small businesses recognise CSR issues, but do not necessarily have knowledge of the standards in terms of implementation. In chapter six, Marek Jabłoński addresses a fundamental issue of the relationship between the monetisation and profitability of digital business models. The chapter presents the issue of the monetisation of business models of enterprises operating in the digital economy. The author assumes that every business model should be monetised, and thus be economically justified. Attention was paid to assessing the profitability of the business models studied and defining the sources of their revenues, as well as analysing the economic and social benefits of key actors. The aim of the chapter is to conduct a critical analysis of the sources of the monetisation of business models of selected enterprises operating in the digital economy. Magdalena Syrkiewicz-Świtała, Rafał Świtała, Piotr Romaniuk, Joanna Kobza and Ewa Ptak are the authors of chapter seven entitled "The sustainable marketing mix of pharmaceutical companies". The pharmaceutical market is considered one of the most profitable and innovative in the world. It is very stable and not sensitive to the turmoil associated with economic crises. It must, however, meet the needs of humanity associated with global health problems and social expectations. The current trends require pharmaceutical companies to focus on social and environmental activities while maintaining economic rationality. Therefore, these entities in particular are obliged to manage the ideals of sustainable development. In order to meet market demand, the companies are forced to undertake sustainable activities in all aspects of management operations, as well as in marketing activity. The aim of the study is to present the possibilities of implementing a sustainable marketing mix to pharmaceutical companies in terms of the specifics of the industry and drug market. This chapter provides an overview of the literature. Pharmaceutical companies which achieve their goals in accordance with the concept of sustainable marketing can contribute to the development of a competitive advantage in the pharmaceutical market. In chapter eight Marek Jabłoński and Piotr Janulek focus on tokenisation as specific digitalisation of business models. Entrepreneurs are interested in finding optimal communication and collaboration systems which can generate additional value for customers, redefining a business model anew in the context of emerging technological opportunities. In the aspect of technological paradigms which are suitable for contemporary business conditions (such as the Internet of Things, Big Data, etc.), we are witnessing the transformation of traditional business models into digital models. So far, the theory of management has left the gap open; researchers are attempting to fill it by analysing digitalisation in business models. This

section aims to identify and discuss the results of desk research into the potential application of tokenisation to designing innovative business models. As part of broader-scope research into the digitalisation of business models, in this part of the research the authors address modern forms of crowdfunding, investment in assets, digital residency, the specificity of smart contracts and opportunities to monitor the supply chain. This is how an outline of the concept for the application of tokenisation to the digital transformation of business models emerges. In another chapter Piotr Barczak addresses the issue of thermodynamic equilibrium in a small family business. Thermodynamic laws affect all processes occurring in the environment around us. One of the objects that is subject to these laws is a small family company, which consists of several people creating a system that is part of the economic space. A company is also a system that always comes back to equilibrium regardless of processes and running time. If this is not the case, the company disintegrates and sometimes ceases to exist. A helpful issue in the sustainability analysis of the company is group synergism and the concept of synergy, understood as functioning in a limited environment, a group operating on the basis of limited resources, both financial and biological.

Łukasz Makowski and Tomasz Grzegorzyca also pay attention to important issues in the chapter titled "Factors and mechanisms and actions supporting the restructuring process". In the case of unfavourable changes taking place inside the company, or in the external environment, adaptation and restructuring activities play a key role in limiting or completely eliminating the possible effects of these changes. Well-planned activities and the appropriate manner of their implementation may positively affect the financial condition of the company and ensure its stability. Developmental, corrective and preventive actions may even be elements of building a competitive advantage through rational and adequate reactions to specific changes. The aim of this chapter is to indicate and to extract determinants and mechanisms and actions supporting the restructuring process. The hypothesis that adequately carried out restructuring measures ensure the stability of the company and maintain its market position was adopted. It was also assumed that both remedial and developmental actions can build a competitive advantage. In their next chapter, the same authors, i.e. Łukasz Makowski and Tomasz Grzegorzyca, present an analysis of the restructuring process of Poczta Polska SA. In certain situations, adaptation and restructuring activities play a key role in order to limit and / or completely eliminate the possible effects of negative changes or trends that occur in the internal environment or the external entity. Properly planned activities and appropriate implementation should positively affect the

