# Sustainable service business models

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# Sustainable and sustainability

- Often mixed together
- If very very correct:
- Sustainable business model = b.m. which is **able to continue, to be realized over a period of time**
- **But in practice**…both – also a business model for sustainability, is a framework for how organisations create, deliver and capture value based on sustainable development principles (e.g. focused on SDG).
- Not only focused ON PROFIT, but…it can help organisations to tackle sustainability challenges whilst continuing to operate profitably. By addressing a range of ecological and social issues within the framework, companies can evolve their purpose, products and processes whilst contributing positively to the planet and to people.

# Business model

- help understand how a firm does business and can be used for analysis, comparison and performance assessment, management, communication, and innovation
- concerned with how the firm defines its competitive strategy through the design of the product or service it offers to its market, how it charges for it, what it costs to produce, how it differentiates itself from other firms by the value proposition, and how the firm integrates its own value chain with those of other firm's in a value network
- a holistic description on 'how a firm does business' and how the company will convert resources and capabilities into economic value.
- the organisational and financial 'architecture' of a business and includes implicit assumptions about customers, their needs, and the behaviour of revenues, costs and competitors
- a business model CANVAS = a series of elements: the value proposition (product/service offering, customer segments, customer relationships), activities, resources, partners, distribution channels (i.e. value creation and delivery) and cost structure, and revenue model (i.e. value capture).
- a consolidated view of the components of a business models as: the value proposition (i.e. the offer and the target customer segment), the value creation and delivery system, and the value capture system.
- an activity-based perspective, including the selection of activities ('what'), the activity system structure ('how'), and who performs the activities ('who').


Bocken, N. M., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of cleaner production*, *65*, 42-56.

# Business model and servitisation

Servitisation = providing customers with a bundled package of products, services and support, training and self-service knowledge

= The transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic.

It is more than a SERVICE INFUSUION = The process whereby the relative importance of service offerings to a company or business unit increases, amplifying its service portfolio and augmenting its service business orientation.

The TRANSFORMATIONAL PROCESS involves a redeployment and reconfiguration of a company's resource base and organizational capabilities and structures; a redefinition of the mission of the firm; and a revamping of routines and shared norms and values. A service business model means that the supplier commits to improving customers' value in use, so assuming greater responsibility for the overall value-creating process as compared to product-centric, transaction-based business model (Kowalkowski, C., Gebauer, H., Kamp, B., & Parry, G. (2017). Servitization and deservitization: Overview, concepts, and definitions. *Industrial Marketing Management*, *60*, 4-10.)

- The main driving force = manufacturers can no longer compete by making and selling high quality products alone. In most markets products become increasingly similar, leaving limited room for product differentiation and profitability. To overcome this problem, firms have to go downstream, closer to the customers – selling services, integrated solutions and even experiences – to capture value throughout the value chain. Servitization is also driven by customer demands, changing from products to solutions over the past decades. (Yang, M., & Evans, S. (2019). Product-service system business model archetypes and sustainability. *Journal of Cleaner Production*, *220*, 1156-1166).

Categories and motives:

- (1) Customer service to improve the quality of the customer relationship (demand-based motivations);
- (2) Product-related services (Services Supporting Products or SSPs to ensure the correct functioning of the product (competitive motivations);
- (3) Services supporting business needs (Services Supporting Clients or SSCs), which support the operational needs of customers and enable new revenue streams to be developed (economic motivations). (Raddats, C., Baines, T., Burton, J., Story, V. M., & Zolkiewski, J. (2016). Motivations for servitization: the impact of product complexity. *International Journal of Operations & Production Management*, *36*(5), 572-591.)

- CONTINUUM - ONLY PRODUCT CENTRIC B. M……ONLY SERVICE-CENTRIC B.M.

# Digitalisation and servitisation of business model – dig. also enabler of sustainable b.m.

List of digital technologies and definitions.

| Digital technology | Definition | References |
|---|---|---|
| Additive Manufacturing/3D-Printing | This fabrication technique involves the progressive deposition of material onto a substrate, layer by layer, enabling the creation of high-complexity parts that personalised goods require. | (Guoping, Yun, & Aizhi, 2017) (Pfeiffer, 2017) |
| Advanced Manufacturing Solutions | Cyber-physical systems and collaborative robots that can physically interact with humans in a shared workspace to reach common goals, equipped with sensing technologies that make them aware of contextual conditions and guided/moved by artificial intelligence software. | (Thoben, Wiesner, & Wuest, 2017) (Tjahjono, 2017) |
| Artificial Intelligence | Simulation of the thinking and behaving process (such as studying, reasoning, thinking, and planning) of human beings. One of the most active niches of artificial intelligence is machine learning that supports preventive decisions. | (Bortolini et al., 2017) (Caruso, 2017) |
| Big Data and Analytics | Techniques (e.g., statistical analysis, machine learning, neural and Bayesian networks) used to mine and process large structured and unstructured datasets (big data that include numbers, text, pictures, posts, news, videos, etc.) to generate insights, identify patterns, and develop predictive models that are beneficial in a business context. | (Ferreira et al., 2017) (Astrid et al., 2017) |
| Cloud Computing | Access authorisation from anywhere to a shared pool of computing resources (e.g., servers, storage, and operating systems) that can be conveniently configured and provisioned on demand with minimal management effort. | (Celaschi, 2017) (Santos et al., 2017) |
| Cyber Security | Control and protection of processes and systems that operate online, identification of changes and vulnerabilities, and verification of authorised users. | (Astrid et al., 2017) |
| Horizontal and Vertical System Integration | The structural changes in the organisation, the management of physical objects, and the establishment of connections with information systems. | (Liao et al., 2017) (Caruso, 2017) |
| (Industrial) Internet of Things | The integration of some technological developments whereby products and industrial equipment are connected to provide large datasets and provide insights into the status of the equipment in order to predict other kinds of occurrences and to deliver smart services (e.g., remote control, operations and optimisation, fleet management, spare parts management, and predictive maintenance). | (Xu et al., 2018) (Hofmann & Rüsch, 2017) (Santos et al., 2017) (Suri, Gaaloul, Cuccuru, & Gerard, 2017) |
| Mixed Reality (Virtual and Augmented Reality) | The merging of real and virtual worlds to produce new environments and visualisations where physical and digital objects co-exist and interact in real time. | (Bortolini et al., 2017) (Celaschi, 2017) |
| Simulation of Connected Machines | The best option for saving time and resources as it evaluates the changes and behaviors in the configuration of machines, process flows, and plant designs. It also tests the effectiveness of the | (Bortolini et al., 2017) (Astrid et al., 2017) |

Paschou, T., Rapaccini, M., Adrodegari, F., & Saccani, N. (2020). Digital servitization in manufacturing: A systematic literature review and research agenda. *Industrial Marketing Management*, *89*, 278-292.

# Digital servitisation

Concepts of digital servitization.

| Author(s) | Concepts of digital servitization |
|---|---|
| (Porter & Heppelmann, 2014) | The business model for smart solutions, which entails a combination of various products, services, software, and analytics. |
| (Opresnik & Taisch, 2015) | The creation and delivery of service offerings with the support of technology (big data) to increase a company's competitive advantage. |
| (Lenka, Parida, & Wincent, 2017) | The dematerialisation of physical goods through the support of ICT capabilities to strengthen a firms' performance and competitiveness. |
| (Vendrell-Herrero et al., 2017) | A reference to business models that enhance traditional non-digital goods and services with the implementation of ICT or other digital technologies. |
| (Kowalkowski et al., 2017) | The utilisation of digital tools for transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic. |
| (Bustinza et al., 2018) | The need for digitally enabled integrated solutions, organisational change, and a reconfiguration of business models. |
| (Opazo-Basáez, Vendrell-Herrero, & Bustinza, 2018) | The adoption of digital technologies achieves more environmentally friendly production processes, communication channels, and products and services, enhancing economic value. |

Paschou, T., Rapaccini, M., Adrodegari, F., & Saccani, N. (2020). Digital servitization in manufacturing: A systematic literature review and research agenda. *Industrial Marketing Management*, *89*, 278-292.

