Extended Abstract: Limits to Success of the Individualization Business Model in DigitalTextile Micro Factories

Juan Esteban Martinez-Jaramillo
University of Stuttgart,
Institute for Diversity Studies in
Engineering, Pfaffenwaldring 9,
70569 Stuttgart, Germany
Tel.: +49 711 685-60702
juan.martinez@ids.uni-stuttgart.de

Meike Tilebein
University of Stuttgart,
Institute for Diversity Studies in
Engineering, Pfaffenwaldring 9,
70569 Stuttgart, Germany
Tel.: +49 711 685-60700
meike.tilebein@ids.uni-stuttgart.de

Second Affiliation: German Institutes of Textile and Fiber Research, Körschtalstr. 26, 73770 Denkendorf, Germany, meike.tilebein@ditf.de

Keywords: Archetypes, Digital Textile Micro Factories, Individualization Business Model, Fashion Industry, Simulation

The textile and clothing industries face challenges such as severe competition from low-cost nations, rising demand for sustainable and ethical production, automation, and a skilled labor shortage (Lee, 2019). Furthermore, the sector must continually adjust to changing fashions, designs, and client preferences, which adds to the difficulty.

The need for customized items is a notable trend in customer preferences, leading to increased demand for personalized clothes (Tilebein, 2019). Historically, small manufacturers and artisans met this demand. With the rise of Industry 4.0 technologies, DTMFs have gained significant attention as they enable a fully digital end-to-end development and production process for textile and clothing products. This digital infrastructure enables speed, customization (including tiny batch sizes and single-piece production), efficiency, sustainability, and excellent quality. Furthermore, DTMFs have a high potential for innovation and improved customer engagement (Kiel et al., 2017; Winands et al., 2022).

Despite these potential advantages, the industry has hesitated to adopt technologies of Industry 4.0 together with new business models due to various challenges (Saebi et al., 2017). These challenges are well known also from other industries and include a lack of time, the cost of changing current processes, and resistance to change (Chesbrough, 2010). With no previous experience in this field, decision-makers require more information to assess the financial feasibility and customer acceptance of the individualization business model,

urging concerns about its viability and slowing the adoption of new technologies and new business models (von den Eichen et al., 2015).

This paper aims to develop a System Dynamics-based model analyzing Digital Textile Micro Factories (DTMFs) with the individualization business model. A medium-term perspective enables the detecting of unintended effects and comprehending complex business strategy relationships. The individualization model faces challenges, such as "limits-to-success" scenarios involving design service assistance for customers lacking design skills. Adequate design service capacity leads to satisfied customers and facilitates company growth. The research provides valuable insights for decision-makers to identify critical system drivers and understand their impact, which is vital for developing viable and flexible business models.

Our results have two main contributions. On the one hand, in the industry, it could help firms considering implementing the individualization business model, based on DTMF processes, make informed decisions that increase the firm's benefits while mitigating any possible negative consequences. On the other hand, our paper adds to the literature on System Dynamics with a specific case of limits to growth in the field of business models.

In this paper, we developed an SD-based model to analyze the complex relationships underlyingadopting the individualization business model on a DTMF. We tested two possible scenarios. The first scenario limits customers to ordering only if they have received the design support service, while the second scenario relaxes this limitation. Both scenarios show a decline in thecustomer base reaching the maximum. In both cases, we can distinguish the limits to the successarchetype. In this archetype, there is an endogenous resource that limits the growth of the system. In our case, the decision-makers on DTMFs have to balance sustainable growth with the expansion of the design support capacity.

The findings of this research may provide helpful insightsfor decision-makers in identifying key system drivers and understanding how changes in thesedrivers impact the overall system, which is critical in creating viable and flexible business models. DTMFs that want to offer fully customized garments to their customers need to understand the importance of balancing their key processes and sales that attract new customersand increase customer loyalty.

Our results should be seen as an exploratory experiment and thus should be seen as a tool for organizational learning. For this, the DTMF technology is new and companies aiming to start urban production business for individual clothing need decision support for their investment decision. Our model can provide insights into limits to growth mechanisms that have to be considered upfront. This model could be adapted to study the financial feasibility or the environmental impact of the individualization business model for the textile industry.

REFERENCES

Amit, R., & Zott, C. (2012). Creating Value Through Business Model Innovation. *MIT Sloan Management Review*. https://sloanreview.mit.edu/article/creating-value-through- business-model-innovation/

Arango, S., & Torres, A. (2008). Economic Incidences of Ethanol as Biofuel in Colombiaover the Sugar Cane Products : A System Dynamics Approach. *Revista Avances En Sistemas e Infórmatica*, *5*(2), 69–75.

