

Chapter 11

Conclusions and New Developments

Anabela Carvalho Alves, Shannon Flumerfelt and Franz-Josef Kahlen

The editors of this volume have been collaborating in the field of Lean Engineering Education and competency development in the engineering workforce for several years. Among them, they hold interests in mechanical, industrial and system engineering, organizational leadership, educational leadership and process engineering disciplines, which allows them to carry out research in Lean Education while maintaining an engineering and a social science perspective.

By creating this edited volume, the editors believe that they have provided a platform for authors to share their efforts in building a Body of Knowledge (BoK) for Lean Education. It is expected that the BoK is current as of the year of publication but will be evolving as a result of practice, technology, perspectives or other developments. This edited volume showed that Lean Education is, in fact, being adopted as a Body of Knowledge taught in Higher Education Institutions (HEI), particularly, in universities, where academics (Industrial Engineering (IE) traditionalists' teachers) may continue to perceive Lean as simple 'common sense' or as 'the application of classical IE.' Although LE does apply common sense approaches, most of the time it is very counterintuitive, requiring the discipline of a body of knowledge. In addition, this text showed that many HEIs are adopting Lean Education in their courses

A. Carvalho Alves (✉)
Centro ALGORITMI, Department of Production and Systems,
School of Engineering, University of Minho, Braga, Portugal
e-mail: anabela@dps.uminho.pt

S. Flumerfelt
Department of Organizational Leadership, School of Education
and Human Services, Oakland University, Rochester, USA
e-mail: flumerfe@oakland.edu

F.-J. Kahlen
Kahlen Global Professional Solutions, Fabrikstraße 3, 48599 Gronau, Germany
e-mail: fjk@kahlen-gps.com

and projects in valuable interactions with industry. This provides new insights into university partnerships that benefit student learning.

All chapters presented were unanimous in concluding that Lean is an organizational need, encompassing several sectors and organizational types. The workforce development need to be trained in Lean is significant. And if provided independently to engineers, managers, shop-floor employees, academics, administrative personnel, is viewed as beneficial but difficult to offer through internal means. Therefore, the business case for HEI to provide Lean Education is of interest to organizations. This is because the Lean Principles and tools do drive daily workplace improvements when deployed with fidelity. Through problem-solving, excuses for failure and other negative organizational citizenship behaviors can be mitigated with skilled Lean workforce deployment.

This edited book showed the embodiments of Lean Education in the form of courses, projects, training short-courses sessions and specialization advanced programs (*what*). This demonstrates that Lean Education is offered by HEI (*who*) using shared Lean Education methodology, active learning, PBL, serious games, scenarios, etc. (*how*). Lean Education strives to highlight staging of students' development (*when*). These chapters in total summarize the impact of this type of learning (*why*) for the students, organizations and society, exposing the reasons various HEIs include Lean in their curriculum.

In this edited volume, readers can see that HEIs are committed to Lean Education. Further, through the use of Lean Education as a methodological improvement approach, HEI faculty will also benefit from the transfer of lessons learned about these highlighted Lean programs. The value in the volume may be found in sharing in the knowledge about various extant Lean Education programs/courses in order to further evolve Lean Education the Body of Knowledge.

The editors also hope that this edited volume intentionally reaches professors, teachers and/or researchers in the Lean Body of Knowledge network in these and adjacent research areas by providing an interdisciplinary platform for jointly developing research proposals. In offering a common platform to discuss Lean Education among scholars, it is possible to identify the multidisciplinary applications of Lean Education.

In this edited volume, new developments are presented that intend to help to propel into action the use of Lean Thinking Principles in the classroom. Lean Thinking Principles constitute critical content, and can be modeled by HEIs to improve teaching/learning, for example, by pulling from the students what they need through active learning like serious games, simulations, and hands-on approaches, among others. This means that when someone educates people in Lean, normally, it is also possible to be "touched" by the Lean spirit by seeing wastes in everything, particularly, in his/her diary activities. This provokes an endless search for perfection.

Therefore, this volume is presented with the hope of both improving the Lean Body of Knowledge and improving HEI education delivery. Much has been accomplished, but there is much more to be done. This is the essence of the pursuit of perfection, always looking for problem-based/needs-based improvements in curriculum/program design and review processes and in quality of curriculum content. It falls to HEI's to share in the commitment to model Lean Thinking and principles to students, for these lessons are valuable in daily living and in the workplace.