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Lean in universities: assessing practicality across university functions

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ABSTRACT

The lean management approach supports the ambitions of the European Union Industry 5.0 doctrine in human-centricity, adequate use of technology, and sustainability. Yet universities, the sources of scholarly wisdom, have been slow in investigating and implementing the approach in their teaching or, moreover, the university's own processes. This study investigates one of the most frequently listed barriers to implementing lean in universities – resistance by the academics. This quantitative study unveils significant differences in the practicality of lean practices in supporting scholarly research and the university's administrative activities. Based on the findings, we provided recommendations on the involvement of university staff in lean implementations in a university.

1. Introduction

Since the uncovering of the lean approach in the manufacturing sector in the 1990s as a result of an elaborate research by the Massachusetts Institute of Technology (MIT)-led international group of researchers in the International Motor Vehicle Program (IMVP) (Womack et al. 1990), lean has spread to numerous other sectors, including services and the public sector, and has been declared the "new dominant division of labour" (Anttila et al. 2021, p. 424). In Europe, the contemporaneity of lean was highlighted in 2021 by the publishing of the Industry 5.0 doctrine. The Industry 5.0 policy document (European Commission 2021) refers to the Japanese concept of Society 5.0. Both Society 5.0 and lean have their roots in the Japanese total quality control (TQC) philosophy according to which industry belongs to society and respect for humanity must be the basis for management (Ishikawa 1985; Kondo 1999).

A modern-day university is an institution of higher education and research that awards academic degrees in a number of academic disciplines. A university can contribute to society in three ways with respect to a new organizational phenomenon: by researching it, by providing a testing ground for the research, that is, by applying the phenomenon in its own processes, and by teaching the gained knowledge to members of society. In addition, the university may benefit from the outcomes of these activities by way of more efficient processes and a better quality of teaching.

The pioneers of both researching and teaching lean have been the universities whose scholars participated in the international team of researchers that uncovered the lean phenomenon over the course of the IMVP investigation. Following the activities of IMVP, a number of respective research groups were established in the participating universities, such as Lean Advancement Initiative (LAI) at MIT, the Lean Enterprise Research Centre (LERC) at the Cardiff Business School at Cardiff University (Radnor and Bucci 2011; Jones 2021), lean initiatives at the Harvard Business School and Harvard Medical School and at the Chalmers University of Technology. The activities of these research groups continue feeding society with new findings regarding lean despite changes in associations, sponsors, and names of some of the groups over time.

Other leading universities with strong operations and general management programs, such as Stanford University (USA), Georgia Institute of Technology (USA), and University of Cambridge (UK), have followed. The rest of the universities have been slower in starting research and teaching in lean. However, with lean spreading to almost every sector of life, whether privately or publicly administrated, it is hard to imagine an internationally renowned university today without any

scholarly research published or a strip of knowledge taught about lean.

The exact number of universities offering a course in lean production or management can vary greatly and is not specifically documented, as many institutions include lean principles within broader courses in engineering, operations management, or business. Lean production concepts are widely taught in many countries, and universities often integrate these into curricula related to manufacturing, quality management, and supply chain management. In an exploratory study by Alves et al. (2021) among academics on the importance and spread of lean education, 10% of the respondents reported teaching lean in their classes.

The application of the lean approach in universities has been researched since the early 2000s (Gómez-Molina and Moyano-Fuentes 2022). The approach has been implemented in both the universities' academic and administrative processes, motivated by quality improvement, cost reduction, the need to increase process effectiveness and efficiency, and the need to meet requests by university stakeholders (Gómez-Molina and Moyano-Fuentes 2022). An inevitable push for change has been driven by high competition in the sector. In administrative processes, lean has been applied to libraries, laboratories, information technology centers, administrative services, procurement, and human resources management (Radnor and Bucci 2011; Thirkell and Ashman 2014; Jiménez et al. 2015; Gómez-Molina and Moyano-Fuentes 2022). In academic processes, lean has been applied to designing undergraduate and graduate study plans, the process of teaching undergraduate, postgraduate and lifelong training programs, quality assessment of online university courses, digitization of learning resources, and to reducing the student dropout rate (Emiliani 2004, 2015; Radnor and Bucci 2011; Adam et al. 2019, 2021; Zighan and El-Qasem 2021; Gento et al. 2021; Oversluizen and Slomp 2021). The perceived results of these implementations include simplified and improved processes, improved sustainability, increased student satisfaction, better relations with stakeholders, engaged, energized, and motivated staff, increased information flow, and a decrease in faults and accidents in laboratories.

