

Metainformações das revisões bibliográficas (2021)

1. Referência completa do artigo

Yang, M., & Evans, S. (2019). *Product-service system business model archetypes and sustainability*. *Journal of Cleaner Production*, 220, 1156–1166.
<https://doi.org/10.1016/j.jclepro.2019.02.067>

2. Autores (um registro por autor)

(1) [Miyang Yang](#)

2.1. Tipo: Professor Sênior

2.2. Idade: 35 anos (01/11/1986)

2.3. Anos pesquisando no assunto

Desde 2017 como “Circular economy” (5 anos)

Desde 2020 como “Digital Sustainability” (2 anos)

2.4. Instituição

Cranfield University: Cranfield, GB

University of Exeter: Exeter, Devon, GB

2.5. Índice-h:

[Google Scholar](#): 15

[Scopus](#): 12

2.6. Colegas da mesma instituição

Pesquisadores: Prof. Simon Pollard,

Mesmo Lab: Wei Zhang, Yongjiang Shi, Xinjian Gu, Renzhong Tang, Xiaohong Pan, P. Rana, Lloyd Fernando, Palie Smart, Ximing Ruan, Yangjian Ji, Hao Li, Qifeng Li, Tarila Zuofa

Estudantes: Glen Jonata, Wenxiao Bai

2.7. Quantidade de artigos já publicados

Google Scholar: 39 artigos

Scopus: 24 artigos

2.8. Outros artigos significativos (mais citados) sobre outros temas

- 49 citações - Yang, M., Vladimirova, D., & Evans, S. (2017). Creating and capturing value through sustainability: The sustainable value analysis tool. *Research-Technology Management*, 60(3), 30–39. <https://doi.org/10.1080/08956308.2017.1301001>
- 20 citações - Li, H., Ji, Y., Li, Q. et al. A methodology for module portfolio planning within the service solution layer of a product–service system. *Int J Adv Manuf Technol* 94, 3287–3308 (2018). <https://doi.org/10.1007/s00170-016-9976-3>

2.9. Outros artigos significativos (mais citados) neste tema

Circular Economy

- 374 citações - Evans, S., Vladimirova, D., Holgado, M., Van Fossen, K., Yang, M., Silva, E. A., and Barlow, C. Y. (2017) Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models. *Bus. Strat. Env.*, 26: 597– 608. doi: 10.1002/bse.1939.

- 171 citações - M. Yang, S. Evans, D. Vladimirova, P. Rana (2017) Value uncaptured perspective for sustainable business model innovation. J. Clean. Prod., 140 (2017), pp. 1794-1804.
- 82 citações - Yang, M., P. Smart, M. Kumar, M. Jolly, and S. Evans. 2018. "Product-Service Systems Business Models for Circular Supply Chains." Production Planning & Control 29 (6): 498–508. 10.1080/09537287.2018.1449247.

Digital Sustainability

- 53 citações - H. -C. Liu, M. Yang, M. Zhou and G. Tian, "An Integrated Multi-Criteria Decision-Making Approach to Location Planning of Electric Vehicle Charging Stations," in IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 1, pp. 362-373, Jan. 2019, doi: 10.1109/TITS.2018.2815680.
- 34 citações - Y. Liu, Y. Zhang, S. Ren, M. Yang, Y. Wang, D. Huisinigh (2020) How can smart technologies contribute to sustainable product lifecycle management? J. Clean. Prod., 249, p. 119423, 10.1016/j.jclepro.2019.119423
- 30 citações - N. Wang, S. Ren, Y. Liu, M. Yang, J. Wang, D. Huisinigh (2020) An active preventive maintenance approach of complex equipment based on a novel product-service system operation mode J. Clean. Prod., 277, p. 123365, 10.1016/j.jclepro.2020.123365

2.10. Coautores recorrentes

Steve Evans, Doroteya Vladimirova, P. Rana, Maria Holgado, Mélanie Despeisse (ResearchGate)

(2) [Steve Evans](#)

2.11. Tipo: Professor

2.12. Idade: +- 62

2.13. Anos pesquisando no assunto

Desde 2013 como "Circular economy" (9 anos)

