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The Evolution of the Concept of Value in the Development of the Industrial Engineering

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Abstract

Production systems have evolved over centuries from handcraft activities to high-tech complex operations. Through the years, studies aiming to understand best practices for production systems have multiplied; applied techniques, adopted management systems and available resources have changed to continuously produce gains and improve the productivity of the enterprises' production factors. Enterprises experimented high growth in aggregating value to their products, and consequently, firms have aggregated value to their own market value. Organizations that did not accompany the evolution of society have disappeared, while others that 'grasped' this evolutionary process have been quite competent in influencing the behavior of the world's population. This paper is based on a longitudinal study of theoretical literature on how the concept of 'value' has been approached in different moments of the development of the Industrial Engineering maturity. The study highlights aspects that influenced different perceptions about the definition of 'value' over the years; it indicates new possibilities for the development of the concept of value in sustainable production systems. It also intends to provide an in-depth understanding of the basic elements of the sustainable value for modern production management and value chain creation. The concept of value is extensively used to define production systems performance. Nonetheless, its use at times does not cover the multiple aspects that a systemic understanding of value creation encompasses. The present paper emphasizes trends on the increasing offer of high value products in a world that demands sustainable production systems to reach a consistent sustainable development 'utopia'. This task can be accomplished only if the concept of value is revisited.

Keywords: value concept; production evolution; sustainable production.

1 Introduction

Industrial Engineering is supported by many other sciences such as Economics, Business Administration, Statistics and Mathematics, among others. The associations between these sciences allowed the development of disciplines and theories related to production. Thus, certain research studies and seminal works belonging to these sciences can be considered as part of the Industrial Engineering field. Considering the topics that have evolved from the Industrial Revolution and presented different versions and interpretations over time, the attempt to establish the concept of value can be underlined. This paper seeks to analyze different versions of the concept of value adopted and employed over the years. It aims to observe what Marshall indicated in the preface to the first edition of the book "Principles of Economics", where the author addresses changes in economic conditions: "Each generation looks at its own problems at its own way" (Marshall, 1890). In consequence, as academic research on Economics has evolved, studies on management have been developed, technological innovations have emerged and environmental matters have been noticed, the focus on the definition of value has changed. Aiming to indicate how the concept has evolved, the first years of the Industrial Revolution were adopted as the starting point for the present study, including the first landmarks such as the invention of the steam engine and the introduction of the book "The Wealth of Nations" by Adam Smith. Since then, other events, inventions, books and authors have contributed to the changes of viewpoint on the use of production systems or generated studies on other aspects that shifted the analysis, bringing new approaches and definitions of relevant concepts.

Following Marshall's statement, one of the topics that society has indicated as essential for the development of new approaches to production management is the sustainability of operations, which has been incorporated into the research, and, in consequence, in the study of the concept of value. Clearly, the number of themes approached by the different sciences does not allow a detailed account of the different topics. The study of the history of the term "value" would lead to the study of what Ueda *et al.* (2009) indicated in the paper "Value creation and decision-making in sustainable society". The authors begin their analysis on the concept of value during the third and fourth centuries BC, considering the philosophers Plato, Aristotle and Epicurus. The main aim of the present study is to facilitate the association of various studies that focused on the formulation of the concept of value from the Industrial Revolution, throughout the evolution of society. Aspects related to the development of the production are considered, moving toward the objective that is envisaged, the search of a world close to the sustainability. Currently, the topic "value" is directly connected with the stock market, with the formulation and indication of value for stocks and enterprises, the measurement and qualification of personal and institutional assets, the production of goods and provision of services. Different methodologies are generated from the concept for the calculation of value for enterprises, assets and rights, considering contemporary tangible and intangible aspects. However, to understand the evolution of the concept of value, it is necessary to contextualize the productive environment during the nineteenth and the twentieth century; this is presented next.

