Digitalization Associated Circular Economy

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The concept of a circular economy (CE) designates a comprehensive approach towards sustainable development, conceived with the aim of putting together and strengthening the community, businesses and the environment. Despite becoming a stereotypical term in the literature, from the late 1970s to the present day, various researchers have paid attention to different facets of CE while striving to reach a consensus on the most appropriate way of defining it. In the context of new business models focused on circularity principles, cloud computing denotes an IT service model that gives access to a common pool of customizable computing assets, such as databases, networks, servers, storage capabilities, applications, etc., which can be instantaneously provided to costumers on their request through the Internet, irrespective of their location or accessing devices. Cloud technologies frequently show high levels of comprehensibility and their development represents a fairly easy process; therefore, they are extremely widespread among SMEs. Cloud solutions cand contribute to promoting circularity principles through varoius ways: improving the energy efficiency, decreasing in carbon footprints, facilitating e-waste management practices and lowering of operational costs.

digitalization circular economy energy efficiency carbon footprint e-waste SMEs

1. Introduction

The SMEs sector is widely recognized as the backbone of the sustainable development of the entire economic system of the European region. Recent statistics released by the European Commission support this statement, showing that, in 2020, over 21 million SMEs were operating in the EU-27 area, accounting for 99.8% of all the enterprises active in the non-financial business sector. Moreover, 57% of the value added and 65% of the jobs were generated by small EU-27 businesses in 2020 [1]. The retail and wholesale branch represents a fast-growing and labor-intensive sector which provides 11% of the European Union's total GDP. The field is also a significant generator of job opportunities: 33 million employees earn their living from serving the retail and wholesale domain. Likewise, the same field creates an additional few million jobs through the whole of the supply chain components from small domestic enterprises to multinationals [2]. Over 33% of European enterprises (i.e., approximately 6 million firms) operate in retail and wholesale domains, and no less than 99% of them are small businesses.

In Romania, SMEs account for 99.7% of the total proportion of active businesses and 66.1% of the total employment; 55.9% from the total added value generated by the Romanian economic system originates from the SME sector. The most prominent SMEs in Romania are active in the fields of wholesale and retail trade and manufacturing. These domains together cover nearly half of the value added generated by the entire Romanian SME sector, and exceed 50% of the total SMEs' employment creation [3][4][5].

By implementing the sustainable supply chain management concept in the business strategies of wholesalers, it can be highlighted two major trends that can facilitate rapid growth rates: the mutation towards CE and digitalization. Wholesalers and retailers occupy an important place in disseminating CE practices due to their permanent contacts with suppliers and end consumers. Thus, CE-related practices pursuing the decrease in carbon footprint, the optimization of energy consumption in logistics, the employment of renewable energy alternatives, the increase in using waste management modern methods within distribution centers, etc., become increasingly common among the wholesalers. On the other hand, the unprecedented proliferation of digital tools encompassing the supply chain has forced wholesalers to reconfigure their business model in order to allow work to be undertaken across frontiers of time, space or functions, providing continuous services to their customers. Although the abovementioned trends were predetermined in the pre-pandemic era, the COVID-19 crisis has brought about the rapid acceleration of CE practices and digitization phenomena, which were expected to respond to the shortcomings which occurred in supply chain functioning [6].

Thus, the COVID-19 pandemic has brought about overwhelming constraints for SMEs from across the globe, while they were striving to cope with unpredictable burdens provoked by the health crisis. Governmental interventions addressing the COVID-19 outbreak predominantly took the shape of various restrictions such as compulsory social distancing, lockdown policies, quarantine rules, changes in work patterns and practices, temporarily shutdowns of business processes involving employees' physical presence, etc. [7][8]. Such regulations were able to reverse the fast-growing trend exhibited in the pre-pandemic era by SMEs both from developed and emerging economies. Under the circumstances, these entities were forced to face a sudden crisis with miscellaneous effects regarding the narrowing of business opportunities, the worsening of their financial performance, the adjustability of the staff headcount to the variable scale of their business operations, supply chain interruptions, etc. [9][10].

Despite the high level of inconsistency of the business environment, the inherent stage of chaos and amateurism was overcome by the end of 2020, and the majority of managers moved towards the stage of strategic planning. In their attempt to develop new long-term reinforcing strategies, entrepreneurs became aware that beyond the numerous drawbacks of the pandemic, a few significant opportunities showed themselves as innovatory approaches that deserve to be brought to the forefront of scholars' and practitioners' debates in the years to come [11]. Prevalent digital technologies call into question the very roots of traditional business models that require large-scale transformations, such as: (a) the emergence of virtual products and services; (b) the foundation of innovative digital business; (c) the adjustments undergone by industrial structures; (c) the reconstruction of value-delivering patterns; (d) the redefining of the business scope in order to address the "not yet covered demands" of clients, etc. [12]. The literature bears witness to the process of *business model reinvention* with the incorporation of digital technologies in operations related to value creation and confinement [13].

