Peer-reviewed version available at Sustainability 2018, 10, 4428; doi:10.3390/su10124428

Type of the Paper (Article)

Transformative sustainable business models in the light of the digital imperative – a global business economics perspective

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Abstract: We examine how external triggers, including the digital imperative and the need for more sustainable resource and stakeholder employment, spark the development of transformative sustainable business models. Drawing on the resource-based view and the shared value approach we conceptualize a multifaceted framework that helps to identify key determinants and coherent layers of transformative sustainable businesses models. Our theoretical arguments integrate recent research findings on external dynamics, such as digital technological advances and rising global competitive dynamics, with internal capabilities on both the organizational and the individual level, allowing for a more complete understanding of transformative potentials on the firm level. We propose that key determinants of sustainable transformative business models adhere to both, innovative value-creating reconstructionist and sustainable shared-value logic, and include elements such as co-creation with customers, usage-based pricing, agile and adaptive behavior, closed-loop resource employment, asset-sharing, and collaborative business ecosystems. At the same time, organizational, economic, and environmental layers encompassing sustainable business models need to be both horizontally and vertically coherent to unfold their full potential.

Keywords: sustainable transformative business model; shared-value, digitization; innovation management; dynamic capabilities; transformation management; resource based view

1. Introduction

Achieving digital sustainable environments pose major challenges to societies today [1]. A retrospective glimpse on the history of technology reveals that after tens of thousands of years of rather slow development, a number of ground-breaking ideas eventually allowed for programmable computing machines and seemingly unlimited digital storage capacity of data [1]. Three times in the past 50 years information technology radically reshaped competition and business strategy [2-4]. At the same time, business has increasingly be viewed as being a major cause of social, environmental, and economic distress. While definitions of corporate sustainability are widespread and varied [68], corporate ecological sustainability can be articulated through the concepts of total quality environmental management, ecologically sustainable competitive strategies, technology transfer through technology-for nature-swaps, and reducing the impact of populations on ecosystems [69]. Despite efforts to embrace corporate responsibility, the legitimacy of business has fallen, trust diminished, and blame for societies' failures exacerbated. Nevertheless, many companies continue with a narrow approach to value-creation focusing on short-term financial performance while ignoring the broader influences that determine long-term success [5]. Instead of window dressing social responsibility efforts at the periphery companies can respond to

such challenges by putting sustainability at the core of their business model, thus creating shared value for the company, its stakeholders, and essentially society.

Digitization has become a torrent affecting each aspect of the global economy. Consequently, organizations are busy exploring how large-volume data – often referred to as 'big data' – can be usefully deployed to create and capture value for individuals, businesses and organizations [6]. Building on machine learning and analytics to predict individual action, such as consumer choice, big data analytics are going beyond analyzing patterns but attempt to predict the likelihood of events [7]. Although the ever-changing nature and environment of the digital economy has challenged traditional economic and business concepts there is still little systematic scholarly inquiry in organizational research that explores the digital impact on organizations [7].

A turbulent and dynamic global economy driven by waves of mega-trends and an ever increasing velocity of technological advances and global dynamics, drive the creation of latest innovative business models that use existing resources not only in smart and disruptive [8], but also more sustainable ways [9]. However, while the depth and pace of innovation in the wake of the digital revolution is of unprecedented speed, complexity and multitude, new technologies seldom transform industries unless new business models emerge that match novel technologies to emerging market needs [8,10]. While definitions of business models vary, they quintessentially describe how a company creates and captures value [11-14]. In any given industry, usually a business model emerges over time and captures the most efficient way to allocate and employ resources to maximize value. However, every once in while the dominant model is overturned by leveraging a new technology that - if adopted by the competitors - may become the new industry standard.

The catalytic impact of real-time data, based on huge volumes of user-generated data and decisions transferred and analyzed within and across various sectors, has led to an entirely new playing field for businesses [15,16], or the next 'management revolution' [17]. Indeed recent studies by Accenture and General Electric report that 85% of the organizations believe that big data analytics will redefine the competitive landscape of their respective industries within the next three years. The multiplying chain-reaction effect of a single tweet or blog can cause profits or losses within split of seconds. At the same time, such an environment creates a myriad of opportunities for entrepreneurs. However, it is still unclear, how novel models that mix and match services/products with ubiquitous data can generate new value propositions and evolve into viable sustainable business models [7].

The digital revolution is a double-edged sword since it entails not only a plethora of opportunities and benefits but also adds complexity, threats, and vulnerabilities for business and society. The global economy is increasingly dominated by a few digital technological superpowers that threaten to make business more monopolistic instead of more democratic as originally assumed [18]. In light of the vast potential benefits but also vulnerabilities caused by the digital imperative, from a sustainable development perspective, unintended rebound effects and critical tipping points ought to be managed carefully in order to establish resilient systems [1]. This especially applies for transformative sustainable business models. Leaders and managers must be able to grasp opportunities, craft novel sustainable value-creating schemes to capitalize on them, and reconfigure organizations and sometimes entire industries accordingly [19].

In this paper, we examine how external triggers, including the digital imperative and the need for more sustainable resource employment, elicit the development of transformative sustainable business models. Drawing on the resource-based view, the shared value approach, and contingency theory, we develop a framework that helps to identify key elements of the transformative innovative potential of businesses models. We also ascertain that the varied organizational, economic, and environmental layers need to horizontally and vertically coherent. Our theoretical

arguments integrate recent research findings on external dynamics, such as technological digital advances and rising global competitive dynamics, with internal capabilities on both the organizational and the individual level, allowing for a more complete understanding of transformative sustainable potentials on the firm level.

This article is structured according to the conceptualization of transformative sustainable business models: First, we discuss the external environmental level, analyzing diminishing sector borders, technological trends, the need for more efficient resource use, rising market needs, and increasing global competitive dynamics. Second, we introduce the shared economic-societal value logic. Third, we turn to the organizational level and describe the role of dynamic capabilities, transformative capacity, organizational culture, structure and strategy. We also look into the individual level by examining the transformative leadership potential and digital mindset of managers. Lastly, we suggest an overarching framework addressing coherence of the multiple layers that determine resilience of sustainable transformative business models.