Desde 2011 como "Sustainable factories" (11 anos)

2.14. Instituição

University of Cambridge

2.15. Índice-h:

[Scopus](#): 39

[ResearchGate](#): 40

2.16. Colegas da mesma instituição

Professor Tim Minshall, Dr Shima Barakat, Dr Claire Barlow, Dr Alexandra Brintrup, Dr Ronan Daly, Professor Michael De Volder

2.17. Quantidade de artigos já publicados

[Scopus](#): 164

[ResearchGate](#): 163

2.18. Outros artigos significativos (mais citados) sobre outros temas

- 1444 citações - N. Bocken, S.W. Short, P. Rana, S. Evans. A literature and practice review to develop sustainable business model archetypes. J. Clean. Prod., 65 (2014), pp. 42-56

- 292 citações - Bocken, N., Short, S., Rana, P. and Evans, S. (2013), "A value mapping tool for sustainable business modelling", *Corporate Governance*, Vol. 13 No. 5, pp. 482-497. <https://doi.org/10.1108/CG-06-2013-0078>
- 130 citações - The DEDUCE guided Query tool: providing simplified access to clinical data for research and quality improvement. *J. Biomed. Inform.*, 44 (2011), pp. 266-276, 10.1016/j.jbi.2010.11.008

2.19.Outros artigos significativos (mais citados) neste tema

Circular economy

- 375 citações - Evans S. Vladimirova D. Holgado M. Van Fossen K. Yang M. Silva E. A. Barlow C. Y. (2017). Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models. *Business Strategy and the Environment*, 26(5), 597–608. 10.1002/bse.1939
- 339 citações - M. Geissdoerfer, S.N. Morioka, M.M. de Carvalho, S. Evans Business models and supply chains for the circular economy. *J Cleaner Prod*, 190 (2018), pp. 712-721
- 307 citações - M. Geissdoerfer, D. Vladimirova, S. Evans Sustainable business model innovation: a review *J. Clean. Prod.*, 198 (2018), pp. 401-416, 10.1016/j.jclepro.2018.06.240

Sustainable factories

- 1334 citações - T.S. Baines, H.W. Lightfoot, S. Evans, A. Neely, R. Greenough, J. Peppard, R. Roy, E. Shehab, A. Braganza, A. Tiwari, J.R. Alcock, J.P. Angus, M. Bastl, A. Cousens, P. Irving, M. Johnson, J. Kingston, H. Lockett, V. Martinez, P. Michele, D. Tranfield, I.M. Walton, H. Wilson. State-of-the-art in product-service systems. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 221 (10) (2007), pp. 1543-1552
- 367 citações - Martinez, V., Bastl, M., Kingston, J. and Evans, S. (2010), "Challenges in transforming manufacturing organisations into product-service providers", *Journal of Manufacturing Technology Management*, Vol. 21 No. 4, pp. 449-469. <https://doi.org/10.1108/17410381011046571>
- 171 citações - M. Yang, S. Evans, D. Vladimirova, P. Rana (2017) Value uncaptured perspective for sustainable business model innovation. *J. Clean. Prod.*, 140 (2017), pp. 1794-1804.

2.20.Co-autores recorrentes

María Holgado, P. Rana, Miying Yang, Mélanie Despeisse, Peter Ball (ResearchGate)

3. Estrutura do abstract

1. Contextualização:

NADA

2. Gap/Lacuna:

The existing literature has largely discussed the sustainability potentials of product-service systems (PSS) business models, but most of them do not distinguish the sustainability of different PSS archetypes.

3. Objetivo:

This paper aims to investigate how different PSS archetypes may affect firms' sustainability performance differently, and to identify the main reasons for the differences.

4. Metodologia:

They studied three manufacturing firms, each of which has co-existence of various archetypes of PSS. They analyzed the sustainable value generated by each archetype, and observed that, firstly, different archetypes of PSS do create differences in the sustainable value delivered; secondly, the main reason for the difference is the integration level of product maker, owner and user; thirdly, result-oriented PSS is shown to have significant potential to deliver environmental and economic benefits through enhanced resource efficiency in production and consumption; and fourthly, PSS alone does not have significant social sustainability effects.

