

Lean & Green: Aligning Circular Economy and Kaizen through Hoshin Kanri

Eivind Reke¹, Natalia Iakymenko¹, Kristina Kjersem² and Daryl Powell³

¹ SINTEF Manufacturing, Norway

² Møreforskning, Norway

³ Norwegian University of Technology and Science, Norway
eivind.reke@sintef.no

Abstract. As organizations are moving towards a circular economy to enable a transition to more sustainable business practices, there is a need for knowledge on how companies can leverage the capabilities of the entire organization to reach this goal.

In this paper, we present some preliminary but promising results from a single company that has adapted the use of Hoshin Kanri - a strategic management method often associated with lean which seeks to engage the whole organization in breakthrough improvements in Safety, Quality, Delivery, and Cost. The case company has over the last year experimented with including Sustainability (the term the company uses internally) targets in their Hoshin, to develop circular capabilities within the organization. We present a literature study on Circular Economy, Sustainability, Kaizen and Hoshin Kanri, which formed the basis for Action Learning Research interventions. We then compare the results from these interventions with the findings from the review. Finally, we discuss the implications of the results and point to further research.

Keywords: Circular Economy, Hoshin Kanri, Lean Production, Sustainability

1 Introduction

The shift towards more sustainable products and manufacturing operations is pushing companies to improve their environmental performance and efficacy. The idea that lean production can support or facilitate this shift is not new. The underlying principles that they draw on are the same: Productivity improvements (more with less or same with less), quality, cost reduction, continuous improvement, and technology innovation [1]. As such, “lean production” (LP) is a promising approach for companies that wish to move towards sustainable business models that reduce waste, produce more with less, and improve material efficiency while minimizing costs. However, for many practitioners it remains unclear how exactly LP can contribute to a sustainable transformation of their organizations [2]. Building on [3], who suggests six different research questions to guide further research on lean and green, this paper explores the integration of lean and green as a consolidated approach.

Circular Economy (CE), has recently emerged as a useful overarching framework for addressing the sustainability challenge, incorporating many previous environmental approaches [4]. However, as CE is a theoretical framework developed and popularized by the Ellen McArthur Foundation, there is a need for more research into the practical application of the framework. Several research papers [5–7] present result that show how different lean tools can be applied to support the implementation of the CE framework. Kaizen, a practical concept made popular through various books and case studies and closely associated with LP and Toyota Motor Company, is one such established practice that show promising results in aligning CE with front-line improvements [8].

Aligning front-line improvements with CE is only one part of the equation. A challenge already faced by companies is aligning and sustaining continuous improvement initiatives with the overall strategic direction of the company. I.e., that improvements are not just improvements for the sake of improving, but also contribute to improving the overall production, development, and delivery system of the company. Hoshin Kanri represents a method that can assist this alignment [9] [10]. Toyota, who has been practicing its version of Hoshin since 1961 [11], publicly present their own Hoshin on Sustainability as "Global 2050 Sustainability challenge – Going beyond Zero". In fact, Toyota have indeed been quite successful in addressing some of these challenges, expecting their production plants to be carbon net-zero by 2035 [12].

To better understand how companies can integrate lean and green by engaging the whole organization in improvements towards a CE, a study of the relevant literature was carried out. Based on this literature, action learning research interventions are ongoing in a single company. The rest of the paper is structured in the following manner: Section 2 present the literature study. Section 3, the action learning research methodology. Section 4 present the case company and the interventions, and section 5 our preliminary observations and planned further research.