Arnold, C., Kiel, D., & Voigt, K. I. (2016). How the Industrial Internet of Things ChangesBusiness Models In Different Manufacturing Industries. *International Journal of Innovation Management*, *20*(8). https://doi.org/10.1142/S1363919616400156

Baden-Fuller, C., & Haefliger, S. (2013). Business Models and Technological Innovation. *Long Range Planning*, *46*(6), 419–426. https://doi.org/10.1016/J.LRP.2013.08.023

Barlas, Y. (1996). Formal aspects of model validity and validation in system dynamics. *System Dynamics Review*, *12*(3), 183–210. https://doi.org/10.1002/(SICI)1099-1727(199623)12:3<183::AID-SDR103>3.0.CO;2-4

Batten, D. F. (2009). Fostering Industrial Symbiosis With Agent-Based Simulation and Participatory Modeling. *Journal of Industrial Ecology*, *13*(2), 197–213. https://doi.org/10.1111/J.1530-9290.2009.00115.X

Behera, P. M. (2017). Relevance of Business Model Innovation for Sustainable Entrepreneurship: A Perspective. *Journal of Entrepreneurship Development*, *14*(3), 7–30.

Bisogno, S., Calabrese, A., Gastaldi, M., & Levialdi Ghiron, N. (2016). Combining modellingand simulation approaches: How to measure performance of business processes. *Business Process Management Journal*, *22*(1), 56–74. https://doi.org/10.1108/BPMJ-02-2015-0021

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design andbusiness model strategies for a circular economy. *Https://Doi.Org/10.1080/21681015.2016.1172124*, *33*(5), 308–320. https://doi.org/10.1080/21681015.2016.1172124

Bonakdar, A., Frankenberger, K., Bader, M. A., & Gassmann, O. (2017). Capturing valuefrom business models: The role of formal and informal protection strategies. *International Journal of Technology Management*, *73*(4), 151–175. https://doi.org/10.1504/IJTM.2017.083073

Boyd, D., & Crawford, K. (2012). Critical Questions for Big Data. *Information, Communication & Society*, *15*(5), 662–679. https://doi.org/10.1080/1369118X.2012.678878

Bruce, M., Daly, L., & Towers, N. (2004). Lean or agile: A solution for supply chain management in the textiles and clothing industry? *International Journal of Operationsand Production Management*, *24*(1–2), 151–170. https://doi.org/10.1108/01443570410514867/FULL/PDF

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*, *43*(2–3), 354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Cosenz, F., & Noto, G. (2018). A dynamic business modelling approach to design and experiment new business venture strategies. *Long Range Planning*, *51*(1), 127–140. https://doi.org/10.1016/J.LRP.2017.07.001

Cuc, J. E. (2019). Trends in Business Model Research: A Bibliometric Analysis. In *Journal ofBusiness Models* (Vol. 7, Issue 5).

Eurostat. (2022, December). *Business demography statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Business_demography_statistics#Enterprise_survival_rate

Federal Ministry for Economic Affairs and Climate Action Germany. (2022). *Was ist Industrie 4.0?* https://www.plattform-i40.de/IP/Navigation/DE/Industrie40/WasIndustrie40/was-ist-industrie-40.html

Gao, B., Liu, S., Pan, G., & Ong, A. P. R. (2020). Concept and Building Blocks of a BusinessModel: A Systematic Literature Review. *Journal of Economics, Business and Management*, *8*(2), 74–79. https://doi.org/10.18178/joebm.2020.8.2.616

Gassmann, O., Frankenberger, K., & Csik, M. (2014). *The Business Model Navigator: 55 Models that will revolutionise your Business*. https://www.alexandria.unisg.ch/240196

Geissdoerfer, M., Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business modelsand supply chains for the circular economy. *Journal of Cleaner Production*, *190*, 712– 721. https://doi.org/10.1016/J.JCLEPRO.2018.04.159

Geissdoerfer, M., Vladimirova, D., & Evans, S. (2018). Sustainable Business Model Innovation: A Review. *Diversification Strategy & Policy EJournal*, *198*, 401–416. https://doi.org/10.1016/J.JCLEPRO.2018.06.240

Grimal, L., & Guerlain, P. (2014). Mass Customization in Apparel Industry-Implication of Consumer as Co-Creator. *Journal of Economics & Management*, *15*, 105–121.

