PADME – Process Automation for Discrete Manufacturing Excellence

Digital survey for digitalization assessment

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1. Introduction

This report is part of the PADME project that aims to use collaborative process automation systems (CPAS) concept in discrete manufacturing for future applications in smart factories. In the previous phase of the project we build a foundation for the research project at Mälardalen University to identify maturity level of companies in digitalization. The research was based on several extensive interviews at the reference companies. The interviews served as a test for an extended survey in other companies. In order to show the collaboration aspects we defined six collaboration dimensions, being system-to-system, system-to-equipment, system-to-people, equipment-to-equipment, equipment-to-people and people-to-people. A radar diagram is used to visualize the results of each dimension. The advantage of this visualization is that the differences in all mentioned aspects can be shown in one diagram. Figure 1 illustrates an example of such visualization. In this example, each dimension has a rate from 1 to 4, where higher value shows that the relation in that aspect is strong.
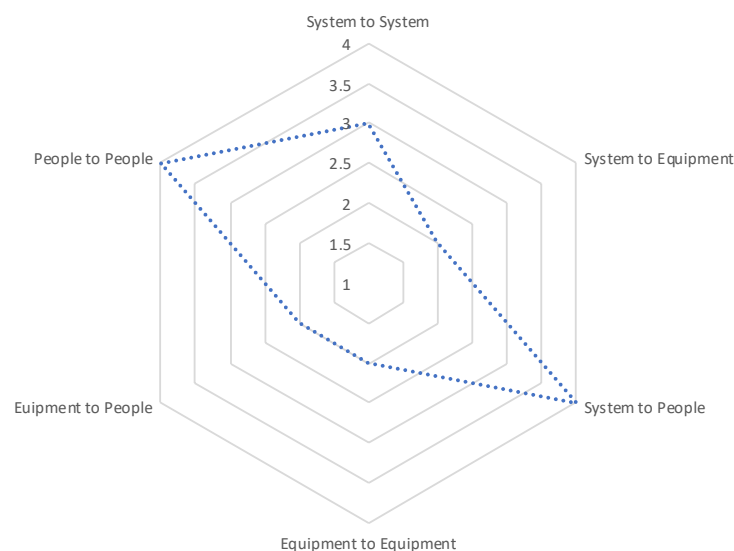

Figure 1 – An example of a radar diagram

SYSTEM TO SYSTEM COLLABORATION: This dimension represents how various systems in the organisation are connected or integrated with each other. Prominent examples are ERP, MES, SCADA, Maintenance, Quality, HR or material handling systems. Each of these systems contains a specific type of information/data and deliver services in the organisation. A high rate in this dimension, all types of systems are interacting with each other and data can be exchanged and correlated with each other. A high level of logic, transparent data models and intelligent systems, is needed to achieve a high rating in this dimension.

SYSTEM TO EQUIPMENT COLLABORATION: This dimension is assessing, the connection between systems and equipment in the production. Potential indicators are if data is collected and used to optimise the production process or if the systems can steer the machines. A high level of integration

between machines and top-level systems including real-time data collection and steering is needed to achieve a high rating in this dimension.

SYSTEM TO PEOPLE COLLABORATION: This dimension is assessing, the connection between systems and operators in the production. Potential indicators are if the operators have access to the systems, can report data and get information as assembly instructions, work orders displayed. Alarm systems or intelligent ANDON systems are further indicators. A high level of integration between operators and top-level systems including real-time data collection and information feedback is needed to achieve a high rating in this dimension.

EQUIPMENT TO EQUIPMENT COLLABORATION: The equipment to equipment collaboration is focusing on the ability of machines or tools to interact with each other. Potential indicators are connections of any kind either wired or wireless, transferring data to the following machine for adjustments, or reporting of tolerance deviations. A high level of integration between the equipment including real-time data collection and information feedback is needed to achieve a high rating in this dimension.

EQUIPMENT TO PEOPLE COLLABORATION: Equipment to people collaboration is focusing on how the machines or tools interact with the operators. Potential indicators or enablers are screens, audio or visual signals, display of production/assembly instructions or maintenance information. A high level of visual and audio integration between the equipment and operators including real-time feedback, or any instructional support for the operator is needed to achieve a high rating in this dimension.

