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Analysis of the Current Situation on Automation and Digitalization in Moroccan Industry

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Abstract

Morocco is establishing itself as a key industrial location and logistical hub for the African continent. The Competence Center on Automation (CCoA), funded by the Federal Ministry for Economic Cooperation and Development, BMZ has the vision to increase economic growth and to create new jobs through knowledge transfer on automation and digitalization technology in key industrial sectors. This paper shows the approach and the results of an analysis based on quantitative and qualitative interviews. The goal of this research is to analyze the degree on automation and digitalization in the selected Moroccan industries. It is based on quantitative and qualitative interviews. The target group of the pilot phase includes automotive and food industry, universities, vocational schools and political stakeholders. The results show several differences regarding technology use and training between the automotive and food industry, as well as between local and international companies in Morocco. These results will be used to develop a digitalization roadmap, tailor made for the Moroccan industry, to make the country even more competitive and to establish international joint ventures on the long term.

Keywords

Automation, Digitalization; Global Manufacturing, International Business, Knowledge Transfer

1. Motivation

The successful transformation from a developing country to an industrialized nation requires international business activities [1]. To remain an industrialized nation, it is also necessary to work on relationships at the global level. A good way to put relationship work into practice is joint success through knowledge transfer. Another long-term step to ensure common success are industrial clusters, joint cooperations and legally joint ventures. Building long-term, sustainable relationships and creating high-quality jobs in Morocco is the goal of the Competence Center on Automation (CCoA). Automation and digitalization will play a major role in the global manufacturing industry in the future [2]. Furthermore, the strategic orientation of international production networks is fundamental, for which knowledge of the interdependencies between network and factory level is essential [3]. Dynamic production networks can be a solution for managing current and future challenges such as high volatility in demand and the trend towards customized products [4]. Facing these challenges requires a transformation with the intelligent use of automation and digitalization solutions to so called cyber-physical systems which represent the core of smart factories [5]. This, in turn, demands high-quality training and further education for specialists and managers.

2. Related work

The challenges of implementing latest automation and digitalization applications in Tunisian small and medium-sized enterprises (SMEs) were analyzed in the work of Ben Hadj Hassine 2021 [6]. Therefore, an exploratory qualitative approach using a questionnaires and individual interviews was chosen. Difficult for SMEs to keep the pace and stay competitive. Lack of skills to drive digital transformation, lack of strategic vision. Companies also have great difficulty funding new technologies and their rollout. As a result, the author recommends governmental action e.g., investments into digital infrastructure and into human capital by upskilling the workforce [6]. The research group around Anass et al. 2021 analyzed the relationship and application of the two concepts Lean and Industry 4.0 in the Moroccan context [7]. A survey was developed and conducted for this purpose focusing on the automotive, aerospace and chemicals sector. The researchers found that the concepts they analyzed are complementary to each other and can therefore be introduced simultaneously in companies. Furthermore, both concepts are considered important by industry.

The work of Faysse 2015 analysed the agricultural policy Green Morocco Plan, initiated in 2008 by the Moroccan Department of Agriculture and Marine Fisheries, based on policy document reviews and implemented instruments [8]. The goal of the Green Morocco Plan was to ensure economic growth within the next 10 - 15 years in the agriculture sector [8]. According to the author, the policy only succeeded moderately in developing and transforming rural areas to increase the agricultural production and thus also the individual income in these areas. The opportunities and challenges of digitalization in the Moroccan agriculture sector were discusses by Jabir & Falih 2020 [9]. For this purpose, latest technologies were identified and their applicability around the region Beni-Mellal Khenifra analyzed, e.g., Wireless Sensor Networks applied in different climates, energy harvesting technology, decision support software. To ensure success in the digital transformation and boost economic growth in agriculture and food industry the authors recommend good governance and policy.