# Business model and sustainability

- incorporate **a triple bottom line =** The triple bottom line is an accounting framework that incorporates three dimensions of performance: social, environmental, and financial. These three facets can be summarized as "people, planet, and profit. (https://www.investopedia.com/terms/t/triple-bottom-line.asp)
- important in driving and implementing corporate innovation for sustainability, can help embed sustainability into business purpose and processes
- NEED FOR A a fundamental shift in the purpose of business and almost every aspect of how it is conducted
- Features of a route to a sustainable economy:
  - A system that encourages minimising of consumption, or imposes personal and institutional caps or quotas on energy, goods, water, etc.;
  - A system designed to maximise societal and environmental benefit, rather than prioritising economic growth;
  - A closed-loop system where nothing is allowed to be wasted or discarded into the environment, which reuses, repairs, and remakes in preference to recycling;
  - A system that emphasises delivery of functionality and experience, rather than product ownership;
  - A system designed to provide fulfilling, rewarding wok experiences for all that enhances human creativity/skills;
  - A system built on collaboration and sharing, rather than aggressive competition (Bocken et al., 2014)

# Sustainable business models

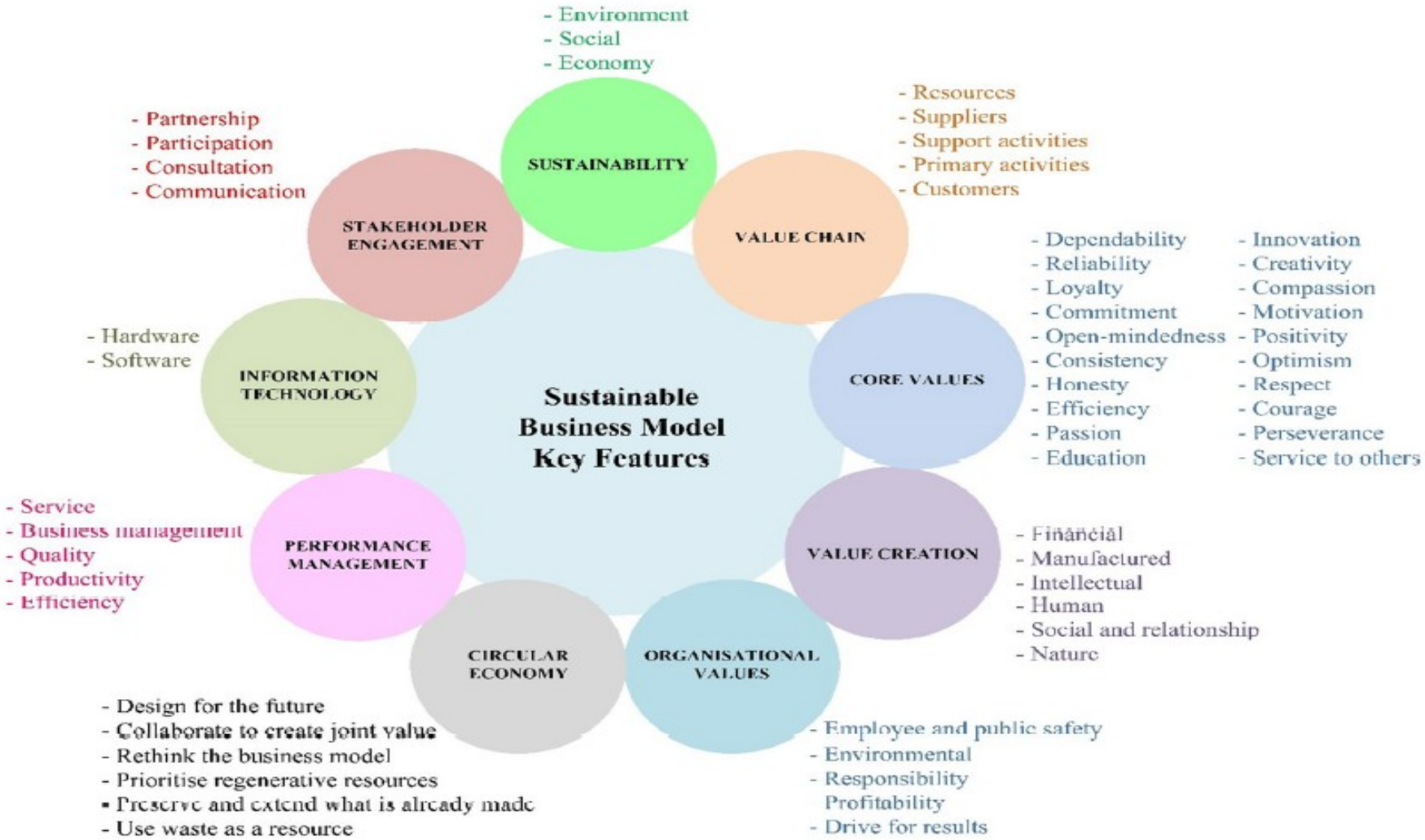



**Fig. 2** The key features and elements of the SBM concept

Goni, F. A., Gholamzadeh Chofreh, A., Estaki Orakani, Z., Klemeš, J. J., Davoudi, M., & Mardani, A. (2021). Sustainable business model: A review and framework development. *Clean Technologies and Environmental Policy*, *23*, 889-897.

# Example of the environemntal SBM

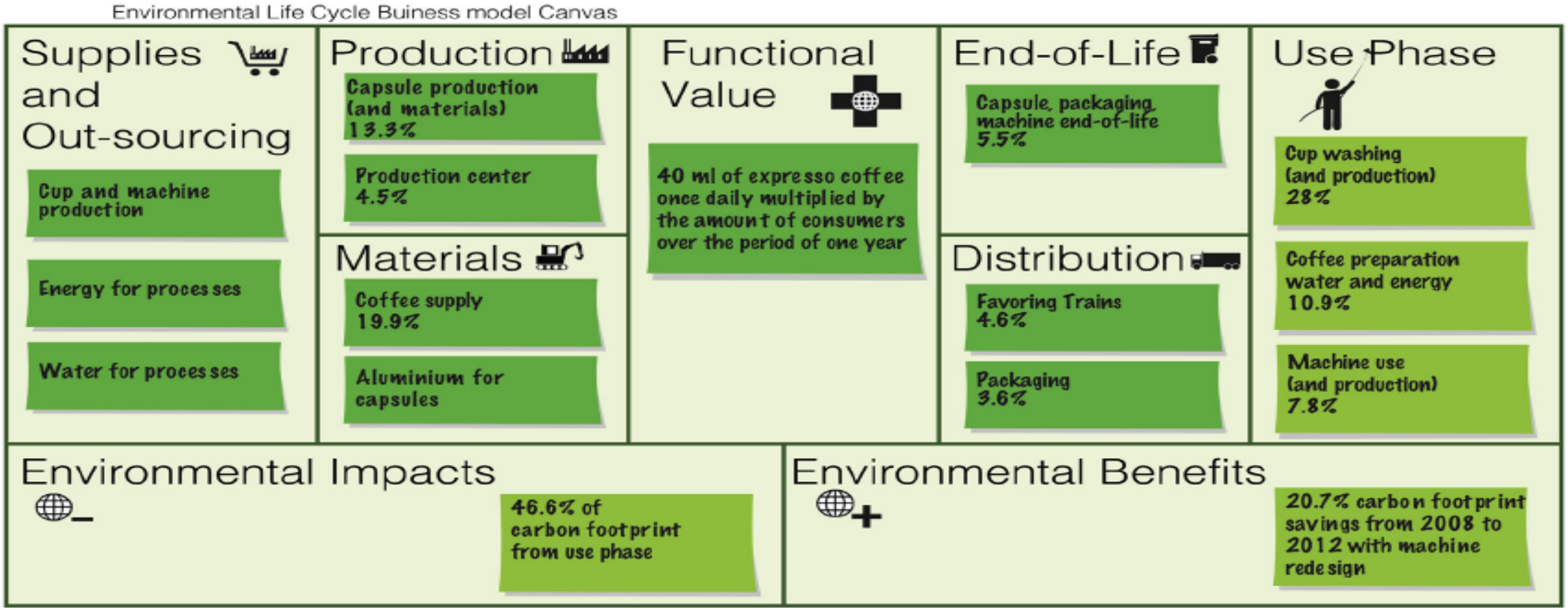



**Fig. 2.** The environmental life cycle layer of the triple layered business model canvas demonstrates the Nespresso case.

Joyce, A., & Paquin, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. *Journal of cleaner production*, *135*, 1474-1486.

