

#### Publicação organizada pelo Programa de Mestrado Profissional *Stricto Sensu* em Engenharia Civil da Universidade São Judas

Volume 05 – 2022



# Sustainability 4.0

<sup>a</sup> Matheus Eurico Soares de Noronha, <sup>b</sup> Rosemeire Souza Vieira Silva, <sup>c</sup> José Carlos Rodrigues, <sup>d</sup> Lucas L F Valente, <sup>e</sup>Letícia Jahn Souza

<sup>a</sup> Escola Superior de Propaganda e Marketing - ESPM, São Paulo, (Brasil). E-mail: <u>math.euriconoronha@icloud.com</u> Orcid id: <u>https://orcid.org/0000-0003-4640-6690</u>

<sup>b</sup> Escola Superior de Propaganda e Marketing - ESPM, São Paulo, (Brasil). E-mail: <u>rose.v.silva@hotmail.com</u> Orcid id: <u>https://orcid.org/0000-0002-6260-6724</u> <sup>c</sup> Escola Superior de Propaganda e Marketing - ESPM, São Paulo, (Brasil). E-mail: <u>contato@jcrodrigues.com.br</u> Orcid id: <u>https://orcid.org/0000-0002-5003-8707</u>

<sup>d</sup> Universidade Anhembi Morumbi - UAM, São Paulo, (Brasil). E-mail: <u>crvgvalente@gmail.com</u> Orcid id: <u>https://orcid.org/0000-0002-7214-3188</u>

<sup>e</sup> Universidade do Estado de Santa Catarina - UDESC, Santa Catarina, (Brasil). E-mail: leticiajahn2019@gmail.com Orcid id: https://orcid.org/0000-0002-3518-0932

#### ABSTRACT

**Purpose**: This essay intends to address brief reflections on the fourth industrial revolution in order to explore its impact on sustainability.

**Theoretical Reference**: The theoretical lenses selected analyze the concept of sustainability and how the 4.0 revolution can contribute positively. As new opportunities arise to create a link between sustainability and technology, companies increase their profitability by eliminating inefficiencies in the manufacturing process while optimally using existing and available resources to create greater added value in offering services and products to the consumer.

**Method:** The study is a theoretical essay based on theories that cover the themes of the Sustainability Tripod and Industrial Revolution 4.0.

**Results and conclusion**: Based on the concept of industry 4.0, organizations have the opportunity to take advantage of existing and available resources to create greater added value in offering services and products to the consumer. The offer of sustainable solutions is indeed increasingly possible and can be infinitely benefited by a positive correlation with the so-called technologies of the 4.0 revolution, it is enough that we are effectively aware of the mistakes of our past and produce a present, future of the past, without ignoring it. them and/or repeat them.

Keywords: Industrial Revolution 4.0. Sustainability. Sustainability Tripod. Digitization.

# Sustentabilidade 4.0

#### RESUMO

**Objetivo:** Pretende-se neste ensaio abordar breves reflexões a respeito da quarta revolução industrial visando explorar seu impacto na sustentabilidade.

**Referencial teórico:** As lentes teóricas selecionadas analisam o conceito de sustentabilidade e como a revolução 4.0 pode contribuir positivamente. À medida que novas oportunidades surgem para criar um elo entre sustentabilidade e tecnologia, as empresas aumentam sua lucratividade eliminando ineficiências no processo fabril ao tempo que utilizam de forma otimizada recursos existentes e disponíveis para a criação de maior valor agregado na oferta de serviços e produtos ao consumidor.

**Método:** O estudo trata-se de um ensaio teórico com base nas teorias que abarcam os temas do Tripé da Sustentabilidade e Revolução Industrial 4.0.

**Resultados e conclusão:** Com base no conceito da indústria 4.0, as organizações têm oportunidade de aproveitar os recursos existentes e disponíveis para a criação de maior valor agregado na oferta de serviços e produtos ao consumidor. A oferta de soluções sustentáveis é sim cada vez mais possível e pode ser infinitamente beneficiada por uma correlação positiva com as chamadas tecnologias da revolução 4.0, basta que sejamos efetivamente conscientes dos erros do nosso passado e produzamos um presente, futuro do passado, sem ignorá-los e/ou repeti-los.