2. Theory Development

In order to determine the potential parameters of sustainable transformative business models, we need to examine both, external dynamics in the business environment as well as internal organizational determinants. Building on contingency theory, transaction cost theory, the resource-based view and shared value-logic we propose a multifaceted framework of sustainable transformative business models. Figure 1 gives an overview the multiple layers encompassing sustainable transformative business models. Given that the organizational, economic and technological, and social and environmental layers of transformative business models are highly intertwined they are ideally both horizontally and vertically coherent. While single components of each layer need to be inherently consistent, vertical alignment across the three layers supports a more robust and holistic systems-level perspective of sustainability-oriented innovation [9,20]. Figure 1 illustrates vertical and horizontal coherence of organizational, economic and environmental layers. In the following, we address all these determinants layer by layer in some detail.

Figure 1. Sustainable Transformative Business Models

Insert Figure 1 here

2.1. Economic and technological layer

2.1.1. Diminishing sector boundaries

Traditional industry boundaries are being radically reordered by digitization [21]. Digital native organizations, such as Rakuten Ichiba, Japan's single largest online retail marketplace, that also provides e-money usable in hundreds of virtual and real stores, issues credit cards, offers financial products and services including Japan's largest online travel portal, and provides an instant messaging app – Viber – used by 800 million users worldwide, are difficult to fit into traditional industry frameworks. Organizations such as these are neither defined nor constrained by traditional sector boundaries. While we may argue that industry boundaries have always been fluid because disruptive technological innovations have caused sectors to emerge, disappear or merge, the digital revolution has certainly accelerated these dynamics. By reducing frictional transactional costs, providing unprecedented large amounts of electronic data, omnipresent mobile interfaces, and artificial intelligence, customer expectations are reshaped and distribution is redefined. At the same time, customer-centric unified value-propositions allow for bridging value-chains and co-creation in unprecedented ways.

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Information technology is also revolutionizing products. Products have become more complex, combining hardware, sensors, data storage, microprocessors, software, etc. in a myriad of new ways. Such smart, connected products fundamentally alter industry structures and the nature of competition and raise a new set of strategic choices, such as how value is created and captured, how relationships with traditional partners are redefined and how company roles need to change [4].

Managers seem aware of the potential threats caused by cross-sector dynamics: A recent survey by McKinsey shows that a third of the interviewed 300 managers of 37 different industries are worried that competitors from other sectors are gaining clearer insights into their customer base [21]. While this new environment will certainly not change everything, boundaries between industry sectors will continue to blur, and play out by novel rules that call for different organizational capabilities. Consequently, defending one's position in a certain industry will be still critical, but capturing opportunities across sectors before others get there will be pivotal. That means companies will need to re(de)fine their business models to effectively compete in rapidly emerging arenas of business opportunities where competition derives from dimensionally different sectors. Such arenas are sometimes described as '*digital ecosystems*' that are highly consumer-centric providing an end-to-end experience for a wide range of products/services through single access gateways regulated by contracts [21]. A case in point are Chinas' three internet giants, Baidu, Alibaba, and Tencent, which have built a rich digital ecosystem that is spreading beyond them [22].

2.1.2. (Digital) Technologies

2.1.2.1. Sensing, interfacing, and augmented reality

During the last decades a pipeline of technological developments, in particular, information and communications technologies (mobility, cloud, data analytics) and material technologies (sensors, new materials, new molecules) spurred technological advances and fueled productivity and growth across industries [23,24]. The development of sensors allow for a broad and cost-efficient capture of data [8]. By 2020, some 50 billion smart devices will be connected, and together with billions of smart sensors, create a global supply of data that is expected to at least double every two years [25].

However, there is still a large disconnect between the wealth of digital data available and the range of application in the physical world. Augmented reality – a set of technologies that allow to portray digital data and images on the physical world and act as an interface between humans and machines – may help to close this gap by smart, connected products [26]. At its' core augmented reality transforms large volumes of data and analytics into images or animations that overlay on the real world. An application in vehicles, i.e., allows for putting navigation, collision warnings and any other relevant information directly in the drivers' line of sight. People will no longer be required to mentally convert 2-D information in a real-world 3-D context. This technology has the potential to reshape how we learn, make decisions and operate. Implications for business are staggering, since augmented reality will 'transform how enterprises serve customers, train employees, design and create products, and ultimately how they compete' [26]. As such smart, connected products and services proliferate, value-creation is amplified, value-chains disrupted, competitive dynamics aggravated, and industry boundaries reshaped [4].

2.1.2.2. Optimization technologies

Big data, artificial intelligence, and machine learning enable turning vast amounts of unstructured data into rules, dependencies, and decisions [27]. Business, engineering, and finance already draw on huge libraries of intelligent functions. Social media platforms and related web resources offer a vast and readily accessible depository of individual data and enable tracking activities, attitudes and personal information at unprecedented scale and depth [28]. While this virtual realm offers a

level of intimacy regarding opinion and social interaction, dealing with 'big data' not only raises ethical issues, but also questions relating to the expertise required to gather, analyze, and interpret it. A steep methodological learning curve calls for bridging disciplinary boundaries and engaging in collaborative cross-disciplinary work, requiring computer scientists and associated information technology specialists to team up with social scientists to make adequate sense of big data [29].

Some argue that digital technologies already created a virtual and autonomous economy that provides external intelligence in business [30]. Algorithms, however, need to be carefully checked for potential bias, as the case of a risk assessment software known as COMPAS sadly showed by making false predictions about black and white defendents [31].

2.1.2.3. Digital platforms

Platform businesses that connect producers and consumers directly have devoured market share and transformed the nature of competition. While platforms have existed for years, information technology drastically diminished the need to own physical infrastructure and assets. Traditional business models are under pressure to learn how to benefit from platforms [32]. For example, how comes that Apple having a market share of less than four percent in 2007 overran dominant incumbents in the cellular phone industry by exploiting the new strategic options provided by platforms? The chief assets forming the basis of competitive advantage and value creation of platforms are information and interactions. Apple understood this from early on and configured the iPhone as a connecting tool for app developers and app users. Although platforms come in varied forms, they essentially comprise four players: Owners who control their intellectual property, providers that serve as user interfaces, producers that offer their products/services, and consumers who use these offerings. Platforms redefine corporate strategies by shifting the focus from controlling to orchestrating resources, from optimizing internal processes to facilitating external interactions, and from enhancing customer value to optimizing ecosystem value [32].