3. Competence Center on Automation (CCoA)

The CCoA is intended to serve as a platform for transferring knowledge in the field of automation and digitalization in an applied manner using new approaches to action-oriented learning. For example, to realize the potential of university-industry-collaborations, a new educational strategy is needed that combines existing concepts and didactic approaches [10]. For the further training of specialists and executives, real-world projects can as well be used according to inquiry-based learning approaches [11].

The focus of the CCoA is during its pilot phase laid on two key industries, automotive and food, to develop differentiated and demand-oriented solutions. The automotive industry plays an important economic role not only for Morocco, but for the entire North African region [12]. Therefore, investments are made not only by the individual states and companies but also by the Africa Bank of development, European Union, World Bank and others. In addition to the high efforts of the Moroccan government by establishing several free trade zones such as Tangier Automotive City and Kenitra Atlantic Free Zone, there has also been a high level of investment from abroad [13]. In the last 5 years, many investments have been made by foreign automotive companies, including French, Spanish, Japanese and US corporations. On the one hand, the Moroccan market is used as a cost-effective production location to supply automotive systems and -parts to plants spread around the world. On the other hand, the African and especially the Moroccan sales market is gaining more and more interest.

Furthermore, the food sector including agriculture and beverage is economically very important and generates revenues over USD 12,8 billion [14]. According to FENAGRI [14], Morocco’s export in the food sector is increasing especially for granulated sugar, fresh fruits, and fresh tomatoes.

Industries such as consumer electronics and energy are also gaining high interest in Morocco but are not focused in this pilot phase of the CCoA.

Innovative and comprehensive education and training seminars are planned within the project scope. Hence, seminars for experienced professionals and managers are planned, as well as trainings for students and graduates in learning factories [15]. Further, industrial train-the-trainer seminars for system integrators are also scheduled.

4. Methodology

Quantitative and qualitative elements are applied to identify the status quo and the need for automation and digitalization in Morocco. For the quantitative analysis, a comprehensive online questionnaire was developed. To take local conditions and requirements into account, the work was carried out by an interdisciplinary team of experts from Morocco and Germany. In addition to expertise in the engineering, natural- and social sciences, domain knowledge was contributed by local experts from Tangier in the automotive industries and from Casablanca in the food sector. The questionnaire was developed by the team in several workshops and review loops with industry experts. The online survey was set up and conducted using *QuestionPro*, a web-based software for market research and experience management. Current guidelines for the design, development and implementation of online surveys [16] have been taken into account. To ensure that as many participants as possible took part, the study was conducted bilingually in English and French. After the successful three-day test phase, the online survey started on 8th February 2021 and ended on 8th March 2021. To obtain a comprehensive picture in Morocco, three target groups were addressed, industry, universities, and vocational schools. Over all three online surveys, a cumulative total of 101 questionnaires were completed in full. The average completion time was 13 minutes. The dropout rate across all three surveys was 43,48 %.

In the following sections, the focus is on the industry questionnaire. The scope of this questionnaire included 46 questions. The limitations of this publication do not allow a detailed presentation of the entire survey; hence several interesting questions are discussed in detail here. Further information on the survey can be found on https://competence-automation.ma/.

5. Results & Discussion

The survey participants include experienced managers from industry networks of various local industry associations, personal contacts of local experts and the network of the German AHK (Foreign Chamber of Commerce) in Morocco. Figure 1 shows the industry distribution of the survey participants. The automotive sector accounts for the largest share of participants with 49 %. This high proportion in the automotive sector is partly due to the strong commitment of the industry association to the CCoA project. The automotive sector includes OEMs, system- and parts suppliers as well as service providers. Furthermore, with 20 % participation, the food sector represents the second largest group of participants. Within the CCoA project, agriculture and beverage are also subsumed under the food industry. The other industrial sectors individually do not account for more than 6%, as can be seen in Figure 1.

