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An Exploration of the Impact of Industry 4.0 Approach on Corporate Communication in the German Manufacturing Industry

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Abstract— **The purpose of this study is to explore the impact of the Industry 4.0 approach on Corporate Communication in the German manufacturing industry. Industry 4.0 is currently one of the most discussed topics within the German industry with its aim to strengthen the competitiveness of German manufacturers. Industry 4.0 comprises the entire life-cycle of a product through an intelligent networked production. Smart factories symbolize the main objective of Industry 4.0 by implementing Cyber-Physical Systems, the Internet of Things and Internet of Services. The impact of Industry 4.0 on Corporate Communication has not yet been investigated. Therefore, a significant gap of research exists, which will be closed by this study on the impacts of Industry 4.0 on internal as well as external communication. The study was conducted through primary data collection, using a mono-method qualitative research technique in form of semi-structured expert interviews. The sampling comprises six interviewees from varying industry sectors in Germany. The interview partners were chosen due to their expertise on thematic aspects of Corporate Communication and/or Industry 4.0 within organisations which deal with Industry 4.0 implementations. The sampling represents different perspectives on Industry 4.0 as it illustrates different Industry 4.0 operators and Industry 4.0 service providers. Data is examined by a thematic analysis approach involving a vertical and horizontal analysis of the cases. Deriving from the data analysis and findings, an overview of the impact and potential opportunities for manufacturers is formulated. Lastly, to conclude the topic a prospective outlook will be given.**

Keywords— *Digitalization, Industry 4.0, Corporate Communication, Manufacturing Industry, Internet of Things, Internet of Services, Cyber-Physical-Systems*

1.   Introduction

Today's economic world is influenced by the digitalisation progress and the development of high-tech, innovative technologies. Researchers in the array of technology developments and digitalization discuss the fact that businesses are forced to adapt their products and services due to the global trend of digitalization and the immense pressure of competitive progresses on high-tech, innovative strategies [1]. Such emergences of changes in the industrial sector regarding to developed technology standards occurred several times in the past, causing events such as the initial industrial revolution [2]. Scholars suggest that we experience the fourth industrial revolution nowadays, whereby the term Industry 4.0 got its name. The development of technologies in this fourth revolution are summarized as the upcoming utilization of Smart Factories through the implementation of Cyber-Physical-Systems (CPS) and the inclusion of Internet of Things (IoT) and Internet of Services (IoS) [1].

The adoption of the Industry 4.0 approach faces a lot of challenges within organisations. Scholars of Corporate Communication agree that all organisational changes' may arise uncertainty due to i.e. necessary restructuring of the organisation, wherefore the way of communicating such changes reflects a key success factor [3]. For this reason, ref. [3] argues that communication must be very aligned to the organisational identity and must provide as much information to stakeholders as possible. Ref. [4] suggests that Corporate Communication is part of the corporate governance and deals with the all communication activities of internal and external coordination as well as

interest pronouncement for stakeholders. Other scholars added the perspective of using Corporate Communication to position business in society and to create an organisation's image through Public Relations, which is part of the external Corporate Communication [5].

Researchers state that the initiative of Industry 4.0 approach is expected to have influences on Corporate Communication as it comprises communication systems and tools by network systems and will change internal communication as well as their external communication, especially towards their stakeholders [6]. Balmer and Greyser, two pioneers of Corporate Communication, affirm the special impact of external and internal alignments on a firm's business success [7]. Therefore, it is an important business field to create a competitive advantage in today's world of digitalization [8].

This study investigates the impact of the implementation of the Industry 4.0 approach on Corporate Communication as the rollout of the Industry 4.0 in Germany has just started in 2015. Manufacturers who already have started to implement this approach as well as future potential implementers may benefit from this research as the outcome of the investigation of Industry 4.0 approach on Corporate Communication has not been explored yet.

2.   Literature Review

In order to explore the impact of the implementation of the Industry 4.0 on Corporate Communication, we'll hereafter review the key literature of Corporate Communication as well as of the Industry 4.0. The study will focus on how organisations use communication approaches and will explore how the implementation of Industry 4.0 affects Corporate Communication including its activities. In order to explore any impacts between Corporate Communication and Industry 4.0, it is important to first review each topic separately.

Most of literature and articles on Corporate Communication is referring to seminal pioneers and scholars from 1923 to 2004. Pioneers such as Bernays, Allen, Grunig and Argenti are stated by current Corporate Communication researchers as the most reliable sources as they shaped the definition of Corporate Communication and its

scope [9]-[12]. Modern literature comprises findings by recent scholars in the field of Corporate Communication like van Riel & Fombrun (2007). Corporate Communication (CC) deals with the communication and relationship with targeted stakeholders (van Riel C. , 1995) and is defined by scholars as a "set of activities involved in managing and orchestrating all internal and external communications aimed at creating favourable starting points with stakeholders on which the company depends" (van Riel & Fombrun, 2007, p. 25).