While traditional businesses do not gain more commensurate value after a certain number of consumers is reached because the value creation curve typically flattens out with increasing consumers, many platform businesses become more valuable the more people and/or companies use them, connect with one another and create network effects [18]. Hence, with increasing participants on both sides of the market, the value – known as '*the network effect*' – soars as well. Moreover, consumers and producers can easily switch roles in generating value for platforms. At the same time, hub firms increasingly create and control essential connections and use their customer base to aggressively move into new sectors that were once considered separate industries. For example, Alibaba spin-off Ant Financial does not offer any superior financial service that other institutions do not already provide but builds on data from Alibaba's existing user base to commoditize traditional financial services on their digital platform. Similarly, Google moved from search engine into mapping, mobile operating system, driverless cars, and voice recognition.

The emergence of digital hubs can be explained by three principles of digitization and network theory: First, Moore's law postulates that computer processing power will double every two years [33]. Second, Metcalfe's law states that the value of a network increases proportionally with the number of nodes or users ('network effect') [34]. Third, Barabási's notion that digital network formation naturally leads to positive feedback loops that reinforce increasingly highly connected hubs [18]. Once a hub is highly connected in one industry it can leverage this advantage by spreading out into new sector, such as Ant Financials did. Such domino effects can be observed in many sectors from telecommunications, music, E-commerce, and are currently accelerating into brick-and-mortar industries, such as the automotive sector.

However, value generated by hub networks is subject to competition, innovation and responses by the user community and regulatory pressures. Multihoming, i.e., a practice were participants use

various hubs simultaneously, can considerably mitigate hub power. For example, drivers as well as passengers routinely multihome across different ride-sharing platforms, and scout for the most beneficial deal before using a specific hub. At the same time, companies tend to make their products and services available on multiple hubs to avoid being held hostage by single dominant players.

2.1.2.4. Mobility and cloud technology

Mobile cloud computing executes mobile applications on resource providers external to the mobile device [35]. It provides a tool to the user irrespective of his/her movement or location, hence, the user is able to continue his/her work seamlessly while enjoying being utterly mobile. Cloud computing encompasses both, applications delivered as services over the internet and the hardware and systems software in the datacenters providing the service. It has allowed developers to deploy their innovative ideas for internet services without any large capital outlays in hardware or other expenses. The combination of both, rendering fast-paced development possible without worrying about wasting costly resources - or under-provisioning a service who may become unexpectedly popular - and allowing for quick results of large batch-oriented tasks, made for an elasticity of resources without charging a premium for large scale unprecedented in the history of IT [36].

2.1.2.5. Decentralized small-scale manufacturing

Advanced manufacturing technologies coupled with consumer demands for more customized products and services have lead to shifts in scale and distribution in manufacturing [37]. Additive manufacturing, or 3-D printing, is clearly part of the digital industrial transformation. It allows organizations to be very disruptive, by producing what they want, where they want, and at what scale they want. Essentially, it permits both, to get leaner and cleaner, and to get more global by actually getting more local. A more cost- and resource-efficient small-scale production can have a positive impact on a firm's competitiveness. A literature review on additive manufacturing and it's societal impact clearly points towards the promise of a reduced environmental impact for manufacturing sustainability [38]. Moreover, it can improve resource efficiency, enable closed-loop material flows, and realize synergies across the product and material life cycles [37].

2.1.3. Increased global competition

The expansion of international trade has led to a greater specialization on a global scale, which requires firms to make a global system of vertical specialization and bilateral dependence work by combining and reconfiguring parts of the global value chain in search for novel joint solutions [19].

New technologies drive global competitive dynamics by enabling new digital ventures and vice versa. Sustained competiveness in a global marketplace calls for continuous and rapid innovation that is difficult to achieve and sustain [39]. For example, China has become a leading force in several areas of the digital economy over the last decade and is home to powerful digital innovators with global reach, such as Baidu, Alibaba, and Tencent. The Chinese government has actively encouraged digital innovation by giving innovators plenty of room to experiment and shaping a digital infrastructure later, and is also a global investor in the latest technologies [22]. In e-commerce, i.e. China accounts for more than 40 percent of worldwide transactions, mobile payments related to consumption by individuals accounted for US$ 790 billion in value, 11 times that of the US [22].

While digital technology enables growth in value across the economy, the value captured is getting more skewed and concentrated in the hands of a few globally powerful hub firms [18]. For example, Google's Android technology forms a bottleneck through which other product and service providers need to squeeze in order to reach the billions of mobile Android smartphones users. Such

hub firms typically leverage their power by using the network-based assets they employ to create scale in one setting and transfer – or re-architect - them into another industry. Consequently, adjacent industries may get locked-in a vicious cycle of competitive dependencies.

At the same time, internationally operating venture capital firms play an ever-increasing role in innovation by providing capital to firms that typically possess few tangible assets and operate in rapidly changing markets [40].

2.1.4. Changing market needs

2.1.4.1. Increasing demand & diversity in consumer preferences & resource efficiency

On a worldwide scale, a stable increase in demand based on a steady progress of emerging economies are accompanied by a greater fragmentation in consumer preferences. A combined upturn of economic growth in major regions and sound corporate profits are boosting business confidence and investment propensity. Despite commodity price reductions in 2015 commodity prices are likely to strengthen and underpin a recovery in developing countries in 2017 [41]. These developments give momentum to a more sustainable and environmentally benign resource employment. Hence, the demand for eco-efficient and –effective innovations that help conserve and improve natural, social and financial resources and embrace stakeholder involvement is rising [9].