2 Literature Study

A considerable amount of literature has been published on the interplay between lean and green, sustainability, circularity/CE. It is important to understand the difference between the three terms. "Green" and "sustainable" terms both point to preservation of environment and natural resources. However, "green" is strictly about the environmental preservation, while "sustainable" includes environmental health, economic vitality, and social benefits. Similarities and difficulties between sustainability and CE are more ambiguous. [13] studied similarities and differences between sustainability and CE based on an extensive literature review. They define sustainability as "the balanced integration of economic performance, social inclusiveness, and environmental resilience, to the benefit of current and future generations" and CE as "a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through

long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling". The main differences between the two terms, according to [13], are:

- (1) The difference in agency and responsibility. Agency and responsibility are diffused in the case of sustainability, the CE has a clear emphasis on businesses, regulators, and policy makers.
- (2) Difference between commitments, goals, and interests. The sustainability prioritizes alignment between all three pillars and all stakeholders, while CE prioritizes financial advantages for companies, and less resource consumption and pollution for the environment.
- (3) Difference in time frame for achieving results – CE gives relatively immediate results comparing to sustainability.

In summary, CE aims to intentionally design a circular system (in contrast to the established linear economy) with companies and governments carrying the main responsibility for establishing and sustaining the circular system. Sustainability, on the other hand, is a concept that aims at benefiting environment, economy and society, where responsibilities are shared by everyone, but not clearly defined.

Positive synergies between lean and green/sustainability have been shown in existing literature, well documented in the latest literature reviews [14–16]. In this literature, lean is mostly seen as an approach for waste reduction, which consequentially contributes to improved resource usage and better environmental performance. Even when studying impact of lean on sustainability, mostly environmental and economic dimensions are addressed from the position of waste reduction [14].

Despite the growth of research on lean and green/sustainability, consideration of how lean complement CE has been almost absent from the literature due to a mismatch between research on lean green, which has focused on internal manufacturing operations (product and process levels), and research on CE, which takes a broader, more holistic view of environmental impact (the system level) [17]. Furthermore, the same study found that pure lean and green perspective leads to viewing waste as dirty, but not a resource. CE perspective, on the other hand, allows to focus on reuse, remanufacturing, refurbishment, repair, and upgrading throughout the life cycle of products, leading to lowered emissions and less resource demand.

The conducted literature study points towards three challenges in the lean and green research

- 1) Lean is seen mostly as a waste reduction method, which indirectly improves green/sustainability/CE performance [2]. There is lack of studies that look at how lean principles can help in setting and moving towards green/sustainability/CE goals.
- 2) There is a lack of studies that consider the combined impact of lean-green/sustainability/CE on social aspects.
- 3) Currently, most of the existing literature is being dominated by theoretical papers – empirical evidence is lacking [16].

In this paper, the first and third challenges are addressed. As the literature study suggests, the traditional interpretation of LP in CE is that lean is a method for the reduction of waste in the production system [6]. Even though the reduction of waste might be an outcome of LP, it is not the aim. LP, born from the constraints of the Toyota Motor Company [18], studied and presented as a full business system [19], can also be described as a people centric system for continuous learning and growth [20], from which companies can find and face their business challenges, and frame and form solutions through developing people [21].

If CE is included in the business strategy, it is often without giving direction to day-to-day continuous improvement actions. Hoshin Kanri is precisely recognized for building the link between strategic goals and day-to-day actions [22]. Hoshin Kanri is a strategy deployment process which attempts to integrate top management goals into Continuous Improvement (Kaizen) activities [23]. It aims to [24]:

- Provide focus on corporate direction by setting annual strategic priorities
- Align strategic priorities and local plans through a process of catchball, sharing ideas back and forth towards a consensus on how to achieve the Hoshin targets.
- Integrate strategic priorities with daily management by breaking down overall challenges into more manageable problems
- Provide a structured review of the progress of the strategic priorities

Based on the presented gaps in the literature and the notion of Hoshin Kanri, we formulated the following research question: *"How can Hoshin Kanri help companies succeed in the transition towards a circular economy?"*

3 Research Method

In contrast to traditional positivist experimental science, our research question requires an investigation that is built on socially distributed, application-oriented knowledge production. Therefore, given the practical nature of our study and being guided by our research question, we adopt action learning research, a form of action-oriented research which has collaborative learning at its core. Unlike more traditional case study research, where researchers observe the phenomenon under investigation from the outside, action learning research entails the active participation of the researcher in a reflexive questioning and learning process [25]. The action learning research process ultimately aims to create and disseminate new, actionable knowledge, contributing to a theory-building process which is situation specific, emergent and incremental [26].