# Example of the social SBM

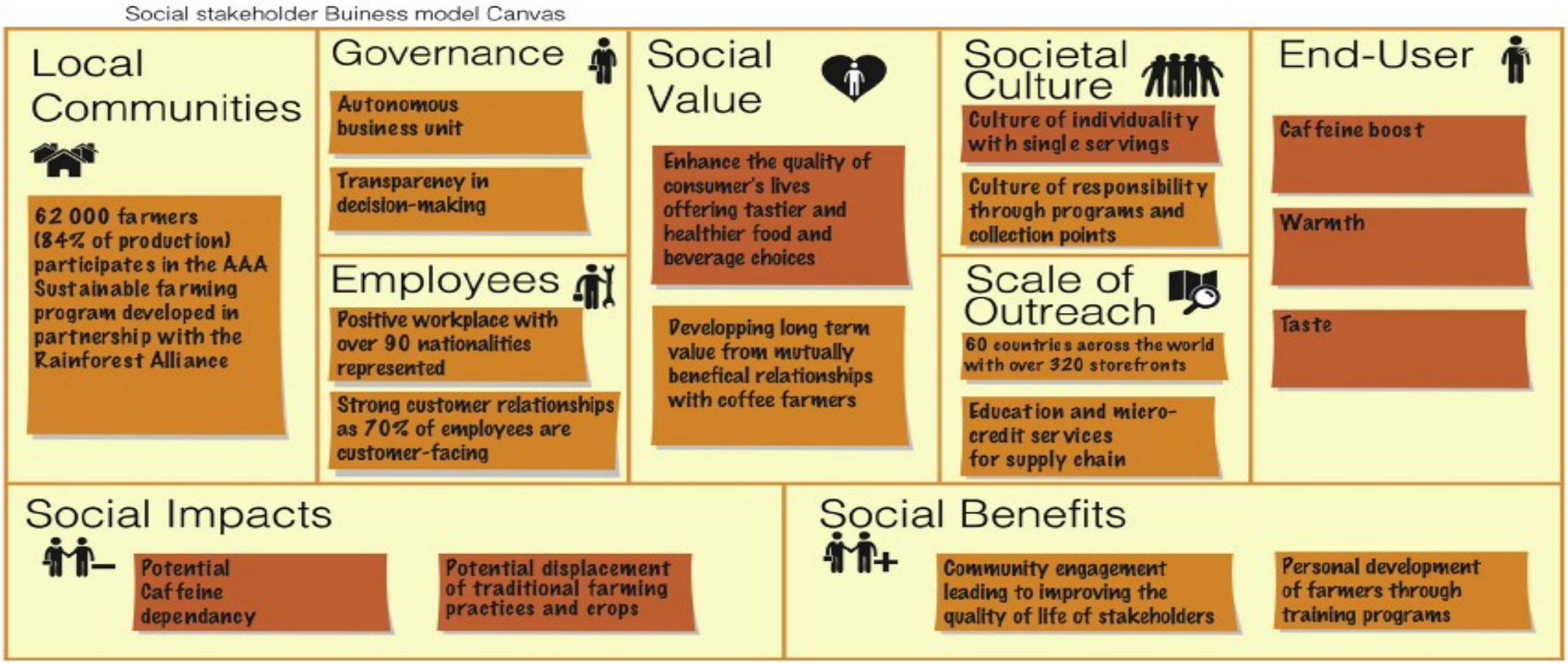



**Fig. 3.** The social stakeholder layer of the triple layered business model canvas demonstrates the Nespresso case.

Joyce, A., & Paquin, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. *Journal of cleaner production*, *135*, 1474-1486.

# Example of the economic SBM

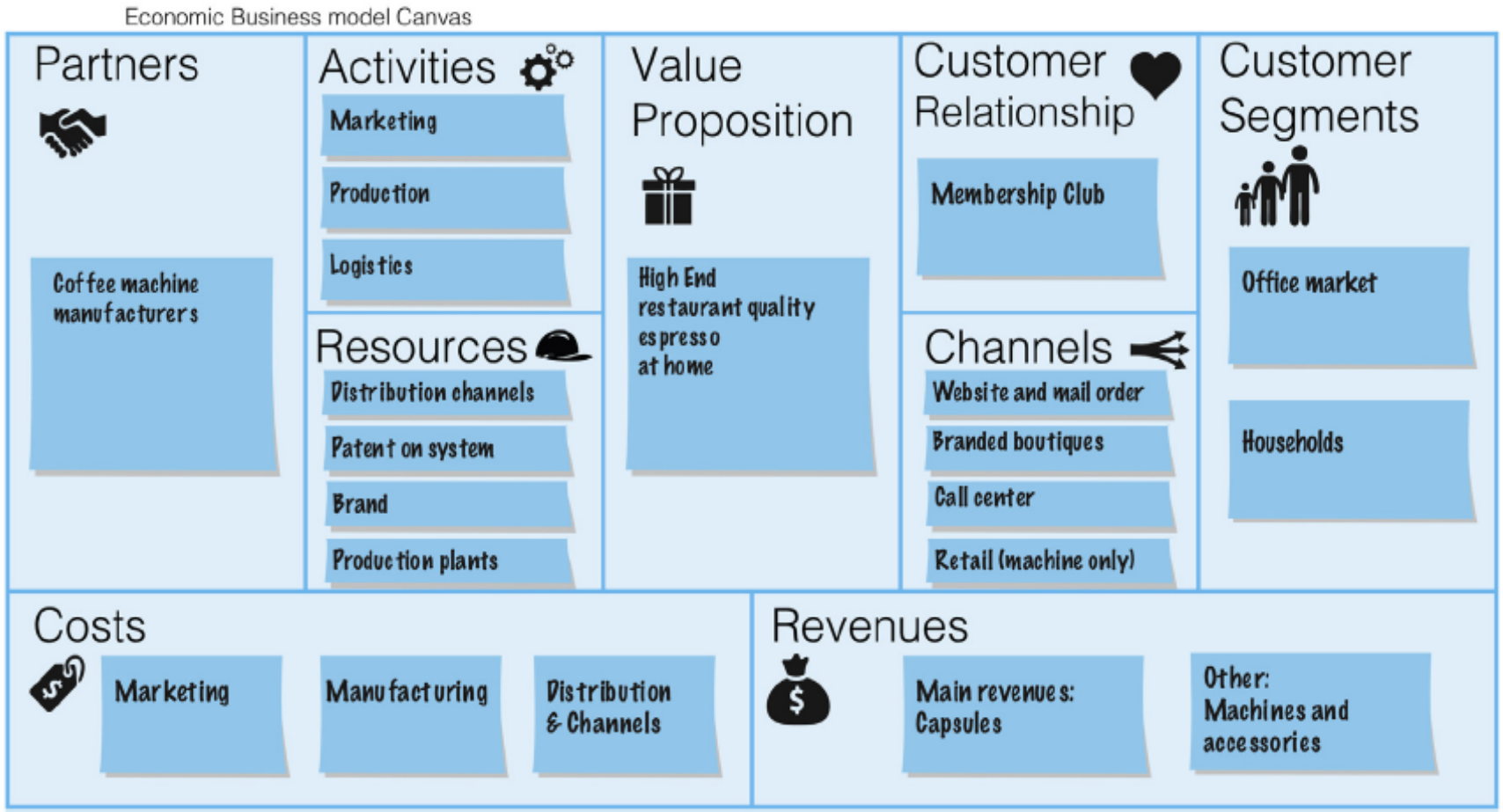



**Fig. 1.** An analysis of Nespresso through Osterwalder and Pigneur (2010) original Business Model Canvas, which forms the economic layer of the Triple Layer Business Model Canvas.

Joyce, A., & Paquin, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. *Journal of cleaner production*, *135*, 1474-1486.

# Sustainable business model archetypes

- describe groupings of mechanisms and solutions that may contribute to building up the business model for sustainability.
- The aim of these archetypes is to develop a common language that can be used to accelerate the development of sustainable business models in research and practice.
- The archetypes are:
  - Maximise material and energy efficiency;
  - Create value from ‘waste’;
  - Substitute with renewables and natural processes;
  - Deliver functionality rather than ownership;
  - Adopt a stewardship role;
  - Encourage sufficiency;
  - Re-purpose the business for society/environment; and
  - Develop scale-up solutions

Bocken, N. M., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of cleaner production*, *65*, 42-56.