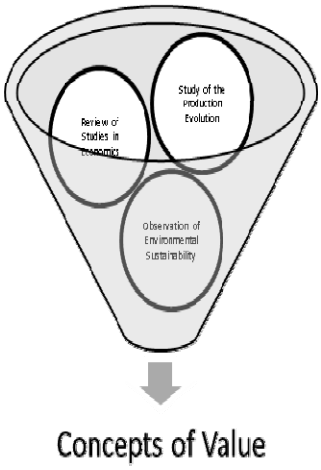

Figure 1: The Process Established for the Study of the Concept of Value

2 Landmarks of the Production Development

Among the many studies and discoveries that could be indicated as the starting point for this research, the studies of the philosopher, chemist and physicist Robert Boyle, born in Ireland in 1627, died in 1691. Boyle stated the Compressibility Law of Gases, which establishes the relationship between temperature, volume and pressure of a gas mass. Around the same period, the topic was being studied by Mariotte in France. Both studies reached the same conclusions and the law was named Boyle-Mariotte. In 1675, Boyle worked with Denis Papin, a French physician, physicist and inventor, who was born in 1647 and died in 1712. In 1690, Papin developed a piston model, which allowed the utilization of mobile parts in steam engines. Up until that time, an English military engineer and inventor, Thomas Savery (1650-1712), had patented in 1698 a machine to pump water from coalmines by turning water into steam, but his invention did not contain mobile parts. In 1712, Thomas Newcomen, an English blacksmith and mechanic, born in 1663, died in 1729, installed and patented a steam machine which drained the water accumulated in coalmines. Newcomen combined the discoveries of Papin and Savery, made an agreement with Savery due to the domain over the registered patent. Scottish-born inventor James Watt (1736-1819) developed studies and research in a small workshop in the University of Glasgow. While repairing a Newcomen

machine, he introduced improvements, producing a more efficient engine. In 1769, the inventor patented the engine, later produced and marketed it on an industrial scale.

The development of new production technologies resulted in great social changes at the end of the eighteenth century and beginning of the nineteenth century. There was a great rural exodus, and in consequence, the industrial organizations had the opportunity to hire workers with very low wages, demanding high workloads and providing hazardous working conditions. Within this context, the world experienced a rapid growth in the industrial production and academic production as well. Similarly, new inventions and others were improved, e.g., the use of the electricity. The publication of the "Treatise on Electricity and Magnetism" in 1873 constitutes a landmark for its acknowledgement and application. While innovations emerged, academic work including economical and social analyses multiplied, introducing the thoughts of different economic trends, those in favor of capitalism and those closer to socialism.

The end of the nineteenth century was marked by the beginning of scientific studies on labor productivity, resulting in 1911 in the publication by American mechanical engineer Frederic Winslow Taylor, who was born in 1856 and died in 1915, of the book "Principles of Scientific Management". That book presents the fundamentals and principles of the Scientific Management. In general, a methodology to enhance productivity is attributed to the author, however, in his book, where the author states how he believes the distribution of benefits associated with the scientific management should be, he indicates that, "the rights of the people are therefore greater than those of either employer or employee. And this third great party should be given its proper share of any gain" (Taylor, 1911). Considering the way of life and guidelines of the period, this was a seminal positive purpose: the offer of social benefits to society, a concern that was relegated to an inferior place in the proliferation of the work of this researcher.

With the combination of efforts of several employees within his company, Henry Ford, who was born in the United States on June 30th 1863 and died on April 7th 1947, the founder of the Ford Motor Company implemented in 1913 an assembly line of Model T cars on moving benches. The entrepreneur utilized a wage policy, which allowed the best workers to remain in his installations, resulting in high productivity. Other researchers such as Frank and Lillian Gilbreth and Henri Fayol presented work that improved production systems. Another eminent entrepreneur, from the 20s of the last century, was American business executive Alfred Pritchard Sloan Jr, who was born on May 23rd 1875 and died on February 17th 1966. Sloan was an executive of the General Motors Corporation, who managed several changes in the way cars were produced and marketed. It is credited to him the formulation of a pricing structure for different products launched yearly, including changes of style and resulting in a planned obsolescence. Following a natural progression of management and economic studies and starting in 1940, books, papers, and works about Marketing were produced. They highlighted the outcomes of the creation of value for products and services in terms of consumer satisfaction, and resulting in advantageous relationships for both parties. Theodore Levitt and Philip Kotler constitute eminent authors in this field.

