

# The Synergy between Augmented Reality and Lean Methods

Dr.ir. Jannes Slomp, Msc. Deric de Wilde, Drs. Menno Herkes

Lectorate Lean/World Class Performance, HAN University of Applied Sciences

## The need to search for synergy between Augmented Reality (AR) and Lean methods

Many firms do not gain competitive advantages after the introduction of AR technologies. Important reasons are (i) a poor design of the back-and frontend system, (ii) not understanding the need to adapt the planning and control system to the demands of the new equipment, (iii) a poor implementation process, and (iiii) not including the users themselves in the design process. Case studies, shortly indicated on this poster, illustrate the difficulties companies face trying to gain a competitive advantage trough the technology.

**Table 1** presents the performance characteristics of new automated technology. Not all characteristics are helpful to gain competitive advantages. These disabling characteristics need to be dealt with. Table 1 illustrates which Lean methods can be used for this purpose, indicating the synergy between Lean and AR.

**Table 2** is meant to support decision makers in finding synergy between Lean AR. Asking the correct questions is essential in order to avoid wrong, unprofitable, investments.

### What is Lean?

A lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste. Lean methods can be organized in methods (i) to improve the connection with suppliers and customers (SCM), (ii) to improve the quality of the process activities (TQM), (iii) to realize a flow of activities (FLOW & PULL) and (iv) to involve employees in improvement activities [1]. Increasingly relevant is the effect of high variety, low volume demand on production, as it has great effect on the flexibility demands of production [2]. New industrial technologies such as AR may play a role in the Future of production and may support the use of Lean methods.

### What is Augmented Reality?

Augmented reality (AR) is an interactive experience of the real world, where the real world is enhanced by computer-generated perceptual information. This experience is overlaid with the physical world such that it is perceived as an immersive aspect of the real environment. The difference with Virtual Reality (VR) is that VR completely replaces the user's real-world environment with a virtual one. Instead, Augmented reality alters one's ongoing perception of a real-world environment with a stimulated one. In the business environment, the technology is currently mainly used as an aid in assembly and logistics, training employees, in maintenance/service and during the design process [3].

Table 1. Some Connections between Market Requirements, Performance Characteristics of AR and Supporting Lean Methods

Market Requirements		Enabling Characteristics	Disabling Characteristics	Required Lean Methods to cope with negative characteristics of AR	Illustrated by case
1	Low price	Optimization (less labor needed)	Expensive, high investment. Preparatory tasks	Focus on reducing waste, autonotation (avoid production of waste).	1 tm 5
2	High quality	Standardization (accuracy, repetitive))	Acts only well if input is uniform and of high quality. Acceptance by employees can be a limiting factor.	Standardization, SPC, Andon	1 tm 5
3	Short delivery times	Flexibility (programmable)	Preparatory tasks: Requires a significant amount standardized input data.	Balancing the workload (Heijunca), standardization such as (digital) working instructions.	2
3	Better delivery performance	Flexibility & standardization	Lack of understanding ways to cope with variability of assembly and processing times.	Capacity buffer enabling to cope with strategic flexibility, lowering variety of quality by improving working instructions.	4,5
4	Higher flexibility (more variants, small batches	Flexibility (availability of information)	Preparatory work is usually extensive. All information needs to seamlessly available.	Streamlining preparatory work. High variety low volume control methods.	2
5	More innovative / integrated	Information Technology	i. Lack of communication standards. ii. Limited accuracy of data - time lag iii. Information everywhere available iv.No clear linkage with desired control system	i. Standardization ii. Use of real time data iii. Principle: Information arises first where it need to be used	1,2,5

#### CASE 1: (Boeing)

A large airplane builder implemented augmented reality to tackle the complexity of the wiring process [4]. The technology provides reliable dynamic information to field operators during the assembly process, reducing cognitive strain and time (waste). The implementation, though successful, was difficult to achieve as the development was complex and required a significant amount of data.

#### CASE 2: (DHL)

A logistic company invested in a pick-by-vision system in order to reduce order picking times and mistakes. In order to gain a high utilization of the equipment, management of another, smaller, company decided to implement the system as well. The implementation is difficult because the workflow was not sufficiently standardized [5]. The older workforce developed a dissonance towards the technology.

#### CASE 3: (Amfors)

A small company invested in licensed pick-to-light smart beamer technology to reduce assembly training time and to standardize work. The company quickly realized the technology was relatively expensive. The company is currently experimenting with less expensive presentation software to achieve a similar result, making concessions on flexibility[5].

#### CASE 4: (Remeha)

A company decided to invest in an augmented reality solution; a head mounted device for assembly training purposes. This enabled the company to take the training of new employees from the assembly line to a separate room. It reduced disturbances from learning-on-the-job on other employees and reduced training time. The company is experiencing difficulties with further development as it required standardized high input quality of data[5].

#### CASE 5: (BMW)

A big automobile company is currently successfully using a head mounted device in their manufacturing department [6]. New employees receive standardized training in the assembly of complex engines. The company sees the benefit of using head mounted devices as a training device but struggles to use the technology in the assembly line itself as employees dislike the lack of flexibility and the increased strain of wearing a device all day.

Table 2. Lean questions to avoid unprofitable investments in new industrial technology

Critical issues for success		Some Lean questions to be answered when investing in new industrial technologies	Illustrated by case
(i)-1	Strategic Integration	Which Value Streams are supported by AR? Does the new technology solve a strategic bottleneck? (case 1) A lack of a clear goal can mitigate the benefits of the technology. (case 3)	1, 3
(i)-2	Logistic Integration	What is the effect of new technologies on the material flow in the company?	1, 2
(i)-3	Organizational Integration	What is the impact of AR on the processes to be performed by support functions?	4
(ii)	Design of the system	Can the users of the AR technology run without operator attendance? Are the elements of the system adopted by the users? Is there cognitive dissonance towards the technology?	1,2,5
(iii)	Planning and control of the goods flow	How to cope with sequence constraints of the AR technology? How to balance the workload (Heijunca)? Mind here that working in sequence can be a benefit as well.	1,2
(iv)	Implementation	Where and how to involve employees?	1 tm 5

### Research Project and Contact

This research is part of the European LEAN4.0 project. For more information, contact: drs. Deric de Wilde, HAN University of Applied Sciences, P.O. Box 2217, 6802 CE Arnhem, [deric.dewilde@han.nl](mailto:deric.dewilde@han.nl)

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