2.1.4.2. Institutional context - rising regulatory pressure

Firm-level innovation also depends on external contexts, including domestic and local institutions, such as the supply of skilled workers, universities, financial institutions, the legal system, regulatory and standard bodies, government and judiciary, supply base, and presence of related and or same industries [42,43]. A recent analysis based on evidence from 125 countries over the period of 1997-2013 shows that the strength of the national innovation system still drives economic growth rather than participation in global value-chains [44]. Hence, the development of national technological capability building may enhance successful exploitation of foreign knowledge and therefore economic progress [45]. At the same time, heightened environmental regulation further increases pressure on firms for more sustainable innovative business models.

2.1.5. Dissolving market and firm boundaries

Along the lines of dismantling sector boundaries, market-firm boundaries are getting increasingly blurred as well. According to Coase [46] firms establish their boundaries based on transaction costs (TCE). Essentially, Coase's logic entails that only when the cost of market transactions for products or services exceed the cost of coordinating and managing all incremental activities needed to produce that product or service within a firm ('hierarchy'), a company performs the focal activity in-house. Digitization, however, reduces transaction costs and facilitates contracting out activities, leading to sophisticated networks of specialized market relationships [21]. Such networks triggered by dissolving firm boundaries in turn make it easier to meet rising customer expectations.

Advanced analytics, maturing artificial intelligence, and an ever-present mobile internet left consumers expecting fully personalized solutions. Organizations that act as orchestrators of networks, i.e. by linking potential consumers to potential producers, can capitalize on adding value by predicting future consumer needs before they are even articulated. On the other hand, digitization lowers switching costs for consumers and increases price transparency, potentially shifting the balance of power towards consumers. Haier, i.e., the world's leading white goods

manufacturer, drastically disrupted its organizational structure around platforms to create entrepreneurial teams within the firms that interact directly with users/customers and their needs[1].

Similarly, as the global sources of invention and innovation have become dispersed even very large firms cannot continue to rely entirely on their internal R&D. Declining costs of computing and communications have facilitated collaboration with suppliers and other players in the market ecosystem, increasing the viability for open innovation [47]. Hence, open innovation allows firms to identify and exploit new technological capacities developed inside and outside firm boundaries [48]. The 'lean startup' idea grasps at the very essence of customer centricity [49]. It favors experimentation over elaborate planning, customer feedback over intuition, and iterative design over traditional up-front desktop design. Concepts such as 'minimum viable product' or 'pivoting' quickly spread and tend to bring the customers into the product/service design from the very beginning.

2.2. Social and environmental layer – Shared value logic

Externalities occur when firms create social costs, i.e. pollution, that they do not bear. Traditionally societal institutions counteract this by imposing taxes and regulations in order to 'internalize' such externalities. This vantage point often led to corporate strategies that largely excluded social and environmental considerations from their business models. The principle of 'shared value' as introduced by Porter [5,50] is a novel way of achieving economic success that recognizes that societal and economic needs define markets, and couples economic with societal value. Essentially, it includes policies and practices that advance a firms' competitiveness while simultaneously advancing the economic and societal conditions of the community it operates in. The competitiveness of the firm and its surrounding community are intertwined, a business needs a successful community – whether a virtual one or a real one – to create demand for its products and in turn provides jobs and wealth creation for its citizens. In particular, social harms or weaknesses frequently cause internal costs for firms - i.e. wasted energy or resources, or remedial training to compensate for inadequacies in education. At the same time, addressing societal constraints may not necessarily augment corporate costs but instead enhance productivity by innovative operation methods, management approaches, or entire business model disruptions. Firms can create shared value by reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters. A shared value perspective does not focus on redistributing value, as i.e. the fair trade model does, but on expanding the overall value created. Studies on cocoa farmers at the Cote d'Ivoire, i.e., show that while fair trade enhances their income by 10-20%, shared value investments, including improved growing techniques and a cluster of supporting and related industries can boost their income by 300% [5]. Hence, sustainable business models need to adopt a shared-value approach that encompasses their social and environmental surroundings.

2.3. Organizational layer

'The firm is a central actor for the effectuation of innovation and technological change' [19: 680]. Consequently, we set out to scrutinize organizational-level capabilities, organizational strategy, culture, and structure as foundations of transformative action and innovation.

2.3.1. Dynamic transformative capabilities

Business model transformation is still elusive. A recent survey of some 1,600 companies showed that a mere 7% of respondents said that their company's digital initiatives were helping to launch

[1] http://www.haier.net/en/about_haier/one_person_alone/ (accessed 08.03.2017)

new businesses, and only 15% stated new business models were emerging thanks to digital technology. Digital transformation seems to be impeded by a lack of vision or sense of urgency in some companies, while culture and organizational constraints inhibit transformation at others [16]. Nevertheless, the MIT Technology review (2017) published a list of 50 companies that created new business opportunities by combining innovative technology with savvy business models. While this list contains usual suspects such as Apple, GE, or IBM, it is full of ambitious startups, like SpaceX , creating reusable rockets for space travel, Nvidia, providing processing power for AI software, Face++, pioneering face recognition technology, or Carbon and Desktop Metal, in additive manufacturing. By analyzing the transformative sustainable potential of business models we attempt to unveil some of their common underlying key elements of success.

Dynamic capabilities are a firm's ability to integrate, build, and reconfigure internal and external resources to address and shape rapidly changing environments [51]. These include all skills, procedures, and organizational structures that firms use to create value. While such capabilities may be rooted in certain change routines and analysis, they are generally based on creative managerial and/or entrepreneurial acts aimed at matching internal competences with opportunities of the business environment. Critical to its innovative capabilities is a firms' 'ability to recognize the value of new, external information, assimilate it, and apply it to commercial ends' [52: 128], coined as '*absorptive capacity*'. As organizations grow, their capabilities are embedded in competences/resources which are essentially shaped by organizational values. These in turn define the implicit norms and rules in organizations and ultimately determine how priorities are set.

