

The Virtual Sensei: Using Assisted Reality to Digitalize Gemba Walks

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Abstract - As more and more companies adopt lean management as a system to continuously develop people, leaders are increasingly intent on conducting gemba walks. This means going to the workplace, be it production, engineering, or supply chain - to explore and discover important business challenges - often under the guidance of a sensei. As a result of the COVID-19 pandemic and the associated social distancing measures and travel restrictions, physical meetings in the workplace have been hampered, especially those involving outsiders. This has since led organizations to consider reducing travels and physical gatherings in general. Therefore, in this paper, we present assisted reality technology as a means of digitalizing gemba walks, allowing managers and executives to benefit from working with external sensei – albeit on a remote basis. We explore the use of RealWear HMT-1 technology as an enabler of the virtual sensei concept, comparing it with the more traditional face-to-face approach to gemba walks and offering insights from multiple interventions between external sensei offsite and local management representatives onsite. The assisted reality approach has been tested both within and across international borders. In general, we find that the digitalization of gemba walks using assisted reality offers multiple benefits over more traditional means. However, there are also several limitations. As such, this work has implications for both research and practice, in that we contribute towards the growing literature on digital lean manufacturing as well as offer practical guidelines for managers and executives embarking on a lean transformation.

Keywords - Digital lean manufacturing; virtual sensei, gemba walks, assisted reality

I. INTRODUCTION

The Coronavirus (COVID-19) pandemic has driven unprecedented changes worldwide, disrupting entire social and industrial ecosystems. The manufacturing industry stands as one of those most significantly impacted by the pandemic, with a growing need to address worker health and safety measures, to meet new standards, and to deal with additional local and federal regulations [1].

Though some authors suggest that lean manufacturing practices can increase resilience [2], even lead the manufacturing sector through pandemics such as COVID-19 [3], lean manufacturers are certainly not immune to the consequences of social distancing and travel restrictions. For example, even the chief executive officer (CEO) of Toyota Motor Corp., Akio Toyoda, was reportedly forced

to rethink the company's long-ingrained practice of *Genchi Genbutsu* as part of measures to guard against the spread of the coronavirus [4].

Genchi Genbutsu (go and see) is one of the most fundamental leadership practices in a lean organization. The core idea of this practice is that any lean leader should do first-hand observation at the real place – known as *Gemba* (Genba) in the lean lexicon. In fact, [5] suggests that managers and executives must learn lean by participating in gemba walks led by a *sensei*, and then by practicing kaizen through self-study projects. As such, Gemba walks will remain an important means of finding and facing business critical problems in lean organizations for many years to come. However, the strict social distancing measures introduced in response of COVID-19 and the emergence of remote and virtual ways of working have hampered physical, on-site meetings between managers, associates, and indeed sensei. As such, in this paper, we explore the use of assisted reality technology to continue gemba walks, albeit in a hybrid, physical-digital (phygital) form. We present the virtual sensei concept – based on experiences in the field with the RealWear HMT-1 device. We offer practical insights that can be used by managers and practitioners to accelerate and strengthen efforts towards lean transformation – even during the troubling times presented by the COVID-19 pandemic. We also contribute to the growing literature on digital lean manufacturing.

II. THEORETICAL BACKGROUND

In this section we present relevant theoretical foundations for this investigation, namely gemba walks, digital lean manufacturing, and lean sensei.

A. Gemba Walks

A successful lean transformation is completely dependent upon the adoption of a coach-like style of leadership to create a learning organization, which also demands a long-term perspective [6]. [7] presents practical insights and implications for learning that emerged from a 5 year study of a Norwegian multinational's lean program deployment. The authors suggest that action learning (AL) through gemba walks and problem-solving emerges as a critical success factor for the deployment of Lean Production and in the

sustainability of the resulting improvements. This should place gemba walks high on a lean leader's agenda.

