

# **Governance structures affecting data protection in advanced manufacturing - How much room does Germany's ambition to lead the fourth industrial revolution leave for RRI?**

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## **Introduction**

After prior industrial revolutions resulting from mechanisation, electricity or information technology, the introduction of the Internet of Things into the manufacturing environment is expected to usher a fourth industrial revolution. Under the umbrella term of smart factories actors in the manufacturing industry are expected to establish global production and value networks that incorporate enterprise applications, data warehouses and the Internet with production facilities, supply chains and products in the shape of cyber-physical systems (CPS). The components of CPS autonomously exchange information, trigger actions and control each other independently.

This case study focusing on governance structures affecting data protection in advanced manufacturing does not only allow further refining the ResAGorA research model to better explain responsible research and innovation with respect to emerging technologies which are

considered very promising in commercial terms but also contributes to ResAGorA by putting limelight on a highly complex area of research and innovation where governance arrangements are still in the making and have neither proven legitimated nor effective.

## **Scope and methodology**

The application of the ResAGorA research model in the context of Germany's Industrie 4.0 strategic initiative allows investigating the governance of research and innovation not only in an area where a specific country is under great pressure to succeed, but also in an area which is characterized by a high degree of global interdependence, a complex actor landscape with contradictory interests and priorities, and the fact that what it proclaims is expected to be common practice in about 10 years at the earliest. In the context of advanced manufacturing, there are many questions waiting for an answer. Among them are, for instance, questions related to liability, the valuation of data or the protection of intellectual property rights and personal data.

Due to the relevancy of the topic in the advanced manufacturing context and Germany's spearheading role in its protection, particular emphasis is placed on issues related to the handling of personal data of both employees and customers. Data protection is particularly important in the context of advanced manufacturing as large volumes of data, which in part qualify as personal data, are stored, processed and transferred not only within but also across organizational boundaries and national borders. Being convincing in terms of data protection is critical for the future development of advanced manufacturing in Germany and beyond. Respecting fundamental rights as well as social values and standards appears to be particularly challenging in an area of research and innovation which is subjected to great economic success pressures.

Due to the fact that the fourth industrial revolution is just about to be ushered by the introduction of the Internet of Things into the manufacturing environment, it is not reasonable to concentrate on one of the few early-stage research projects to gain an understanding of how governance arrangements, the actor landscape and de facto governance practices in the context of advanced manufacturing are constituted and evolve. Answering the question whether or not Germany's ambition to lead this revolution leaves sufficient room for responsible research and innovation (RRI) requires a wider perspective which looks beyond organizational boundaries and national borders.

To provide the necessary background for a survey and to identify the most relevant stakeholders to be contacted, documentation focusing on the German Industrie 4.0 strategic initiative as well as publications on similar efforts aiming to bring advanced manufacturing forth were reviewed. The primary objective of this part of the research was to gain an initial understanding of the actor landscape and the key government arrangements. Actor perceptions were then captured by means of a series of eight telephone interviews with an

eight written position statements from representatives from a wide variety of stakeholders including the industry, research institutions and associations. All survey participants were from Germany but developments in other leading regions in the field of advanced manufacturing were addressed. Comparing endogenous and external perceptions with respect to the initiative helped not only to identify discrepancies between governance arrangements and de facto governance practices but also to avoid biased results. To gain a deep understanding of the de facto practices of governance as well as their link to governance arrangements was the primary objective of this part of the research.

## **Situation of case study**

Currently, Germany does not only have one of the most competitive manufacturing industries in the world but is also a global leader in the manufacturing equipment sector. The country is specialised not only in research, development and production of innovative manufacturing technologies but also in the management of complex industrial processes. It is considered extremely well placed to reinforce its position as a leader in the manufacturing engineering industry. Missing out on the rapid developments in the manufacturing environment would mean for Germany to suffer considerable losses with respect to an important pillar of its economic strength. Emerging as a winner from the fourth industrial revolution, however, requires achieving and maintaining a balance between empowering the manufacturing industry and making sure that fundamental rights as well as social values and standards are respected.

With the ambition to lead the fourth industrial revolution, the German Federal Government launched in November 2011 a strategic initiative entitled 'Industrie 4.0' within the scope of the High-Tech Strategy 2020 action plan. The intention of the ongoing initiative is to make Germany a lead supplier of cyber-physical production systems until 2020. From January until October 2012, an Industrie 4.0 working group coordinated by acatech (National Academy of Science and Engineering) developed a set of recommendations for implementing the strategic initiative (acatech 2013). The set of recommendations was handed over to representatives of the German Federal Government at the Hanover Fair in April 2013. At the same time, the Industrie 4.0 Plattform, a cooperation of the three industrial associations BITKOM (German Federal Association for Information Technology, Telecommunications and New Media), VDMA (German Engineering Federation) and ZVEI (German Electrical and Electronic Manufacturers' Association), commenced its activities. The platform promotes the development of technologies, standards and business models through specific working groups and aims at driving forward the practical implementation and application of advanced manufacturing.