Nonetheless, the evolution of production counts on the predominance of the technology factor, which is incorporated into the traditional production factors described by Adam Smith: capital, natural resources and labor. Thus, it moves from a mechanized production to automation and cybernetics. The two World Wars of the 20th century promoted research on new weapons, defense systems and communication. Many of these new discoveries were improved during the post-war years, resulting in products and services, which changed dramatically the formulation and management of production. In the 30s, Germany developed the first robot through the Goliath Program, a remote control land mine. Because of the development of Cybernetics in 1946, a group of scientists led by American electrical engineer John Presper Eckert, born on April 9th 1919 and died on June 5th 1995 and physicist John Mauchly, born on August 30th 1907 and died on January 8th 1980, created the ENIAC (Electronic Numerical Integration and Computer). It is regarded as the first digital computer and the inspiration for the informatics industry. Moreover, because of the "war industry" investments, beginning in 1957, ARPA (Defense Advanced Research Agency) developed Arpanet, an operational network of computers based on commuting. It was developed by Joseph Carl Robnett Licklider and Lawrence Roberts; the latter based his work on the

research of Paul Baran. Counting on the collaboration of Leonard Kleinrock, Robert Kahn and Vinton Cerf, Robert developed work that originated the Internet.

The changes regarding the concept of value followed the described modifications of products and their way of production. Until the end of the nineteenth century, the concept of value was one of the main objects for these studies. However, throughout the twentieth century, some economic concepts were "strengthened" and new situations, and elements received more attention from academics, such as the events of the World Wars and the crash of the New York Stock Exchange, though the term would still generate various interpretations and definitions, which are discussed next.

3 Historical Review of the Concept of Value

In 1804, Richard Trevithick's steam carriage reached the maximum speed of 8 km/h. At present, the TGV train in France, among several models of "bullet trains", can reach 574.8 km/h. This rough comparison establishes the context in which the authors who described economic, management, political and social aspects in the beginning of the 19th century were found. The access to the literature of the period was extremely slow. As an example, the access to the contents of Adam Smith's "The Wealth of Nations" by David Ricardo only occurred in 1799, i.e., 23 years after its first publication; and the analysis of the text was published in 1808. The analyses of seminal works and concepts, such as the concept of value, proceeded throughout the nineteenth century, as in the case of Karl Marx, who in 1867 publishes his first book, "The Capital", with critiques regarding Smith and Ricardo.

Another important factor to be considered, which indicates major changes in the world over these years, is the variance of the world's population beginning with the Industrial Revolution. Through the table "Evolution of the World's Population", a drastic positive variance of the growth is observed, and in consequence, the human occupation of the planet and the deployment of resources. This trend had already been identified at the end of the eighteenth century and beginning of the nineteenth century. This was indicated by the first publication, still anonymous, of the "Essay on the Principle of Population" by Thomas Robert Malthus, who was born in England on February 14th 1766 and died on December 23rd 1834. In spite of Malthus expressing his concern on the future of humankind, since he considered that the production of food would be smaller than the population growth, the discovery of more effective techniques for the agriculture and raising livestock, as well as the use of contraceptives did not confirm his studies.

Table 1: Evolution of the World's Population

Year	Population	Variance*
1750	791,000,000	
1800	978,000,000	+23,6%
1850	1,262,000,000	+29,0%
1900	1,650,000,000	+30,7%
1950	2,518,629.000	+52,6%
2000	6,070,581.000	+141,0%
2011	7,000,000.000	+15,3%

*in relation to the previous period

The authors of the nineteenth century that studied the topic "value" can be categorized through the theories they developed. Smith, Ricardo and Marx among others presented objective theories, thus bringing classical approaches; on the other hand, Jevons, Enger, Walras and others introduced subjective theories, elaborating approaches that were considered marginalists, and, finally, there were other authors, who presented theories for market prices such as Mill and Marshall.

Beginning in 1776 with the work of Scottish economist Adam Smith (1723-1790), who published "The Wealth of Nations", his text influenced not only researchers of economics whether they were his followers or his critics, but other academic disciplines as well. The book presents through a clear and organized language a well-structured analysis of possibilities for the economic growth of different countries through the potentialities of production resources. Smith defined the production factors as land, capital and labor (the rent of the production factors would be the income from the land factor, the profit or interests of the capital factor and the wages of the labor factor). Considering that "in every society, the price of every commodity finally resolves itself into some one or other, or all of those three parts" and that "the real value of all the different component parts of price, it must be observed, is measured by the quantity of labour which they can, each of them, purchase or command". The author differentiates between the natural price (real cost of a commodity including the profit) and the market price (price regulated by the quantity put on the market and the demanded quantity). It also considers that depending on the sectors, "the same quantity of industry will, in different years, produce very different quantities of commodities; while, in others, it will produce the same or very nearly the same" (Smith, 1776). For the first part of the citation, the author considers agricultural activities while the second relates to the textile industry.