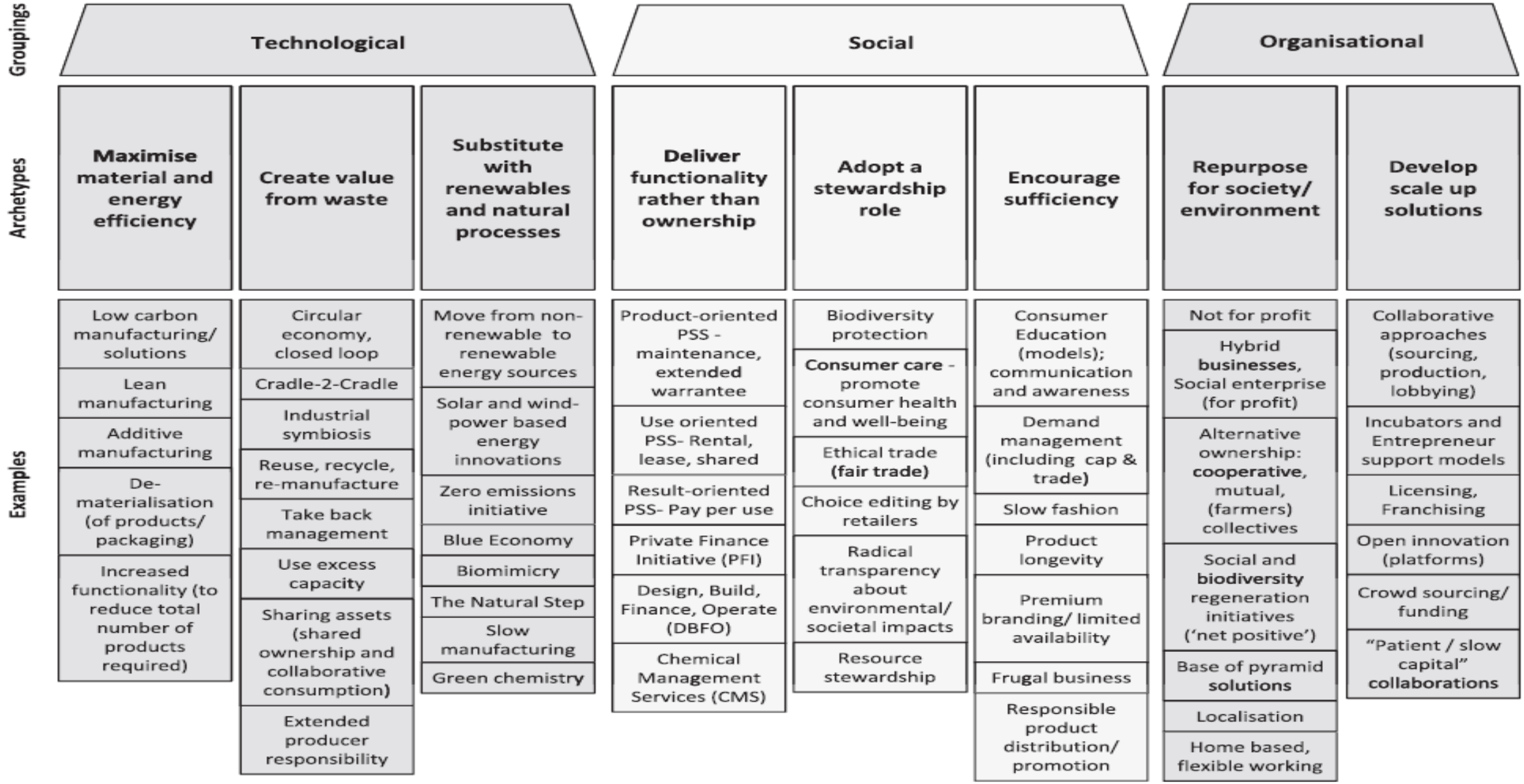



**Fig. 3.** The sustainable business model archetypes.

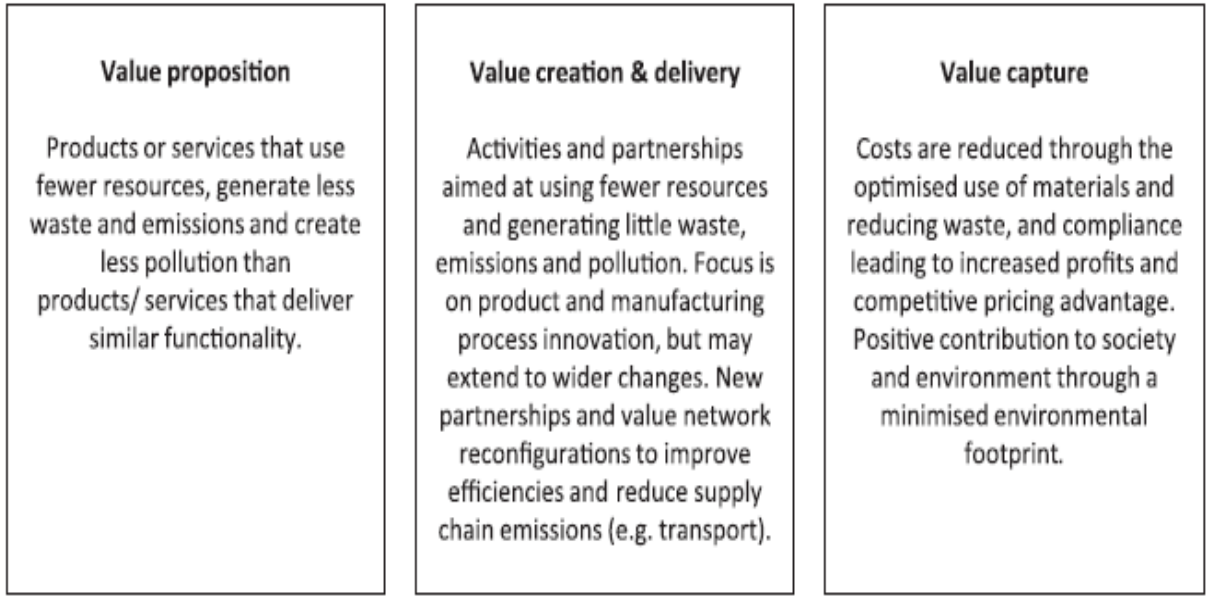



**Fig. 4.** Sustainable business model archetype 'Maximise material and energy efficiency'.

- Lean manufacturing
- Factor 4 and Natural Capitalism

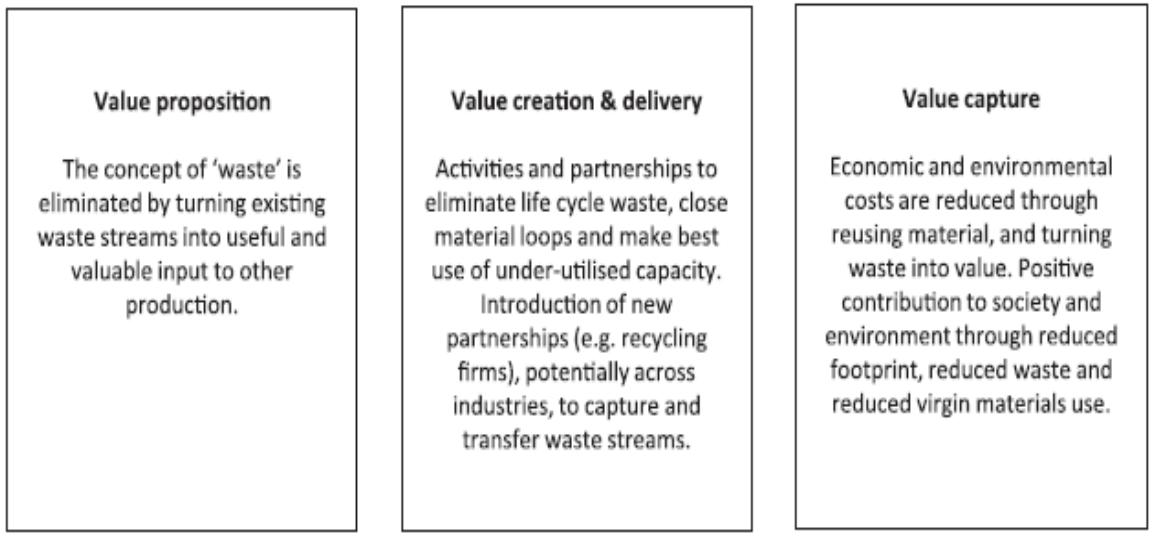



**Fig. 5.** Sustainable business model archetype 'Create value from 'waste"

- Industrial symbiosis, is a process orientated solution turning

waste outputs from one process into feedstock for another process or product line

- Closed-loop business models include products and business processes designed in a manner that enables waste at the end of the use phase of a product to be used to create new value
- Cradle-to-Cradle incorporates the idea of a closed loop technical nutrient cycle with a biological open-loop cycle
- Under-utilised assets and capabilities as a form of wasted value

| Value proposition | Value creation & delivery | Value capture |
|---|---|---|
| Reduce environmental impacts and increase business resilience by addressing resource constraints associated with non-renewable resources and man-made artificial production systems. | Innovation in products and production process design by introducing renewable resources and energy and conceiving new solutions by mimicking natural systems. New value networks based on renewable resource supply and energy systems. New partnerships to deliver holistic 'nature inspired' solutions. | Revenue associated with new products and services. Value for the environment is captured through reducing use of non-renewable resources, reducing emissions associated with burning fossil fuels, reducing synthetic waste to land-fill. |

Fig. 6. Sustainable business model archetype 'Substitute with renewables and natural processes'.

Focus = addressing resource constraints 'limits to growth' associated with non-renewable resources and current production systems

- Substitution with renewable (non-finite) resources
- Local renewable energy solutions
- Environmentally benign materials and production processes

| Value proposition | Value creation & delivery | Value capture |
|---|---|---|
| Provide services that satisfy user needs without users having to own physical products. Business focus shifts from manufacturing 'stuff' to maximising consumer use of products, so reducing production throughput of materials, and better aligning manufacturers' and consumers' interests. | Delivery through product/service offerings require significant changes within the firm to deliver this and may incentivise redesign for durability, reparability and upgradability. Potentially, more direct consumer contact and consumer education to shift away from ownership. Supply chains become more integrated. | Consumers pay for the use of the service, not for ownership of products. Cost of ownership of physical products are borne by the company and/ or partners. This can enable consumers to access previously expensive products, so expanding the market potential of new innovations. |

Fig. 7. Sustainable business model archetype 'Deliver functionality, rather than ownership'.