The resource-based view (RBV) of the firm building on Penrose [53] and others [54-56] theorizes that a firm earns rents from leveraging its unique resources, which in turn give rise to the analysis of learning and knowledge management as means to create novel hard-to-imitate resources. A firm's resources, that are tacit to varying degrees including knowledge and intellectual property, are significant sources of competitive advantage. Since they are rather a stock than a flow they need to be constantly renewed [57]. This need for renewal is amplified in the light of the digital imperative. Essentially resources/competences and dynamic capabilities must be established internally and cannot simply be acquired externally. Hence, sensing (identification of assessment of an opportunity), seizing (mobilization of resources to address an opportunity and capture value from doing so), and transforming (continued renewal) are particular attributes that enable firms to (co)evolve with the business environment [58]. While almost every company ascertains the potential for using digital technologies to achieve transformation, most of them are still unclear on how to get results [16]. This may be due to lacking dynamic capabilities and path dependencies, since the ability to utilize outside knowledge is largely a function of the level of prior related knowledge within the firm [52].

Sensing and seizing, however, are similar to two other activities prominently discussed as incompatible inside a single organization in the management literature, namely exploration and exploitation [59]. These two types of activities require different management styles and are therefore rarely found within one firm, except for the ambidextrous organization where two separate sub-units with distinct cultures are linked [60].

In sum, transformative sustainable capacity is a seminal capability required for creating and capturing (future) value. Firms need to periodically (re)consider its own 'fit' to the opportunities arising it plans to exploit [19]. Yet commitment to existing path dependencies, processes, and assets makes this hard to do especially if a firm performs satisfactorily.

In innovation studies, a consensus is emerging that the role of the business model in fostering innovation is twofold. First, business models can be vehicle for innovation by connecting innovative products and technologies to realized market outputs. Second, they can be a 'source of innovation in and of itself' [61: 420]. Quintessentially sensing and seizing efforts show a path for creating value

but over time firms still need to periodically (re)consider their own fit with arising opportunities. Our conceptualization suggests that sustainable transformative business models need to adhere to two sets of logics: Reconstructivist/disruptive logic in the sense of creating blue-oceans *[62]* and shared value/sustainable logic.

3.8.1 Reconstructionist elements: Personalization & Co-creation – Usage based - Agility

Leveraging digital technology towards creating unique service and/or product offerings that allow for a *personalized* customer experience can help to disrupt markets and give organizations a competitive edge. Transformative firms often take advantage of technology to achieve product and/or service offerings that are personalized and custom-tailored to individual needs [8]. Moreover, products and strategies are constantly tested, refined and even *co-created* in close cooperation with customers. This enables them to create a blue-ocean by carving out uncontested market spaces that are less - if at all - dominated by competition [63].

Reconstructionist business logic often embraces technology that allows for moving away from traditional, often hierarchical, modes of decision making to better reflect changing market needs by rendering real-time adaptation possible. By becoming more *agile and adaptive*, firms can maximize value for customers and reduce costs for themselves [8]. To fully exploit their transformative potential and actually create value from data, organizations need to alter their core business fundamentally to make it more agile, lean, and cost-effective. The more holistic digital efforts are embraced in order to enhance both, value for customers and firm performance, the more complete a firms' core dynamic capabilities will be shaped and refined.

Some transformative models incorporate a *product as a service and pay per use approach* charging customers based on usage rather than requiring them to buy their products. This essentially means that instead of products outcomes are sold and a product based business model changes into a service offering. This can turn out beneficial to both parties, since costs for customers only incur as offerings create value, and companies can serve a broader base of customers without tying up more resources. However, it does have financial implications. For example, BMW DriveNow does not generate a large up-front financial revenue from a car sale but a constant flow of smaller amounts over time. Consequently, customer retention becomes seminal [64].

3.8.2. Shared-value/sustainable elements: Closed loop processes – Asset sharing – Collaborative Ecosystems

Empirical research on the effects on firm performance of sustainable management, which are supposed to simultaneously cut costs and protect the environment, suggests that firms need to specifically build capabilities for process innovation and implementation to positively influence firm performance [65]. Motivations that induce corporate ecological responsiveness include competitiveness, legitimation, and ecological responsibility [66], however, both resource-based and institutional factors influence corporate sustainable development [67].

Sustainable transformative business models often (re)configure linear value-chains and consumption patterns with *closed loops* that incorporate resource efficiency, recycling or reuse of products already at the conceptualization stage. This minimizes both resource use and costs.

Sustainable business models also succeed because they *share* valuable and costly *assets*. For example, Airbnb allows homeowners to share their home with tourists, hence, providing hotel-like services without actually owning any tangible assets such as hotel rooms. Similarly, Uber shares existing assets with car owners. Typically, online platforms and marketplaces that connect producers with customers unlock value for both business partners. At the same time, entry barriers into many traditional industries are rendered irrelevant since new entrants no longer need to own

the assets but merely act as intermediaries instead [8]. Unlocking transformative potential may not only be an answer to diminishing sector boundaries but can actually potentiate this process.

Collaborative ecosystems are essential in a sustainable digital economy. By collaborating across the ecosystem of partners and institutions, companies can jointly create new capabilities and accelerate innovation. Sustainable innovations and platforms are successful because they enable collaboration along the value-chain and across sector borders, i.e. by facilitating cooperation among supply-chain partners and allocating risks better, which may lead to cost reductions and a more efficient resource use for all participating agents.

2.3.2. Organizational strategy, culture, and structure

A firms' strategy that proactively balances transforming the scope of one's business while building on one's core competences is essential for staying competitive in the digital age since competition often comes laterally, from new players [68]. Today some of the most valuable assets of a company, namely data and customer base are not accounted for in the balance sheet. Yet, customers can create a powerful network effect and also help with introducing complementary services. For example, Amazon can easily leverage its Prime customer base to introduce new services or products. A costumer centric strategy requires a firm to come up with new capabilities to meet changing customer needs. John Deere, e.g., a traditional tractor producer, followed this approach by hiring engineers to build new capabilities in value-added services, such as satellite navigation, artificial intelligence, and predictive maintenance to optimize crop output [68]. However, building new capabilities while exploiting existing ones, 'is like repairing an aircraft engine while flying' [68].

