A Field Study: The Perception of Edge Computing for Production Industry

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DFKI - SmartFactory

TU Kaiserslautern

Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI)

Technologie-Initiative SmartFactory KL e.V.

Department Production and Automation (pak)
Subject: Machine-Process engineering

Kaiserslautern
Research subject: Innovative Factory Systems

Registered association
50 members from industries and research institutes
SmartFactory Lab
Motivation
Problems with Cloud Computing

- Increased raw data generation within factories/field level
- Increased load in the Cloud server
- Increased load on the network
- Increased latency
- Reduced performance
- No computing in case of network failure
- Security & privacy
Edge Computing

Edge Computing moves computation power, applications and services from centralized units into the logical extremes to the source.

Source: Gezer, Um, Ruskowski: An Introduction to Edge Computing and A Real-Time Capable Server Architecture, International Journal of Intelligent Systems 11(1&2):105, UBICOMM 2018
FAR-EDGE

• An ongoing EU Project which defines a reference architecture on three domains:
  • Analytics
  • Automation
  • Simulation

• The architecture is applied in 13 active use cases on three use case partners:
  • Volvo Trucks Company
  • Whirlpool
  • SmartFactory Lab

• The project aims to solve the challenges of use case partners.
Survey

Purpose:

• To determine the level of relevance and focus of Edge Computing within industry and academia.
• To determine which factors are more relevant and should be prioritized in the development.
• To estimate necessary development time and cost for software development and compare with Cloud solutions.

Process:

• A set of relevant Edge Computing factors are defined.
• Each interviewee is asked the same questions with slight adaptations.
• None of the answers were shared with other partners.
Survey

Organized in five distinct sections.

1. Evaluation of Relevant Factors for Edge Computing: Set of factors preselected based on prior experience and literature: latency, data ownership, autonomy, quantity, and connectivity.

2. Importance of Additional Edge Computing Benefits: Set of additional factors to determine the importance of requirements: reliability, scalability, extensibility, abstraction, and interoperability.

3. Development Time Distribution for an Application: Time distribution in percentage during analysis, design, implementation and build, deployment, testing, revision, and training.

4. Development Cost Distribution for an Application: Similar to (3), but in terms of cost.

5. Hardware and Software Distribution: Estimated distribution in percentage.
Survey Results – Section 1

Aim: To evaluate to which degree the Edge Computing is better alternative to the Cloud.

Question:
How important are these criteria for you? (Separate answer for each use case)
Survey Results – Section 1 and 2

Automation Use Cases:
- VTC: #1-#3
- WHR: #1
- SFK: #2-#7

Analytics Use Cases:
- SFK: #1
- VTC: #5

Simulation Use Cases:
- VTC: #4

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Legend:
- 1: Not applicable
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- 7: Crucial

VTC: Volvo Trucks
WHR: Whirlpool
SFK: SmartFactoryKL
### Survey Results – Section 1 and 2

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#### Table: Factors for EC

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VTC: Volvo Trucks
WHR: Whirlpool
SFK: SmartFactoryKL
Aim: To figure out if the solution satisfies the Industry 4.0 requirements from the partners.

Question:
How many of the additional important factors have been covered by the developed or in progress solutions? Add if missing.
## Survey Results – Section 1 and 2

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<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provider #6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

**Legend:**
- 1: Not applicable
- 2: Very Low
- 3: Low
- 4: Medium
- 5: High
- 6: Very high
- 7: Crucial

VTC: Volvo Trucks
WHR: Whirlpool
SFK: SmartFactoryKL
Survey Results – Section 3 and 4

Aim: To figure out how much saving w.r.t time and cost is estimated with the Edge Solution.

Question:
How much time/cost is expected to be reduced with Edge Solution?
Survey Results – Section 3 and 4

Development Time Distribution

Provider #1
Provider #2
Provider #3
Provider #4
Provider #5
Provider #6
Owner #1
Owner #2
Owner #3

Results 1

Development Cost Distribution

Design
Build
Deploy
Maintain
Upgrade

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Survey Results – Section 3 and 4

Development Time Distribution

Development Cost Distribution

Results 2
Survey Results – Section 3 and 4

Development Time Distribution

Development Cost Distribution
Survey Results – Section 5

Aim: To understand whether the solutions require more hardware or software

Question: How much hardware/software do you expect to use in the use case? (For each case you are involved in)
Survey Results – Section 5

- Provider #1
- Provider #2
- Provider #3
- Provider #4
- Provider #5
- Provider #6
- Owner #1
- Owner #2
- Owner #3

0% 20% 40% 60% 80% 100%
Software Hardware
Conclusion

• Edge Computing moves computation power, applications and services from centralized units into the logical extremes to the source.

• The list is „complete“ (partners were ask to extend - no necessity to extend was found).

• Cost primarily software for solution developers but hardware needs to be considered.

• Different use cases, different requirements → Necessity of an Edge platform to cover everything.

• More than a third of cost associated with design → Saving potential in time and cost in case of a common architecture (Validates: Zietsch, J., L. Büth, M. Juraschek, N. Weinert, S. Thiede, und C. Herrmann. „Identifying the potential of edge computing in factories through mixed reality“. In Procedia CIRP, 81:1095–1100, 2019.).
Future Work

• Compare the estimated numbers with the real ones.
• Extend the survey by more participants (only 9 interviewees)
• A clear picture will be visible when this number is increased.

Questions?