financial condition of the company, as well as ensure its stability. Developmental, corrective and preventive actions can, or even should, constitute an element of building a competitive advantage achieved as a result of rational and adequate reactions to these changes. The purpose of this chapter is to analyse the restructuring process in Poczta Polska SA. The research methods used in this chapter are analyses of reports and statistical data, as well as internal documents of Poczta Polska SA. This chapter assumes that properly conducted restructuring activities guarantee the stability of the company and maintain its market position. It was also assumed that both remedial and developmental actions can build a competitive advantage. The chapter presents an analysis of restructuring measures taken by Poczta Polska SA, starting from the company's designation of restructuring goals, to formulating a recovery plan and clarifying strategic tasks. Subsequently, the analysis of the restructuring activities undertaken by the company was undertaken, based on the set goals and strategic tasks. In addition, the chapter shows activities that were the answer to the threats then present on the postal services market, which were supposed to contribute to the defence of revenues and generation of profit by the company. The collected research material has been presented using a chart and tables and accompanied by comments. The last chapter by Bogdan Nogalski, Adam Klimek, Joanna Czerska, and Agnieszka Szpitter focuses on the formation of a state institution on the basis of a process analysis. The modification of the structures of public administration encounters major obstacles. Institutional changes are difficult to introduce due to their complexity and broad impact. Non-substantial (political) factors are of importance as well. The resistance to change is aggravated by how difficult it is for decision-makers to assess the impact of the proposed changes.

The monograph influences many key areas of business science and practice. It is mainly embedded in the field of strategic management with a special focus on the concept of business models and the new dimensions of the economy, and refers to the network and system paradigm. In terms of economic conditions, it is based on the principles of the sharing economy, the circular economy and the networked economy. Such a multi-faceted approach makes the monograph holistic, creating a comprehensive image of a multidimensional market. From this perspective, it can be a specific platform for the development of business theory and practice. Editors hope that the monograph will not only make for excellent reading but, above all, will become an inspiration for a wide range of readers interested in seeking explanations for the complex phenomena of the modern world. The editors would like to thank the authors of the

individual chapters for sharing their thoughts and experiences, which allowed for a thorough exploration of the complex issue of the scalability and sustainability of business models in the sharing, circular and networked economies.

The monograph is multidimensional, and its very title pertaining to the scalability and sustainability of business models in the sharing, circular and networked economies points to various cognitive perspectives focused on several (both theoretical and utilitarian) problems embedded within. Therefore, the monograph should reach a wide audience. It should be read by theoreticians and scientists who deal with the issues of building and operationalising innovative business models, and also by students who explore the issues of strategic management and the new economy. Furthermore, it should be read by business practitioners, both entrepreneurs and top managers, who want to be business virtuosos, who can change their organisations and their business models. The monograph should be an inspiration which helps to change the way the communities around their organisations think and behave. Finally, it should be read by experts looking for inspiration in the development of modern management concepts.

Adam Jabłoński
Marek Jabłoński

CHAPTER 1

TECHNOLOGICAL PROGRESS AND MANAGEMENT STUDIES

BOGDAN NOGALSKI[1], ARKADIUSZ ROKICKI[2]

Abstract

This article is a voice in the discussion on the role of technological progress in the development of management theory and studies. The advance of mechanisation in the organisational environment is leading to a world where intelligent machines make decisions based on algorithms and machine learning. It can be expected that the role of technology will increase in an organisational context. The leading thought of the article is that technological progress has determined the development of management studies. The aim of the article is to provide evidence to support that idea. Management theories will be divided into those where technology has a direct impact and those where technological influences can be observed indirectly. The reasoning will be supported by the concept of four industrial revolutions. The latter will be subsequently confronted with the management theory scheme as presented by S. Lachiewicz and M. Matejun (Lachiewicz, Matejun, 2012, p. 89). The article also indicates further research areas which may reveal the need to create new management approaches as organisations progressively achieve automation in many areas.

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1. Introduction

Technological advancement is considered a factor in determining civilisational progress (Skowroński, 2006, p. 48). As pointed out by A. Skowroński, "*the development of science and technology improves our lives, changes its quality, enables us to discover the world, cure people, broaden our horizons etc.*"' (Skowroński, 2006, p.48). Technological advancement is also considered a driving force of economic growth (Rensman, 1996, p.3). Economics recognises the paramount role of changes in technology. According to R. Solow, in the long term, technological progress brings an increase in productivity, despite the decreasing marginal productivity of capital and labour (Skawińska, 2011, p.9-10). Other authors regard changes in technology as superior to other factors, creating a deeper and more stable basis for productivity growth (Jagas, 1995, s.37). The argument that technology growth is a major force in creating economic growth is supported by Nobel prize winner P. Krugman, who described technological progress (understood as the technical means to produce goods and services) as the main factor in the growth of productivity (Krugman, 2012, p.135). Krugman also stated that it is very often not only great technological breakthroughs, but also an aggregated sum of small inventions, which play that role.