In 1803, French author Jean Baptiste Say, who was born in 1767 and died in 1832, publishes the book "Treatise on Political Economy". In his book, Say states that the "valuation of an object is nothing more or less than the affirmation, that it is in a certain degree of comparative estimation with some other specified object; an any other object possessed of value may serve as the point of comparison. A house, for instance, may be valued in corn or in money"(Say, 1803). The author also indicates that "the wants we feel make us desire to possess the things to satisfy them" and "of these wants, some are satisfied by the gratuitous agency of natural objects; as of air, water or solar light ... because they are the spontaneous offering of nature; and, as such, mankind is not called upon to earn them by any sacrifice or exertion whatever; for which reason, they are never possessed of exchangeable value" (Say, 1803).

In 1817, English economist David Ricardo (1772-1823), wrote the "Principles of Political Economy and Taxation". Ricardo differentiates between the concepts of value and wealth (riches), considering that "value, then, essentially differs from riches, for value depends not on abundance, but on the difficulty or facility of production" (Ricardo, 1817). Analyzing Smith, the author indicates that "it is true, that the man in possession of a scarce commodity is richer, if by means of it he can command more of the necessaries and enjoyments of human life; but as the general stock out of it which man's riches are drawn, is diminished in quantity, by all that any individual takes from it, other men's shares must be necessarily reduced in proportion as this favoured individual is able to appropriate a greater quantity to himself". Ricardo (1817) cites Lord Lauderdale, regarding the analysis of the value of water, "if it should be scarce, then the riches of the country and of individuals would be actually diminished inasmuch as it would be deprived of a portion of one of its enjoyments", and as he concludes, "not only would there be a different distribution of riches, but an actual loss of wealth" (Ricardo, 1817).

German philosopher Karl Marx, who was born in 1818 and died in 1883, publishes between 1867 and 1905, a set of four books which together are designated as "The Capital". Within the text that presents a prolix language, the author criticizes the work of a number of his predecessors. However, there is an agreement with some of their positions such as the acceptance of the labor theory of value and the focus given by Ricardo, which attributed a value to the time of labor, but not Smith's focus on the "value of labor". Marx is connected with authors with a socialist tendency. Considering that the contents of the four books were written in different periods and different stages of his life, philosophical, economic, social and political analyses are evidenced in his work.

Léon Walras was born in Normandy on December 16th 1834 and died on January 4th 1910. It is among the first authors to explore the possibility of establishing a study for "value" using a mathematical focus: "Since value in exchange is a magnitude that is measurable, and the object of mathematics is to study magnitudes, it follows naturally that the theory of value in exchange is a branch of mathematics, this far forgotten by mathematicians and still not elaborated, which is the theory of value in exchange" (Walras, 1874).

William Stanley Jevons, who was born on September 1st 1835 and died on August 13th, also deals with economic themes with greater mathematical focus. Referring to the term "value", Jevons (1871) points out: "I must, in the first place, point the thoroughly ambiguous and unscientific character of the term value. Adam Smith noticed the extreme difference of meaning between value in use and value in exchange; and it is usual for the best writers on Economy to caution their readers against the confusion to which they are liable. But I do not believe that either writers or readers can avoid the confusion so long as they used the word" (Jevons, 1871). The author emphasizes that, "thus I come to the conclusion that, in the use of the word value, three distinct meanings are habitually confused together, and require to be thus distinguished:

1. Value in use;
2. Esteem, or urgency of desire;
3. Ratio of exchange.

Jevons also highlights the existence of the concept of negative and zero values, according to the author, "yet there cannot be the least doubt that people often labour, or pay money to other labourers, in order to get rid of things, and they would not do this unless such things were hurtful, that is, had the opposite quality to utility - disutility" (Jevons, 1871).