Acknowledging both the substantial contribution of the wholesale trade sector to Europe's economy and the opportunities brought about by the fast-paced digitalization trend and the circular economy goals, the focus encompasses a performance-based analysis of Romanian SMEs which operate in trade field, supported by a case study of a small company implementing a digital business solution in order to face the challenges of the pandemic and to shift towards circular economy practices.

2. The Circular Economy and the Sustainable Supply Chain

The concept of a circular economy (CE) designates a comprehensive approach towards sustainable development, conceived with the aim of putting together and strengthening the community, businesses and the environment. Despite becoming a stereotypical term in the literature, from the late 1970s to the present day, various researchers have paid attention to different facets of CE while striving to reach a consensus on the most appropriate way of defining it. Debates on the issue are still running their course [14][15][16].

Thus, the CE is perceived as an unconventional alternative to the so-called “linear economy” based on extracting raw materials from the nature, producing something out of it and then disposing the entire output (i.e., the “take–make–waste” formula) [16][17][18]. The new system calls into requisition the principles of reusing, regenerating, recycling, reducing, etc., materials or products, which slowly tend to replace the traditional “end-of-life” approach while generating new value-creating alternatives for businesses of all sizes and spheres. Through its own functioning mechanism, the CE system enables permanent material flow, thus becoming a closed loop [19]. The linear economic system is transposed in a circular model by emphasizing the nexus established between resource usage and waste removal through innovative business solutions that involve material recycling, the use of renewable sources of energy, the employment of Internet 4.0 technologies, the switch from traditional products to new products-as-a-service, etc. From the standpoint of the CE, the process of value creation is placed within the framework of a larger and holistic perspective as compared with the traditional approach and it is focused on the need to ameliorate the environmental, social and economic performance both at micro- and macro-levels [20][21].

Supply chain management represents a concept that reunites manufacturers, governmental institutions, suppliers, distributors, retailers, warehouses and other economic entities in such a manner that products can be offered and distributed in the appropriate amount, at the right place and at the right moment under the circumstances of reducing optimizing costs and satisfying consumers’ demands [22][23]. More recently coined, green supply management involves the “green” concept into the architecture of supply chain management from product manufacturing to raw material procurement, to warehousing, inventory management and distribution in the view of end-of-life management of the products and services [24].

The early stages of developing the CE concept revealed a significant body of research focused on issues such as: constructing the architecture of the new business models; describing circular business innovation models; identifying catalysts and barriers of adopting CE practices; comprehending the stakeholders’ perspective on CE development, exploring the reconfiguration of supply management strategies in order to comply with CE requirements, etc. [20][25][26][27].

The scientific literature on CE issues has evolved over the past few years with the help of empirical research initially undertaken in some specific fields that were closer to engineering sciences than to the business administration domain, such as industrial ecology, production economics, waste management, renewable energy efficiency, operation research, smart city development, etc. [26][28][29][30][31][32][33][34].

An interesting conceptual framework was constructed in the literature by Bressanelli et al. [35] based on their empirical investigations on the issue of assimilating the Internet of Things (IoT) and Big Data and Analytics to underpin the application of CE principles within companies' supply chains. The researchers were able to establish three factors that are likely to bear testimony to the process of CE value creation: increased efficiency regarding resource usage, considerable lifespan extension for products and services, and closing the loop alternatives (repairing, recycling, remanufacturing options, etc.).

Thus, SME wholesalers can bring a significant contribution to CE implementation due to their specific position along the distribution supply chain [36]. In their day-to-day work, wholesalers target CE-related goals such as: supporting the low-carbon economy; intensifying green purchasing activities; increasing the level of their efficiency in logistic activities; developing new packaging solutions with the lowest environmental impact; implementing efficient waste management practices; improving the energy efficiency of their buildings, etc. These processes imply intense collaboration between the wholesalers and their suppliers and customers (regardless of whether they are B2B customers or en-customers). To be more specific, these components of the supply chain must carry out common planning, organizing and controlling endeavors with the aim of the effective coordination of information, capital and knowledge while implementing CE principles [24]. At the center of this functioning mechanism, wholesalers play a crucial role in accelerating the process of embracing CE practices.