**Palavras-chave**: Revolução Industrial 4.0. Sustentabilidade. Tripé da Sustentabilidade. Digitalização.

https://doi.org/10.47842/juts.v5i1.51 ISSN: 2675-780X

1

Article info

Received 19 July 2022 Accepted 27 October 2022

#### Keywords

Industrial Revolution 4.0; Sustainability; Sustainability Tripod; Digitization

## Informações

Recebido 19 Julho 2022 Aceito 27 Outubro 2022

#### Palavras-chave

Revolução Industrial 4.0; Sustentabilidade: Tripé da Sustentabilidade; Digitalização

## **1. INTRODUCTION**

To the most inveterate classifiers, we traditionally know of three great technological revolutions that have fundamentally affected and changed those challenges that the new generations are imposing on their successors. To this same group belong the believers that we are living at this very moment the new great technological revolution, the so-called Fourth Revolution or Revolution 4.0, led by the new possibilities that the evolution of information technology and artificial intelligence creates for us.

The most inveterate classifiers have traditionally known 3 major technological revolutions that have fundamentally affected and changed these challenges that the new generations impose themselves on the successors. To this same group belong the believers who live at this very moment the new great technological revolution, the so-called Fourth Revolution or Revolution 4.0, led from the new possibilities that the evolution of computer science and artificial intelligence creates for us.

Among the more or less adepts of these nomenclatures and classifications, what we care about is to understand how in fact these novelties can impact our social organization, and for the present text, especially how they can affect the consumption model. In no way do we intend to have an exhaustive study of all verifiable correlations on the subject. diametrically, our proposal is much more positive than descriptive. Here we propose some brief reflections of what we can take advantage of this phenomenon for the sake of a noble goal: sustainability.

This essay is divided into three parts: in the first one some conceptual aspects of sustainability are presented. In the second, we discuss the 4.0 revolution, and in the third, the correlation between digitization and technology is addressed as fostering sustainable awareness and production with its dynamics supported by some practical examples.

#### 2. THEORETICAL FRAMEWORK

The theoretical lenses selected analyze the concept of sustainability and how the 4.0 revolution can contribute positively. As new opportunities arise to create a link between sustainability and technology, companies increase their profitability by eliminating inefficiencies in the manufacturing process as they optimally use existing and available resources to create greater added value in offering services and products to consumers.

## 2.1. The Sustainability

In a scenario of digitalization of processes and technological revolution, one can notice a growing trend, at least from the point of view of discourse, about the frenzy of organizations in search of productive efficiency, often through bets on the creation of startups and/or mobile apps that allow innovative proposals of behavior, consumption, practices based on the use of the same resources already existing and available to create products and services with higher added value (De Noronha et al., 2023; Thurner, 2015, p.24). The so-called sharing economy, unimaginable a few years ago, seems to have come to stay, even creating leviathans of the corporate world, for example, UBER, AirBNB, Blablacar, etc.

This first observation allows us to affirm that the processes of technological innovation and digitalization brought about by this new wave have a strong potential to contribute in economic, social, and environmental spheres. Solutions that bring visible benefits in these spheres are the ones that we can attribute the sustainable character (Severo, De Guimarães & Oliveira, 2022). For Portilho (2005, p. 36) and Jacobi (2003, p. 203), the sustainability can be practiced as a political and citizenship exercise people and organizations. between The sustainability consists of a tripod, thus represented by having 3 dimensions; social, economic and environmental (Elkington, 2001).

This tripod aims to serve as a parameter so that companies, people, and agents in general can evaluate their individual and collective contributions to an effective development that provides human dignity with equality to all citizens, guarantees the production of present wealth, and does not harm the access of future generations to natural resources.

Seen in these terms, Barbosa (2007, p.14) explains that in addition to the tripod of sustainability, sustainable practices in companies involve discussions such as sustainable development, corporate citizenship, corporate social responsibility, corporate social performance, social inclusion, among others.

Nakagawa (2012, p.47) illustrates that organizations that pursue good performance in sustainability actions should be ready to present the results of their practices to society and the market, and that the mechanism used by corporations is the annual sustainability report. Through indicators, sustainability reports show the results of companies in the social, economic and environmental dimensions. This type of document contributes to the expansion of dialogue and relationship between the main participants of the business environment that the company operates.