In addition to the industry distribution, the participant's function in the organization was also asked. More than 80 % of the participants hold management or executive positions. The revenue distribution of the participating companies presents a differentiated image. 25.9 % of the companies have revenues of $1 million or less per year. 20 small businesses with between 1 and 10 employees participated and represent about one-third of the industry participants. 36.5 % of the companies have revenues between $1 million and $50 million per year. 44 participating companies have more than 250 employees. A detailed analysis of the survey revealed that more than half of the participants were from international companies or Moroccan companies with foreign sites. 44 % of the participating companies are located only in Morocco. The survey therefore includes both SMEs and large companies.

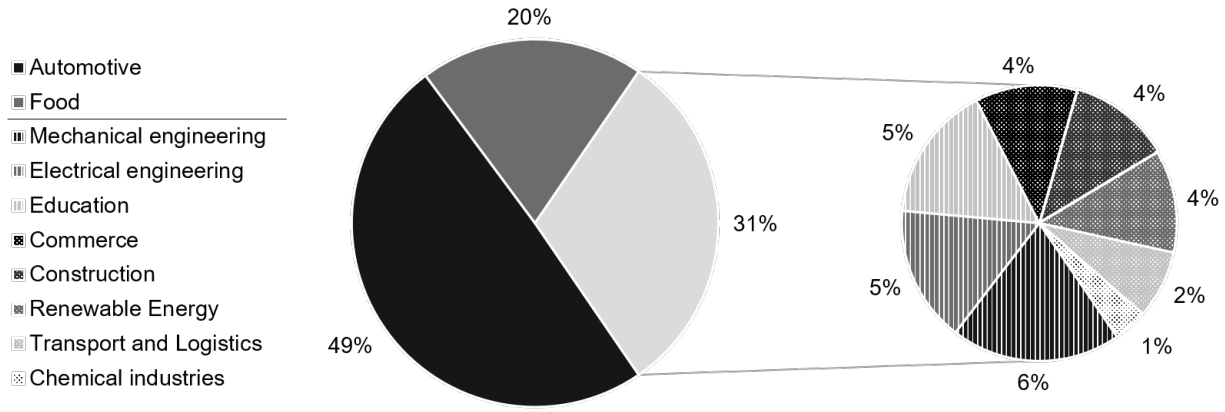

Figure 1: Industry distribution of the survey participants

In order to determine the status quo in the automation and digitalization field in Morocco, the As-Is Analysis team considered it very appropriate to ask the participants about the impact of global challenges on their organization. The following question was therefore asked for the industry's self-assessment:

- How would you rate the impact of the following challenges on your organization?

The results to this question are shown in Figure 2. 49 participants of the surveyed companies considered the impact of economic growth high till very high. Connectivity and Knowledge culture are also seen as important topics in the future, as 48 respectively 43 participants think it will have a high till very high impact. After analyzing the raw data, unexpectedly, the pollution challenge for the automotive industry is not as great in direct comparison to the food industry. This may be due to the less complex political conditions in the free trade zones. However, this must be investigated in further interviews with experts. Looking at the answers in more detail, the shortage of specialists is a greater challenge for the food industry than for the automotive industry. This will have a variety of reasons; from the point of view of local experts, the automotive industry finds it easier to attract skilled workers, as these often offer higher salaries, an international environment and thus a higher level of attractiveness.