5. Resultados:

They then proposed a framework of PSS business model archetypes and sustainability based on the literature study and empirical evidence. The proposed framework is novel and provides a comprehensive analysis of the economic, environmental and social sustainable value creation of known PSS business model archetypes.

6. Conclusão:

The findings can be applied in manufacturing firms to explore sustainable value sources when developing different archetypes of PSS business models.

4. Palavras-chaves e se foram citadas no abstract.

Product-service system; PSS; Sustainable business models; Sustainable value; PSS archetypes; Servitization

5. Introdução e/ou revisão bibliográfica introdutória, afirmações / constatações (tipo) versus citações (essa lista pode ser longa, por isso coloquei em forma de tabela)

| Afirmação / Constatação | Tipo (*1) | Referência (*2) |
|--|-----------|------------------------------|
| "An increasing number of manufacturing firms are transforming their business models from traditional product-based models to product-service system (PSS) business models, where manufacturers sell an integration of product and service rather than the product alone" | C | (Goedkoop et al., 1999) |
| "The process of this transition is called servitization" | C | (Vandermerwe and Rada, 1988) |
| "The well-known servitization examples include the power by the hour and total care contracts offered by Rolls Royce, in which the customers pay for the availability and reliability of the engines rather than the engines themselves" | C | (Neely, 2009) |
| "The main driving force for developing such PSS business models is that manufacturers can no longer compete by making and selling high quality products alone" | C | (Visnjic et al., 2017) |
| "In most markets products become increasingly similar, leaving limited room for product differentiation" | L | (Tukker, 2015) |

| | | |
|--|---|---|
| “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” | C | (Pine and Gilmore, 1998, Wise and Baumgartner, 1999) |
| “Servitization is also driven by customer demands, changing from products to solutions over the past decades | C | (Baines et al., 2009, Martinez et al., 2017) |
| “Servitization/PSS has received increasing interest from researchers. The current literature has studied servitization/PSS from various perspectives, such as the drivers and barriers of servitization, PSS design, PSS modularization and the sustainability features of PSS.” | J | (Vladimirova, 2012; Sakao and Lindahl, 2009; Sakao and Mizuyama, 2014; Song and Sakao, 2017; Fagnoli et al., 2018; Li et al., 2018; Tukker, 2004; Tukker, 2015) |
| “The potential benefits of PSS business models are obvious. Many servitized companies have largely gained revenue from continuous services” | J | (Martinez et al., 2017) |
| “Studies also identified that PSS business models have the potential to improve firms’ environmental performance” | J | (Goedkoop et al., 1999, Omann, 2003, Tukker, 2015) |
| “The argument is that servitized companies have high incentive to internalize the externalities along the entire product life cycle, so that their profits and the environmental benefits have the potential to be synergized” | C | (Baines et al., 2009, Tukker, 2015) |
| “The existing literature has mostly discussed the sustainability potentials of PSS business models in general. However, different PSS archetypes differ in their characteristics, and may result in diverse environmental, economic and social impacts.” | L | - |
| “Tukker (2004) initiated the discussion by proposing eight types of PSS and analyzing their environmental sustainability potentials respectively, but little empirical evidence has been provided to support the arguments. There is a need to examine the sustainability effects of different archetypes of PSS business models in practice.” | L | (Tukker, 2004) |

(*1) Tipos de afirmação / constatação: G (geral), C (contexto), J (justifica o artigo / pesquisa), L (explicita a lacuna). A constatação da lacuna é muito importante. Mas é difícil diferenciar J de L.; (*2) Inserir somente autor(es) e ano. A referência completa encontra-se no próprio artigo

6. Casos citados e principais características dos casos

NADA

7. Questão da pesquisa, Foco (escopo) e Objetivos (geral primário e secundários)

- 1- Questões de pesquisa: his paper investigates the questions “what is the sustainable value created in different archetypes of PSS business models”, “what are the main

differences between each archetype” and “what are the main reasons for the differences”.