From the individual's point of view, practicing sustainability can involve several actions that are in the daily lives of people such as: preservation of vegetation areas, use of clean and renewable energies, mechanisms of energy efficiency, recycling and use of materials and exploitation of mineral resources in a controlled manner. According to Kotler (2010, p. 122), these sustainable practices drive organizations to turn their production processes focused on social and environmental concerns to help global problems (Anelli, 2020).

# 2.2. The industrial revolution 4.0

Making a tour in the line of thought of the so-called classifiers, we can verify that they understand that the transformations of industrial societies of the nineteenth and twentieth centuries culminated in the current computerized society (Capurro, 2010), whose social structure is formed thanks to communication and information technologies

Thus, today we would find ourselves in the age and in the information society, which can be understood by the crucial role that connectivity and consequent flow of information play in services (business, communication, finance), public administration (education, health) and intangible intellectual issues (knowledge-based economics), in what Floridi (2001) called infosphere, the need for understanding the surrounding environment, processing the information available and responding appropriately (Rodrigues, 2022).

This connectivity was the predecessor of what was coined as "Industrial Revolution 4.0", the term used to characterize a set of technological processes related to autonomy, efficiency, digitization and customization of value chains and product life cycles (Santos, Alberto, Lima & Charrua-Santos, 2018). This includes technological innovations related, for example, to the robotization and autonomous optimization of processes, internet of things and digitization of machines (Noronha *et al.*, 2022; Manyka, 2013, p.7).

These transformations revolutionize the forms of commercialization and promote

behavior changes in the spheres of production and consumption, and to what interests us, may contribute to the structuring and formation of more sustainable business models (Stock, Seliger, 2016, p. 536). New technologies have a recurrent impact on sectors such as health, energy, and construction, and are configured as a sum of intelligent processes that originate products and services whose goal is to generate comfort and quality of life associated with the management of existing resources (De Noronha, Ferraro, Longo & Melvin, 2022). The digitalization process triggers a formatting in the industrial models leading to the creation of new ways of doing business through artificial intelligence mechanisms, industrial automation, and different forms of data storage.

In this way, the process of technological innovation through digitization has the possibility of deconstructing and reformulating obsolete business models, which include those that do not establish a sustainable balance between productivity and the intelligent use of human and environmental resources for their productive purpose. (Diamantoulakis, Kapinas & Karagiannidis, 2015).

# **2.3.** Digitalization and technology as enablers of sustainable awareness and production

Technologies in general cannot be considered just tools, but also ways of receiving and providing society with values and interpretations of reality. Its relationship with sustainability has not always necessarily been positive. The vision that marked the first socalled industrial revolutions denied to the background the impacts of these technologies on the use of scarce resources, implementation of ample dignity and isonomy to people (in this way here is a cinematographic hint, Germinal) and sometimes even the economic viability of the ventures (which is modernly explained by what, in behavioral economics, is called sunk cost fallacy). Not much different, puts DiFelice (2013):

> "In the industrial era, with the advent of the steam machine, electricity and mass production, the analysis of the social function of media focused mainly on the studies of the processes of distribution and reproduction of the dominant ideology and capitalist mode of production. the subordinating the social function of communication to productive logic."

This focus on production - to the detriment of sustainable issues in their three-dimensional sense - lasted through the first three industrial revolutions, from the beginning of mechanization with the steam engines of the 18th century, through the assembly lines and the transformation of mechanical energy into electrical energy of the 19th and 20th centuries, to the automation technology of the 20th century.

However, the nature of what is considered the 4th industrial revolution, where there is greater integration between the physical/biological and the virtual/artificial, aligned with a concomitant environment of greater diffusion of information, access to information, brings with it the search not only for a productive increase, but that it exists in a way that does not torment the conscience of the users of the product (Rodrigues, 2018).

See, in times of information control what was allowed to reach the consumer about the benefits of a particular product were limited to what the available means of information at the time wanted to show him. This same product, in the current market, should be shown to consumers with much broader awareness than what is commercially shown to it, but with the potential for the very low costs to obtain numerous information about the product it consumes.

The research by Schules and Cleto (2017, p.7) shows that this technological revolution has a direct contribution in the three dimensions of sustainability (tripod of sustainability): economic, environmental and social. In the social dimension, this connection can be illustrated in the creation of new professions and in the qualification of professionals, greater autonomy and flexibility in relation to social and professional life, even through the inclusion

of gender and social classes in the labor market. In the economic dimension an increase the productivity and revenues in of organizations, investment in research and development, greater consumer participation in value chains and productive efficiency. In the environmental dimension, a more efficient use in energy consumption, mitigation of pollutants and waste to the environment, reuse of natural resources, contribution to global agendas and climate targets (Noronha, Benfatti, Themoteo & Gannoum, 2021).