- Product Service Systems (PSS) and
- Servitisation = how companies shift the business model from offering a manufactured product to offering a combination of products and services….see further

| Value proposition | Value creation & delivery | Value capture |
|---|---|---|
| Manufacture and provision of products and services intended to genuinely and proactively engage with stakeholders to ensure their long-term health and well-being. Broader benefits to stakeholders often become an important aspect of the value proposition by better engaging the consumer with the full story of production and the supply chain. | Ensuring activities and partners are focused on delivering stakeholder health and well-being. Production systems and suppliers selected to deliver environmental and social benefits. Network reconfiguration may require alternative suppliers. To achieve scale, use of third-party certification may facilitate implementation and monitoring. | Stewardship strategies can generate brand value and potential for premium pricing. Stakeholder well-being and health generate long-term business benefits for the company: Healthy customers are good for the firm and for society, healthy happy workers may claim less sick days and may be more productive, and secure suppliers ensure more resilience. |

**Fig. 8.** Sustainable business model archetype 'Adopt a stewardship role'.

| Value proposition | Value creation & delivery | Value capture |
|---|---|---|
| Product and service solutions that seek to reduce demand-side consumption and hence reduce production (e.g. durable, modular, education about reduced consumption). The focus of such innovation is on the customer relationship and influencing consumption behaviour. | Ensuring activities, partners and customer relations are focused on consuming less, wasting less, and using products longer. This may involve product redesign for durability. It will require a fundamental shift in promotion and sales (no discounting, overselling); supplier selection based on durability; and incentive systems to discourage 'over-selling' / obsolescence. | Profitability (premium pricing), customer loyalty, and increased market share realised from provision of better products (longer lasting, durable/ not subject to short fashion-cycles). Societal and environmental benefits captured: educated society, using less product, reuse across generations. |

**Fig. 9.** Sustainable business model archetype 'Encourage sufficiency'.

Aim = maximise the positive societal and environmental impacts of the firm on society by ensuring long-term health and wellbeing of stakeholders (including society and the environment)….usually a combination of other SBMs

- Employee welfare and living wages
- Community development: Education, health, livelihoods
- Sustainable growing and harvesting of food and other crops, minimising chemical fertilisers and pesticides, water consumption, and top soil erosion
- Environmental resource and bio-diversity protection and regeneration

Aim = radical reduction in consumption

- Energy and water saving
- Product durability and longevity through product redesign
- Market places for second-hand goods
- Frugal business models - provision of products and services to low-income markets – or core product/service

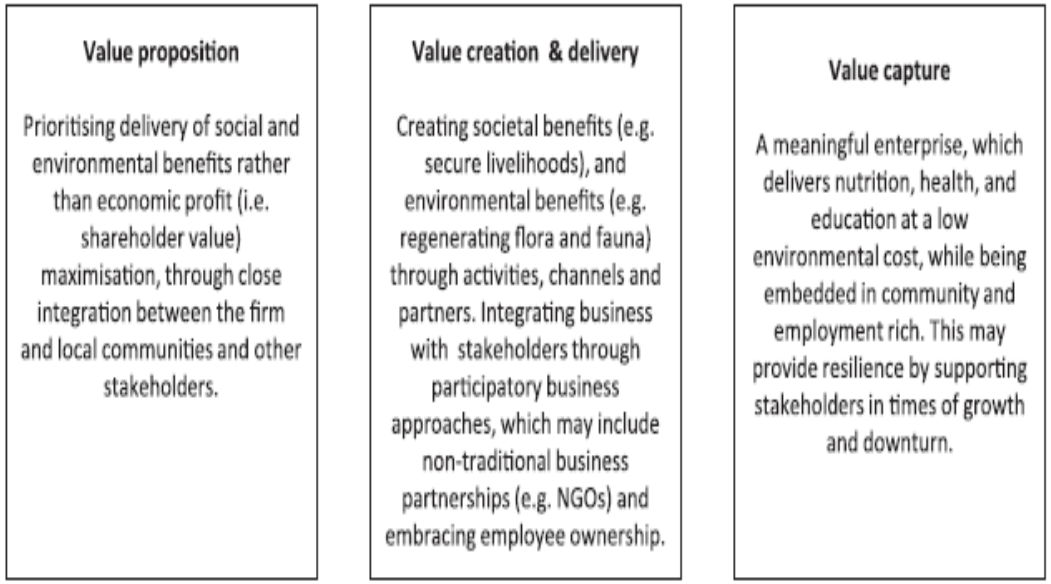



**Fig. 10.** Sustainable business model archetype 'Re-purpose the business for society/environment'. Note. Value capture builds on Jackson (2009)

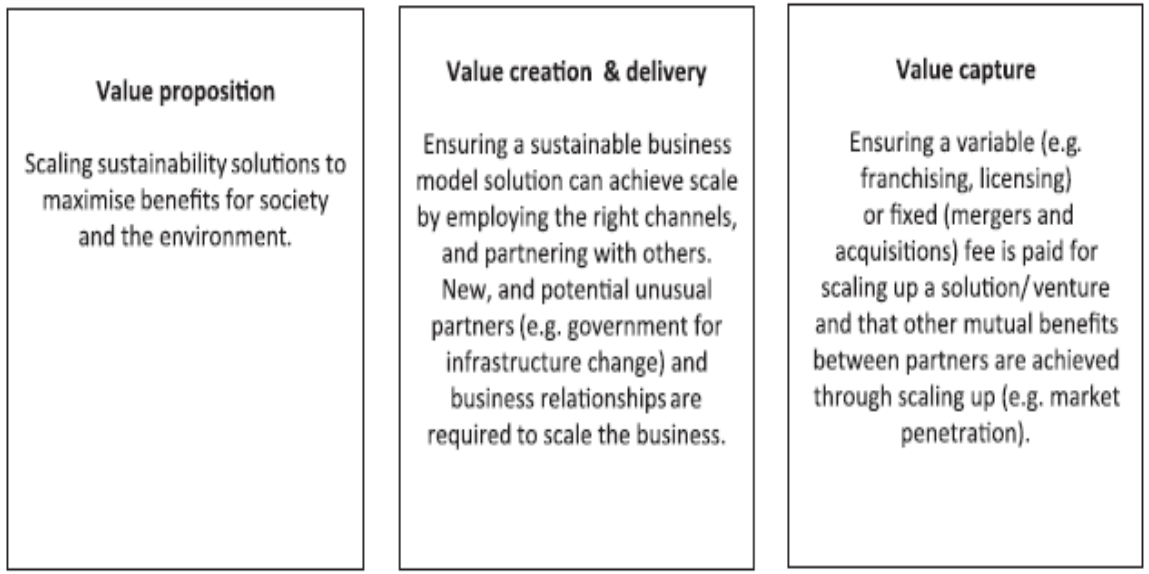



**Fig. 11.** Sustainable business model archetype 'develop scale-up solutions'.

Value not only for customers but also for other stakeholders

Social enterprises or hybrid bus. models

- Driven by a social mission;
- Generate positive externalities (spill overs) for society;
- Recognise the centrality of the entrepreneurial function;
- Achieve competitiveness on markets through effective planning and management.

Why? Emerging examples of businesses are being built on sound sustainability principles using combinations of the aforementioned archetypes. Albeit positive, these are often small scale.