In the action learning research process, data comes through engagement with others during action cycles. This means that the act of collecting data is itself an intervention. As such, the observations made during the action cycles are not simply seen as collecting data per se, but rather as generating learning for the researcher and the participants in the action. Such an approach provides a rich foundation of data with which to generate knowledge and learning. Observations and reflections were documented through notetaking during interventions, as well as through direct consultation with participants in the action learning network using telephone, email and direct conversation. Where necessary, technical and contractual documents were consulted.

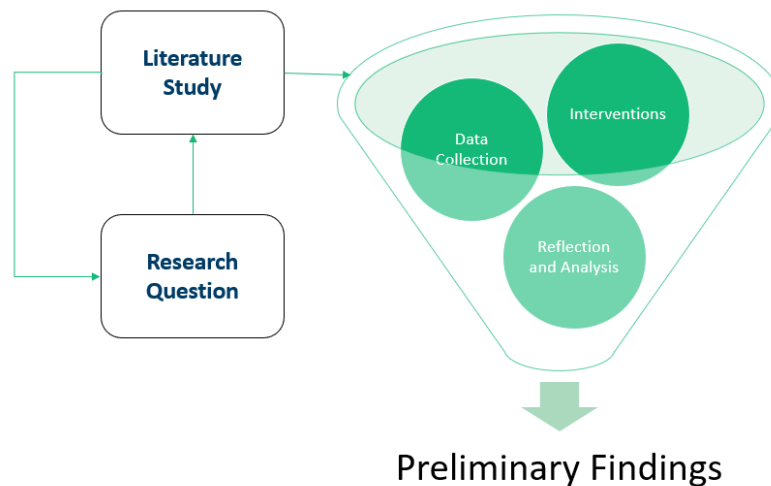


Fig. 1. Action Learning Research Funnel

4 Company description and interventions

The case company is a global manufacturer of medical equipment and devices. The company has used lean production for almost 20 years. Over the last 5 years the Supply Chain & Manufacturing (SC&M) organization has shifted its use of lean production from tools- and methods-oriented approach to a more holistic learning approach focused on business development through people development. In 2020 the company conducted a thorough study of its environmental impact and set out its sustainability goals in a 2030 vision to, among other goals, reduce its carbon footprint by 50% in 2030 by implementing CE.

The hoshin system already in place was structured as follows: the company goals were updated yearly on Quality, Cost, People and Service, then a catch-ball process broke down and aligned the overall targets with local initiatives once a year. However, since the sustainability targets are 10 years ahead, the VP also decided to look further ahead on the traditional areas. To do so 5-year targets were established for all areas, including sustainability. The catch ball process will still be yearly and each plant and department in the SC&M organization has their own 1-year hoshin.

Intervention 1: The researcher discussed with the Vice President (VP) of SC&M how to achieve sustainability goals in that part of the organization. To avoid implementing a new system to follow up on CE goals, the researcher suggested adopting the hoshin system the organization had been practicing in one of their plants and include sustainability in this system. The VP then created a 5-year hoshin for the organization.

Intervention 2: The decision to include CE goals in the hoshin system triggered a discussion between the researcher, the VP and a Plant Manager (PM) on how to break down and present goals in the hoshin. The outcome was clear targets and the removal

of the VPs ideas and suggestions on how to achieve these targets. It was agreed that this should be the outcome of the catch ball process.

Intervention 3: Researcher participated in the regular follow-up meetings already in place, with the intention of better understanding how this is carried out today. In addition, the management team in the main plant was interviewed.

Intervention 4: Further discussions on how to break down and create specific targets for the factory and how middle managers can contribute to these targets. Discussed the connection between system and culture after meeting with the HR-Director of another company who have successfully worked with a Hoshin process. Key take-away was that when establishing targets, they should be almost unattainable, and to have the right method, systematic Kaizen activities, to reach targets.