Lean has been implemented in universities by way of separate *kaizen*-events as well as comprehensive institution-wide programs. It has been taught to staff as general training to everybody or voluntary training to those who want to take part, or as training targeted primarily to managers (Radnor and Bucci 2011; Cano et al. 2022; Lima et al. 2023). Projects have been carried out under the guidance of in-house lean experts or facilitated by external consultants and experts.

While results in the administrative processes have been positive, notable inertia towards lean has been reported on the part of universities' academic staff (Emiliani 2004, 2015; Radnor and Bucci 2011; Thirkell and Ashman 2014). Academics are generally unwilling to apply lean in their activities or teaching or take part in lean improvement activities. Radnor and Bucci (2011) have described this resistance as "down to stubbornness" (Radnor and Bucci 2011, p. 35). It is noteworthy that in the study by Alves et al. (2021), 50% of the respondent academics considered lean education valuable, practical and timely, while only 10% of them reported teaching it in their classes.

The essence of lean is continual improvement with the aim of making every activity and process easier for the executor(s) of the activity or process. If a group of professionals, despite very successful implementations and satisfied colleagues, is reluctant to get inspired, then it is worth investigating what the objective reasons for this are. However, prior research has not stratified the practicality of lean according to the main processes and activities in a university, such as research, teaching, and administrative activities. This study aims to investigate issues related to one of the most frequently reported barriers to implementing lean in universities – resistance by the academic staff – by asking seasoned academics, who are concurrently experts in lean, how beneficial they have found a selection of lean practices to be in their work as researchers and teachers. We also asked them to assess the practicality of applying the same practices in the university's administrative processes.

We expected to see a difference in how practical the lean practices were rated, depending on the function they were applied to. For example, delivery process design in lean starts with defining the customer, that is, the end-user. While this is rather clear-cut in a university's administrative processes regarding an internal customer and can be fairly reliably defined for teaching processes, it is in most cases not applicable in research. In fundamental research, by definition, there is no end-user for the findings in the foreseeable future. Also, the ways of getting to a scientifically significant finding are complex and unpredictable. There is no predefined flow of activities or a standard for the delivery process, although individual tests may be standardized. Even if we cynically limited the end-users of scholarly achievements to scholarly publications and readers, a reliable quality function deployment cannot be performed because the reviewers and readers of the publications are anonymous. Lean has been called time-based competition (TBC) and quick response manufacturing (QRM) in its early years due to its ability to quickly and reliably deliver products and services. In science, the time of making a breakthrough discovery is unknown. A line of research may also never deliver a result, which makes the applicability of concepts such as "takt time", "cycle time", and "lead time" questionable for scholarly research, whereas in an organization's internal processes the operability of these three concepts is easy to imagine and recommend. We concluded our study with suggestions on the inclusion of university staff in lean implementation to support a university's value creation in the most effective way.

2. Method

We applied the quantitative study approach in order to assess differences in the perceived practicality of lean practices across different functions of a university. An online survey was conducted for seven academics, regarded by the authors as possessing in-depth knowledge of lean. In this survey, the respondents were asked: "How likely are the following lean practices to assist you in your work as a researcher?", "How