Economic sciences also recognise the links between technology and management. As noticed by G. Mankiw and M. Taylor, it was predominantly Henry Ford's technical knowledge (the knowledge of the best methods of producing goods and services) that determined his success as a car manufacturer (Mankiw, Taylor, 2014, s. 72). In Ford's case, one can argue that the origin of that success story was both his ability to organise work (management skills) as well as his technical aptitude, including its practical application. Mankiw and Taylor state that technological progress means, as it is the reason for an increase in quality, that the average productivity of capital and labour is higher for any amount of both. On the other hand, this means that the economy is able to manufacture more goods and services with the same pool of resources at its disposal (Mankiw, Taylor, 2014, p.72).

The impact of technological changes on the economy is substantial enough that it warranted the creation of a periodisation approach for economic history based on five stages. The scheme below was suggested by W. Rostow (Rostow, 1960, p.4-16):

1. The traditional society – identified with the natural economy, with agriculture being the main branch, as well as low labour

productivity. Technical innovations were sporadic and the minimal level of technological progress brought low production capability.
2. The preconditions for take-off – starting in western Europe at the end of the 17th century (Isaac Newton and scientific progress). Characteristics of that period include the increased division of labour and innovations supporting several organisational methods such as craft production.
3. Take off – from the end of the 18th century, linked to advancements in technology which brought about increased efficiency in manufacturing industries and agriculture. This is the period in which the first factories were set up as a consequence of the invention of electricity, engines and assembly lines.
4. Drive to maturity – during this stage, technological changes became commonplace in all fields of the economy, occurring approximately 60 years after the previous stage.
5. Age of high mass consumption – the 20th century, the era in which the economy was able to fulfil all consumer needs. This is also where services are the basis of the economy as opposed to manufacturing industries. According to Rostow, the breakthrough moment was the popularisation of cars.

To summarise this part of the discussion, the impact of technological change on the economy has been proven. The same can be applied to the impact of the economy on management. Management as a field of study came about as a consequence of changes in the economy, mostly related to capitalism becoming the dominant system of production. The latter changes were caused by changes in technology. As stated by M. Kusters, management is a process of planning, organising, motivating and controlling work in an organisation and its participants as well as utilising all available resources to accomplish organisational goals (Kostera, 1998, p.5). Those resources are acquired from the environment external to the organisation (Brzeziński et al, 2007, p.12). Actors in an economy such as suppliers, clients, competitors or financial institutions are part of that environment (Koźmiński, Jemielniak, 2008, s.95). Therefore, the impact of technological progress on management is:

- **Indirect** – through processes in the economy that can be observed in the external environment, which would then influence organisational resources
- **Direct** – through initiating changes in organisational approaches