The smart factories that are already beginning to appear employ a completely new approach to production. The Siemens Electronics Works facility in Amberg, Germany which produces and distributes the organization's Simatic control devices is an example of advanced manufacturing in practice (Hessman 2013). The journey towards advanced manufacturing presents itself as an

evolutionary process with large organizations being at the forefront. End-to-end transparency over the manufacturing process promises to facilitate optimised decision-making which does not only allow more dynamic business and engineering processes but also resource productivity and efficiency gains.

Global competition in the manufacturing engineering sector is becoming tougher and particularly Asia and North America are also taking measures to combat deindustrialisation through programmes promoting advanced manufacturing. At the same time, however, integration within and across organisational boundaries as well as across national borders is essential in the context of advanced manufacturing. According to the recommendations for implementing the strategic initiative, a considerable amount of research is required with respect to the horizontal and vertical integration of manufacturing systems and the end-to-end integration of engineering. Continuing integration, however, will only be possible if a single set of common standards is developed. Standardisation efforts will need to focus on stipulating cooperation mechanisms and the data exchanged. This implies addressing questions related to data protection.

As personal data is relevant in the context of advanced manufacturing, fundamental rights as well as social values and standards may be at risk if their consideration is not enforced appropriately. As the interaction between employees and CPS increases in smart factories, more and more personal data about individual employees is stored, processed and transferred. Systems may record information about the location, vital signs or quality of work of employees. Personal customer data is relevant in the context of advanced manufacturing as products are expected to increasingly meet individual customer requirements and as end products still contain data processing components used during the manufacturing process.

In terms of legal compliance but also in terms of fundamental rights as well as social values and standards, production and value networks with an international dimension are particularly problematic. German data protection laws place strict restrictions on the transfer of personal data to organizations outside the European Union (EU) or the European Economic Area, particularly if data protection in the respective country is lower than in the EU. This could result in problematic constraints for global networks. Production and value networks do not only face country-specific differences but also comprise of a heterogeneous sets of organizations with varying business models.

## **Conditions for 'RRI in the making'**

The investigation of the emergence and development of governance arrangements takes the actor landscape relevant in the context of advanced manufacturing as starting point, paying particular attention to the Industrie 4.0 Plattform. It is studied, on the one hand, how the actors involved are urged to be responsive with respect to objectives related to data protection (responsibilisation) and, on the other hand, how instruments and procedures are

redesigned to align competing standpoints (managing contestation). From a German perspective, respecting fundamental rights as well as social values and standards from several countries makes research and development in the context of advanced manufacturing more complex but nevertheless seems unavoidable to exploit the full potential that global production and value networks promise. Similarly, the role that German actors play in efforts focusing on advanced manufacturing driven by other regions is not negligible as it codetermines whether German interests in terms of data protection are respected in the global arena.

The main instruments used to urge actors to be responsive with respect to objectives related to data protection are of legal nature. The Charter of Fundamental Right of the EU forms an integral part of the Treaties. In Germany, the German Federal Data Protection Act (BDSG) and the Data Protection Acts of the federal states are particularly relevant with respect to data protection. Data protection laws are applicable in the context of advanced manufacturing just as in any other context. The laws are technology-neutral and were not adapted due to the emergence of advanced manufacturing. Innovative business models as well as emerging technologies thus have to meet the specified requirements which are legally binding without restrictions. The laws define principles actors have to comply with when collecting and processing personally identifiable data of employees or customers. Among them are principles such as data minimization, appropriation and consent of the data subjects.

Advanced manufacturing solutions have to be designed in a way that they do not constrain the right of informational self-determination. The primary options to achieve this goal are, firstly, to renounce entirely the use of personally identifiable data, secondly, to successfully anonymise personally identifiable data obtained, or, thirdly, to put in place controls which are in accordance with the current state of law. The BDSG requires prior checking in case an organization intends to process personally identifiable data that may threaten the right of information self-determination. Prior checking provides a framework where instruments such as privacy impact assessments (PIA) fit in. A PIA is an attempt to predict future danger through certain technologies. PIA is not as widespread in Germany as it is, for instance, in the USA. Profiling or tracking, which are not unlikely in the context of advance manufacturing solutions, usually (the law remains rather vague in this regard) make prior checking necessary. However, whereas PIA normally focuses on certain technologies regardless of an actual application, prior checking is always focused on a concrete procedure applied in an organization.

In the future, the General Data Protection Regulation (GDPR) will be the single data protection law in the EU. The GDPR will supersede the current Data Protection Directive which influenced the current national data protection laws in the EU including the BDSG. The GDPR will have and the Data Protection Directive already has strong influence not only within the EU but also beyond its borders. EU organizations are permitted to transfer personally identifiable data to countries having a level of data protection similar to the one in the EU. This is highly relevant in the context of advanced manufacturing.

In terms of setting objectives related to data protection, the data protection laws are complemented by approaches to self-regulation. Self-regulation allows industry sectors to define own codes of conduct which go beyond laws. It is possible to obtain the approval for self-regulations from the competent data protection authority, which then examines whether the self-regulation is in accordance with applicable data protection laws. This makes self-regulation simpler and legally safer for the actors involved. In Germany, however, it has happened only once so far – in the insurance industry – that such an approval was obtained. It is possible to explicitly define a competent supervisory body such as an industry association within the scope of self-regulations. According to a representative from a German state data protection authority, self-regulation could also be a good approach to deal with divergent national data protection laws in international settings. This has not happened in practice, though.