Table 1. Mean ratings of the lean practices by university functions

	Lean practice	Research	Teaching	Administrative activities
Management	Top management commitment	3.50	3.50	4.00
	Daily management (daily or weekly meetings)	3.00	3.00	4.00
	Measurement system (typically QCDSM for every unit and sub-unit)	2.00	1.75	3.50
Delivery process	Quality function deployment	2.50	2.50	3.50
	VA-NVA analysis	1.50	2.25	2.50
	Just-in-time	2.00	2.75	2.75
	Jidoka (automation with a human touch/built-in quality)	2.25	2.25	2.50
	Takt time	1.00	1.75	1.50
	Cycle time	1.00	1.75	2.25
	Lead time	2.25	2.75	2.50
	Heijunka (workload levelling)	2.50	3.00	3.00
	Standardization of processes and operations	2.50	3.50	4.00
Continual improvement	Organization structure based on daily small groups	2.50	2.00	3.25
	Kaizen (frequent continual improvement activities)	2.75	3.50	3.75
	Multi-departmental project teams	2.00	2.00	3.75
	Using scientific methods to solve problems	4.75	3.75	2.75
	Communicating plans and results clearly and concisely	4.25	3.75	4.00

likely are the following lean practices to assist you in your work as a teacher?", and "How likely, in your view, are the following lean practices to benefit administrative activities in the university?" The list of lean practices that the respondents were asked to rate was the same for each question and can be viewed in Table 1. For analytical purposes, the lean practices were categorized as "management", "delivery process", and "continual improvement". However, the categories were not displayed to the respondents. The lean practices were rated based on a Likert scale: "not at all likely", "somewhat likely", "likely", "very likely", "extremely likely", and "not applicable". The respondents were also asked their gender ("female", "male"), age ("25 to 35 years", "36 to 65 years", "over 65 years"), length of experience with lean, and length of service in the university.

3. Results

Four academics filled in the survey (response rate 57%). 75% of the respondents were male, all respondents were in the age range of 36 to 65 years. The average experience with the lean approach was 17 years, and the average length of service in the university was 12 years.

The following weights were assigned to the Likert-scale ratings: "not at all likely" = 1, "somewhat likely" = 2, "likely" = 3, "very likely" = 4, "extremely likely" = 5, and "not applicable" = 0. Means and the response range (minimum, maximum) were calculated for each practice rated. The mean ratings of the lean practices by university functions are provided in Table 1.

There was substantial variability among the responses. In as many as 15 occasions (for example, "*Heijunka* (workload levelling)" and "Standardization of processes and operations" in research, "Quality function deployment" and "VA-NVA analysis" in teaching, and "Just-in-time" and "*Jidoka* (automation with a human touch/built-in quality)" in administrative activities) the ratings ranged from "not applicable" to "extremely likely". This may signal uneven conceptualization of the practices, which is characteristic of defining lean.

Means and standard deviations (SD) were calculated for each category and university function. The results are provided in Table 2. Ratings for lean practices were lower in research and teaching than in administrative activities. Category ratings were similar in research and teaching, except for ratings for lean delivery process practices (mean 1.94 (SD 1.67) in research, mean 2.50 (SD 1.90) in teaching).

The significance of the means was assessed with ANOVA. The key finding was that there was a significant difference ($P = 0.02$ at significance level $\alpha = 0.05$) between how the practicality of lean practices was rated in research (mean 2.49) and in administrative activities (mean 3.15). Other differences in the mean ratings were not statistically significant at significance level $\alpha = 0.05$.

Table 2. Means and standard deviations by category

	Research	Teaching	Admin.act.
Management	2.83	2.75	3.83
SD	1.53	1.60	1.03
Delivery process	1.94	2.50	2.72
SD	1.67	1.90	1.92
Continual improvement	3.25	3.00	3.50
SD	1.55	1.38	1.40
Total function	2.49	2.69	3.15
SD	1.70	1.70	1.70

4. Conclusions

Our findings confirmed our expectation that the practicality of the lean practices was rated differently in different functions of a university. Namely, the lean practices were rated significantly lower in research than in the university's administrative activities. This sheds light on one of the potential causes of the academics' persistent inertia to get inspired by lean – this approach may not be helpful to them in functional delivery. We therefore recommend focusing on the university's administrative activities (including the set-up and management of laboratories) in seeking benefits from lean. We suggest that applying lean in teaching is optional for most academics but obligatory for those who teach lean. Lean is a hands-on approach that applies real-life examples, such as model production lines, model machines, and model workplaces, as tools in knowledge transfer. Thus, its lecturer should also be a role model. We have summarized our recommendations in Table 3.