- 2- Escopo: They will first review the current literature on the sustainability effects of PSS business models, and then present the findings from our empirical studies on three manufacturing firms, each of which has transformed to servitized companies and has co-existence of PSS business models archetypes. The sustainable value created in different PSS archetypes and the main reason for the differences will be discussed.
- 3- Objetivos: The purpose of this paper is to understand how different archetypes of PSS business models create economic, environmental and social value.

8. Caso seja uma survey sobre o assunto: qual o diferencial deste artigo (análise da revisão) com relação a outras revisões e/ou surveys? (segundo o autor, caso ele tenha citado). Avaliar cada um dos diferenciais separadamente, caso o autor tenha feito isso. Pode montar uma tabela se for o caso.

NADA

9. Metodologia

9.1. Descrição Geral: Nome do(s) método(s); se é qualitativo, quantitativo ou combinação de ambos

- Multiple-case study, qualitativo.

9.2. Fontes (referências) utilizadas sobre os métodos científicos adotados. Pode montar uma tabela: método x fonte.

| Método | Fonte |
|---------------------|-------------|
| Multiple-case study | (Yin, 2009) |
| Focus group | - |

9.3. Período de análise das referências (publicações desde que ano)

NADA

9.4. Tamanho da amostra analisada

The study was conducted in three firms. The primary data was collected from a one-day focus group (24 participants) and 17 semi-structured interviews/workshops (25 participants)

9.5. Quantidade de referências citadas

NADA

9.6. Foram realizadas observações complementares?

Primary data were collected from interviews, workshops and focus group; and secondary data from annual reports and company documents.

9.7. Fontes da revisão (casos, periódicos específicos, e quais bases de dados). Quais as justificativas para escolher essas fontes.

NADA

9.8. Estratégia para construção da string de busca

NADA

9.9. String de busca

NADA

9.10. Filtros

NADA

9.11. Técnica / método de análise utilizada

| Método | Fonte |
|---|-------------------------------|
| Cross-case analysis | (Eisenhardt, 1989, Yin, 2009) |
| Three procedures of data analysis: data reduction, data display and conclusion drawing and verification | (Miles and Huberman, 1994) |
| Three stages of coding: open coding, axial coding, and looking for explanation and patterns in coding | (Miles and Huberman, 1994) |
| MAXQDA software | - |

9.12. Metodologia para definição de pesquisas futuras

NADA

10. Resultados

10.1. Quantidades resultantes antes e após cada filtro

NADA

10.2. Definições (resultantes da análise ou mesmo adotadas como premissas no início da publicação)

NADA

10.3. Evolução da pesquisa / das publicações no assunto

NADA

10.4. Comunidades / “tribos” / “igrejas” / áreas de conhecimento / disciplinas identificadas

NADA

10.5. Características de cada tribo (os atributos e/ou explicações são definidos pelo próprio artigo)

NADA

10.6. Principais “achados” (*findings*)

- The findings show that PSS business models have positive effects on improving the environmental and economic sustainability and a minor social benefit (little evidence).
- The research also confirms that in theory the more a PSS is result-oriented, the higher the potential for sustainable benefits.

- The findings also indicate that the integration level of maker, owner and user plays a key role in affecting the sustainability of PSS. The more a PSS business model involves manufacturers owning products, the greater the potential for creating sustainable value.
- This study provides rich empirical data from manufacturing companies having co-existence of different archetypes of PSS business models.

| Resultados similares | Fonte |
|--|---|
| “believe that result-oriented PSS is the most promising PSS business model in terms of encouraging a move towards a circular and resource-efficient economy” | (Tukker, 2015, Tukker and Tischner, 2006) |
| “result-oriented PSS offer greater potential for dematerialization.” | (Beuren et al.,2013) |
| “that use- and result-oriented PSSs are not necessarily more sustainable than product-oriented PSS.” | (Manzini and Vezzoli, 2003) |
| “ownership of the product brings a feeling of control and encourages more freedom when using products, which can be considered a valuable attribute.” | (Tukker, 2015) |

10.7.Outros tópicos que não foram tratados aqui (sugestão para nova meta-informação ou resultados significativos)

- They identified that a great deal of economic, economic-environmental and economic-social value was created, but very little environmental, social or social-environmental value was identified. It implies that the firms were mainly interested in value that makes an economic contribution to the company.
- Some environmental value was created but only because it was combined with economic value. It was a coincidental benefit produced as part of the process of the company pursuing its economic goals.
- The findings also empirically confirm that PSS business models, especially result-oriented PSS, have high potential to combine economic and environmental value.