Table 1. Overview of interventions and outcome

Intervention number	Type of intervention	Outcome
1 st intervention	Integrate sustainability targets in the organization	Include sustainability in the SC&M organizations Hoshin
2 nd intervention	Discussion on how to break down targets	Set targets and use catch ball process to challenge organization
3 rd intervention	Observe follow-up meeting of current hoshin process, including interviews with managers in the plant	Refresh the hoshin process itself
4 th intervention	Discussions on how to break down goals and achieve commitment to goals.	Also need the right method to achieve goals

5 Preliminary Observations and Planned Interventions

The organization has faced several challenges in the preliminary stages of the 5-year hoshin process that started in mid to late 2021. First, the progress of the catch ball process has been slow as the organization has found itself in a state of constant fire-fighting due to global supply chain disruptions and a highly complex supply chain created during the years of cost reduction efforts. Second, there are issues with how the process itself has been practiced over the years that the organization has found hard to change. I.e., the conversations are driven by compliance rather than learning, possibly due to the nature of medical equipment manufacturing - there are strict regulatory measures related to clinical equipment that drives a bureaucratic compliance system within the organization. Third, the sustainability/CE terminology itself is confusing for practitioners. And finally, their complex supply chain is now under pressure also because of the covid-19 pandemic that has caused supply chains to be disrupted across the globe. Supply chain issues have left parts of the organization in a constant state of firefighting. Because of these issues, the organization is struggling to address the long-term challenges posed by its own hoshin. In addition, the hoshin system as it is currently

practiced is arguably too complex itself and needs to be simplified as current practices hinders the involvement of the front-line of the organization.

With regards to the challenges presented in the literature, findings so far suggest that the lean principles of Continuous Improvement and Respect for People can help companies face up to the sustainability challenge by engaging everyone in problem finding and problem solving, and therefore have an impact outside of the mechanical reduction of waste. Furthermore, from a practitioners' point of view, Hoshin shows promise, however there is a possibility the system can become a bureaucratic exercise and as such hinder real improvements. Furthermore, as CE issues are often complex, so-called "ultra-solutions" are likely to be sought, possibly increasing the likelihood of problem-shifting [27].

We stated our research question as "*How can Hoshin Kanri help companies succeed in the transition towards a circular economy?*" The preliminary observations are promising, but more data is needed as it is too early to indicate performative impact. Therefore, we plan to conduct further interventions together with the case company guided by our initial findings. First, we plan to test a dedicated visual management room (Obeya) for the plant-management team to follow up on the improvements they have planned for 2022 and onwards. Second, we look at how the departments engage operators and other front-line workers in improving CE. Third, we will work with the case company to simplify the language of CE, making it more suitable for practitioner context.

Acknowledgement

The authors acknowledge the support of the Norwegian research council for the research project Circularær.

References

1. 1. Florida R (1996) Lean and Green: The Move to Environmentally Conscious Manufacturing. *California Management Review* 39:80–105.
2. 2. Caldera HTS, Desha C, Dawes L (2017) Exploring the role of lean thinking in sustainable business practice: A systematic literature review | Elsevier Enhanced Reader. *Journal of Cleaner Production* 1546–1565.
3. 3. Garza-Reyes JA (2015) Lean and green – a systematic review of the state of the art literature. *Journal of Cleaner Production* 102:18–29.
4. 4. Winans K, Kendall A, Deng H (2017) The history and current applications of the circular economy concept. *Renewable and Sustainable Energy Reviews* 68:825–833.
5. 5. Ciliberto C, Szopik-Depczyńska K, Tarczyńska-Łuniewska M, Ruggieri A, Ioppolo G (2021) Enabling the Circular Economy transition: a sustainable lean manufacturing recipe for Industry 4.0. *Business Strategy and the Environment* 30:3255–3272.
6. 6. Nadeem SP, Garza-Reyes JA, Anosike AI, Kumar V (2019) Coalescing the lean and circular economy. *Proceedings of the International Conference on Industrial Engineering and Operations Management* 2019:1082–1093
7. 7. Kvasdheim NP, Nujen BB, Powell D, Reke E (2021) Realizing Value Opportunities for a Circular Economy: Integrating Extended Value Stream Mapping and Value Uncaptured Framework. In: Dolgui A, Bernard A, Lemoine D, von Cieminski G, Romero D (eds)