In order to embrace and build sustainable transformative capacity, firms need to alter their organizational mind and culture accordingly. So far there is only anecdotal evidence on firms doing so. Seminally, an analytics driven transformation needs to be based upon a cultural change as much as upon crunching data and numbers. Jeff Immelt [69] - CEO of General Electric (GE) - openly admits that while he first thought transformation was all about technology he soon found out that it needed a much more holistic approach including major behavioral, cultural, and structural changes. '*We want to treat analytics like it's as core to the company over the next 20 years as material science has been over the past 50 years […] in order to do that, we have to add technology, we have to add people, we have to change our business models. We have to be willing to do all those things*.' [69]. Consequently, GE decided to become a cloud-based platform - combining its own information flows with customer data - and an application company. This meant a drastic cultural makeover for GE, a 'culture of simplification' as they call it, with fewer hierarchical layers, fewer processes, fewer decision points but continuous reviews and fluid planning.

Similarly, Intel believed that it needs a more collaborative culture to help gain an edge in certain technologies and took small steps towards that. After agreeing on an overall vision, they created new ways of breaking down communication barriers and bringing people together, including establishing 220 video conferencing rooms, novel search functions to its sharepoint implementation, and setting up teams around accounts rather than internal departments [16].

Essentially, embracing data analytics also means instilling a company-wide culture of data orientation with adoption in mind, and building teams with complementary data skills [25]. The same applies for adopting a sustainable shared-value based strategy and organizational culture. Only based upon a strong organizational foundation, technology and infrastructure are created, insights are gained in loops, transformed into action, and adoption is delivered. In order to enact such an organizational culture, the organizational structure also needs to be aligned accordingly. However, the structural alignment seems to be one of the most significant challenges to organizations' effectiveness of incorporating sustainability, data and analytics today [70].

494 2.3.3. Sustainable transformative value-chain

495 Transformative sustainable business models are based on a shared-value approach and innovative
496 digital solutions that can reduce costs, enhance resource-efficiency, advance customer experience,
497 and add value within single stages of the value chain but also across its entirety. From connected
498 cars in the automotive industry to smart virtual learning in the education sector, almost all
499 industries are undergoing at least some sort of technology driven transition in their value-chains
500 [71]. Hence, the traditional concept of the value-chain as established by Michael Porter 1985 [72]
501 needs to be carefully rethought. In order to maximize synergies of digital technologies the
502 transformative value-chain is multifaceted, and typically involves future customers already at the
503 product/service design stage.

504 Technology has altered the entire consumer decision journey or purchasing path. Often long before
505 a purchase is made consumers systematically scan the web for relevant information, which
506 provides an opportunity for firms to understand preferences and influence buying behavior. Hence,
507 social media and online reviews opened up new avenues in targeting and digital marketing, and
508 enable co-creation and personalized product development. Novel forms of customer/user
509 engagement including gamification elements and augmented reality can enrich purchasing
510 decisions and customer experience. Similarly, 3-D printing may reinvent how product development
511 is effectuated by allowing customers to co-design products and print prototypes. Simultaneously, it
512 revolutionizes the entire supply chain, including warehousing, inventory management, logistics
513 and distribution.

514 At the same time, companies leverage not only expertise from customers but also experts and lead
515 users outside the company. Open-innovation or crowd-sourcing have been used in a wide range of
516 business applications. Procter & Gamble, e.g., reported that they moved from R&D (research and
517 development) to C&D (connect and develop), with more than 35% of their innovations being based
518 on open-innovation [73]. Open-innovation is often both quick and inexpensive. In a study of 489
519 projects of a large European manufacturer, open innovation turned out to be financially more
520 attractive than traditional projects and quick in delivery [74].

521 Digitized operations allow firms to change quickly any component, machine, or process without
522 compromising on productivity, speed, or quality. This leads to unprecedented levels of flexibility in
523 manufacturing. Siemens, e.g., increased its output by 8,5 times based solely on digitized operational
524 excellence [75]. With rising connectivity in the industrial internet and falling costs to connect, store,
525 and process machine data, predictive maintenance and optimized operations have enhanced
526 efficiency and contributed greatly to a more sustainable resource use. For example, Predix, GE's
527 cloud-based operating system for industrial applications, hosts many applications for asset-
528 performance management in order to increase asset reliability, reduce maintenance costs and
529 resource use [76]. At the same time, local, small scale manufacturing, combining classic production
530 techniques with cyber-physical production systems leads to the 'Internet of things, data and
531 services'. Additive manufacturing (3-D printing) replaces traditional sourcing, direct procurement,
532 and manufacturing. It allows to produce more complex products, enables customization, and on
533 demand production, and helps reducing inventory. It also enhances sustainability by optimizing
534 logistics and transportation since companies may print products closer to the point of need, which
535 in turn may reduce a company's CO_2 footprint. Decentralized manufacturing may also bring back
536 offshore manufacturing from emerging to developed economies.

537 Demand-driven supply chains based on a combination of data analytics and monitoring real time
538 shifts in demand reduce inventories and the risk of excess stock [77,78]. Enterprise resource
539 planning (ERP) systems including varied applications from customer relationship management
540 (CRM) to sourcing, manufacturing and forecasting, allow for real time data on all entities of the
541 supply chain. Electronic Kanban (eKanban), i.e., uses the internet to instantly route messages to

external suppliers to provide real-time visibility to the supply chain, rendering lower inventory levels, less transportation and reduced bound capital possible. BMW, e.g., was able to capitalize on major savings by using an eKanban system with their supplier Lear corp. sharing their resource planning in real time. Synergies between societal progress and productivity in a multilayered digital value chain give rise to a more viable sustainable understanding of productivity and the fallacy of mere short term economic gains [5].

Distribution in transformative value-chains often uses multiple channels simultaneously. Effective omnichannel distribution in response to customers that move from bricks to clicks requires firms to think of different channels as complementing each other [68].

In short, primary activities in transformative sustainable value-chains are no longer linear, but multifaceted, and often client/user focused. Supporting activities are based on a shared-value product and/or service conceptualization and collaborate closed-loop ecosystems. The following figure illustrates potential new configurations of the value-chain.