Carl Menger, who was born on February 28th 1840 and died on February 26th 1921, brings to the economic literature a distinction between first order (consumption), second, third, and higher orders and complementary goods. Menger (1871) also reflected on the production systems, as observed in the excerpt: "However great these differences between the various branches of production may be, and even though the progress of civilization tends to diminish the uncertainty involved, it is certain that an appreciable degree of uncertainty regarding the quantity and quality of a product finally to be obtained will always be present, although sometimes to a greater and sometimes to a less extent, according to the nature of the case" (Menger, 1871). In consequence, the author explores the topic of demand and offer of goods. Regarding economic and non-economic goods, analyzing the variation of the flow of the water of a river throughout a year to supply a small village, observing the water as a non-economical good, he concludes: "under such circumstances, there is no practical necessity for any individual to secure a part of the whole sufficient to meet his requirements" (Menger, 1871). The author concludes that "... it is clear, accordingly, that all the various forms in which human economic activity expenses itself are absent in the case of goods whose available quantities are larger than the requirements for them, just as naturally as they will necessarily be present in the case of goods subject to the opposite quantitative relationship. Hence they are not objects of human economy, and for this reason we call them non-economic goods" (Menger, 1871). However, according to the author, "conversely it may happen that there are some goods that nature spontaneously produces in excess of those required by men, but for consumers who purchase the same economic if a despot excludes other economic entities of the free disposal of such property". According to Menger, "value is the importance which concrete goods, or quantities of goods, receive for us from the fact that we are conscious of being dependent on our disposal over them for the satisfaction of our wants" (Menger, 1871).

Alfred Marshall was born in England on July 26th 1842 and died on July 13th 1924, he organizes diverse economic concepts studied to date; the classification attributed to the term "goods", divided into external and internal, economic and collective can be highlighted. The seminal reference to "value" of a "free" natural resource can be underlined: "But the Thames has added more to the wealth of England than all its canals, and perhaps even its railroads. And though the Thames is a free gift of nature (except in so far as its navigation has been improved), while the canal is the work of man, yet we ought for many purposes to reckon the Thames a part of England's wealth" (Marshall, 1890). Specifically related to the concept of value, the author regards the theory established by Smith as partially correct, he states: "the value, that is the exchange value of one thing in terms of another at any place and time, is the amount of that second thing which can be got there and then in exchange for the first. Thus the term value is relative, and expresses the relation between two things at a particular place and time" (Marshall, 1890).

The Moravian economist Joseph Alois Schumpeter, born on February 8th 1883, died on January 8th 1950 in the US, published in 1909 a text that presented an analysis of the economic dynamics. Considering the possibility of observing the evolution of the events originated in the use of the discoveries of the beginning of the 19th century, such as the mechanic looms, the author listed aspects that contributed to a better understanding and entrepreneurial development. As verified in the excerpt: "The profit will fall to those individuals whose achievement it is to introduce the looms, whether they produce and use them, or whether they only produce or only use them. In our example the chief importance attaches to employment, but that is not essential. The introduction is achieved by founding new businesses, whether for production or for employment or for both. What have the individuals under consideration contributed to this? Only the will and the action? Not concrete goods, for they bought these – either from others or from themselves; not the purchasing power with which they bought, for they borrowed these – from others or, we also take account acquisition in earlier periods, from themselves. And what have they done? They have not accumulated any kind of goods, they have created no original means of production, but have employed existing means of production differently, more appropriately, more advantageously. They have 'carried out new combinations'. They are entrepreneurs" (Schumpeter, 1911). In the sequence of his study, Schumpeter (1911) addresses the issue of the value for new products, indicating that: "First of all a valuation must be made by producers: the value of new products must be compared with the value of the products, which the same means of production were producing until then on a normal circular flow. This valuation is perfectly necessary to make any estimation on the advantage of the new combination and without it no action would be possible" (Schumpeter, 1911).