10.8.Proposições de pesquisas futuras (geral)

- They suggest that it is necessary for manufacturers to consider the sustainable value of different PSS business models, in relation to their varying impact on sustainability. The proposed framework provides a foundation for further study at the intersection of PSS archetypes and sustainability.

10.9.Contribuições (para academia / prática / ambas?)

Teórica

This paper mainly contributes to literature in three aspects:

- First, they developed a framework of PSS business model archetypes and sustainability based on theoretical and empirical studies. This framework is novel and provides a systematic understanding of the sustainable value of different PSS archetypes in each dimension of sustainability (i.e. economic,

social and environmental), as well as the overlapped dimensions (e.g. economic-environmental value).

- Second, they provided empirical evidence to demonstrate the levels sustainable value which are provided by all PSS archetypes, as well as the sustainable value specific only to one or more archetypes.
- Third, they analyses the main reasons for the differences and identified that the integration level of product maker, owner and user play an important role in influencing the sustainability of PSS business models.

Prática

- The research in this paper can be applied to manufacturing firms developing PSS to initiate business model innovation for sustainability. To be specific, the findings can be used in practice to help firms develop sustainable PSS archetypes (e.g. developing leasing models or result-oriented PSS business models) or identify more sustainable value in existing PSS business models (e.g. identifying uncaptured economic-environmental value in the current PSS business models).

11. Conclusões

11.1. Trabalhos futuros (que o autor se propõe, diferente das proposições futuras)

- The future work includes adopting quantitative method to further investigate the relationship between PSS archetypes and sustainability in a wider range of industrial sectors and departments.

11.2. Limitações

- One is the difficulty for other researchers to replicate this study – a common limitation for qualitative research that required highly interactive engagement between researchers and practitioners.
- Another limitation is that the research only covers three industrial sectors, and that most of the company case studies are large B2B manufacturing companies, and some departments are not included in the interviews, such as sales department. These might limit the generalization and applicability of the findings to other sectors or other types of companies.

12. SUA ANÁLISE

12.1. Pontos fortes

- O artigo é claro e de fácil leitura e cumpre seu objetivo de explorar a lacuna de falta de distinção sobre a sustentabilidade nos diferentes arquétipos de PSS;
- Os estudos de casos foram muito bem conduzidos e o cross-case analysis entre as empresas ajudou muito na evidenciação e exemplificação do escopo proposto;
- A análise foi bem executada e com ajuda do software MAXQDA que contribui para acurácia dessa etapa;
- A revisão de literatura apresentada se revela satisfatória na elucidação de definição e das principais contribuições da literatura relativas ao tema.

12.2. Pontos fracos

- As contribuições não são generalizáveis, visto que se trata de estudo de múltiplos casos;
- Os resultados não foram suficientes para contribuir com novos achados relacionados a arquétipos puramente sociais;
- Os autores esclareceram dois conceitos importantes de valor sustentável antes de iniciar a entrevista. Análise está decisão como um ponto fraco por temer pelo enviesamento das respostas, mas compreendo que talvez tenha sido uma medida necessária;
- Aprofundar a explicação dos métodos utilizados, porque a forma como foi conduzido a coleta de dados não foi plenamente compreendida.

12.3. Sugestões para melhoria do artigo

Em relação a estrutura e escrita do artigo a única sugestão é em relação a exploração dos métodos que poderia ter tido mais clareza. Com relação a pesquisa, corrobora-se as sugestões de estudos futuros propostos pelos autores, de ampliar a gama de aplicação diversificando setores e departamentos industriais e utilizando métodos quantitativos robustos.