Groesser, S. N., & Jovy, N. (2016). Business model analysis using computational modeling: astrategy tool for exploration and decision-making. *Journal of Management Control*, *27*(1), 61–88. https://doi.org/10.1007/S00187-015-0222-1/METRICS

Gu, X., & Koren, Y. (2022). Mass-Individualisation–the twenty first century manufacturing paradigm. *International Journal of Production Research*, *60*(24), 7572–7587. https://doi.org/10.1080/00207543.2021.2013565

Hsieh, Y.-H., & Yuan, S.-T. (2010). Using System Dynamics to Analyze Customer Experience Design. *International Journal of Service Science, Management, Engineering,and Technology*, *1*(3), 84–99. https://doi.org/10.4018/jssmet.2010070105

Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. *Harvard Business Review*, 57–68. https://media.mises.org/Academy/2014_winter/managers/HBR_on_Strategy.pdf#page=5 7

Kiel, D., Müller, J. M., Arnold, C., & Voigt, K. I. (2017). SUSTAINABLE INDUSTRIALVALUE CREATION: BENEFITS AND CHALLENGES OF INDUSTRY 4.0. *Https://Doi.Org/10.1142/S1363919617400151*, *21*(8). https://doi.org/10.1142/S1363919617400151

Kraus, S., Filser, M., Puumalainen, K., Kailer, N., & Thurner, S. (2020). Business Model Innovation: A Systematic Literature Review. *International Journal of Innovation and Technology Management*, *17*(06). https://doi.org/10.1142/S0219877020500431

Lee, J. (2019). ANALYSIS ON TRENDS OF ICT-BASED FASHION TECH BUSINESS MODELS. *Journal of Theoretical and Applied Information Technology*, *15*, 17. www.jatit.org

Lin, J. H., & Liu, H. C. (2008). System Dynamics Simulation for Internet Marketing. *2008 IEEE/SICE International Symposium on System Integration*, 83–88.

Liu, X., & Zeng, M. (2017). Renewable energy investment risk evaluation model based onsystem dynamics. *Renewable and Sustainable Energy Reviews*, *73*, 782–788. https://doi.org/https://doi.org/10.1016/j.rser.2017.02.019

Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformationarising from digitization and big data analytics: A research agenda. *The Journal of Strategic Information Systems*, *24*(3), 149–157. https://doi.org/10.1016/J.JSIS.2015.08.002

Magnusson, M., & Pasche, M. (2014). A contingency-based approach to the use of product platforms and modules in new product development. *Journal of Product Innovation Management*, *31*(3), 434–450. https://doi.org/10.1111/JPIM.12106

Martínez, J. A. (2019). MARKUPS, PROFITS AND LIVING WAGES IN THE GARMENT INDUSTRY. In *International Journal of Education and Social Science Research* (Vol. 2,Issue 03). http://ijessr.com

Mitchell, D., & Coles, C. (2003). The ultimate competitive advantage of continuing businessmodel innovation. *Journal of Business Strategy*, *24*(5), 15–21. https://doi.org/10.1108/02756660310504924/FULL/XML

Moellers, T., Bansemir, B., Pretzl, M., & Gassmann, O. (2017). Design and evaluation of a system dynamics based business model evaluation method. *Lecture Notes in ComputerScience (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notesin Bioinformatics), 10243 LNCS*, 125–144. https://doi.org/10.1007/978-3-319-59144-5_8/COVER

Moellers, T., von der Burg, L., Bansemir, B., Pretzl, M., & Gassmann, O. (2019). System dynamics for corporate business model innovation. *Electronic Markets*, *29*(3), 387–406. https://doi.org/10.1007/s12525-019-00329-y

Morecroft, J. (2007). *Strategic Modelling and Business Dynamics: A Feedback Systems Approach*. John Wiley & Sons.

Mutanov, G., Ziyadin, S., & Serikbekuly, A. (2020). Application of system-dynamic modeling to improve distribution logistics processes in the supply chain. *Communications - Scientific Letters of the University of Žilina*, *22*(3), 29–39. https://doi.org/10.26552/com.C.2020.3.29-39

Neugebauer, C., & Schewe, G. (2014, December 23). *Wirtschaftsmacht Modeindustrie – Allesbleibt anders*. https://www.bpb.de/shop/zeitschriften/apuz/198384/wirtschaftsmacht- modeindustrie-alles-bleibt-anders/?p=all

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers*. https://books.google.com/books?hl=de&lr=&id=UzuTAwAAQBAJ&oi=fnd&pg=PP1&dq=Business+model+generation:+A+handbook+for+visionaries,+game+changers,+and+ challengers&ots=yYITwiFa1t&sig=U54pK_eH1M44WZ9Ko6tdFMDJtaU

Pasaoglu, G., & Or, I. (2006). A system dynamics model for the decentralized electricity market. *International Journal of Simulation Systems, Science and Technology*, *7*(7), 40–55.