The first emergence of 'Industry 4.0' was found as an initiative of the German Federal Ministry of Education and Research and was first mentioned and presented as a concept on the Hannover Fair in 2011. Industry 4.0 got its name as it is seen a successor to earlier industrial revolutions, as illustrated in Figure 1 [15].

Researcher from the TU Dortmund University provided a very specific definition of Industry 4.0 [16] p. 11: "Industry 4.0 is a collective term of technologies and concepts of value chain organization. Within the modular structured Smart Factories of Industry 4.0, CPS monitor physical processes, create a value copy of the physical world and make decentralized decisions. Over the IoT, CPS communicate and cooperate with each other and humans in real time. Via the IoS, both internal and cross-organizational services are offered and utilized by participants of the value chain."
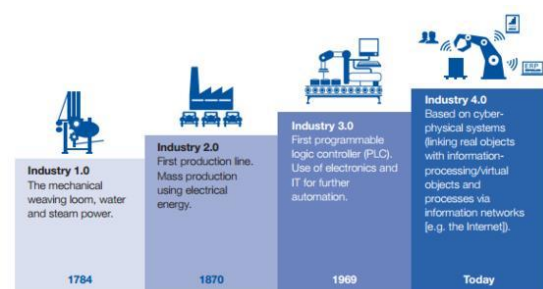

Figure 1. The Industrial Pathway adopted by RSA Solutions [15]

Furthermore, the change of a manufacturer's production plant into a smart factory suggests to arise conflicts, first of all in the organisation itself. Studies of human-machinery interactions discuss the change of the role of humans within the production as the most affected organisational area due to changing requirements and functions [17].

3.   Research Approach

The research will be adopting an inductive, interpretivist approach concerning the epistemology assumption. Inductive research allows, according to Saunders, Lewis and Thornhill, the exploration of situations within a specific research theme with its aim to develop a framework [18]. Easterby-Smith, Thorpe and Jackson suggest that the developed framework is created after the data has been collected in the inductive approach [19]. In this study, the inductive perspective is chosen as the research field has not been investigated yet.

The sampling of this data collection was limited to German industry due to the limitations of the research field. Six interviews are conducted from five different organisations. The sample size of 5 to 25 participants in case of semi-structured interviews is suggested sufficient by Saunders, Lewis and Thornhill [18]. Three of five participating organisations represent Industry 4.0 service providers and two do represent Industry 4.0 operators. The sampling includes interviewees from sectors of automotive, tele-communication, industrial engineering, medicine and pharmaceutics and IT consultancy.

4.   Data Analysis

Using the thematic analysis research approach [18] the semi-structured interviews were transcribed within the first stage of familiarisation. The next step hereafter is the coding, whereby identified and marked similar data units in the transcripts were identified to emphasize related areas. The results of the semi-structured elite interviews were interpreted, based on the epistemological position of interpretivism, with the understanding of the social context and perceptions of research participants [18].

4.2   Industry 4.0 and Corporate Communication Findings

To explore the impact of Industry 4.0 on CC a section in the interview about the relationship between them as well as to identify areas where Industry 4.0 is affecting CC was included.

All participants stated, that the implementation of Industry 4.0 was internally announced (in average) two years ago within the experts' organisations by board members. Due to the topicality, the external communication followed within six months after the internal announcement. The short period of time between internal and external communication clarified the importance of Industry 4.0 for German manufacturers.

4.3   Effects on Corporate Communication through Industry 4.0

With one exception, all experts noticed a change in CC due to the implementation of Industry 4.0 in combination with digitalization. Participant A is the only interviewee who denied any changes since their employer's position as a service provider. However other participants of alternative industry 4.0 service providers are reporting changes.

Main findings of this study concerning the effects of CC on Industry 4.0 include the requirement of a interconnected communication (Participants B, D), trends of digitalization of communication (Participant B, C), delivering of information about the progress and success of Industry 4.0 components in real time (Participant F) and the requirement of flexible communications strategies (Participants E, F).