13. Figuras ou tabelas importantes (caso você queira copiar e citar nos tópicos anteriores)

Figura 1 - (Table 2. PSS business model archetypes in the studied firms)

| Empty Cell | Industries | PSS business model archetypes | | | |
|---------------|--------------------------------|--|--|------------------|--|
| | | Product-oriented PSS | Integration-oriented PSS | Use-oriented PSS | Result-oriented PSS |
| Firm A | Gas generator (3 interviews) | Products and technical services, e.g. installation, maintenance and repair | Engineering Procurement Construction (EPC) | Leasing | Industrial gas projects, i.e. selling gas rather than gas generators |
| Firm B | Steam turbines (6 interviews) | Products and technical services, e.g. installation, maintenance, consultation and repair | Engineering Procurement Construction (EPC), Build Operate Transfer (BOT) | Leasing | Energy management projects, i.e. selling electricity rather than steam turbine |
| Firm C | Turbo machinery (5 interviews) | Products and technical services, e.g. consultancy, installation, testing, maintenance, technological upgrading and remote monitoring, repair | Engineering Procurement Construction (EPC), Build Operate Transfer (BOT) | Leasing | Wind power projects, i.e. selling wind power rather than turbo blower |

Figura 2 – (Table 3. The sustainable value creation in different archetypes of PSS business models)

| Empty Cell | Product-oriented PSS | Integration-oriented PSS | Use-oriented PSS | Result-oriented PSS |
|-----------------------|--|--|--|---|
| Economic value | <ul style="list-style-type: none"> •Increased revenue from service (ABC) •Provide more professional service to solve customer problems (ABC) | <ul style="list-style-type: none"> •Increased revenue through service income and expanded businesses (ABC) •Provide more professional service to | <ul style="list-style-type: none"> •Continuous revenue from leasing (AB) •Provide more professional service to solve customer problems (ABC) | <ul style="list-style-type: none"> •Improved technology (A) - Experiment and test on products (A) -High incentive for long-term technology development (A) |

| Empty Cell | Product-oriented PSS | Integration-oriented PSS | Use-oriented PSS | Result-oriented PSS |
|----------------------------|---|---|---|--|
| | <ul style="list-style-type: none"> •Reduced cost for customers (ABC) •Increased customer loyalty (C) •Improved resource efficiency (C) •Better understand customer needs (C) •Guide the direction of product development (C) | <p>solve customer problems (ABC)</p> <ul style="list-style-type: none"> •Reduced total cost for customers (ABC) •Better understand customer needs (C) •Build a business eco-system with the firm as the core firm (C) •Use of service data (C) •Lock out competitors (C) | <ul style="list-style-type: none"> •Reduced financial pressure for customers (ABC) •Reduced risk for customers and banks (C) •Increase market by making previously unfeasible projects feasible (C) •Build a business eco-system with the firm as the core firm (C) | <ul style="list-style-type: none"> •Expanded groups of potential customers (ABC) •Reduced life cycle cost for manufacturer (A) -Less restricted by customer need and more freedom to control cost (A) -Fewer products produced and fewer workers needed (A) -Reduced life cycle cost due to improved service efficiency in MOL (A) •Reduced risk on market (A) •Long-term continuous and stable revenue (ABC) •High gross profit rate (ABC) •Use of service data (ABC) -Prediction of problems (ABC) -Quick response to problems (ABC) •Improved design - more freedom in design (AB) •Reduced costs for customers (ABC) •Provide more professional service to solve customer problems (ABC) •Reduced financial pressure for customers (AB) •Lock in customers (C) |
| Environmental value | <ul style="list-style-type: none"> •Saved energy for customers (B) •Upgraded high energy efficient technology (C) •Longer product life (ABC) | <ul style="list-style-type: none"> •Saved energy for customers (BC) •Reduced total emission (C) •Longer product life (ABC) | <ul style="list-style-type: none"> •Saved energy for customers (BC) •Longer product life (ABC) | <ul style="list-style-type: none"> •Saved energy for customers (BC) •Reduced total emission (C) |
| Social value | <ul style="list-style-type: none"> •Improved safety (ABC) •Improved employee salary and satisfaction (C) | <ul style="list-style-type: none"> •Improved safety (ABC) •Domestic production of heavy industrial equipment (ABC) •Improved employee salaries and satisfaction (C) | <ul style="list-style-type: none"> •Improved safety (ABC) •Domestic production of heavy industrial equipment (ABC) •Improved employee salaries and satisfaction (C) | <ul style="list-style-type: none"> •Increased job opportunities for local community (AC) •Improved safety (ABC) •Domestic production of heavy industrial equipment and therefore |

