Drivers for implementing Augmented Reality to support industrial service delivery

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Abstract

The purpose of this study is to investigate drivers of using Mobile Collaborative Augmented Reality (MCAR) to facilitate industrial service delivery in capital equipment industries. To this end an exploratory interview study was conducted to uncover companies' motivations to launch MCAR implementation projects. The study uncovered 6 drivers for using MCAR to facilitate industrial service delivery. The drivers represent challenges of industrial service delivery, which are expected to be addressed by using MCAR, applying two distinct approaches.

Introduction

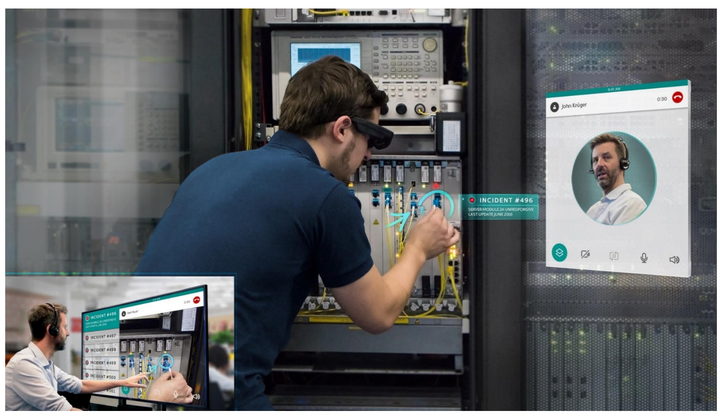

Figure 1. Remote expert and on-site technician using MCAR (Source: RE'FLEKT www.re-flekt.com)

- Capital equipment, such as machine tool or coating machines, is usually sold worldwide
- Thus, equipment manufacturers are expected to provide a local service delivery infrastructure to ensure least possible production downtime for their installed base [1]
- Maintenance and troubleshooting, however, are very complex and knowledge-intensive [2] and often require interdisciplinary skills [3]
- MCAR is expected to address these challenges by improving the quality of service delivery, while at the same time reducing costs of service provision [4]
- MCAR is realised through audio-video streams, which are enhanced with AR, enabling real-time collaboration between remote experts and on-site technicians (see figure 1)
- User studies indicate that using MCAR is superior to audio only collaboration [5, 6]

Research Gap

- Published research is dominated by descriptions of developed MCAR prototypes, prototype evaluation in laboratory settings and mostly lacks an industrial context [7]
- MCAR is on the verge of industrial maturity and currently on test level in industry [8]
- So far, only very few researchers took a service business perspective [4, 9]

Data Collection

- Due to the lack of comparative literature and the fact that only few companies are testing MCAR, an exploratory interview study was conducted
- Theoretical sampling was applied [10]
- Sampled companies had to fit inclusion criteria: using similar configuration of hardware and software, min. experience with MCAR of two months, diverse in size and products offered
- Semi-structured interviews with 38 informants (11 senior executives, 19 service managers and 8 MCAR users) were conducted

Table 1. Sample of the interview study

Case	Products of Case Company	Size of Company [employees/revenue in €]
C1	Air purification systems	< 50 / < 10 million
C2	Coating machines	< 500 / < 250 million
C3	Clamping systems, hydraulic cylinder i.a.	< 1,000 / < 100 million
C4	Drilling machines	< 50 / -
C5	Finishing machine	< 500 / < 60 million
C6	Food processing lines	< 10,000 / < 3 billion
C7	Grinding machine	< 1,000 / < 200 million
C8	Intralogistics' systems, conveyer systems	< 5,000 / < 1 billion
C9	Material flow control systems, high-bay warehouses	< 500 / < 100 million
C10	Gear units, water turbines i.a.	< 20,000 / < 4.5 billion
C11	Micro milling machines	< 250 / < 30 million
C12	Plastic processing equipment	< 250 / < 25 million
C13	Production lines for consumer electronics i.a.	< 2,500 / < 300 million
C14	Valve controls, converters i.a.	< 2,500 / < 300 million