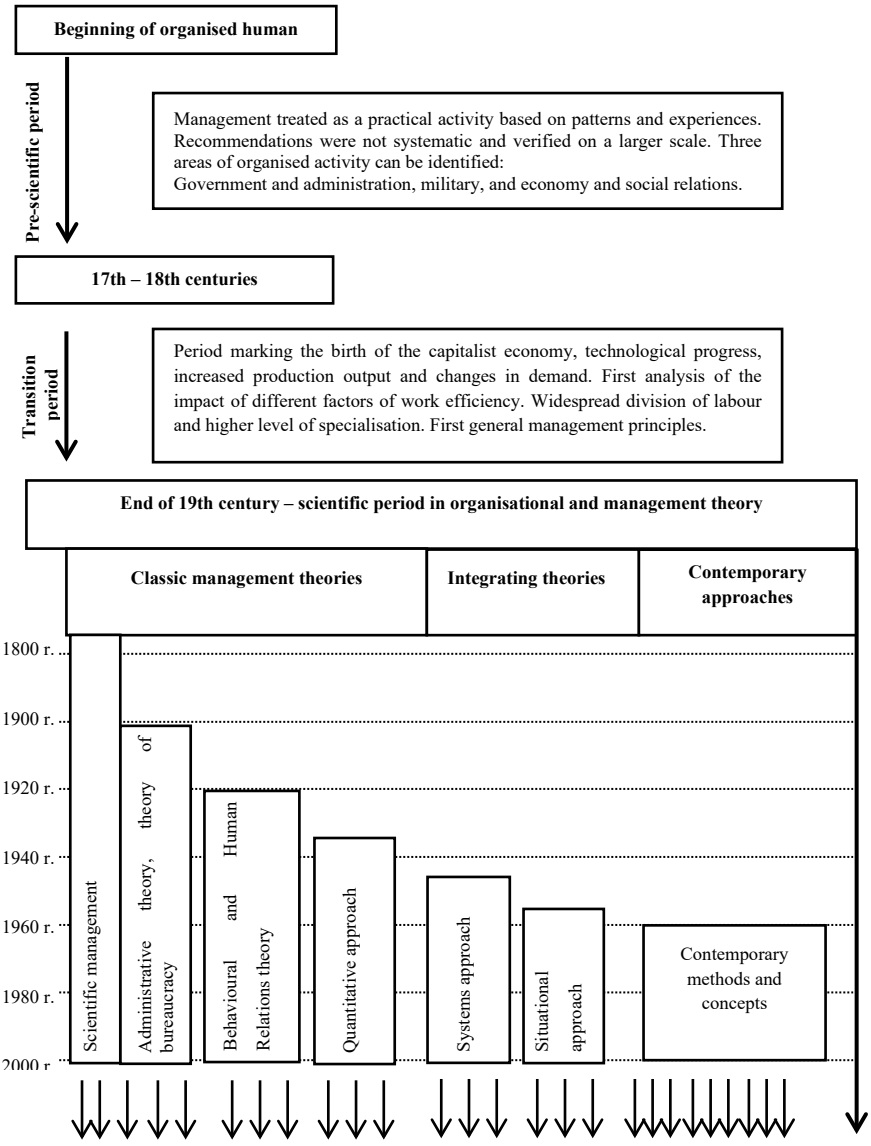

Fig. 1-1. Evolution of the development of organisational and management studies
Source: Lachiewicz, Matejun, 2012, p. 89 (original in Polish, translation – AR)

This perspective is a basis for further discussion. To add another dimension, the model of evolution of organisational and management studies as proposed by S. Lachiewicz and M. Matejun in their article "Ewolucja nauk o zarządzaniu" (English: "Evolution of management studies") published as part of a monograph called "Podstawy zarządzania" (English: "Management basics") in Warsaw in 2012, is shown in Figure 1.1.

The two authors divide the history of management into three periods: pre-scientific, transitional and scientific. The aim of this article is to investigate how technological progress determined and continues to determine management as a field of study and practical activity. The model described will be related to the events of four industrial revolutions:

Table 1-1. Industrial revolutions.

	First revolution	**Second revolution**	**Third revolution**	**Fourth revolution (Industry 4.0)**
Beginning	end of the 18th century	2nd half of the 19th century	1960s	early XXI century
Major development	mechanisation	electrification	digitisation	Internet of Things
Major innovations	steam engine	electrical bulb, telephone, first production line, oil refining	microprocessor, IT systems, automation	Smart City, Smart Factory, artificial intelligence, Big Data

Source: based on Palka, D., Stecuła, K., "Postęp technologiczny – dobrodziejstwo czy zagrożenie?", p. 588

2. Technological changes during the period of pre-scientific management

The pre-scientific period marks the beginnings of organised human activity. Lachiewicz and Matejun describe three areas of said activity:

a) Government and administration
b) Military and the art of war
c) Economy and social relations

The last area mostly relates to management studies according to the authors. In that context, they mention the construction of the Egyptian pyramids, where an extensive number of people were involved. To complete those tasks, referring to the planning, organisation and control of work was of paramount importance.

According to K. Łacny and M. Janczar-Smuga, in order to stay alive, humans had to use technology in order to obtain and prepare food from the outset. Furthermore, they state that technology is not only machines but also elements of practical and theoretical knowledge, the ability to utilise it, and the procedures and methods used to produce goods (Łacny, Janczar-Smuga, 2013, s.79). The real history of humanity starts from when people had to work together to achieve common goals.