Our study also confirmed the general perception in scholarly literature that there is still a lot of confusion about lean practices and their application in university settings. Respondents in this study rated the practices diversely. More respondents may or may not have provided more focused ratings.

Yet the low number of survey respondents is an evident limitation of this study. In our opinion, the helpfulness of lean in university functions, and the perception of such helpfulness, is worthy of further study. This can be done either by using the same survey with more respondents or by providing the respondents with scenarios of lean principles and tools being applied in the university context, and then asking them how helpful they found the principle or tool. This approach enables deeper exploration of the varying practicalities of lean principles across different university functions. Using scenario-based research can expand the pool of respondents by removing the requirement for in-depth knowledge of lean. Instead, participants would only need familiarity with the university's main functions.

The field of lean education would benefit from more research on the objective reasons for inertia in applying continual improvement approaches, such as lean, in universities. This would follow the lean principle of always looking for the root cause. Other aspects, such as possibilities for staff rotation and tangible rewards in the university context, merit attention. While in production and service industries staff can, with the help of adequate training opportunities, easily rotate from function to function, depending on the staffing needs and redundancies, such options are limited between a university's administrative and academic staff. Also, universities, especially the publicly owned institutions, have very limited options for sharing tangible benefits earned through operational improvement with their stakeholders. As universities play an important role in investigating and influencing phenomena in society, they also have an obligation to adequately assess and apply approaches that can benefit society. Lean has proven its positive effect on organizations over decades. Constructive ways must be searched to integrate it into university research and teaching in order to facilitate scholarly support for Europe's transition to a sustainable, human-centric, and resilient economy.

Table 3. Recommendations on how to involve university staff in lean implementations

Function	Recommendation
Research	Not applicable
Teaching in general	Optional
Teaching lean	Recommended
Administrative activities	Recommended

Data availability statement

All data are available in the article.

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References

Adam, M., Hofbauer, M. and Mandl, B. 2019. Integration of IT into a lean basic training: target group-specific insights and recommendations. *Procedia Manuf.*, **31**, 52–59. https://doi.org/10.1016/j.promfg.2019.03.009

Adam, M., Hofbauer, M. and Stehling, M. 2021. Effectiveness of a lean simulation training: challenges, measures and recommendations. *Prod. Plan. Control*, **32**(6), 443–453. https://doi.org/10.1080/09537287.2020.1742375

Alves, A. C., Leão, C. P., Uebe-Mansur, A. F. and Kury, M. I. R. A. 2021. The knowledge and importance of lean education based on academics' perspectives: an exploratory study. *Prod. Plan. Control*, **32**(6), 497–510. https://doi.org/10.1080/09537287.2020.1742371

Anttila, T., Oinas, T. and Mustosmäki, A. 2021. Lean in Europe and the USA – a new dominant division of labour? In *The Cambridge International Handbook of Lean Production: Diverging Theories and New Industries around the World* (Janoski, T. and Lepadatu, D., eds). Cambridge University Press, Cambridge, 423–447. https://doi.org/10.1017/9781108333870

Cano, M., Murray, R. and Kourouklis, A. 2022. Can lean management change the managerial culture in higher education? *Stud. High. Educ.*, **47**(4), 915–927. https://doi.org/10.1080/03075079.2020.1817892

Emiliani, M. L. 2004. Improving business school courses by applying lean principles and practices. *Qual. Ass. Edu.*, **12**(4), 175–187. https://doi.org/10.1108/09684880410561596

Emiliani, M. L. 2015. Engaging faculty in lean teaching. *Int. J. Lean Six Sigma*, **6**(1). https://doi.org/10.1108/IJLSS-06-2014-0015

European Commission. 2021. *Industry 5.0: Towards a Sustainable, Human-Centric and Resilient European Industry.* https://data.europa.eu/doi/10.2777/308407 (accessed 2024-11-06).