PEOPLE TO PEOPLE COLLABORATION: The last dimension is focusing how the people are collaborating in the organisation. Potential indicators are E-Mail access, personal logins to access systems, or access to computer terminals, iPads or mobile phones. A high level of support tools for the operator is needed to achieve a high rating in this dimension.

2. Digital survey for maturity assessment

In the second phase of the PADME project we built a digital survey to be used instead of interviews. We have used the experience from running the interviews from the first phase and made a digital questionnaire. The questions are aimed at identifying the digitalization activities in the six mentioned dimensions. Each set of questions targets one aspect, e.g., system-to-system collaboration. The answers are rated from i) not implemented, ii) low, iii) trending high, and iv) high in the implementation. An example of the questions set is shown in Figure 2 for assessing the level of collaborations between systems and people. In this example 6 questions are identified focusing on how people interact with implemented systems in a company.

Figure 2 – An example of questions for assessing collaboration between systems and people

In order to get results from this survey, we numerated the answers by setting 1 for not implemented choice and 4 to High choice. The average of the values can identify the level of maturity in this direction. The advantage of this digital survey is that the questions are flexible and can be adapted based on the target, companies and goals. The digital survey can be accessed by public[1].

3. Maturity assessment of ABB Robotics

We have performed the digital maturity assessment for ABB Robotics using the developed digital survey. The results are shown in Figure 3.
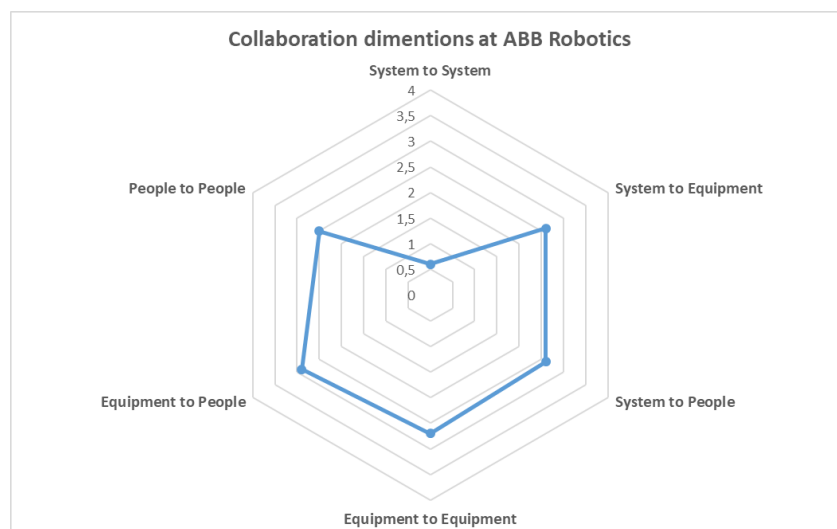

Figure 3 – Maturity assessment for ABB Robotics

[1] https://bit.ly/2Muvg8g

ABB Robotics is an original equipment manufacturer (OEM) and discrete manufacturing type with low volume/high mix situation. The company has developed several systems, including enterprise resource planning (ERP), quality management system, supply chain management, computerized maintenance management, process control system, document management, product data management, social networking applications and customer relationship management. These systems are partially connected, but not fully integrated as a whole.

As it can be seen from Figure 3, the collaborations are around 2.5 to 3 out of 4, except for system to system integration. The system-to-system integration is around 0.6 out of 4. The results show that there is a level of communication between different entities, but in case of systems it is not fully integrated. The PADME digitalization solutions can advance this aspect, in particular collaboration between equipment to systems.

4. Conclusions

Within the PADME project, Mälardalen University started with a process to identify maturity of companies with respect to digitalization. The target was to identify the level of relations between systems, equipment and people. In the first phase a set of intense interviews were carried out in the reference companies. The results are presented in a report with detailed explanations. In this phase of study, we developed a digital survey which increases the performance of the study. We performed the study for ABB Robotics to show the maturity level in this company. The digital survey is based on questions experiencing from the interviews. These questions can be adapted to become more detailed with the aim of extracting more information.