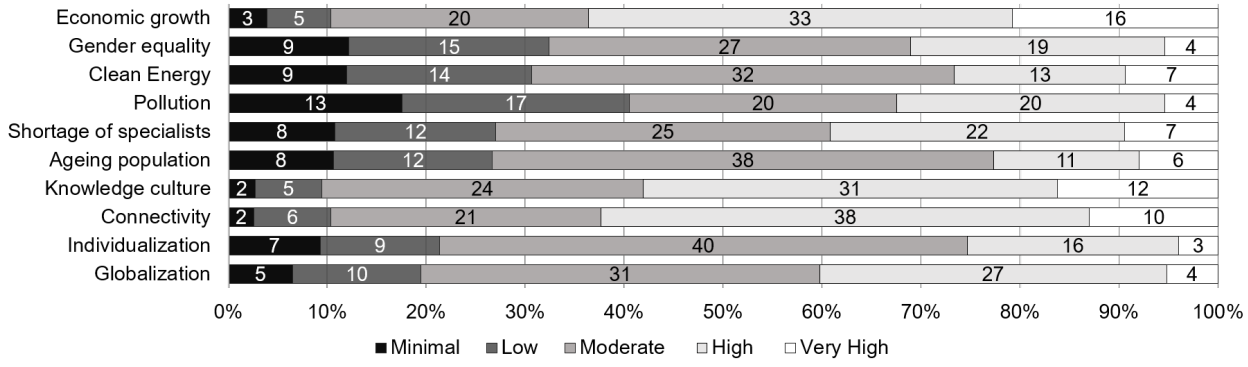

Figure 2: Impact of global challenges on the participating organizations

Furthermore, the following self-assessment question was asked of the survey participants:

- What is your experience with the following technologies?

Most of the surveyed participants are well experienced in electrical machines, industrial networks as well as network and communication. Many participants regularly use these technologies or even develop it further (see Figure 3). On the other hand, technologies like Blockchain, Process Mining, IoT (Internet of Things), RFID (Radio-Frequency Identification) and PLC (Programmable Logic Controller) are for half of the participants less known. Respectively they have not heard of these technologies or have heard of them but do not know more about them. Based on the self-assessment and detailed analysis of the raw data, it can be concluded that the food sector has less experience with the latest technologies.

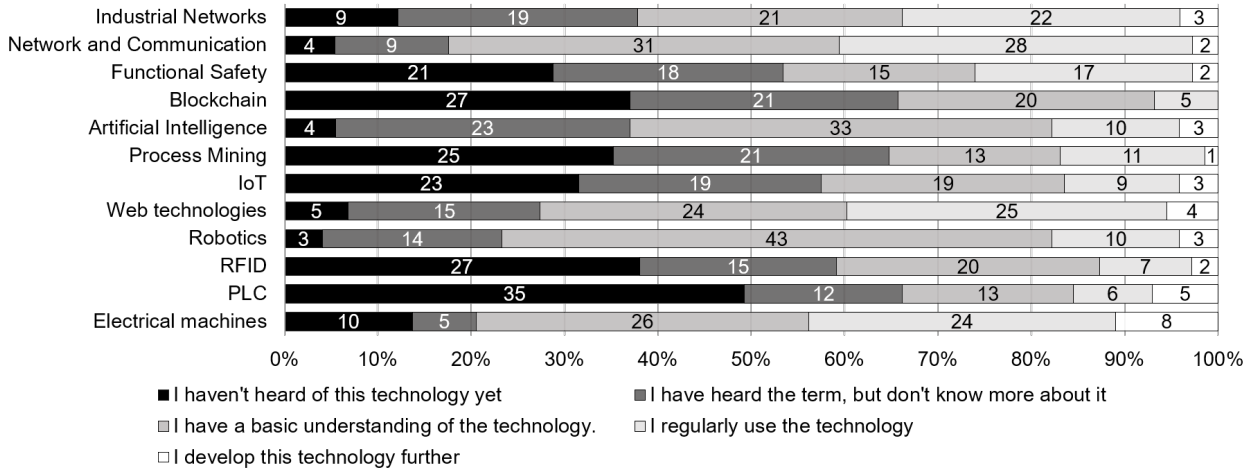

Figure 3: Self-assessment on experience with key technologies

Another key question on the status quo is covering the order management process:

- Is your order management process fully digital?

Cumulatively across all sectors, around half of the companies have already eliminated the need for paper orders and are handling them digitally. A closer look at the raw data reveals a large gap between the two industries, automotive and food, as shown in Figure 4. Over 63 % of companies in the automotive sector have implemented digital order management. However, only 31 % of companies in the food sector have implemented such a system.