| Empty Cell | Product-oriented PSS | Integration-oriented PSS | Use-oriented PSS | Result-oriented PSS |
|-------------------------------------|---|--|--|--|
| | | | | no dependence on other countries (ABC) |
| Economic-environmental value | <ul style="list-style-type: none"> •Reduced energy consumption in usage phase (A) •Improved resource efficiency (C) •Utilisation of customers' waste (C) •Improved utilisation of resources (C) | <ul style="list-style-type: none"> •Improved utilisation of resource in production (AC) •Reduced energy consumption in production and usage phase (A) •Longer product life (ABC) •Improved utilisation of resources in production (B) •Utilisation of customers' waste (C) •Improved resource efficiency (C) | <ul style="list-style-type: none"> •Improved utilisation of resource and products (ABC) -Reuse of products for different markets (B) -Increased remanufacturing activities (B) •Reduced energy consumption in production (AC) •Longer product life (ABC) •Utilisation of customers' waste (BC) | <ul style="list-style-type: none"> •Increased utilisation of products' products and co-products (AC) •Improved utilisation of resource, assets and products (ABC) •Utilisation of customers' waste (AC) •Improved resource efficiency (ABC) •Reduced waste in use (ABC) •Increased incentive to improve sustainable technology and design (AB) •Increased energy efficiency and reduced energy cost (AC) •Reduced life cycle energy and life cycle cost (ABC) •Longer product life (ABC) •More freedom and incentive to design for sustainability (AB) |
| Economic-social value | <ul style="list-style-type: none"> •Improved customer relationships (AC) •More efficient use of human resources (AC) | <ul style="list-style-type: none"> •Improved customer relationships (AC) •Improved local business ecosystem (A) •More efficient and sufficient use of human resources (AC) | <ul style="list-style-type: none"> •Improved customer relationships (AC) •Improved local business ecosystem (A) •More efficient and sufficient use of human resources (AC) | <ul style="list-style-type: none"> •Improved customer relationships (AC) •Improved local business ecosystem (AC) •Improved service efficiency (AC) •More efficient use of human resources (AC) •Improved local GDP (AC) |
| Environmental-social value | No data | No data | No data | No data |

Figura 3 - (Fig. 3. Data distribution of sustainable value creation from PSS business models in the studied firms)