Data Analysis

- Interview data was recorded and transcribed for analysis
- Thematic analysis was applied, employing an inductive structural coding approach [11]
- Data was coded and analysed using NVivo 12

Results

Table 2. Drivers for using MCAR identified in the interview study

#	Divers	Cases	No. of Cases
#1	Lack of service skills in foreign subsidiaries	C2, C3, C6, C8, C10, C13	6
#2	Long training periods of recruits	C1, C8, C9, C10, C11	5
#3	Skills Shortage	C1, C8, C10, C12	4
#4	General necessity for interdisciplinary work	C5, C7, C8	3
#5	Capacity constraints	C8, C10	2
#6	High service costs	C4, C14	2
	Total number of mentions		**22**

Discussion

- **#1 Lack of service skills in foreign subsidiaries**, due to high labour fluctuation rates, a small and dispersed local installed base that doesn't justify a local service infrastructure, or locally distributed expertise, results in low first-time fix rates
- **#2 Long training periods of recruits,** due to low qualification levels and variety / complexity of installed base, results in low first-time fix rates
- **#3 Skills Shortage**, due to unavailability of skilled workers, also willing to travel extensively and multi-lingual, results in vacancies
- **#4 General necessity for interdisciplinary work** also for experienced technicians due to variety / complexity of installed base, results in low first-time fix rates,
- **#5 Capacity constraints**, due to demand peaks that do not justify hiring additional technicians, results in long response times
- **#6 High service costs** due to traveling expenses for uncharged service provision or warranty claims
- The drivers identified represent challenges of industrial service delivery that are expected to be addressed by implementing MCAR
- Companies intend to apply two distinct service approaches to address the challenges (see figure 2)

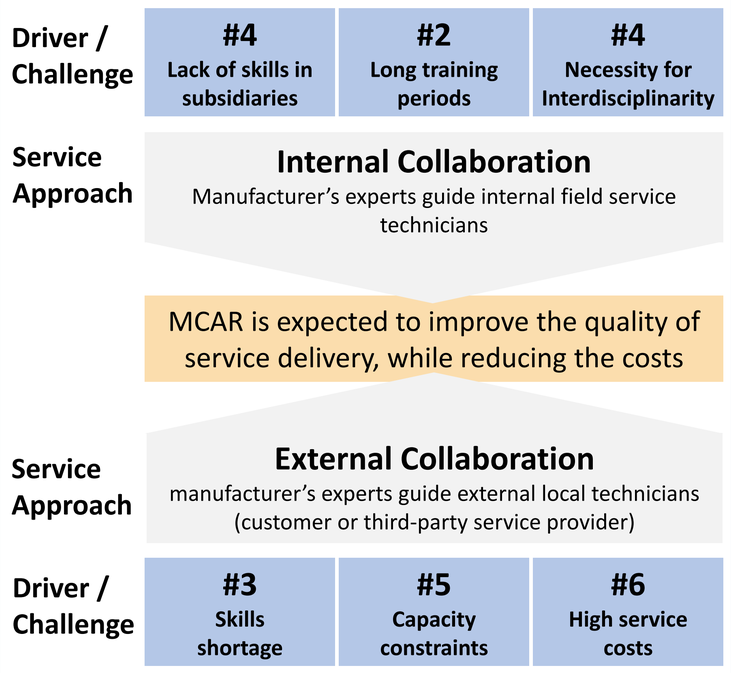

Figure 2. Internal and External Collaboration Approach

Conclusion

- 6 drivers for using MCAR, representing challenges of industrial service delivery, were uncovered from a sample of 14 companies
- Companies intend to apply two service approaches to address these challenges, namely internal and external collaboration
- The study contributes to the understanding of companies' motivation to use MCAR

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