The 4.0 revolution can also be articulated as a facilitating tool for social, political and environmental debates, expanding and transforming market opportunities with the function of modifying the way they consume and produce, and assist the different types of public in their choices as consumers.

It is in this context that technological advances can help meet the demand for responsible consumption; understood as a consumption practice that avoids exploiting society and the resources of the environment. The responsible consumption is consolidated as a form of response to pressure from environmental groups, social, governmental and media movements (Fontenelle, 2017, p. 142).

Car sharing, the choice of a renewable energy type, online thrift store applications, 3D printing are actions derived from scanning processes and technology that naturally drive the path to more responsible consumption and in line with greater consumer autonomy over their choices in different markets (De Noronha, Martins, Lietti & Silva, 2022). This autonomy reverberates in several possibilities of choosing more customized services, more engaged in technological, social and environmental issues (Manyika, 2013, p. 14), where brands and organizations that meet the criteria of technological development and sustainability begin to win the trust of their consumers.

For example, Nike through an app named Making of Making has developed a Materials Sustainability Index (MSI), which serves as a reference guide, presenting the materials as energy used and water consumption for the creation of products with the aim of inspiring entrepreneurs to choose more sustainable materials that cause less impact to the environment.

This technological movement has encouraged companies from different sectors to seek better economic and sustainable performance, consolidating business practices through technology that seek the balance between natural resource management and obtaining profits for companies.

Through artificial intelligence, some companies have identified niche markets and ways to contribute to sustainability and responsible consumption of natural resources. Microsoft recently created the artificial intelligence program called AI for Earth that provides computing resources from the cloud to organizations looking to transform the way they manage the earth's natural resources. The tool can be used to diagnose water, air and soil conditions by capturing data and information for the development of more sustainable solutions, having as fronts of action, in principle, four

main areas: agriculture, water, biodiversity and climate change.

In the renewable energy sector in Brazil, from intelligent information systems and big data, it has been possible to contribute to issues such as distributed generation, free market and a more diversified energy matrix aiming against a centralized and obsolete model of power generation, transmission and distribution.

These disruptive innovations are directly linked to the ordinary concepts of sustainability; have the least environmental impact, provide a social good and be economically viable.

Despite technological advances, there is still resistance from certain consumer sectors and some industries and production chains. According to the Akatu Institute (2013, p.79), 45% of people who have been questioned about sustainable products said that consuming this

type of product is more expensive and that their budgets do not include spending with it. Additionally, 42% also stated that consuming more responsibly is consuming less. But solutions to these vieses are also sprouting.

Some organizations develop solutions to guide their consumers to buy more rationally and with better cost benefit, the GoodGuide is a platform that provides data and information about various types of products, where it is possible to access, for example, the existence of toxic substances or the socio-environmental impact of a given brand, impacting consumer decision-making and stimulating more responsible consumption.

Through the technological revolution and application creation, there is the beginning of the deconstruction that sustainable is more expensive, seen, for example, in the economy of sharing, a scenario where insums are shared among consumers, reducing idle use time. Carsharing or ride-sharing services optimize vehicle occupancy while reducing the cost of idleness (space or use) and, consequently, reduce the underutilized consumption of another vehicle (De Noronha, Silva, Sauer & da Silva, 2022). A shared ride, for example, contributes to reducing the costs of drivers and passengers, reducing cars on the streets and mitigating pollutants that are emitted by these cars. By not having to bear Eurico Soares De Noronha, M.; Souza Vieira Silva, R.; Rodrigues, J. C.; L F Valente, L.; Jahn Souza, L. (2022). Sustainability 4.0. Journal of Urban Technology and Sustainability, *5*(1), e51. https://doi.org/10.47842/juts.v5i1.51

the cost of idleness, the total cost is reduced (Rodrigues, 2018).

## **3. CONCLUSION**

The central objective of the essay that we produced here is to demonstrate the window of opportunity that is found, provided that efforts are directed to objectives, said, noble.

While opportunities arise to create a link between sustainability and technology, a number of key challenges for sustainable industrial advancement are also identified. The challenges of this technological scenario include barriers in market regulation, technology cost, technical training and obsolete business models that make it impossible to advance digitization in the different sectors where sustainability permeates.