During the first half of the 20th century, studies on the production resources and the concept of value do not present specific research, which would change dramatically the consolidated concept. However, after the Second World War, many authors focused on studies and theories that concluded that the creation of value had become essential to widening markets or even maintaining them. Peter Ferdinand Drucker was born in Vienna on November 19th 1909 and died on November 11th 2005. Drucker summarized the main thoughts of diverse studies and theories, which indicated the acknowledgement of the growing importance of intangible assets for the valuation of enterprises and their production as shown in the following excerpt: "The basic economic resource - the means of production - is no longer capital, nor natural resources, nor labour. It is and will be knowledge. The central wealth-creating activities will be neither the allocation of capital to productive uses nor 'labour'... Value is now created by 'productivity' and 'innovation', both applications of knowledge to work" (Drucker, 1995).

The speed of the changes that have occurred is intense. As a function of this intensification of the use of the natural resources and the growth of pollution levels and residuals generation, the number of investigations on the relationship between environment and industrial production has increased. At the end of the 20th century, studies about sustainable production can be highlighted. In consequence, a new way of observing the concept of value has emerged.

4 The Concept of Value for the Sustainable Production

As an increase of the speed of available transportation means has been observed, the outcome of the growing importance of knowledge has been the recognition on the need for studies on the utilization of production natural resources and the treatment of generated residuals through a new rationale. This new rationale aims to improve the quality of life for the planet inhabitants and the preservation of an appropriate environment and resources for the next generations.

The first scientist to formalize the existence of the "Greenhouse Effect" was French author Jean-Baptiste Joseph Fourier, who was born on March 21st 1768 and died on May 16th 1830. Fourier observed that, if the warmth of the Earth were only due to the incidence of direct sunlight, its temperature would be a lot inferior than the one usually registered, because the atmosphere captures the energy and recycles the energy emitted by the surface of the Earth.

Still in 1896, Svante August Arrhenius, working on studies that sought a more in-depth understanding of the events related to the ice ages, called attention upon the increased levels of carbon dioxide in the atmosphere and consequent temperature increases. However, as the aim of the research was connected with specific aspects of the Ice Age, his work did not get much attention from scientists.

Other researchers highlighted certain aspects related to the changes in the environment throughout the first half of the twentieth century. These discoveries received attention only after the publication by American scientist Charles David Keeling, born on April 20th 1928 and died on June 20th 2005, of the findings of his research, known as the Keeling Curve. It presented in 1961 the results of his investigation on the increase of the levels of carbon dioxide originated by human action. After this alert, main scientific institutions and important researchers began to develop new studies and monitor environmental indicators. Furthermore, organizations of a political nature expressed opinions on this emergent topic. Among the initiatives, the United Nations Conference on the Human Environment, which took place in Stockholm in 1972 and resulted in the Stockholm Declaration, can be underlined.

The global concern related to the publication of the results of other studies that indicated the occurrence of great environmental problems has brought growing concerns. Nevertheless, in spite of the acknowledgement of negative indicators, there was some resistance from certain political and business sectors. This was due to the belief that an environmentally correct production and behavior could generate the need for unforeseen investments and costs, resulting in a reduction of financial outcomes for the institutions involved in the economic processes. However, according to Hart and Milstein (2006) "the 1980s brought a growing sense of unease with command and control regulation. Despite enormous expenditures, it was not at all clear that the end-of-the-pipe approach to pollution control and regulation was working. Greening, which first appeared in the mid-1980s, was an important breakthrough, because it eliminated, once and for all, the myth that a trade-off exists between a firm's financial and societal performance".

For Ueda et al. (2009), "now is time to begin a new study of values toward a sustainable society… 'sustainable value' is an important concept that targets not only ecological sustainability but also social and economic values". For these authors, "it is desirable to realize a system in which both the overall purpose and individual happiness can be achieved concurrently through decision-making among various stakeholders. To this end, we must study values from various viewpoints: environmental, national, economic, ethical, and psychological viewpoints. Moreover, 'sustainable value' must be a synthetic value that is achievable through dynamic interaction among decision-making agents that have various goals and values" (Ueda et al., 2009). Hart and Milstein (2006) developed a model that directly combines the challenges of a globally sustainable society and the creation of value for enterprises: "the framework shows how the global challenges associated with sustainability - viewed through the appropriate business lens - can help identify strategies and practices that contribute to a more sustainable world while simultaneously driving shareholder value. This 'win-win' approach is defined as the creation of 'sustainable value' by the firm. There are four core dimensions of sustainability strategy with different linkages to firm performance and value creation:

- Pollution Prevention: minimizing waste and emissions from current facilities and operations;
- Product Stewardship: engaging stakeholders and managing the full life cycle of today's products;
- Clean Technology: developing and deploying 'next-generation' clean technologies; and
- Base of the Pyramid: co-creating new businesses to serve the unmet needs of the poor and underserved".