Furthermore, the findings of the research study (see Figure 2) suggest that most changes of CC occurred by IoT implementations and digitalization. CC was stated by experts to become networked, digital and flexible through Industry 4.0 and digitalization aspects. The use of the gathered data by Industry 4.0 approaches is seen as one of the major advantages for CC to create new tasks.
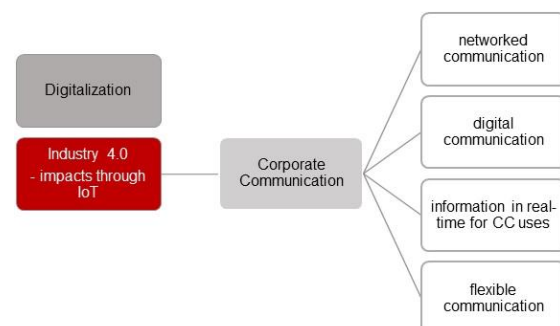

Figure 2. Illustration of Impacts on CC through Industry 4.0

4.4   Internal Communication within Industry 4.0

Studies by Deutscher Bundestag Wissenschafts-gruppe [20] and ING DiBa [21] show that the

implementation of Industry 4.0 approaches and components leads to the fear of loss of jobs by employees. The findings on this question are salient as it does not depend on the initial point of the employer being a user or service provider.

Participant A advocated the opinion that it is enormously important to inform employees and work councils at the very beginning of any change. Further, all experts suggested that the communication must be transparent. Participant B confirmed that within organisation B, the fear of loss of jobs appears to be very present. The internal communication reacted to this fear through different tools right from the beginning of the announcement of Industry 4.0. The tools were described by Participant B as published reports of the production executive addressing the affected employees as well as constant publications about the status of the implementation. Furthermore, organisation B created a daily 'employee's minute' – a video where employees' questions are being answered by the management and where employees are motivating colleagues to increase the loyalty towards the firm. Participants C, D, E and F reported a similar strategy of their organisations. To further reduce the fears, organisation B and E stated that they are implementing Industry 4.0 by today's workforce.

The fear of loss of jobs is therefore confirmed to be present and veritable by literature. The interviewed organisations reacted on this occurrence in a constant manner with the knowledge of its significance.

4.5 Possible outcome for Corporate Communication through Industry 4.0

The third considered question in this section is referring to the chances and possibilities for CC by Industry 4.0 approaches. The findings (see Table 1) demonstrate that impacts on CC exist through the implementation of Industry 4.0, mainly by the implementation of IoT to network machineries, products and customers. Additional impacts on CC can be found to be attributable to digitalization.

Table 1. Overview Findings on New Areas and Tasks for CC

Participant A	Participant B	Participant C
• new areas through CPS, IoT and Machine to Machine (M2M) → inter-connections, data collection and disclosure of data from production and products	• Marketing benefits from Industry 4.0 → IoT and CPS enables interconnection and networked products	• sustainable change of value chains → new service components emerge e.g. customer portals and resource-sharing portals
Participant D	Participant E	Participant F
• CC gets standardised by networking and digitalization → time is emerging for new tasks of CC → digitaliza-tion of the entire work-places	• new areas of CPS, IoT and M2M → inter-connections, data collection and disclosure of data from production and products	• new areas through IoT and IoS → provide information in real-time → latest developments can be published

Further findings (see Table 2) illustrate that the use of IoT, IoS and CPS solutions enables organisations to gather information through the interconnection of production and networked products. This information can be used by CC to create and strengthen the corporate image. Furthermore, it can be used for strategic decisions and corporate marketing activities.

Table 2. Overview How the Findings affect and develop CC

Participant A	Participant B	Participant C
• to create new knowledge about customers • to receive sales indicators, information about the effectiveness of the organisation's strategy	• data is available in real-time and • can be used for Marketing strategies and publications through CC	• new and further developed CC is required
Participant D	**Participant E**	**Participant F**
• innovative CC tools to create an agile, flexible and modern picture of the business to advance the corporate image	• to create new knowledge about customers, • to receive sales indicators & information about the effectiveness of the organisation's strategy	• data is available in real-time and • can be used for Marketing strategies and publica-tions through CC

5.   Discussion of Findings

The results demonstrate that CC in practice is structured into three sub-segments, which are Public Relations, Marketing (Communication) and internal communication – often referred to as internal Public Relations. The findings suggest unanimously that Public Relations is seen as the main component of CC and the main focus of organisations.

The interviewed experts suggested internal social-media platforms as one of the internal communication tools to keep up with time and requirements. Besides the internal interpretation of social-media benefits on businesses, experts additionally stated the importance for external communication.

The above discussed research findings show that the objective of CC is seen by experts as the creation and improvement of a corporate image. The shaping of corporate reputation by the use of

different communication tools is another finding regarding to the conducted interviews.

However, the organisation's image does not only have an impact on (potential) customers but also on potential employees. Today, the majority of graduates are looking for jobs at an agile and flexible organisation with 'start-up'-characteristics [22]. The expectations of recent graduate can be attributed to the Generation Y, but also to today's technology progress [23].

