

MSc Final Project
Smart Factory Design Research Portfolio
2022/23 (Spring)

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Final Project as a research portfolio

This assessment is an alternative to performing a final project and requires you to perform a series of mini projects, to be submitted as a portfolio of 11,000 words equivalent:

ID	Portfolio component	Description	First draft deadline	Weight (Words)
0.1	Start	Start date	22/01	
0.2	Ethical form	Complete the ethical application . Enter the name of your portfolio and answer the questions to indicate that you will not be collecting data.	29/01	
1	Research proposal	Write a research proposal	23/02	20 (2500)
2	Graphical summary	Prepare a summary of a research paper as a poster	01/03	10 (1000)
3	Research Paper Summary	Prepare a written summary of a research paper	11/03	10 (1000)
4	Theory Development	Develop a theory about the Smart Factory from the perspective of human-centered Industry 4.0	18/04	25 (2500)
5	Comparing research methods	Compare two papers' methodologies and contributions to knowledge	29/04	15 (1100)
6	Discrete Event Simulation (DES)	Beverage Plant – Production System Simulation Modelling	08/05	10 (1500 eq.)
7	Quantitative and Qualitative Simulation Data Analysis	Beverage Plant – DES results report	15/05	10 (1400 e.q.)
	Portfolio Submission		24/05	100 (11,000)

It is recommended that you submit first drafts of the components by the deadlines shown above so that you can receive feedback (this schedule has been designed to consider when the instructor can review your work). Do not submit a component draft before the deadline. Also note that you can only submit a draft for review once.

Part 1: Smart Factory – future of manufacturing industry

Despite the increasing devotion of academia and practitioners, the research field around Industry 4.0 remains fragmented and spotty. This fact becomes apparent when we think of the various perspectives from which the topic is approached. These may have a rather technical peculiarity, such as the decrease of failure rates of manufacturing systems, or adopt a business process perspective, for instance. One of the key concepts within Industry 4.0 is the so-called Smart Factory, also termed digital or intelligent factory. The smart factory depicts a future state of a fully connected manufacturing system, mainly operating without human force by generating, transferring, receiving and processing the necessary data to conduct all required tasks for producing all kinds of goods. Again, it is coherent that the smart factory concept may be approached with altering focal points and therefore cannot be covered by one single research stream (Osterrieder et al., 2020).

Smart factories connect the digital and physical worlds in order to monitor an entire production process, from supply chain management to manufacturing tools and even the work of individual operators on the shop floor. Fully integrated, collaborative manufacturing systems provide a range of benefits for operators, including allowing operations to be adaptable and readily optimised.

However, presented topics/problems raises many questions, such as: How exactly will products be manufactured? How different could production become? And how will this affect the way we work? What will factories of the future look like? What is the effect of new technologies and ways of productions on the workers?

Use the documents listed below and write a 2500 words research proposal for a dissertation addressing either an underlying theoretical issue or an applied research issue. You are only expected to work on the identification of a problem which is topical and where a genuine knowledge gap/issue exists. It is important that your research questions be clearly and directly linked Industry 4.0 and Smart Factory by relying on one or all of the references shown below. You should address all the steps of the problem definition process, show a set of research objectives or research questions, and a proposed methodology.

Your report should be written as a research proposal. More information about writing a research proposal is available in this [video](#).

Documents:

Di Sia, P. (2022). Industry 4.0 Revolution: Introduction. In: Hussain, C.M., Di Sia, P. (eds) Handbook of Smart Materials, Technologies, and Devices. Springer, Cham.
https://doi.org/10.1007/978-3-030-84205-5_88

Petrillo, A., De Felice, F. (2022). Industry 4.0 Perspectives: Global Trends and Future Developments. In: Hussain, C.M., Di Sia, P. (eds) Handbook of Smart Materials, Technologies, and Devices. Springer, Cham.
https://doi.org/10.1007/978-3-030-84205-5_1

Deloitte. (2015) *Industry 4.0: Challenges and solutions for the digital transformation and use of exponential technologies*, available at;
<https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf>

Michelsen, KE., Collan, M., Savolainen, J., Ritala, P. (2022). Changing Manufacturing Landscape: From a Factory to a Network. In: Hussain, C.M., Di Sia, P. (eds) Handbook of Smart Materials, Technologies, and Devices. Springer, Cham. https://doi.org/10.1007/978-3-030-84205-5_2

Deloitte. (2017) *The smart factory* https://www2.deloitte.com/content/dam/insights/us/articles/4051_The-smart-factory/DUP_The-smart-factory.pdf

Part 2: Graphical Summary

Watch the video lecture about [preparing graphical summaries](#) and draw an A3 poster summarising the 2022 paper by Parmentola. For more informations of how to write an graphical summary and some examples, see the following link (<https://www.elsevier.com/authors/tools-and-resources/visual-abstract>).

Parmentola, A., Tutore, I., Costagliola Di Fiore, M. (2022). Environmental Side of Fourth Industrial Revolution: The Positive and Negative Effects of I4.0 Technologies. In: Hussain, C.M., Di Sia, P. (eds) Handbook of Smart Materials, Technologies, and Devices. Springer, Cham. https://doi.org/10.1007/978-3-030-84205-5_84

Part 3: Research Paper Summary

Write a 1000 words summary of the Leng et al. (2021) paper.