Porter and Kramer (2006) point toward the current priority for the business world leaders to establish their corporate strategies: "the mutual dependence of corporations and society implies that both business decisions and social policies must follow the principle of shared value". As observed in new studies, the new point of view has evolved from the concept of value creation to the concept of "co-creation" of value. A common place for society, environment and enterprises is envisaged. Similarly, Hutchins and Sutherland (2008) write: "the interrelationships among society, the environment, and economic/industrial development are integral to the concept of sustainability. In order to achieve sustainable development in

both industrialized and developing nations, we must characterize the connections and interactions among these three 'pillars' of sustainability. This is because a balance among the pillars cannot be achieved without an adequate understanding of how societal and industrial actions affect the environment or how today's decisions may impact future generations. Therefore, increased knowledge and awareness of the issues encompassed by sustainable development are needed".

The concept of value has changed since the studies of Adam Smith. This evolution can be observed in the table "Associations of the Types of Productive Operations with the Concept of Value over Time", which contains a summary of the profile of the evolution of industrial operations and productions factors and considerations on the environmental concerns in the analyzed periods. As initially reported, the industrial operations were based on the production factors, land, capital, human and natural resources; and yet they did not consider environmental aspects. As described by Say when the author pondered that air, water, sunlight did not possess any value; this was attributed as a function of the work, utility and scarcity. As time went by, there was an increase in the productivity of production factors, and, in consequence, gains in scale, technology was valued and knowledge was enhanced. The summary of the study on this evolution can be observed in the following table.

Table 2: Associations of the Types of Productive Operations with the Concept of Value over Time

Period	Beginning 19th century	End 19th century	Beginning 20th century	End 20th century
Operations	Industrial	Scale	Automated	Sustainable
Production Factors	Capital Human resources Natural resources	Increase in the productivity of the factors	The technology factor is incorporated	Ethics in the use of the factors
Environment	Not considered	First considerations	First records and effective studies	Setting a global agenda
Concept of Value	A Function of Work and a Function of Utility and Scarcity	A Function of Offer and Demand	A Function of Creation	A Function of Co-creation

5 Conclusion

Currently, a common direction is perceived among those who study and work with production management. The search for integration between society, environment and enterprises, and the use of a new rationale for the deployment of production factors, not only considering the valuation of resources in a specific place and time as established by Marshall, but considering the impact of the use of factors for the planet and society and also in the future. The immediatism indicated by Menger in the use and availability of concrete goods is abandoned, to pursue ways to assure that the future generations will have the potentialities of available means of production and will recognize the importance of knowledge. The healthy sharing of the environment by society and entrepreneurial organizations indicates the need to establish a new concept of value, which encompasses the possibility of co-creation of situations, goods and production means, to maintain the balance between different parties, and to consider the possibility of good quality of life for future generations and ours. Among the "despot" cited by Menger, the villains may be corruption, ignorance, and arrogance, lack of interest or greed of people, institutions and industries. The academic stream devoted to the production management may provide benefits to society if it studies new methodologies and production systems, which will include the goal of a world with sustainable operations. To make those responsible for the capital and resource administrators sympathetic, the need for new studies on the concept of value ought to be emphasized, showing the importance of aspects that have been otherwise sidelined, as the valuation or change of point of view related to non-economic assets/goods. Certainly, managers and entrepreneurs are familiar with the language that will allow them to determine numerically the advantages or disadvantages of operations.

Specially, regarding the concept of sustainable value, methodological procedures to attribute value to companies and stocks and shares, patrimonial valuation systems and lines of production or products should consider sustainability. As a result, they could be reviewed, and eventually, modified or even new valuation methods could be created. As occurred over 200 years, there will be diverse focus and points of view for the study of sustainable value. Nevertheless, it is a selective process, and incremental improvements will be integrated into the different analyses conducted by academics and researchers. These will certainly contribute with views of different sciences and areas of human knowledge.

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