- Franchising, licensing, collaborative models (peer-to-peer models, crowd-sourcing, and open Innovation) –

= rapid replication with localised adaptation and local financing

+ bring like-minded individuals, firms, and investors, together to drive adoption of business ideas and have the potential to radically change consumption patterns across

# Product Service Systems

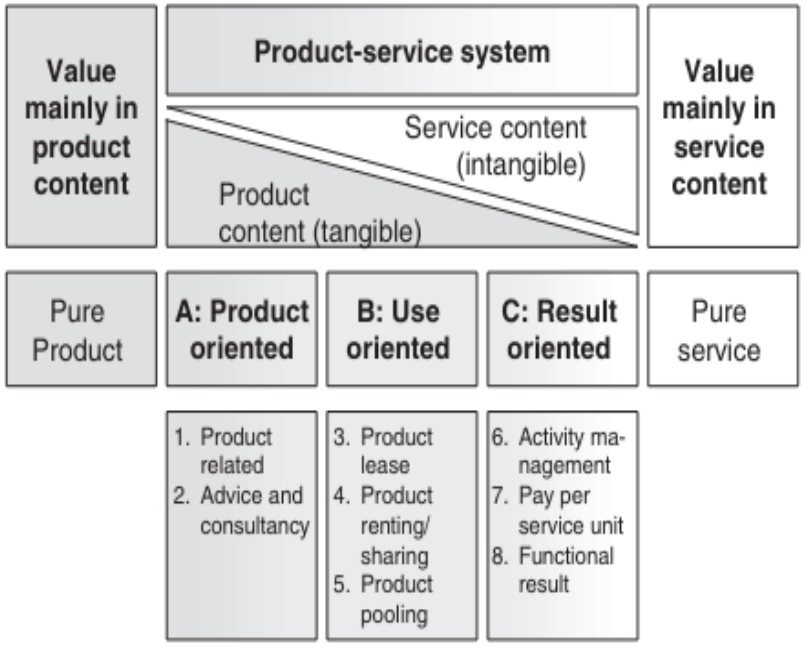



Figure 1. Main and subcategories of PSS

- Some explanations:
- Product related – e.g.: a maintenance contract, a financing scheme or the supply of consumables, but also a take-back agreement when the product reaches its end of life.
- Product renting/sharing) - the main difference to product leasing is that the user does not have unlimited and individual access; others can use the product at other times. The same product is sequentially used by different users.
- Product pooling. This greatly resembles product renting or sharing. However, here there is a simultaneous use of the product.
- Functional result. Here, the provider agrees with the client the delivery of a result - a functional result is meant in rather abstract terms, which is not directly related to a specific technological system. The provider is, in principle, completely free as to how to deliver the result. Typical examples of this form of PSS are companies who offer to deliver a specified ‘pleasant climate’ in offices rather than gas or cooling equipment, or companies who promise farmers a maximum harvest loss rather than selling pesticides.

Tukker, A. (2004). Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet. Business strategy and the environment, 13(4), 246-260.

**Table 1. Sustainable potentials of PSS business models**

| Three pillars of Sustainability | Sustainability potentials | Literature sources | Explanation |
|---|---|---|---|
| Environmental | *Longer product life* | (Baines et al., 2007) | Professional services (such as maintenance and repair) can avoid products or components being thrown away unnecessarily and can extend product life to some extent. |
| | *Increased resource and energy efficiency and reduced carbon emission* | (Tukker, 2004; Tukker, 2015; Byers et al., 2015) | In most situations, both customers and manufactures have the incentive to increase resource and energy efficiency in the use phase of products. Customers pay per use or per service unit, so increasing efficiency in use will reduce the total cost. If manufacturers are the owners or even users (in result-oriented PSS) of products, they are incentivised to use products as efficiently as possible in terms of materials and energy in order to reduce costs. |
| | *Increased recycling, remanufacturing and reuse* | (Yang et al., 2018; Guidat et al., 2014; Ijomah et al., 2006; Sundin et al., 2009; Sundin and Bras, 2005) | Use- and result-oriented PSSs have the potential to increase the reuse of products at their end of life by recycling, reconditioning and remanufacturing. They increase customers' acceptance of remanufactured products since customers do not own the products and care less about how new the products are. Moreover, manufacturers find it easier to collect used products as they can more easily predict the timing and quantity of returns. They also incentivise firms to reuse parts as much as possible at the end of the product life cycle, to improve remanufacturing technology and to design for remanufacturing. |
| | *Increased product usage* | (Beuren et al., 2013; Tukker, 2004; UNEP, 2009) | PSS providers own products and therefore have the incentive to maximise product use (to ensure that products are used as intensively as possible) by keeping them in good working order. The utilisation of products is increased since more people can use the same product at less cost. As makers of the products manufacturers are usually more expert than customers at using products (e.g. installing, maintaining and operating products). They are incentivised to fulfil customer needs using the least resource-intensive products and services, to achieve a more efficient use of the products. |
| | *Dematerialisation* | (Lin et al., 2010) | PSS enables a total reduction in the use of materials, energy and products because the same number of products can meet the needs of more people (termed dematerialisation). |
| | *Freedom to design for sustainability* | (Tukker, 2004) | Result-oriented PSS has higher potential to enable the freedom to design for sustainability. |
| Economic | Better fulfilment of customer needs | (Baines et al., 2007; Tan et al., 2010) | PSS enables a more tailored offering with new functionalities and different combinations of products and services. |
| | Stronger customer relationships | (Baines et al., 2007; Neely, 2009; Tan et al., 2010; UNEP, 2009) | Service contracts can result in a stronger, longer and more direct customer relationship. They can also increase customer loyalty and even lock in customers. |
| | Lock out competitors | (Annarelli et al., 2016; Neely, 2009) | PSS business models are usually hard to be imitated due to the uniqueness of services. |
| | *Differentiation* | (Baines et al., 2007; Cavalieri and Pezzotta, 2012; Gebauer et al., 2006; Mathieu, 2001; Neely, 2009; Wise and Baumgartner, 1999) | Technologies and products in mass markets tend to be similar. Services can differentiate a firm's offering. Services can create barriers for competitors and even lock out competitors by creating stronger customer relationships. |
| | *Increased revenues* | (Mathieu, 2001; Tan et al. 2010; Wise and Baumgartner, 1999) | Services provide a more stable and continuous revenue stream, and higher profit margins compared to product sales. |
| | *Identification of new markets and faster response times* | (UNEP, 2009) | Services are more flexible compared to products and allow a rapid response in changing markets. |
| | *Access to service data* | (Baines et al., 2007; Tan et al., 2010) | Service data can provide information about product performance and customer behaviour, and can be used to improve the design of products and to analyse changing customer demand. |
| | *Reduced ownership responsibility for customers* | (Baines et al., 2007) | Customers are released from the responsibilities of owning products (Baines et al., 2007), which reduces the burden of caring in some situations. |
| | *Improved technology* | (Sakao et al., 2013) | Integrated Product Service Offering (IPSO) enables the producers to keep intellectual property and improve technology innovation. |
| | *Reduced risk* | (Sakao et al., 2013) | IPSO could reduce risks such as the changes of regulation, business environment and market. |
| | *Reduced life cycle cost* | (Lindahl et al., 2014; Sakao and Lindahl., 2015) | IPSO could reduce the life cycle cost and environmental impact. |
| Social | *Increased jobs* | (Beuren et al., 2013) | The provision of service could create more jobs since it could be more labour-intensive. |



(Yang, M., & Evans, S. (2019). Product-service system business model archetypes and sustainability. Journal of Cleaner Production, 220, 1156-1166).