It is accepted that the neolith agricultural revolution of 12,000 years ago had a direct effect on the abandonment of nomadic lifestyles and the increasing complexity of societies through growing plants and farming animals (Nowakowski, 2014, p.3). At that point, the first division of labour took place into those who grew plants and those who farmed animals (Legucka, 2016, p.100). That occurrence was supported by tools like the hoe, lister or plow pulled by animals (Topolski, 1993, p.50). A further division of labour was linked to subsequent technical innovations, for example the cart wheel, potter's wheel, loom, machine for brickmaking, copper- and noble metal-working (Spark, 2003, p.52). As investigated by Łacny and Janczar-Smuga, when groups of society dealing with farming, hunting or crafts developed as separate entities, a connection between technology and the organisation of work was established (Łacny, Janczar-Smuga, 2013, s.79). It is also important to highlight that the only sources of energy at the time were plants, animals and humans (Topolski, 1993, p.50).

With wheeled carts, bricks and metals at their disposal, it was possible to begin construction activities. As highlighted by J. Trzciniecki and J. Teczke, the effectiveness of work was analysed as early as during the construction of the Great Wall of China (Trzcieniecki, Teczke, 1998, p.9). Production planning and control took place in ancient Babylon (Walczak, 2012, p.99). One of the first thinkers who wrote about the division of labour in workshops was Xenophon (Gray, 2010, p.32). He claimed that a skilled, specialised craftsman could deliver better work than a non-skilled one. He advocated specialisation, understood as training the workforce to conduct specific tasks. This was supposed to bring about an increase in productivity (Wieczorek-Szymańska, 2010, p. 158). An example of highly organised human activity during Antiquity was the construction of 120 ships for the 260 B.C. war with Carthage which only lasted several months

(Walczak, 2012, p.99). Nevertheless, during Antiquity (as opposed to neolith), there was no considerable technical progress that would enhance the speed of production or cause major changes in the organisation of work. It is claimed that the reason for this was that there was insufficient demand for technological advancements. The other major factor could be the attitude of the ancient elites to physical work (Szpak, 2003, p.70).

A major breakthrough was observed in the 13th century as a consequence of the wider use of wind and water as sources of energy. It was a time when both windmills (http://wiatraki1.home.pl/wiatraki /info/historia.php) and water mills (Kaniecki, Brychcy, 2010, p.145) were becoming commonplace. Another key innovation was a fully powered water wheel (Lilley, 1963, p.61). All those inventions stimulated further division of labour in the economy, and different individuals became proficient in their field of work. The consequence was that the work conducted by one individual was an element of an interconnected web of work delivered by other individuals to provide goods for their societies (Szambelan, 1967, p.11-12). As demand for everyday goods was increasing (in itself an effect of technical solutions such as pottery-making or metal-working), the first craft workshops were set up in the 13th century (Tomaszewska-Lipiec, 2016, s. 85). A **craft workshop** can be defined as a production workplace where the mass production of a complex end-product was delivered manually and was based on the division of labour. Specialised, skilled craftsmen were gathered together to perform production processes divided into stages (Tomaszewska-Lipiec, as above). That type of organised production was popular in Florence in clothes-making (Beliczyński, 2012, p.163), where the production process was clearly divided into stages (cleaning, combing, colouring, weaving etc.) The spread of craft workshops is an example of the indirect impact of technological progress on the organisation and management of work. Innovations in production gave impulse to economic processes (increases in supply and demand), which enabled the emergence of craft workshops as organised human activity (Beliczyński, 2012, p.159). The more technological solutions which were introduced to production and tool enhancement, the more complex the division of labour became (Sołdaczuk, 1995, p.38).

Guilds are also worth mentioning in this context. These were groups of craftsmen performing the same type of work (Manteuffel, 1999, p.268) (for example: coopers, shoemakers, furriers). Guilds decided on and controlled the size of production output and therefore controlled the supply (https://encyklopedia.pwn.pl/haslo/cech;3883763.html). However, they also did not allow its members to use any technical innovations (such as

fulling or the spinning wheel) and as a consequence they would hinder both technological and economic growth.