Leng, J., Wang, D., Shen, W., Li, X., Liu, Q., & Chen, X. (2021). Digital twins-based smart manufacturing system design in Industry 4.0: A review. *Journal of manufacturing systems*, 60, 119-137. Available at: <https://www.sciencedirect.com/science/article/pii/S0278612521001151>

Part 4: Theory Development

Industry 4.0 is a ubiquitous term throughout general newspapers, on company websites or in scientific journals. One of its key constructs is the smart factory, envisioned as a future state of a fully connected manufacturing system, mainly operating without human force by generating, transferring, receiving and processing necessary data to conduct all required tasks for producing all kinds of goods. Although the understanding of smart factory concepts has been sharpened in the last years, it is still difficult for industrial companies to establish a concrete strategy roadmap within the jungle of different terminologies, ideas and concepts (Osterrieder et al., 2020).

The critics of the Industry 4.0 paradigm emphasized its orientation to new technologies and digitalization in a technocratic way. Therefore, the new industrial paradigm Industry 5.0 appeared very soon and automatically triggered a debate about the role of, and reasons for applying, the new paradigm. Industry 5.0 is complementing the existing Industry 4.0 paradigm with the orientation to

the worker who has an important role in the production process, and that role has been emphasized during the COVID-19 pandemic (Zizic et al., 2022).

Watch the [video lecture](#) on theory development. Based on given papers, develop your own theory about the industrial transformation process from the factory of the future and a worker perspective. In no more than 2,500 words, develop and write your own theory about the industrial transformation process from the factory of the future and a worker perspective. It should include a summary problem definition section and a summary literature review presenting the references that are key to your theory development. You should conclude either with research questions, hypotheses, or a conceptual framework.

Documents:

Zizic, M.C.; Mladineo, M.; Gjeldum, N.; Celent, L. From Industry 4.0 towards Industry 5.0: A Review and Analysis of Paradigm Shift for the People, Organization and Technology. *Energies* 2022, 15, 5221. <https://doi.org/10.3390/en15145221>

Dornelles, J, Ayala, N. F., Frank, A. G..(2022) Smart Working in Industry 4.0: How digital technologies enhance manufacturing workers' activities, *Computers & Industrial Engineering*, Volume 163, <https://doi.org/10.1016/j.cie.2021.107804>.

Part 5: Methodology

The two research papers that are listed below are researching the role of human/workers within the smart factory. Read and compare the methodology used by these two papers. Write a 1,100 words essay about the differences in methodology and contribution to knowledge made by these two papers. In which circumstances would you recommend the use of the first methodology and of the second? This [video](#) is designed to help you get started on this part.

Documents:

Kumar, N., Lee, S.C. (2022). Human-machine interface in smart factory: A systematic literature review, *Technological Forecasting and Social Change*, Volume 174, <https://doi.org/10.1016/j.techfore.2021.121284>
<https://www.sciencedirect.com/science/article/pii/S0040162521007186>

Jo, H. (2022) Success Factor of Smart Factory: Moderating Role of Commitment to Learning, *Procedia Computer Science*, Volume 204, Pages 736-743, ISSN 1877-0509, <https://doi.org/10.1016/j.procs.2022.08.089>
<https://www.sciencedirect.com/science/article/pii/S1877050922008274>

Part 6: Beverage Plant – Production System Simulation Modelling

Beverage is the most essential a necessity through the human history, which is why, it has a wide range of production and consumption. Production has begun to digitalize with the developing technology, changing customer demands, and increasing competition between businesses. Due to the digitalization of production, automation has undergone major vicissitudes that experts refer to as the “fourth industrial revolution” or “Industry 4.0” that can be defined as the development of manufacturing technologies to allow higher levels of interconnectivity, leading to greater communication between machines and local processing of data. Nowadays, the systems in the beverage industry are centrally controlled, while in the future the machines and raw materials will be used in information and communication technologies for communication objectives. Future factories will be smart and cross-linked (Otlis & Sakalli, 2019) .

Check the data for two-week beverage plant production, recorded in time study presented as Excell data (Excel file). Analyse the results of the data and perform manufacturability analysis regarding the workstations capacity, production output per week and all the recorded breakdowns.

Following the facility layout presented in the drawing (Autocad file), design “Digital Twin” of your manufacturing system by using Enterprise Dynamic software and considering all the data extracted from given two-week time study.

In no more than 1,500 words, develop and write the report of above stated tasks.

Part 7: Quantitative and Qualitative Simulation Data Analysis

Watch the [video lecture](#) on qualitative data analysis.

Write a report (no more than 1,500 words) containing:

- Simulation results when using Digital Twin model
- Data analysis of the simulation model designed (this can involve tables and different types of diagrams)
- Evaluate and suggest optimisation by exploiting the potentials of Lean manufacturing and Industry 4.0

References

- Osterrieder, P., Budde, L., & Friedli, T. (2020). The smart factory as a key construct of industry 4.0: A systematic literature review. *International Journal of Production Economics*, 221(August 2019), 107476. <https://doi.org/10.1016/j.ijpe.2019.08.011>
- Otles, S., & Sakalli, A. (2019). 15 - *Industry 4.0: The Smart Factory of the Future in Beverage Industry* (A. M. Grumezescu & A. M. B. T.-P. and M. of B. Holban (eds.); pp. 439–469). Woodhead Publishing. <https://doi.org/https://doi.org/10.1016/B978-0-12-815260-7.00015-8>
- Zizic, M. C., Mladineo, M., Gjeldum, N., & Celent, L. (2022). From Industry 4.0 towards Industry 5.0: A Review and Analysis of Paradigm Shift for the People, Organization and Technology. *Energies*, 15(14). <https://doi.org/10.3390/en15145221>