**Table 3. The sustainable value creation in different archetypes of PSS business models**

| | Product-oriented PSS | Integration-oriented PSS | Use-oriented PSS | Result-oriented PSS |
|---|---|---|---|---|
| **Economic value** | • Increased revenue from service (ABC)<br>• Provide more professional service to solve customer problems (ABC)<br>• Reduced cost for customers (ABC)<br>• Increased customer loyalty (C)<br>• Improved resource efficiency (C)<br>• Better understand customer needs (C)<br>• Guide the direction of product development (C) | • Increased revenue through service income and expanded businesses (ABC)<br>• Provide more professional service to solve customer problems (ABC)<br>• Reduced total cost for customers (ABC)<br>• Better understand customer needs (C)<br>• Build a business eco-system with the firm as the core firm (C)<br>• Use of service data (C)<br>• Lock out competitors (C) | • Continuous revenue from leasing (AB)<br>• Provide more professional service to solve customer problems (ABC)<br>• Reduced financial pressure for customers (ABC)<br>• Reduced risk for customers and banks (C)<br>• Increase market by making previously unfeasible projects feasible (C)<br>• Build a business eco-system with the firm as the core firm (C) | • Improved technology (A)<br>- Experiment and test on products (A)<br>- High incentive for long-term technology development (A)<br>• Expanded groups of potential customers (ABC)<br>• Reduced life cycle cost for manufacturer (A)<br>- Less restricted by customer need and more freedom to control cost (A)<br>- Fewer products produced and fewer workers needed (A)<br>- Reduced life cycle cost due to improved service efficiency in MOL (A)<br>• Reduced risk on market (A)<br>• Long-term continuous and stable revenue (ABC)<br>• High gross profit rate (ABC)<br>• Use of service data (ABC)<br>- Prediction of problems (ABC)<br>- Quick response to problems (ABC)<br>• Improved design - more freedom in design (AB)<br>• Reduced costs for customers (ABC)<br>• Provide more professional service to solve customer problems (ABC)<br>• Reduced financial pressure for customers (AB)<br>• Lock in customers (C) |
| **Environmental value** | • Saved energy for customers (B)<br>• Upgraded high energy efficient technology (C)<br>• Longer product life (ABC) | • Saved energy for customers (BC)<br>• Reduced total emission (C)<br>• Longer product life (ABC) | • Saved energy for customers (BC)<br>• Longer product life (ABC) | • Saved energy for customers (BC)<br>• Reduced total emission (C) |
| **Social value** | • Improved safety (ABC)<br>• Improved employee salary and satisfaction (C) | • Improved safety (ABC)<br>• Domestic production of heavy industrial equipment (ABC)<br>• Improved employee salaries and satisfaction (C) | • Improved safety (ABC)<br>• Domestic production of heavy industrial equipment (ABC)<br>• Improved employee salaries and satisfaction (C) | • Increased job opportunities for local community (AC)<br>• Improved safety (ABC)<br>• Domestic production of heavy industrial equipment and therefore no dependence on other countries (ABC) |
| **Economic-environmental value** | • Reduced energy consumption in usage phase (A)<br>• Improved resource efficiency (C)<br>• Utilisation of customers' waste (C)<br>• Improved utilisation of resources (C) | • Improved utilisation of resource in production (AC)<br>• Reduced energy consumption in production and usage phase (A)<br>• Longer product life (ABC)<br>• Improved utilisation of resources in production (B)<br>• Utilisation of customers' waste (C)<br>• Improved resource efficiency (C) | • Improved utilisation of resource and products (ABC)<br>- Reuse of products for different markets (B)<br>- Increased remanufacturing activities (B)<br>• Reduced energy consumption in production (AC)<br>• Longer product life (ABC)<br>• Utilisation of customers' waste (BC) | • Increased utilisation of products' products and co-products (AC)<br>• Improved utilisation of resource, assets and products (ABC)<br>• Utilisation of customers' waste (AC)<br>• Improved resource efficiency (ABC)<br>• Reduced waste in use (ABC)<br>• Increased incentive to improve sustainable technology and design (AB)<br>• Increased energy efficiency and reduced energy cost (AC)<br>• Reduced life cycle energy and life cycle cost (ABC)<br>• Longer product life (ABC)<br>• More freedom and incentive to design for sustainability (AB) |
| **Economic-social value** | • Improved customer relationships (AC)<br>• More efficient use of human resources (AC) | • Improved customer relationships (AC)<br>• Improved local business ecosystem (A)<br>• More efficient and sufficient use of human resources (AC) | • Improved customer relationships (AC)<br>• Improved local business ecosystem (A)<br>• More efficient and sufficient use of human resources (AC) | • Improved customer relationships (AC)<br>• Improved local business ecosystem (AC)<br>• Improved service efficiency (AC)<br>• More efficient use of human resources (AC)<br>• Improved local GDP (AC) |
| **Environmental -social value** | No data | No data | No data | No data |

*(Note: A, B and C refer to empirical evidence from the Firm A, B and C)*



(Yang, M., & Evans, S. (2019). Product-service system business model archetypes and sustainability. Journal of Cleaner Production, 220, 1156-1166).

# Business model and circular economy

- CE = generic term for an industrial economy that is, by design or intention, restorative and in which
- material flows are of two types, biological nutrients, designed to re-enter the biosphere safely, and technical nutrients, which are designed to circulate at high quality without entering the biosphere

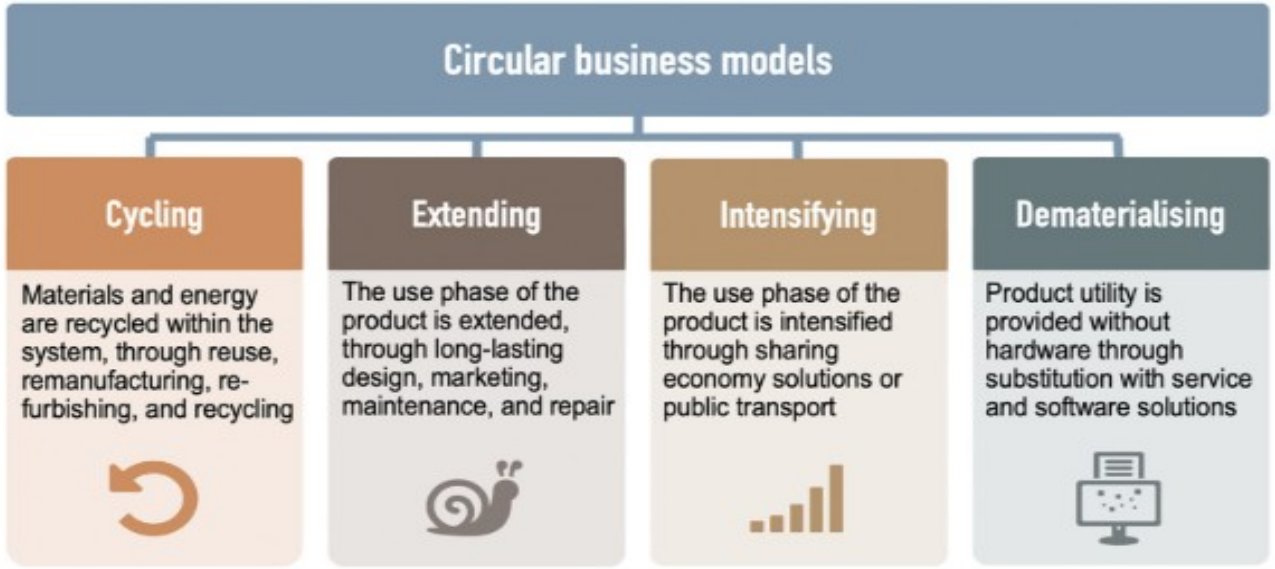



**Fig. 3.** Circular business model strategies, developed from Bocken et al. (2016) and Geissdoerfer et al. (2018a,b).

Geissdoerfer, M., Pieroni, M. P., Pigosso, D. C., & Soufani, K. (2020). Circular business models: A review. *Journal of cleaner production*, *277*, 123741.


Geissdoerfer, M., Pieroni, M. P., Pigosso, D. C., & Soufani, K. (2020). Circular business models: A review. *Journal of cleaner production*, *277*, 123741.

# RESOLVE framework and CBM

The Ellen MacArthur Foundation, 2015 - ReSOLVE proposes six CE-based business model development strategies:

- **Regenerate** – This model focuses on a shift to renewable energy and material. Biological cycles circulate flows of energy and materials and convert organic waste into sources of energy and raw material for other chains.
- •**Share** – This model has a shared economy perspective in which individuals share goods and assets; and ownership loses importance. Products are designed to last longer, and maintenance focuses on reuse of products and extending their life. Coordination between individuals is necessary for model viability. The “internet of things” can facilitate asset sharing (The Ellen MacArthur Foundation, 2015).
- •**Optimise** – This model is technologically centred. Organisations use digital manufacturing technologies, such as sensors, automation, radio-frequency identification (RFID), big data, and remote steering to reduce waste in production systems and supply chains. Organisations benefit through a performance improvements; for instance, predictive maintenance schemes can be planned using real-time data (The Ellen MacArthur Foundation, 2015).
- •**Loop** – This model uses biological and technical cycles. Biological cycles, for example, anaerobic digestion, can recapture the value of organic waste. Technical cycles can restore the value of post-consumption products and packaging through repair, reuse, remanufacturing, and recycling activities. Collaboration and coordination in supply chains is essential to close the loop and convert waste into useful resources. The use of intelligent devices, physical objects that are able to sense, record and communicate information about themselves and their surroundings for instance, provide information on location, condition, and availability of post-consumption products; supporting the loop strategy (The Ellen MacArthur Foundation, 2015).
- •**Virtualise** – This model is a service-focused strategy. This model replaces physical products with virtual and dematerialised products implying the enhancement of customers' satisfaction. Smart connected products, linking with the internet of things, enable data gathering for the technical cycle (Spring and Araujo, 2017).
- •**Exchange** – This model encompasses transferring old and non-renewable goods into advanced and renewable ones. Additive manufacturing using 3D printers can shift traditional mass production systems. Traditional mass production may produce more than the necessary to satisfy actual and potential demand; 3D printing may produce only when and what is needed at the source of demand. 3D printers are also be used for product parts repair implying a reduction of consumption of materials and of inventory (Despeisse et al., 2017).