Based on the industry 4.0 concept, organizations have the opportunity to leverage existing and available resources to create greater added value in offering services and products to consumers. Renting a car shared by an app, booking a hotel or apartment online and even selling and buying the energy that is used at home by mobile phone are technological solutions that have provided an efficiency savings with the use of the same resources to create greater value collaborating with social, economic and environmental issues related to sustainability.

However, historical experience shows us that the mere technological advance is not for itself the development of sustainable solutions, these solutions are effectively born from the consumer's consciousness in order to create demand with the producer market for such solutions.

The offer of sustainable solutions are increasingly possible and can be infinitely benefited by a positive correlation with the socalled technologies of the 4.0 revolution, it is enough that we are effectively aware of the mistakes of our past and produce a present, future of the past, without ignoring and/or repeating them.

#### REFERENCES

Anelli, R. L. S. (2020). As cidades e o aquecimento global: desafios para o planejamento urbano, as engenharias e as ciências sociais e básicas. *Journal of Urban Technology and Sustainability*, 3(1), 4–17. https://doi.org/10.47842/juts.v3i1.17

Akatu, Pesquisa. Rumo à Sociedade do Bem-Estar: Assimilação e Perspectivas do Consumo Consciente no Brasil–Percepção da Responsabilidade Social Empresarial pelo Consumidor Brasileiro. Recuperado em 22, dez. 2022.

https://assets.publishing.service.gov.uk/media/5 7a08a46e5274a27b20004f9/60956\_Sumario\_Pe swuisaakatu.pdf

Índice de Barbosa, P. R. A. (2007). sustentabilidade empresarial da bolsa de valores de São Paulo (ISE-BOVESPA): exame da adequação referência como para aperfeiçoamento da gestão sustentável das empresas e para formação de carteiras de investimento orientadas por princípios de sustentabilidade corporativa. 2007. Dissertação (Mestrado em Administração) Universidade Federal do Rio de Janeiro - UFRJ, Instituto COPPEAD de Administração.

Capurro, R. (2010). Desafíos teóricos y prácticos de la ética intercultural de la información. In Conferência inaugural en el I Simpósio Brasileiro de Ética da Informação, João Pessoa (Vol. 18).

De Noronha, M. E. S., Camacho, G. B. C., Neves, J. B., & Lietti, T. (2023). O papel do Investimento Direto Estrangeiro para o desenvolvimento da Capacidade Inovadora na Indústria de Energia Eólica Offshore Brasileira. Internext, 18(1).

De Noronha, M. E. S., Ferraro, D. M., Longo, L. R., & Melvin, S. S. (2022). The orchestration of dynamic capabilities in cleantech companies. Innovation & Management Review, (ahead-ofprint). <u>https://doi.org/10.1108/INMR-08-2021-0144</u>

4

Eurico Soares De Noronha, M.; Souza Vieira Silva, R.; Rodrigues, J. C.; L F Valente, L.; Jahn Souza, L. (2022). Sustainability 4.0. Journal of Urban Technology and Sustainability, *5*(1), e51. https://doi.org/10.47842/juts.v5i1.51

De Noronha, M. E. S., Martins, J. B. N., Lietti, T., & Silva, R. D. S. V. (2022). A agilidade organizacional e a difusão de inovação tecnológica das empresas cleantech. Revista Inteligência Competitiva, 12(1), e0412-e0412.

De Noronha, M. E. S., Silva, R., Sauer, P. G., & da Silva, P. B. (2022). Economia da Informação na Indústria 4.0. Retail Management Review, 2(1), e17-e17. https://doi.org/10.53946/rmr.v2i1.17

Di Felice, M. (2013). Ser redes: o formismo digital dos movimentos net-ativistas. Matrizes, 7(2), 49-71.

Diamantoulakis, P. D., Kapinas, V. M., & Karagiannidis, G. K. (2015). Big data analytics for dynamic energy management in smart grids. Big Data Research, 2(3), 94-101.

Elkington, J. (2001). Sustentabilidade Canibais Com Garfo e Faca: Triple botton line. São Paulo: M. Books.

Floridi, L. (2002). Information ethics: an environmental approach to the digital divide. Philosophy in the Contemporary World, 9(1), 39-45.