Although the manifestation of unprecedented technological transformations that prefigured the global spread of the roots of the digital economy has received a great deal of attention in the literature since the 1990s [37][38][39], the post-pandemic recovery will be focused on digitalization and CE practices, as major prerequisites of reshaping the traditional paradigm in economics [40].

3. Digitalization Trends and the Circular Economy

Numerous studies in the literature have indicated digitalization to be a catalyst of CE implementation for manifold rationales [17][35][41][42][43][44][45]. Firstly, inside the boundaries of a CE business model, durable products could be accessed, rented or shared extensively in any place possible. In other words, the mutation towards product service systems (PSSs) is frequently mentioned in the literature as being one of the main alternatives that could pave the way towards the integrated implementation of CE and digitalization, the last one being viewed as a major impetus in the process [43][44]. PSSs can transmute attention from the classical manner of selling products to the selling of a set of values or advantages adjusted to costumers' needs with the help of a mix of products and services that exert a lower impact upon the environment, as compared with the traditional approach.

Secondly, the employment of Internet 4.0 tools, such as Smart Services, e-Commerce, digitized green mutation strengthened by 5G technology, cloud computing, Big Data analysis, Internet of Things (IoT), virtual reality, etc., will transmute the very pillars of the traditional business model [46][47][48], revealing tremendous quantifiable benefits. Thus, the CE often conveys a higher-level capital and technology intensity associated with a diminished degree of workforce involvement in routine activities, resulting in a greater level of involvement in the circularity-based decision-making processes. Furthermore, the digital transformation is viewed as a pivotal enabler for CE business

model adoption, because it shows a huge potential to enhance visibility and bring smartness into assets and products [49][50][51][52][53].

CE-orientated business practices are expected to strengthen the level of performance and to open new doors in exploiting market niches that manifest themselves more and more frequently. In the context of new business models focused on circularity principles, cloud computing denotes an IT service model that gives access to a common pool of customizable computing assets, such as databases, networks, servers, storage capabilities, applications, etc., which can be instantaneously provided to costumers on their request through the Internet, irrespective of their location or accessing devices [45][51][54]. The innovation behind the concept of cloud computing resides in the opportunity of delivering IT services as utilities, by the same token as other public utilities are provided (water, gas and energy, for instance) [23][55].

For instance, the employment of enterprise resource planning (ERP) systems can help companies strengthen integration both with suppliers and with consumers. Under the circumstances, the entrepreneur can achieve significant cost savings related to the acquisition of IT infrastructure, pre-and/or post-support operations, security issues, maintenance services, etc. Cloud technologies frequently show high levels of comprehensibility and their development represents a fairly easy process; therefore, they are extremely widespread among SMEs. The main impacts of cloud computing solutions on fostering circularity practices are represented by: the energy efficiency improvement; the decrease in carbon footprints; the facilitation of e-waste management practices and the lowering of operational costs.

From the energy efficiency standpoint, by substituting high-powered computers with low-power devices, one can optimize the level of energy consumption. To this end, the main solutions that can be put into practice can vary from simple methods, such as providing effective energy management for the servers that are used in the cloud (by activating/deactivating or putting them in the sleeping of hibernating mode), to more complex approaches, such as the employment of virtualization techniques in order to improve resource administration. Furthermore, the literature puts forward various approaches that can be taken into account on the long run, from the use of alternative energy sources in daily operations to the redesigning of the architecture of company's buildings in such a manner that maximum energy efficiency with minimum environmental effects can be reached.

Another direction of promoting CE practices through cloud ERP is represented by decreases in carbon footprints [56][57][58]. There is a significant body of literature which addresses the issue of CO_2 emissions as a proxy for measuring cloud computing contribution to sustainability. Frequently, the carbon footprint issue is approached form the point of view of its direct or indirect relationship with the optimization of energy consumption. The advantages brought about through cloud computing employment by enterprises from the SME sector, with respect to energy efficiency and decreasing carbon emissions, were also put forward by Williams et al. [59]. The researchers established a mathematical model in order to assess the impact of the wide-range adoption of cloud computing solutions in 11 countries across the globe, with the highest degree of cloud penetration (over 80%). It turned out that approximately 4.5 million tons of CO_2 emissions could be mitigated in the analyzed countries through a massive adoption of cloud computing solutions. Moreover, 60% of the total savings could be attributed to small

businesses' influence. In addition to the significant macro-level impact, the move towards green computing yields, in the long run and at the micro level, various indirect benefits, such as: augmented levels of operational efficiency, workforce reductions, accurate customized services, appropriate brand development, high purchase conversion rates, etc., which can give rise to significant improvements in performance indicators [60].