In an attempt to demystify the lean leadership literature, [8] also presents gemba walks as a core lean leadership practice and a primary means of realizing the Genchi Genbutsu principle and offers advice for the various hierarchical management levels: top management, middle management, and front-line management. The level of success of an organization's lean transformation is a direct reflection of the qualities of its leaders – and gemba is the greatest teacher.

B. Digital Lean Manufacturing

Digital Lean Manufacturing (DLM) has emerged as a new approach to production management that combines Lean Thinking and Practice with the new opportunities presented by Industry 4.0 and its enabling technologies [9]. It has implications for production planning and control [10], quality management [11], and indeed learning [12]. In addition, [13] also suggests that new forms of gemba walks are emerging as the adoption of digital technology continues to increase rapidly at the factory floor. They present several new forms of gemba walk, including simplified virtual gemba walks, in which lean managers might use hand-held cameras in remote location to record or transmit their walk live for others, augmented gemba walks – using augmented reality, and advanced virtual gemba walks, using industrial internet of things (IIOT), digital twins, and virtual reality technology. However, the authors do not discuss the important role of the sensei in conducting a successful gemba walk – and how this might be disrupted in light of technological advances and indeed in response of COVID-19 restrictions.

C. Lean Sensei

The “Lean Sensei” role most likely emerged when Toyota wanted to spread its management thinking and production practices to its suppliers and overseas plants [14], yet the idea has only recently emerged in the extant literature [5, 15-17]. Despite being a recent, emergent theme in research, in practice the role of the lean sensei appears to have had a significant influence over the success of lean transformations for decades [15]. But what do sensei actually do? [5] suggests that in practice, the sensei will:

- 1) Take you to the gemba to observe firsthand what is really happening as opposed to what it says on the PowerPoint slides and what we believe is happening.
- 2) Discuss real problems in the context of the organization's strategic objectives and challenges.
- 3) Promote awareness by prescribing concrete exercises (often based on visual management).
- 4) Promote Thoughtfulness by teaching the scientific method *Plan-Do-Check-Act* (PDCA).
- 5) Promote a bad-news-first mindset to push you on to the next step. In the eyes of the sensei, you should never

become satisfied. Continuous improvement is, after all, *continuous*.

Given that more companies are adopting lean management as a system to continuously develop people and leaders are becoming more intent on conducting gemba walks together with sensei, we adopt the following research question to guide this investigation: *Can the role of sensei be "virtualized" – such that a gemba walk can fulfil all the above activities, without the need for physical, face-to-face (F2F) meetings between the leader and the sensei?*

III. RESEARCH DESIGN

We adopt action learning research as a means of investigating the virtualization of sensei-led gemba walks. Action learning research is a form of action-oriented research – grounded in participative and pragmatic values – that aims to create and redeploy actionable knowledge through learning in action. [18] presents criteria to assess the quality of action learning research, namely:

- 1) Action learning research engages with real life issues.
- 2) Action learning research demands collaboration between researcher and members of the organizational system.
- 3) Action learning research has a reflective character – with iterative cycles of action and reflection.
- 4) The outcomes of action learning research must be workable and actionable.

We draw on two interventions between offsite sensei and onsite management representatives, one national (Norway) and one international (Norway-Germany). We also add a traditional, physical gemba walk (conducted as a F2F intervention in Norway) as a control for the investigation.

As the sensei should take you to gemba to observe firsthand what is really happening, we aimed to select an *Assisted Reality* technology such that the manager could maintain physical presence at gemba. As such, we compared several assisted reality devices based on availability, cost, operating system, and ease of access to local support services. The devices evaluated were the Epson BT-350, Google Glass, Moverio BT-350, Moverio Pro BT-2000, RealWear HMT-1, Vuzix Blade, Vuzix M300, and Vuzix M400. The technology subsequently selected and deployed in this investigation was the RealWear HMT-1, which, according to the manufacturer, provides the foundation for *Connected Worker* programs [19]. It has a high-resolution micro display that fits just below the user's line of sight, views like a 7" tablet, and acts as an industrial dashboard – *"there when you need it and out of your way when you don't"*. The HMT-1 also offers completely hands-free voice control, and can be used for remote assistance, for example remote mentor video calling, amongst other applications.