Gento, A. M., Pimentel, C. and Pascual, J. A. 2021. Lean school: an example of industry-university collaboration. *Prod. Plan. Control*, **32**(6), 473–488. https://doi.org/10.1080/09537287.2020.1742373

Gómez-Molina, D.-L. and Moyano-Fuentes, J. 2022. Lean management in universities: a systematic literature review. *Int. J. Lean*

Six Sigma, **13**(1), 156–177. https://doi.org/10.1108/IJLSS-12-2020-0224

Ishikawa, K. 1985. *What is Total Quality Control?: The Japanese Way*. Prentice-Hall, New Jersey.

Jiménez, M., Romero, L., Domínguez, M. and Espinosa, M. M. 2015. 5S methodology implementation in the laboratories of an industrial engineering university school. *Saf. Sci.*, **78**, 163–172. https://doi.org/10.1016/j.ssci.2015.04.022

Jones, D. T. 2021. Disseminating lean across the UK: a personal reflection. In *The Cambridge International Handbook of Lean Production* (Janoski, T. and Lepadatu, D., eds). Cambridge University Press, Cambridge, 490–506. https://doi.org/10.1017/9781108333870.021

Kondo, Y. 1999. *Companywide Quality Control: Its Background and Development*. 2nd ed. 3A Corporation, Tokyo.

Lima, E. de S., de Oliveira, U. R., Costa, M. de C., Fernandes, V. A. and Teodoro, P. 2023. Sustainability in public universities through lean evaluation and future improvement for administrative processes. *J. Clean. Prod.*, **382**, 135318. https://doi.org/10.1016/j.jclepro.2022.135318

Oversluizen, G. and Slomp, J. 2021. Use of A3-method by engineering students in industry projects. *Prod. Plan. Control*, **32**(6), 489–496. https://doi.org/10.1080/09537287.2020.1742372

Radnor, Z. and Bucci, G. 2011. *Analysis of lean implementation in UK business schools and universities*. AtoZ Business Consultancy.

Thirkell, E. and Ashman, I. 2014. Lean towards learning: connecting lean thinking and human resource management in UK higher education. *Int. J. Hum. Resour. Manag.*, **25**(21), 2957–2977. https://doi.org/10.1080/09585192.2014.948901

Womack, J. P., Jones, D. T. and Roos, D. 1990. *The Machine That Changed the World*. Simon & Schuster, New York.

Zighan, S. and El-Qasem, A. 2021. Lean thinking and higher education management: revaluing the business school programme management. *Int. J. Product. Perform. Manag.*, **70**(3), 675–703. https://doi.org/10.1108/IJPPM-05-2019-0215

Timmitud lähenemisviisi praktilisuse hindamine ülikooli funktsioonides

Kadri Kristjuhan-Ling ja Kashif Mahmood

Timmitud lähenemisviis (*lean*) toetab Euroopa Liidu Tööstus 5.0 doktriini pürgimusi inimkeskse lähenemise, asjakohase tehnoloogia rakendamise ja kestlikkuse vallas. Ent ülikoolid, teadusliku teadmuse loojad, on olnud pikaldased selle lähenemisviisi uurimisel ja selle rakendamisel nii õppetegevuses kui ka ülikooli protsesside parendamises. Selles uurimuses vaatleme ühte enim viidatud takistust timmitud lähenemisviisi kasutuselevõtul ülikoolides – akadeemilise personali vastuseisu sellele. Küsimustikule põhinevast uurimusest ilmneb märkimisväärne erinevus timmitud lähenemisviisi meetodite ja põhimõtete praktilises väärtuses teadustegevuse ja ülikooli tugiteenuste kontekstis. Uurimistulemustele tuginedes anname soovitusi selle kohta, mil määral kaasata ülikoolis timmitud lähenemisviisi rakendamisse eri funktsioonide esindajaid – teadlasi, akadeemilist õppetegevust läbi viivaid töötajaid ja tugiteenuste personali.