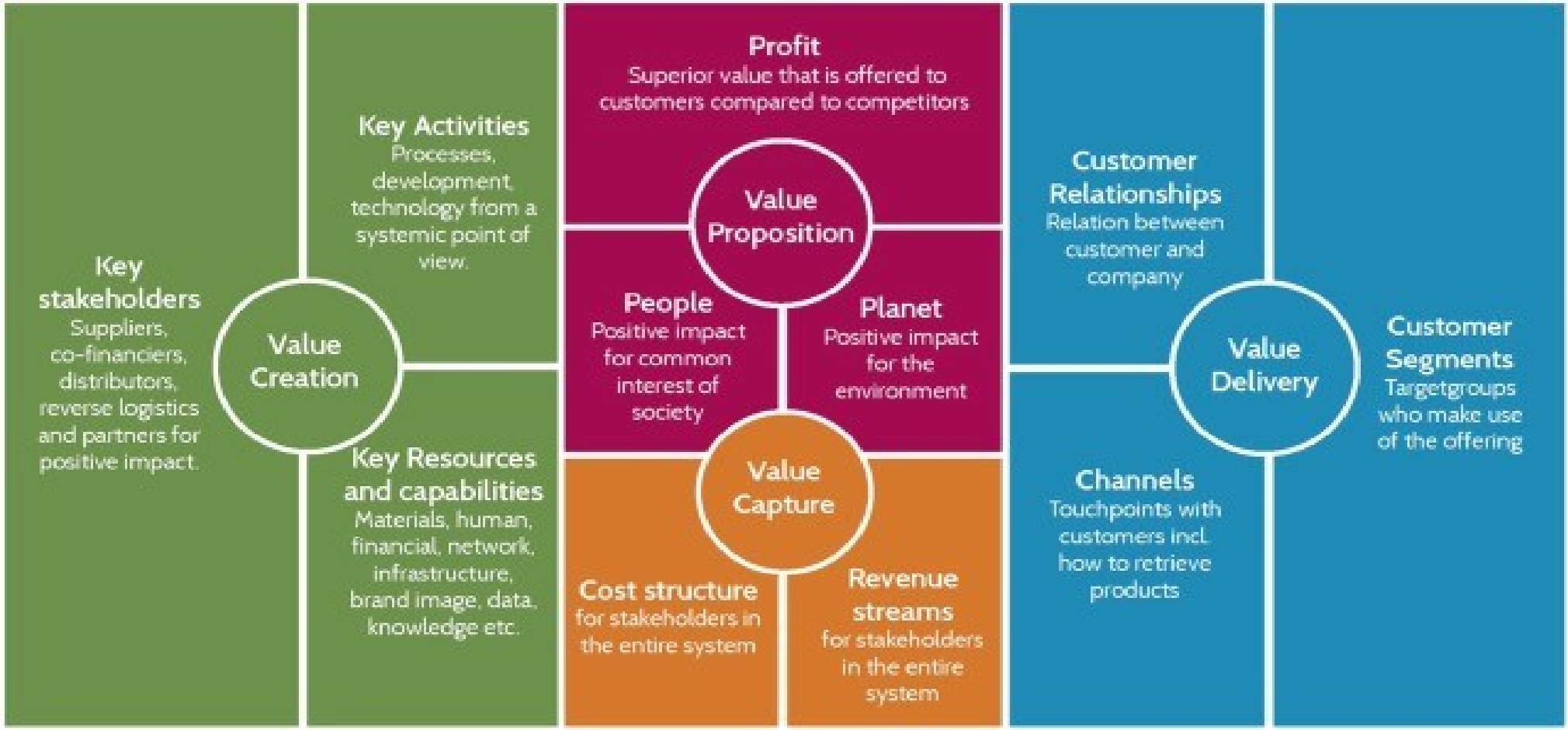
Jabbour, C. J. C., de Sousa Jabbour, A. B. L., Sarkis, J., & Godinho Filho, M. (2019). Unlocking the circular economy through new business models based on large-scale data: an integrative framework and research agenda. *Technological Forecasting and Social Change*, *144*, 546-552.

# Circular business model canvas

| | | | | |
|---|---|---|---|---|
| ***Partners***<br>• Cooperative networks<br>• Types of collaboration | ***Activities***<br>• Optimising performance<br>• Product Design<br>• Lobbying<br>• Remanufacturing, recycling<br>• Technology exchange<br>***Key Resources***<br>• Better-performing materials<br>• Regeneration and restoring of natural capital<br>• Virtualization of materials<br>• Retrieved Resources (products, components, materials) | ***Value Proposition***<br>• PSS<br>• Circular Product<br>• Virtual service<br>• Incentives for customers in Take-Back System | ***Customer Relations***<br>• Produce on order<br>• Customer vote (design)<br>• Social-marketing strategies and relationships with community partners in Recycling 2.0<br>***Channels***<br>• Virtualization<br>***Take-Back System***<br>• Take-back management<br>• Channels<br>• Customer relations | ***Customer Segments***<br>• Customer types |
| ***Cost Structure***<br>• Evaluation criteria<br>• Value of incentives for customers<br>• Guidelines to account the costs of material flow | | | ***Revenue Streams***<br>• Input-based<br>• Availability-based<br>• Usage-based<br>• Performance-based<br>• Value of retrieved resources | |
| **Adoption Factors**<br>• Organizational capabilities<br>• PEST factors | | | | |

Lewandowski, M. (2016). Designing the business models for circular economy—Towards the conceptual framework. *Sustainability*, *8*(1), 43.

# Circular business model




Bocken, N.M.P., Schuit, C.S.C., Kraaijenhagen, C., 2018. Experimenting with a circular business model: lessons from eight cases. Environ. Innovat. Soc. Transit. 28, 79e95

# The Sustainable Business Model Canvas

Project: | Owner: | Version:

## Positive Impact (Maximise)

*What are positive **2nd and 3rd order** effects of your product on planet, society, the economy or your organisation (e.g. brand)? How can these effects be **maximised** along the complete product life cycle?*

*You can use the left side of the Threebility Sustainability Impact Canvas to generate the input for this section*

## Negative Impact (Minimise)

*What are negative **1st, 2nd and 3rd order** effects, and how can these be **minimised**? Is harmful waste generated that requires expensive disposal? Are there **rebound effects** or new **technological risks**?*

*You can use the right side of the Threebility Sustainability Impact Canvas to generate the input for this section*

## Sustainable Partners

*Who are possible **partners** in becoming more sustainable?*

*How can we make the whole supply chain sustainable, transparent and **circular**?*

*Can we **cooperate** with partners from other industries to form an industrial symbiosis?*

*Can we shape anticipated environmental regulations by partnering and cooperating with **relevant regulatory bodies**?*

## Sustainable Value Creation

*Which are our **key activities**? How can we adjust them (e.g. **manufacturing**) to ensure sustainability?*

*Which **enabling sustainable technologies** can be used?*

## Sustainable Tech & Resources

*Which 1) **natural**, 2) **energy** and 3) **technical** resources do we need?*

*Can we **substitute** any for more sustainable resources?*

## Sustainable Value Proposition

*Which **problem** do we solve, which **value** do we create?*

*What are **function** & **form** of our product or service?*

*Can we solve our customers' problems more sustainably?*

*Can we transform sustainability into customer value?*

*Is ownership necessary or is the product as a service model applicable?*

*Can we extend the **product life cycle**?*

## Sustainable Customer Relation

*Which customer relationships satisfy customer expectations **and are sustainable**?*

*How can we make **current relationships** more sustainable?*

## Responsible customers

*Who are our customers? How can we **enable** them to act sustainably?*

*Which target customers may help to **promote our sustainable solution**?*

## Sust. Channels

*How can we make our distribution channel more sustainable and **circular**?*

*How do we best communicate the sustainable aspect of our product / service?*

## End of Life

*What happens at the end of the **product life cycle**?*

*Can the product be **profitably recycled**, upcycled, reused, refurbished?*

## Cost Structure & Additional Costs

*What are the required costs and investments for my endeavour?*

*Which resources / activities are the least sustainable? Do **sustainable alternatives exist**? Is switching economically reasonable?*

## Subsidisation

*Do **tax bonuses & subsidies** or **3rd party funding** exist for my endeavour?*

## Revenue & Sustainability Premium

*Which are existing and possible revenue sources?*

*Are customers willing to pay a **premium for sustainability**?*

*Can we create a **unique advantage** due to sustainable proposition elements?*

*Do **price structures exist that incentivize** sustainable customer behaviour?*



https://www.threebility.com/_files/ugd/b67836_7bd275b345cf4f20bc560590113a8f47.pdf

# Digital services and CE

Operational performance:

- (i) Manufacturing operations: this includes asset management, smart manufacturing, end-to-end transparency, performance optimization, and human resource management;
- (ii) Maintenance and production asset management: involving the tracking and tracing of assets to ensure high quality, enhanced functionality/performance, and to monitor the degradation of assets; (iii) Field services: these are value-added services such as installation, maintenance, and repairs.
- DIGITALISATION = the capable connection between service design and a circular product through streamlined data sharing among stakeholders.
- With BM – DIGITALISATION support creating value by reducing operating costs through end-to-end integration. At the same time, servitisation increases the efficiency of remanufacturing, reusing, and recycling systems due to analytical algorithms that process big data collected at different stages of production. It is a dual-dimensional, conceptual representation of a firm's value creation and value capturing profitably and sustainably. (Atif, S., Ahmed, S., Wasim, M., Zeb, B., Pervez, Z., & Quinn, L. (2021). Towards a conceptual development of Industry 4.0, servitisation, and circular economy: A systematic literature review. *Sustainability*, *13*(11), 6501.)