TABLE I
SENSEI ACTIVITIES

Activity	National	International	Control
Take you to the Gemba	✓	✓	✓
Discuss real problems	✓	✓	✓
Promote awareness	✓	✓	✓
Promote thoughtfulness	✓	✓	✓
Promote bad-news first	✓	✓	✓

IV. RESULTS

In both Virtual Sensei interventions, the local management representatives (e.g., operations director and production manager) first tested a simplified virtual gemba walk [13] using a hand-held device (iPhone) before transitioning to the HMT-1 for a hands-free, assisted reality, Virtual Sensei experience. The researcher (author) played the role of sensei. In the physical gemba walk, both the sensei and the management team were physically present at the gemba. Table 1 illustrates that all five of the sensei activities are made possible by the Virtual Sensei concept. However, the concept presents both advantages and disadvantages, which are explored in the following section.



Fig. 1. The RealWear HMT-1 device in use during a virtual gemba walk.

V. DISCUSSION

Though it is possible to fulfil all sensei activities through the virtual sensei concept using assisted reality technology, we suggest that this approach has both advantages and disadvantages – which form the basis for the emergent actionable knowledge following this action learning research project.

In terms of the alternative gemba walks presented in [13], the Virtual Sensei concept provides an advanced means to simplified virtual gemba walks, presenting a more immersive experience than simply using a smartphone or tablet to provide virtual mobility. As such, the major advantages of the Virtual Sensei concept are that it – through enabling virtual mobility – it has a favorable impact on both the direct and indirect costs of a gemba walk and is also compliant with the social distancing and travel restrictions that were imposed in response to COVID-19. However, we noticed that the virtualization of the gemba walk may inadvertently encourage local management representatives to join the intervention remotely, which could have a detrimental effect on the outcome of the gemba walk. We also observed that it is very difficult, if not impossible, to strike a personal connection between the Virtual Sensei and the local manager(s).

Nevertheless, the Virtual Sensei concept appears overall to show signs of promise in assisting managers with their lean transformations - through remote interventions with a sensei. The HMT-1 device can be used successfully to take managers to the gemba, to discover and discuss real problems, to promote awareness (e.g., by identifying concrete opportunities for deploying visual management countermeasures in situ), to promote thoughtfulness (by challenging managers to work systematically with PDCA – e.g., using A3 management [20]), and to promote a bad-news-first mindset, by pushing the manager to discover and take the next step.

TABLE II
EVALUATING THE VIRTUAL SENSEI CONCEPT

Advantages	Disadvantages
Complies with social distancing measures	May inadvertently encourage remote participation of local management team members
Allows virtual mobility across space and time	Sensei is dependent on the host's line of sight
Reduces both direct and indirect travel costs	Sometimes difficult to hear the sensei talking
The device is operational in a matter of minutes	Assumes technical competence of local manager(s)
Runs on both Microsoft Teams and Zoom "out of the box"	Difficult for the sensei to engage and connect on a personal level with the manager

However, in reflecting with the participants of both the virtual and physical gemba walks, there is a strong recommendation that Virtual Sensei should not replace, but rather supplement, physical gemba walks. In this manner, a personal connection can first be made between sensei and manager onsite, while subsequent interventions can be either virtual or physical. This is similar to the blended approach to network action learning presented in [21].

VI. CONCLUSION

In this paper, we set out to investigate the virtualization (digitalization) of sensei-led gemba walks. We used action learning research to draw on two interventions between offsite sensei and onsite management representatives, one national (Norway) and one international (Norway-Germany) using the RealWear HMT-1 device. The results show that although the five sensei activities can be fulfilled virtually and there are several advantages reported with the virtual approach, there are also several challenges with the Virtual Sensei concept that should be considered. As such, the recommendation is that the Virtual Sensei concept be used to supplement physical gemba walks rather than replace them.

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