Persson, M., & Lantz, B. (2022). Effects of customization and product modularization on financial performance. *Journal of Engineering and Technology Management*, *65*, 101704. https://doi.org/10.1016/J.JENGTECMAN.2022.101704

Saebi, T., Lien, L., & Foss, N. J. (2017). What Drives Business Model Adaptation? The Impact of Opportunities, Threats and Strategic Orientation. *Long Range Planning*, *50*(5),567–581. https://doi.org/10.1016/j.lrp.2016.06.006

Saeed, K. (1987). World Hunger: Do we understand it? *System Dynamics Review*, *3*(1), 36–44.

Schreiber, F., & Felk, K. (2017). Status-Quo und Wertschöpfungsperspektiven digitaler Geschäftsmodelle in der Textilbranche. In D. Schallmo, A. Rusnjak, J. Anzengruber, T.

Werani, & M. Jünger (Eds.), *Digitale Transformation von Geschäftsmodellen: Grundlagen, Instrumente und Best Practices* (pp. 433–450). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-12388-8_18

Smetschka, B., & Gaube, V. (2020). Co-creating formalized models: Participatory modellingas method and process in transdisciplinary research and its impact potentials. *Environmental Science & Policy*, *103*, 41–49. https://www.sciencedirect.com/science/article/pii/S1462901119303909?casa_token=6j6sAS36glIAAAAA:A8IjJQiQ9n7nWKxYmhPHI_vpSeBVM7ChXY2SWRKVTA9mBMsTFtsZWtr48k1_y-Mp_zXuR9M3RL8

Statista. (2021, March 13). *Apparel Report 2021*. https://www.statista.com/outlook/cmo/apparel/germany

Sterman, J. D. (2000). *Business Dynamics* (McGraw Hil).

Stewart, D. W., & Zhao, Q. (2018). Internet Marketing, Business Models, and Public Policy. *Https://Doi.Org/10.1509/Jppm.19.2.287.17125*, *19*(2), 287–296. https://doi.org/10.1509/JPPM.19.2.287.17125

Taddei, E., Sassanelli, C., Rosa, P., & Terzi, S. (2022). Circular supply chains in the era of industry 4.0: A systematic literature review. *Computers & Industrial Engineering*, *170*,108268. https://doi.org/10.1016/J.CIE.2022.108268

Teece, D. J. (2010). Business Models, Business Strategy and Innovation. *Long Range Planning*, *43*(2–3), 172–194. https://doi.org/10.1016/J.LRP.2009.07.003

Tilebein, M. (2019). Small, Smart and Sustainable. *Digital Textile*, *2*, 60–63.

Tukker, A. (2015). Product services for a resource-efficient and circular economy – a review. *Journal of Cleaner Production*, *97*, 76–91. https://doi.org/10.1016/J.JCLEPRO.2013.11.049

Ünal-Saewe, T., Vedder, C., Vervoort, S., & Schleifenbaum, J. H. (2022). Digital Twins inthe Product Life Cycle of Additively Manufactured Components. In W. Frenz (Ed.), *Handbook Industry 4.0: Law, Technology, Society* (pp. 491–501). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-64448-5_25

von den Eichen, S. F., Freiling, J., & Matzler, K. (2015). Why business model innovationsfail. *Journal of Business Strategy*, *36*(6). https://doi.org/10.1108/JBS-09-2014-0107

Wang, C., Wood, L. C., Abdul-Rahman, H., & Lee, Y. T. (2016). When traditional information technology project managers encounter the cloud: Opportunities and dilemmas in the transition to cloud services. *International Journal of Project Management*, *34*(3), 371–388. https://doi.org/10.1016/J.IJPROMAN.2015.11.006

Winands, K., Müller, K., Kollera, C., & Gries, T. (2022). *A New Textile Production Type-Urban Apparel Production In Microfactories*. https://doi.org/10.15488/12114

Winkler, M., Moltenbrey, F., & Tilebein, M. (2022). Business Model Scenarios For Digital Textile Microfactories. *3rd Conference on Production Systems and Logistics*, 574–582. https://www.repo.uni-hannover.de/bitstream/handle/123456789/12239/Winkler-CPSL2022.pdf?sequence=1&isAllowed=y

Yuen, F. T., & Chan, S. L. (2010). System Dynamics Modelling in CRM: Window FashionsGallery. *International Journal of Engineering Business Management*, *2*(2), 77–84.

Zanker, M., Bureš, V., & Tučník, P. (2021). Environment, business, and health care prevail: A comprehensive, systematic review of system dynamics application domains. In *Systems* (Vol. 9, Issue 2). MDPI AG. https://doi.org/10.3390/systems9020028