As the interviewed experts stated, the timespan between the internal and external announcement of Industry 4.0 implementation was about six months. Critics discussed that the rush of implementing Industry 4.0 is one of the reasons of their previously mentioned disadvantages of data security and the un-readiness to react on cyber-attacks [24].

Furthermore, experts, who participated in the interviews, unconsciously revealed an additional influence on Industry 4.0 besides CC. They perceived digitalization to play a significant role in the development of CC and the implementation of Industry 4.0 and vice versa.

The mixing of Industry 4.0 approaches and digitalization advantages demonstrates the uncertainty and the ambiguity within the practice as well as within the literature and theory regarding Industry 4.0 [25].
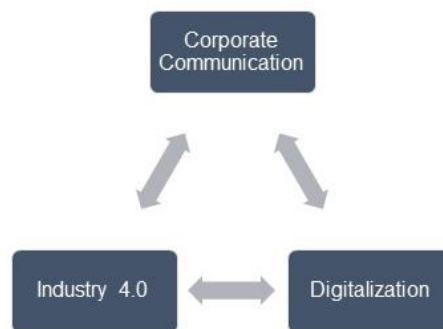

Figure 3. Triangle Corporate Communication, Industry 4.0 and Digitalization

The interviewed experts discussed the changes within CC due to Industry 4.0 and digitalization approaches. The separation of Industry 4.0 to digitalization is barely feasible, which creates the triangle (see Figure 3). Therefore, the findings do not illustrate a proper explanation of the relationship of Industry 4.0 and CC [24].

Nonetheless, the findings show that digitalization and interconnection by CPS and IoT solutions reflect the main impact of Industry 4.0 on CC. The interviewed experts explained that through CPS, networked products and interconnected industrial facilities, the communication gets digitalised and more flexible. Participants suggested that data is available in real-time and can be used faster, easier and more efficient by CC. Furthermore, they stated that processes are expected to get standardized within CC, which involve time-saving aspects. Therefore, standardization based on digitalization enables new tasks for CC, e.g. implementing innovative communication tools.

Internal social-media channels, internal banners, and upcoming external interactive communication tools are suggested to be the main developments of CC methods due to Industry 4.0 implementations (Participants A, D and F). Innovations within CC are argued to be involved in organisation's transformations towards digital businesses [6].

Risks through Industry 4.0 are stated by Participant E as the dependence on technologies in general. The assertion of Participant E is supported by Valik [6] as he discussed the innovation of communication based on digitalization. Risks related on CC are mainly concerned with data security, as CC utilizes information from production to highlight the state-of-the-art technologies within industrial facilities to improve the corporate image [26], [27].

Furthermore, CC tries to create reputation by success stories and by revealing security solutions to secure their productions, products and customers from cyber-attacks. CC faces problems regarding the most mentioned disadvantage of Industry 4.0 which is the lack of high-tech data security solutions [23].

Opportunities are suggested to arise from implementing Industry 4.0 by the interconnection through CPS and IoT and the offering of cloud computing for customers, which is linked to personal customer's information [6].

6. Conclusion

To conclude the analysis, the most affected areas marketing-oriented PR, Media Relations and internal communication are explored and perspective outlooks for their future developments will be given.

6.2 Marketing-oriented PR and Media Relations

Research findings of this study showed changes of marketing-oriented PR as content-related. Through Industry 4.0 implementations and the use of IoT, CPS and Smart Factories, interconnection of production lines, products and customers emerge. This interconnection enables among others M2M communication and therefore data collection and data analytics. The gathered data is available in real-time and is used by PR, Media Relations and Corporate Marketing to promote the organisation externally and to improve the corporate image.

The changes within these sections and especially in Media Relations are stated by experts to be attributable to Industry 4.0 and digitalization implementations. Changes in both external trigger are explained by developments in information technologies [6]. Experts approved that print media is reduced or even will be excluded from PR and Media Relations, which stands in accordance to Valik [6].

6.3 Internal communication

The research findings demonstrated the most significant changes within internal communication to be the implementation of new communication tools. Experts illustrated in their responses that internal communication tools changed through Industry 4.0 approaches. Additionally, changes were noticed through digitalization with real-time information tools with value-adding features of creating dialogues between internal stakeholders and organisations.

The transformation towards a paperless-workplace is supported by new communication tools e.g. networked platforms as they might be used as an internal sharing-place of information and documents. New internal communication tools are described by experts as internal social-media platforms or internal communication banners.

Concluding, the relationship between Industry 4.0, digitalization and CC reshapes the way of doing business for the German industry.

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