Fontenelle, I. A. (2017). Cultura do consumo: fundamentos e formas contemporâneas. (1a ed.). Rio de janeiro: Editora FGV.

Jacobi, P. (2003). Educação ambiental, cidadania e sustentabilidade. Cadernos de pesquisa, 189-206.

Kagermann, H., Lukas, W. D., & Wahlster, W. (2011). Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur 4. industriellen Revolution. VDI nachrichten, 13(1), 2-3.

Kotler, P., Kartajaya, H., & Setiawan, I. (2010). Marketing 3.0: as forças que estão definindo o novo marketing centrado no ser humano. Elsevier.

Manyika, J., Chui, M., Bughin, J., Dobbs, R., Bisson, P., & Marrs, A. (2013). Disruptive technologies: Advances that will transform life, business, and the global economy (Vol. 180, pp. 17-21). San Francisco, CA: McKinsey Global Institute.

Nakagawa, M. H. (2012). A sustentabilidade na estratégia de negócio das empresas brasileiras. Dissertação (Mestrado em Administração) Programa de Estudos Pós-Graduados em Administração, Pontifícia Universidade Católica de São Paulo, SP, Brasil.

Noronha, M. E. S., Hayashi, V. T., Silva, L. O. E. D., & Lima, M. N. (2022). A vantagem competitiva das empresas cleantechs e o desenvolvimento de capacidades dinâmicas utilizando internet das coisas. REAd. Revista Eletrônica de Administração (Porto Alegre), 28, 455-486.

Noronha, M., Benfatti, G., Themoteo, A., & Gannoum, E. (2021). O papel do ecossistema de inovação e a estruturação de um arcabouço regulatório para o mercado de energia eólica offshore no Brasil. International Journal of Business Marketing, 6(2), 32-51.

Portilho, F. (2005). Consumo sustentável: limites e possibilidades de ambientalização e politização das práticas de consumo. Cadernos Ebape. br, 3, 01-12. Recuperado em 20 de dez. 2022, de:

https://www.scielo.br/j/cebape/a/4PXXtKW5Fn k9jmJgRcnCScJ/abstract/?lang=pt

Rodrigues, F. N., Ramos, H. R., Kniess, C. T., & Caruggi-De-Faria, L. (2018). Avaliação da viabilidade de investimento para instalação de um sistema fotovoltaico em residência unifamiliar na cidade de São Paulo–SP. *Journal of Urban Technology and Sustainability*, *1*(1), 28-38. <u>https://doi.org/10.47842/juts.v5i1.50</u>

Rodrigues, J. C. (2018). Autonomous cars, from "ownership" to "usage": how autonomous vehicles might corrupt automotive industry's business model. In Gerpisa colloquium, São Paulo-Brasil. GERPISA-The International Network of Automobile. École Normal Supérieure Paris-Saclay.

Rodrigues, L. D. S. G., Senna, P., & Marujo, L. G. (2022). Estratégia omnichannel na

5

Eurico Soares De Noronha, M.; Souza Vieira Silva, R.; Rodrigues, J. C.; L F Valente, L.; Jahn Souza, L. (2022). Sustainability 4.0. Journal of Urban Technology and Sustainability, *5*(1), e51. https://doi.org/10.47842/juts.v5i1.51

perspectiva da economia circular: uma estrutura conceitual. Journal of Urban Technology and Sustainability, 5(1), e50-e50. https://doi.org/10.47842/juts.v5i1.50

Santos, B. P., Alberto, A., Lima, T. D. F. M., & Charrua-Santos, F. M. B. (2018). Indústria 4.0: desafios e oportunidades. Revista Produção e Desenvolvimento, 4(1), 111-124.

Severo, E. A., De Guimarães, J. C. F., & da Silva Oliveira, N. Q. (2022). Sustainable development goals towards eco-innovation: A survey Brazil. Journal of Urban Technology and Sustainability, 5(1), e41-e41. Stock, T., & Seliger, G. (2016). Opportunities of sustainable manufacturing in industry 4.0. procedia CIRP, 40, 536-541.

Thurner, BDV (2015). Empreendedorismo e Inovação: a influência das Startups no crescimento econômico. Dissertação (Mestrado em Administração) Programa de Pós-Graduação em Engenharia de Produção, Universidade federal de santa maria centro de tecnologia, Santa Maria, RS, Brasil.

6