3. Technological advancements during the transition period for management

The transition period covers the 17th and 18th centuries, during which production was growing and the division of labour became a main method of organising work. General management principles were also created. As the demand for goods grew, so did automation (utilising, for example, water wheels or grindery), which greatly added to the speed of production. As highlighted by Z. Wójcik, in the 17th century the development of craft workshops was still very slow, and had no decisive impact on the economy (Wójcik, 1999, p.17). Real change did not happen until the 18th century. The use of machines undoubtedly had a positive effect on productivity and therefore lowered the prices of manufactured goods. This, on the other hand, influenced both the demand and supply sides and created an incentive to set up companies. As companies were established, there was a gradual need to ensure a more structured approach towards their management. The link between technological progress and management was fully established. That phenomenon was further enhanced in light of the first industrial revolution.

According to Z. Madej, the craft workshop was the first milestone towards automated production, and the industrial revolution was the second (Madej, 2013, p.43). The 18th century was, in comparison, a period of extraordinary technical innovation. This can be tied in with a time of prosperity following the 17th century recession. S. Lilley presented statistics pertaining to inventions over the course of a few centuries. The 18th century largely stands out among them.

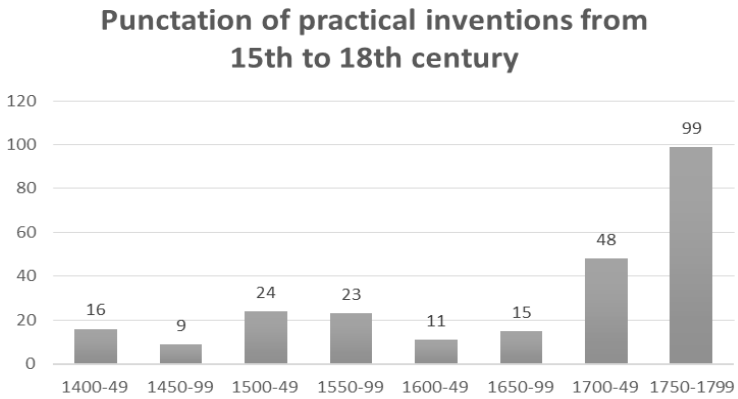

Fig. 1-2. Innovations from the 15th to 18th centuries as per S. Lilley.
Source: S. Lilley as per E. Rostworowski, 1999, p.42

J. Beliczyński has listed the forerunners of scientific management (Beliczyński, 2018, s.42-43). It is important to point out that the vast majority of them were engineers or had a strong technical background.
- Adam Smith – responsible for formalising the law of division of labour. In his opinion, the division of labour increases manufacturing output as it stimulates the competency and productivity of workers. Beliczyński quotes Trzcieniecki and Teczke who concluded that it was **the law of technical division of labour** that de facto heralded the emergence of organisational and management studies.

- Richard Arkwright – considered the inventor of enhanced weaving looms and the creator of the basis of manufacturing production systems. His inventions have greatly contributed to increased production and employment within the cotton industry.
- Ely Whitney – inventor, also thought of as a pioneer of mass production. He would provide workers with gauges or examples of parts that were supposed to be recreated and also used assembly lines in mass cotton production.
- Robert Owen – was of the opinion that division of labour brings about better utilisation of tools. He also thought that humans were more important than machines in the production process and the role of a manager is to enhance working conditions.
- Charles Babbage – mathematician and engineer, considered a pioneer in the scientific analysis of work process improvements. He

analysed production processes, the division and organisation of work taking into account factors such as time, cost and the choice of workers, machines and tools. From the point of view of technological progress, it is essential to highlight that this pioneer of scientific management can also be credited with creating the concept of computers. His difference engine was supposed to add, subtract, multiply, divide, as well as calculate tangents and cotangents. His inspirations were twofold:

a) the method of technical division of work created by Gaspard de Prony (Isaacson, 2014, p.20). De Prony proposed logarithmic and trigonometric tables and divided operations into steps involving adding and subtracting. He then prepared simple instructions for workers to enable them to complete their calculations and hand over the results to their colleagues who were responsible for the next step. That method also contributed to developing the concept of an assembly line. Babbage worked on a way to automate this process.
b) existing mechanical calculators created by Pascal and Leibniz in the 17th century (Goldstine, 1977, p.340)

Babbage did not complete his difference engine as he began work on an analytical engine. It was supposed to complete different tasks as it was programmed (https://www.britannica.com/technology/Analytical-Engine#ref1069898). He developed the idea that punched cards used in weaving looms are able to ensure the ability of the machine to accept an infinite number of instructions. The user could manipulate the sequence of events, which was the stepping stone to a general purpose, re-programmable machine. The analytical machine would not need to simply perform specific tasks as it could be programmed as required. Describing the abilities of such a machine, Ada Lovelace (who worked with Babbage), took the idea even further. She claimed that operations performed by the analytical engine do not need to apply only to numbers but also contain the possibility of storing, manipulation, processing and modifying everything that can be expressed via symbols (words, music etc.) (Manabrea, Lovelace, 1843, s. 21). Ada Lovelace also de facto introduced the concept of subroutines (a range of instructions for performing specific tasks). She also created a list of instructions with commentaries describing the target register and operations required, hence laying the foundations for computer programming.