- Advances in Production Management Systems. Artificial Intelligence for Sustainable and Resilient Production Systems. Springer International Publishing, Cham, pp 739–747
8. 8. Kurdve M, Bellgran M (2021) Green lean operationalisation of the circular economy concept on production shop floor level. *Journal of Cleaner Production* 278:123223.
 9. 9. Monden Y (1995) *Cost Reduction Systems: Target Costing and Kaizen Costing*. Productivity Press, Portland, Oregon
 10. 10. Akao Y (1991) *Hoshin Kanri: Policy Deployment for Successful TQM*. Productivity Press, Cambridge MA
 11. 11. Furuta K (2022) *Welcome Problems, Find Success*. Taylor & Francis, Boca Raton, FL
 12. 12. Fujioka, Ko (2021) Toyota speeds up carbon-zero target for factories to 2035. In: *Nikkei Asia*. <https://asia.nikkei.com/Spotlight/Environment/Climate-Change/Toyota-speeds-up-carbon-zero-target-for-factories-to-2035>. Accessed 31 Mar 2022
 13. 13. Geissdoerfer M, Savaget P, Bocken NMP, Hultink EJ (2017) The Circular Economy e A new sustainability paradigm? *Journal of Cleaner Production* 143:757–768.
 14. 14. Bhattacharya A, Nand A, Castka P (2019) Lean-green integration and its impact on sustainability performance: A critical review. *Journal of Cleaner Production* 236:117697.
 15. 15. Farias LMS, Santos LC, Gohr CF, Oliveira LC de, Amorim MH da S (2019) Criteria and practices for lean and green performance assessment: Systematic review and conceptual framework. *Journal of Cleaner Production* 218:746–762.
 16. 16. Tasdemir C, Gazo R (2018) A systematic literature review for better understanding of lean driven sustainability. *Sustainability (Switzerland)* 10:
 17. 17. Schmitt T, Wolf C, Lennerfors TT, Okwir S (2021) Beyond “Leaneer” production: A multi-level approach for achieving circularity in a lean manufacturing context. *Journal of Cleaner Production* 318:128531.
 18. 18. Shimokawa K, Fujimoto T (2009) *Birth of Lean*. The Lean Enterprise Institute Inc, Cambridge
 19. 19. Womack JP, Jones DT, Roos D (1990) *Machine That Changed The World*. Harper Perennial, New York
 20. 20. Ballé M, Chartier N, Coignet P, Olivencia S, Powell DJ, Reke E (2019) *The Lean Sensei. Go, See, Challenge*. The Lean Enterprise Institute Inc, Boston, MA
 21. 21. Ballé M, Jones DT, Chaize J, Fiume O (2017) *The Lean Strategy: using lean to create competitive advantage, unleash innovation, and deliver sustainable growth*. McGraw Hill Professional, New York
 22. 22. Giordani da Silveira W, Pinheiro de Lima E, Gouvea da Costa SE, Deschamps F (2017) Guidelines for Hoshin Kanri implementation: development and discussion. *Production Planning & Control* 28:843–859.
 23. 23. Tennant C, Roberts P (2001) Hoshin Kanri: a tool for strategic policy deployment. *Knowledge and Process Management* 8:262–269.
 24. 24. Witcher B, Butterworth R (1999) Hoshin Kanri: how Xerox manages. *Long Range Planning* 32:323–332.
 25. 25. Coghlan D, Coughlan P (2010) Notes toward a philosophy of action learning research. *Action Learning: Research and Practice* 7:193–203.
 26. 26. Westbrook R (1995) Action research: A new paradigm for research in production and operations management. *International Journal of Operations and Production Management* 15:6–20.
 27. 27. Watzlawick P (1988) *Ultra-solutions: How to fail most successfully*. WW Norton & Co