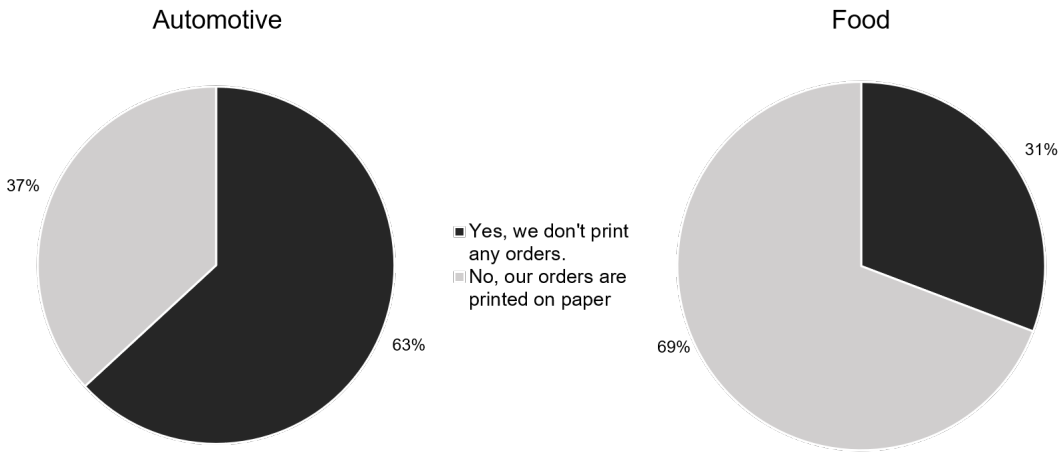

Figure 4: Order management paper based vs. digital.

Furthermore, questions were asked about the automation of quality control tasks. The automotive industry is fulfilling 28 % of quality control tasks manual, 69 % semi-automated and 3 % fully automated. In contrast, the food industry in Morocco is fulfilling 57 % of quality control tasks manual and just 43 % semi-automated. Once again, the automotive industry has made technological progress compared to the food industry and is already using fully automated quality control solutions in addition to semi-automated ones.

The use of professional Enterprise Resource Planning (ERP) systems is also dominated by the automotive industry (over 83 %) compared to the food industry (32 %). This is partly due to the fact that the automotive sector has a significantly higher share of multinationals in Morocco. These corporations often roll out this type of information and communication systems in a centrally driven manner. Thus, the decision and often the financing of these software solutions is made from industrialized nations.

The area of in-house training and continuing education of employees also shows a higher use of digital solutions, such as the use of E-learning platforms, by multinationals. The majority of international companies offer their employees E-Learning platforms. In contrast, only one-third of Moroccan companies offer E-Learning platforms for their staff. Again, Moroccan companies seem to be lacking in the handling and demonstration of the latest educational technologies as well as the financing of these.

6. Summary & Outlook

This publication provides an insight into the status quo in the field of automation and digitalization in the Moroccan automotive and food industry. Furthermore, the procedure of the quantitative and qualitative analysis was explained first. The results illustrate that, in contrast to the food industry, the maturity level of the automotive industry differs significantly with regard to automation and digitalization solutions. This is exemplified by the use of digital solutions in order processing or the use of ERP systems. Furthermore, figures showed that there is also a larger gap between Moroccan and international companies in terms of the use of new digitalization technologies but also the training of these. However, in general, there is a high level of interest in automation and digitalization solutions in Morocco. This was shown by the high level of participation in the survey and the subsequent feedback.

In a first step, the German-Moroccan commitment supported by the BMZ has already led to a higher sensitivity of the industry for automation and digitalization solutions. Furthermore, a high demand for professional education and training on new technologies could be identified. In the long term, the Competence Center on Automation will make a major contribution in the field of education and training and serve as a focal point to encourage bilateral industrial cooperation.

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Biography

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