The first industrial revolutions brought about a technological breakthrough in production. Manual work ceased to dominate and was gradually replaced by mechanisation, the outcome of which was the mass production of

certain goods as well as an increase in productivity. J. Szpak lists three main areas of change (Szpak, 2003, p.139):

a) Mechanisation of the textile industry – the most notable inventions were the spinning jenny (multi-spindle spinning frame) (James Hargreaves, 1764), and the power loom (Edmund Cartwright, 1785)
b) Intensification of iron production – brought about mainly by the application of coal and mechanical cylinders (Henry Cort, 1784, which eliminated manual work previously performed by smiths), the slide rest lathe (Henry Maudley, 1797, which allowed for the manufacturing of precise details of machines but also elements of bridges and iron rails)
c) Adoption of new energy sources – production growth would not be attainable if the only sources of energy were human or animal muscles, wind or water. The period of the industrial revolution is known as the age of steam (Szymanowski, 2018, s.15). The milestones for the utilisation of energy coming from water steam were the steam digester (1679/1690, Denis Papin – the first recorded use of energy from combustion), the steam-powered pump used in coal mines (1711, Thomas Newcomen), the steam engine machine (1769, James Watt transformed Newcomen's pump and in 1781 adapted it for rotary drive, therefore enabling its industrial use). New sources of energy found application in transport: the first steam-powered road automobile (Nicolas Cugnot, 1765), the steam locomotive (Richard Trevithick, 1804), a steam machine to power river boats and ships (Robert Fulton, 1807), and screw propellers for ships (John Eriksson, 1834).

The first industrial revolution brought with it overwhelming consequences. The intensification of productivity through the widespread utilisation of machines brought an increase in the size of production and a higher level of availability of goods on the market. Mass production became increasingly profitable. New businesses were set up, and those business required organisation and management. Without doubt it can be said that the advancements in transportation played a decisive part in this process as well, allowing the new enterprises to reach new markets with their offerings.

As mentioned above, in the transition period for management studies, general rules of management were created. The pioneers of management were, to a large degree, engineers and inventors. It is no surprise that the first scientific management principles refer to production processes

supported by machines. The emergence of machines in the course of technological progress drove changes in management rules. Engineers such as Babbage, Arkwright or Whitney analysed the division of labour, specialisation and mass production to address changes in technology. Those analyses were required to maximise the workability of new technologies. That approach was therefore a practical one. Hence, it can be said that the growth in technical capabilities was the impulse for the emergence of management studies as a field of science. Scientific management was conceived during the industrial revolution as it was only at such time that the appropriate stimuli existed.

4. Scientific period for organisational and management theory

4.1 Scientific management

It comes as no surprise that the official canon of rules of management was formulated at the end of the second industrial revolution. If we closely examine the achievements of technology in that period (Table 1-2) and analyse their consequences, then we can come to a conclusion that the structuring of management rules was in response to the sequence of events presented in Figure 1-3.

Table 1-2. Major inventions of the 2nd industrial revolution

Date	Inventor	Process or machine
1930s	Samuel Morse	Telegraph (1835) Morse code (1838)
1850s	Henry Bessemer William Kelly	Bessemer process
1853	Elisha Otis	Mechanised passenger lift
1867	Christopher Sholes	Typewriter
1876	Alexander Bell	Telephone
1877	Thomas Edison	Phonograph
1879	Edison and Lewis Latimer	Lightbulb
1869	George Westinghouse	Compressed air-brake
1885	Carl Benz	Car
1886	Westinghouse and Nikola Tesla	High-voltage alternating electric current (AC)
1903	Wilbur and Orville Wright	First plane flight

Source: based on https://web.archive.org/web/20131022224325/http:/www.education.com/study-help/article/us-history-glided-age-technological-revolution/ access 7.01.2018