The substantial lowering of operational costs represents another important positive outcome of embracing cloud computing services by small businesses. The main drivers that entail important cost decreases refer to reduced investments in infrastructure and diminished energy-related expenses. However, reduced infrastructure positively impacts the environment as it produces less electronic waste (e-waste) yielded by small enterprises as frequent costumers of cloud computing services. In order to achieve the minimum level of operational costs, many researchers proposed a few innovative technical solutions targeting the programming of servers' workloads in relation with their running costs [61][62].

The term "e-waste" refers to electronic products that have reached the end of their life cycle; thus, they have become out-of-fashion, dispensable or unproductive. However, they can serve as raw materials for other industries, especially because various electronic components have a high susceptibility of turning into waste, as a consequence of the speed of technological progress [63]. E-waste diminishing by fostering both IT equipment recycling and the reuse of components stands as an essential prerequisite for a small business that embraces circularity principles.

Furthermore, by implementing advanced IT tools, wholesalers will find it more easy to collect, monitor and analyze products' and services' performance data. Thus, information regarding the availability of share-used products, which are distributed via digital platforms, can considerably improve waste management and support recycling or remanufacturing operations [41][43].

On the other hand, ERP will allow wholesalers to rapidly act in response to their costumers' exigencies with respect to the sustainability of the supply chain. Thus, the distributor will utilize various tactics in order to meet consumers' demands, such as designing new ways of adding value to their products or conceiving new ways of satisfying consumers' requirements [64]. Moreover, IT tools have led to the emergence of a new generation of better-informed and wiser costumers who are willing to provide valuable feedback on their buying experiences by interacting with distributors and performing comparisons and balances on modern products and services [45][51][54]. Subsequently, push-driven marketing practices, which were focused on the spreading of various messages to consumers, became rather outdated, and marketers evolved to preponderant cooperative business structures which incorporate distributors as the very core ingredient of the new business model [23].

ERP solutions, as well as supply chain management, act together as efficient instruments which are able to determine significant improvements in company performance levels [65][66]. Tarigan et al. argue that, in this context, market performance and financial performance are the main dimensions that could be used in order to provide insights to the overall performance levels reached by a component of the supply chain [64]. Market performance assesses the company's capacity to gain and consolidate a relatively steady market share through sales revenues,

market share growth or the return on sales (ROS). The main proxies which were used in the literature in order to assess company's financial performance make reference to revenues, the average profit, the profit growth or the profitability ratios—return on assets, return on equity, return on expenditures, etc. [64][67][68]. In the same vein, recent studies on the nexus between CE practices and financial performance emphasize manifold ways of improving profitability indicators both by minimizing cost levels (through increasing the level of efficiency in the use of resources) and by boosting revenues, due to gaining access to new market segments [69][70][71][72].

According to the country report *Digital Economy and Society Index (DESI) 2021-Romania* released by the European Commission, Romania ranks last among 27 EU member states in terms of digital adoption [73]. The Western region, which also includes Hunedoara County, follows the same pattern occurring at national level in terms of the degree of assimilation of digital business technologies and processes. Therefore, in accordance with the *Territorial Just Transition Plan* elaborated for Romania, digitalization—understood as a key enabler towards the sustainable development of CE—follows an alarmingly slow assimilation rhythm and is not capable of behaving, under such circumstances, as a real support for the regional and local economy [74].

Analysis of the digitalizing needs of the companies in the Western region, carried out by the *Western Region Development Agency* at the end of 2021, showed an index of companies' digitalization levels of only 56.32 in the county of Hunedoara, as compared with the average regional calculated value—57.86. Taking into consideration that the values of the index range between 0 and 100, it have been analyzed the situation of digitalization per sectors of activity at regional level; thus, the most digitalized fields were as follows: the financial field (69.73), followed by education (69.33) and information–communication (67.61). At the other end, the lowest digitalization rates were calculated for agriculture (37.74), real estate (43.69) and construction (44.68). Exhibiting an index of 59.83, *wholesale and retail trade* holds a median position in this ranking despite the amazing opportunities the health crisis made available for the entrepreneurs in this field in order to hugely migrate towards the online environment [75]. In addition, 27% of SMEs carried out at the level of the Western region obtained less than 10% of their turnover from online activities, whereas almost 30% did not receive any income from e-commerce.

SMEs seem to encounter greater challenges than large companies in terms of enhancing the sustainability of their operations through innovative business strategies. However, despite the cancellation of their business orders or contracts due to the pandemic, studies have shown that certain SMEs that incorporated digital tools were able to implement innovative strategies that enabled them to soar to growth rate levels twice as high as other small businesses that did not embrace new technologies [76].

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