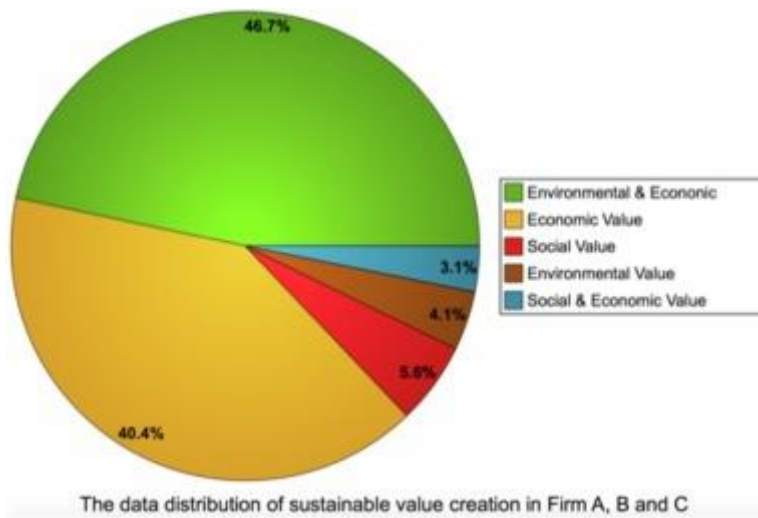


Figura 4 - (Fig. 4. Framework of PSS business model archetypes and sustainability. Slice (a) is the common sustainable value of all four archetypes of PSS. Slice (b) shows the sustainable value of integration-, use- and result-oriented PSS. Slice (c) is the sustainable value of use- and result-oriented PSS. Slice (d) shows the unique sustainable value creation in result-oriented PSS. Slice (e) shows the unique value creation in use-oriented PSS. Slice (f) is the unique sustainable value creation in product-oriented PSS. The area of the blocks becomes larger the closer it gets to result oriented PSS. This symbolizes that the closer to the result-oriented PSS, the stronger the sustainable value becomes)

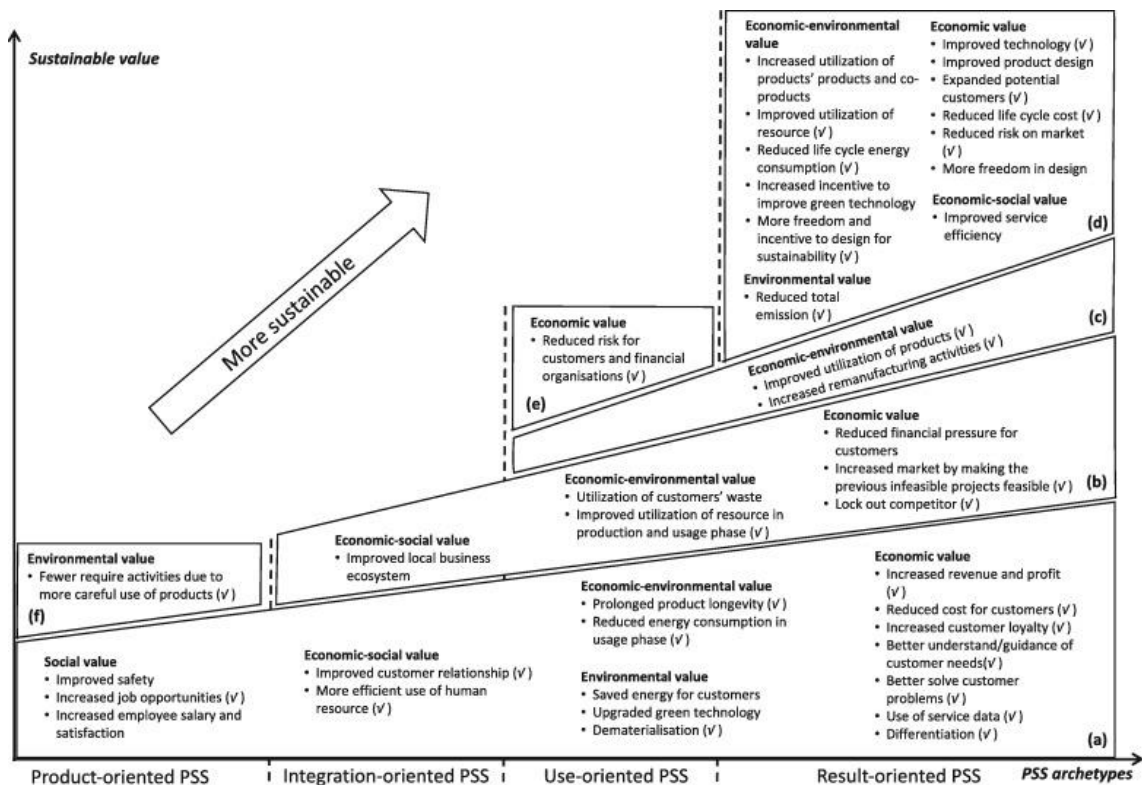


Figura 5 - (Fig. 5. PSS business model archetypes and their integration of product maker, owner and user. The more integrated of the product maker, owner and user, the more sustainable value is created)



The more integrated in the product maker, owner and user, the stronger the sustainable features become