Insert Figure 2 about here

2.4. Individual layer

2.4.1. Transformative leadership & Digital mindset

Bringing analytics and sustainability to the core of a business model requires leadership from the top [25]. Changes of the magnitude of the digital imperative and shared-value logic transform how companies organize, operate and manage talent, and essentially create value. While CEOs are constantly under pressure to perform, they may choose to underestimate the impact of the radical shift, and fail to take action towards an active transition. A recent survey by McKinsey [25], showed that three-quarters of leaders that committed themselves to big data analytics drove home less than one percent in revenue or cost improvements. While such individual gains may seem negligible in the short run, the aggregate of such measures can have a lasting impact. Indeed, only a small minority of CEOs walk the talk with regards to digitization. However, CEOs need to make sure that first, the right kind of conversations are taking place in the boardroom, second, that the right people are empowered to act, and third, ensure direct intervention to enable transition from experience-based decision making to data-based decision making [25] and from pure economic value to shared value logic. In fact, leaders need to ascertain that sustainable principles, data flows, and analytics become embedded in dynamic capabilities and are centered at the core of every single organizational process.

A striking example of how a 125-year old classic conglomerate firm reinvented itself within the past 16 years to become a digital industrial company is General Electrics. Jeffrey Immelt [79] , the CEO who led through this massive makeover points to several crucial transformative leadership lessons: First, transformative leaders need to be focused on a clear point of view and interconnect all initiatives towards that vision. They also need to be disciplined and stay away from ideas that do not fit. Second, the leader itself needs to embark himself and rewire his brain accordingly to be utterly convinced that the survival of the company depends on the change. Third, this sense of existential urgency for change needs to be understood by all the people of the organization. Fourth, the leader needs to make a bold, irreversible and sustained commitment to the transformation. Fifth, (s)he needs to be resilient, anticipate tough times and persevere. Sixth, the leader needs to proactively listen and act simultaneously and stay open for the organization needing to pivot on newly learned things while at the same time keep pushing forward. Finally, (s)he needs to embrace new talent, a new culture, and ways of doing things. In fact, many of these recommendations echo the work of Kotter's change principles [80,81].

Peer-reviewed version available at Sustainability 2018, 10, 4428; doi:10.3390/su10124428

In order to turn modeling outputs into tangible business actions, organizations need 'translators' that connect the needs of the business units with the technical skills of the modelers. Senior leader involvement and organizational structure play a critical role in effective analytics adoption of firms [70]. In a survey of MIT Sloan Management Review and Capgemini Consulting in 2013, only 38% of respondents stated that digital transformation was a permanent fixture on their CEOs agenda. However, when CEOs shared their vision for digital transformation 93% of employees felt that it is the right thing for the organization, however, only 36% of CEOs did share their vision [16].

Discussion and Conclusion

A firm's current businesses influences its choice of likely future business [82]. Hence, one branch of the notion of business strategy prefigures how managers and organizations can leverage existing resources beyond an organization's current business [53,83]. The business model can therefore be conceived as 'a focusing device that mediates between technology development and economic value creation' [82:532]. By adopting a shared-value approach we extend this definition with a sustainable notion.

An economy experiencing major change, such as the digital imperative and the need for a more sustainable resource employment, requires dynamic competences/capabilities in order to maintain functioning. Hence, it will either need new firms to satisfy new demands or existing firms need to morph to address or even shape new opportunities [19]. To encompass digital realities and a sustainable resource use, the theory of the firm needs to be augmented to adequately allow for opportunity, coordination beyond established firm boundaries, variation of capability levels across firms, as well as complementarities, co-creation, and –specialization. In innovation driven economies the firm is key through which technological disruption is effectuated, however, often economic theory is still unclear on firm-level and market determinants of technological change [19].

The digital imperative – or the lack of adoption of new digital realities by a majority of firms – show that organizations must be able to sense opportunities and craft transformative sustainable business models to capitalize on them, and relentlessly reconfigure their organizational structures and strategies, and sometimes even their industries, as external dynamics and technologies shift. Transformative capacity requires the organization and especially its top management to develop and validate conjectures, realign assets and competences on an ongoing basis. The SVIDT-method (Strengths, Vulnerability, and Intervention Assessment related to Digital threats) [84] can be used for assessing and managing the vulnerabilities of human systems with respect to digital threats and changes. Only the presence of dynamic capabilities, culture and mindsets allow corporations to orchestrate its resources, competences, and other assets in a timely and resilient fashion, or completely revamp what the firm is doing so as to maintain a good fit with – or sometimes even transform – the business ecosystem, markets, and/or industries the enterprise occupies.

Transformative sustainable business models are essential to assess when and how to ally with other market players or potential competitors in order to fully exploit or leverage on network effects or other synergies. Given heighted competitive dynamics on a global scale there is an enhanced need for firms to develop and assign resilient capabilities and creatively (re)combine elements of a multifaceted value-chain to deliver novel sustainable joint solutions that are of value to customers. At the same time, the efficacy of (dynamic) organizational capabilities varies with (digital) market dynamism, making them interdependent with the external environment. Key elements of transformative business models adhere to both, innovative reconstructionist and sustainable shared-value logic, and include co-creation with customers, usage-based pricing, agile and adaptive core capabilities, closed-loop resource employment, asset-sharing and participating in an collaborative business ecosystem. This includes dynamic value-chains that allow for multifaceted often non-linear interactions of functions, skills, and processes. It also calls for a more holistic

634 systems-level perspective of sustainable business model innovation including horizontal and
635 vertical coherence of organizational, economic, environmental and social layers.

636

637 **Conflicts of Interest:** "The authors declare no conflict of interest."

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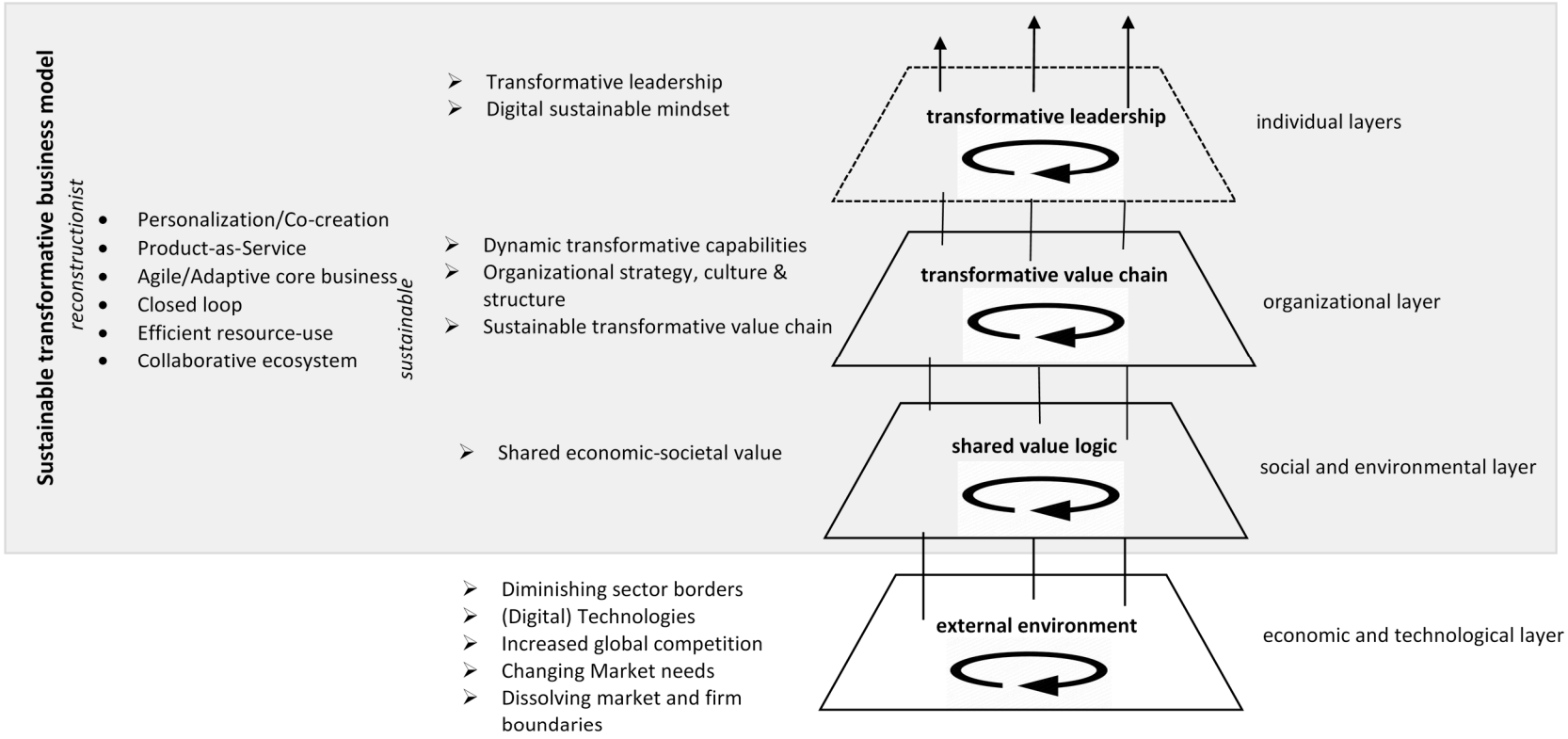
799 Figure 1: Horizontal and vertical coherence in transformative sustainable business models



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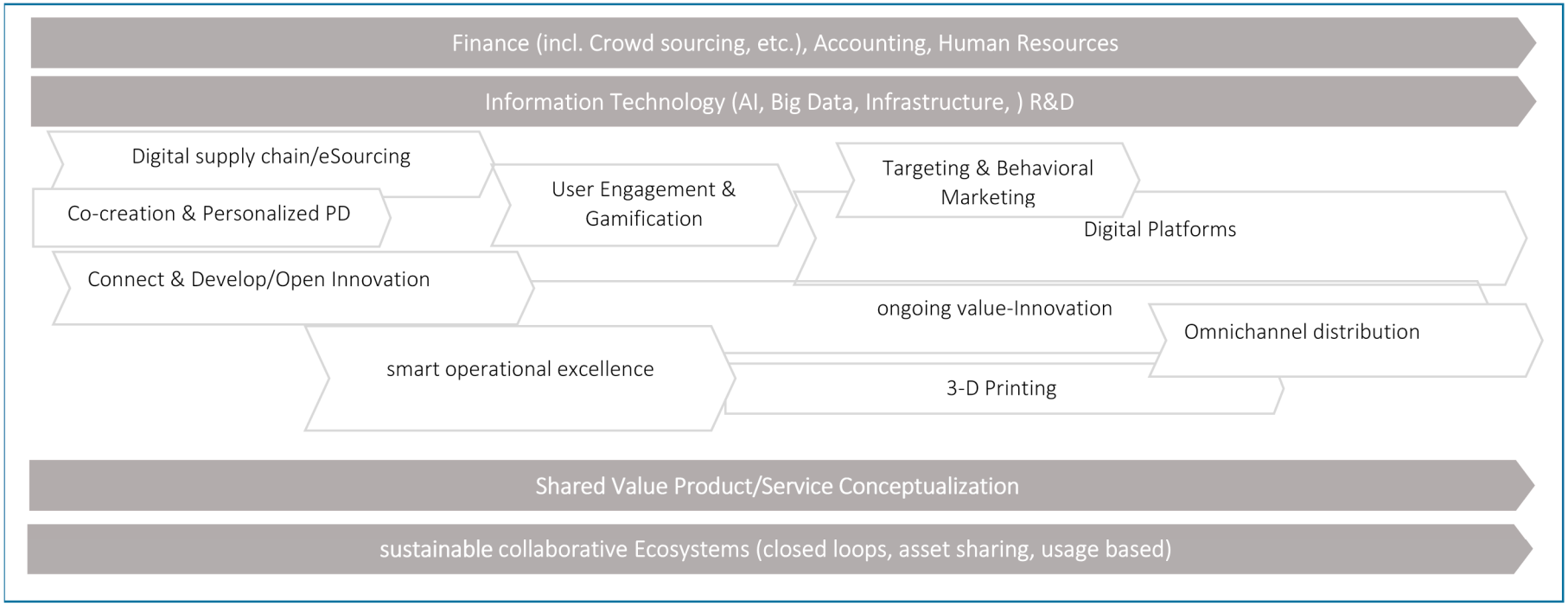
802 Fig 2: Transformative sustainable value chain



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