Besides the legislator, data protection authorities are key actors with respect to informational self-determination in Germany. They act *la bouche de la loi* and examine whether applicable data protection laws are met by organizations. The authorities' instruments to sanctioning illegal practice are court orders and fines. Data protection authorities take action in the event that facts and circumstances indicate that an organization violates relevant laws or non-indication based. Moreover, data protection authorities provide advice to organizations as well as industry associations. Advice through authorities is particularly important since data protection laws have to be interpreted for each particular case. This makes being legally compliant difficult for organizations even if they have qualified organizational data protection officers. In many cases a weighting of interests is essential as the law does not give unambiguous guidance. Both organizations processing personally identifiable data as well as data protection authorities have to interpret the laws. Finally, data protection authorities attempt to answer fundamental questions and guide organizations. Particularly relevant data protection committees in Germany are the Düsseldorf working group (Düsseldorfer Kreis) as well as the conference of federal and state data protection commissioners (Konferenz der Datenschutzbeauftragten des Bundes und der Länder). On the EU level, the Article 29 Working Group is the relevant committee. All of them usually publish their results on their websites.

On the organizational level, there are questions in the context of the protection of employee data where works councils are involved as actors. Codetermination regulations according to industrial constitution law are applicable, for instance, when data is processed on an organizational level or when new technologies are introduced such as tracking systems or other systems collecting employee data. Organizational data protection officers are in charge of both employee and customer data.

The main purpose of the Plattform Industrie 4.0 is to provide a forum for discussions as well as for developing research and development roadmaps. To achieve this aim, the platform focuses on bringing together the relevant actors from politics, the industry and the scientific community. The steering group is composed of representatives from the platform's member companies, representatives from the sponsoring industrial associations and a spokesperson from a scientific advisory board set up for the platform. The platform concentrates on

coordination, information exchange and the definition of shared objectives in the advanced manufacturing context in Germany. The specification or enforcement of objectives related to data protection is considered relevant. Representatives from the platform's scientific advisory board confirmed that data protection is on the platform's agenda as well as that it is tried to address the lack of objectives. Efforts, however, are at a very early stage and, until now, led to the creation of problem sets only.

The scientific advisory board of the platform primarily provides impetus for action and hints to diagnose problems. Two or three members of the advisory board push the data protection topic. It was recognized that data protection as well as legal issues in general play an important role for organizations interested in advanced manufacturing and consequently a person with a legal background was asked to join the advisory board. Nevertheless, according to a representative of the advisory board, data protection has not played a prominent role in the platform so far. It was stated that organizations as well as the advisory board members from the technical sciences are still busy trying to sort out what advanced manufacturing actually is and how Germany should be positioned. The advisory board is supposed to connect the platform to the academic community and to make sure that research and development follows a sustainable strategy.

So far, the advisory board's major outcome has been a set of 17 theses outlining prospects for advanced manufacturing. One of the theses underlines the role of responsibility in general and data protection in particular in the context of advanced manufacturing by stressing that "a new culture with respect to safety and security will lead to trustworthy and socially acceptable systems." Data protection plays a key role with respect to both aspects trustworthiness and social acceptability. The thesis is in line with statements made in publications on the German Industrie 4.0 strategic initiative and related efforts. The recommendations for implementing the strategic initiative, for instance, state that advanced manufacturing "will put increased demands on data protection". According to the German Science Council "data protection plays a particularly important role" in the context of advanced manufacturing. The set of theses was the result of a discussion process between the scientific advisory board and various working groups.

According to a representative of the scientific advisory board, there are plans to promote research efforts such as problem analyses or preliminary studies. This however, is also still at an early stage of debate. The Plattform Industrie 4.0 is increasingly involved in research projects focusing on advanced manufacturing funded by the Federal Ministry of Education and Research (BMBF) or the Federal Ministry for Economic Affairs and Energy (BMWi). The representative underlined that current calls for research projects usually require the explicit consideration of data protection issues or the existence of accompanying research dealing with the respective questions. Research funded by the ministries can go beyond what the platform can deliver.

The BMBF not only supported the strategic initiative which led to the establishment of the Plattform Industrie 4.0 but also other related projects including INBENZHAP which focuses on

the creation of an international benchmark. The benchmark is based on a socio-technical view and investigates the society's influence on selected scenarios and the interplay of technology and society. Questions related to advanced manufacturing are discussed within the scope of bi-yearly workshops involving representatives from industry, research and society. The benchmark focuses rather on companies than on individuals and data protection issues are rather affected than selected explicitly. Nevertheless data protection was discussed within the scope of several scenarios. Moreover, a renowned expert in the field of data protection sanitized the participants at the first workshop of the project. There is an ongoing exchange of information between INBENZHAP and the Plattform Industrie 4.0. The project is a preliminary study for the BMBF exclusively. In general, the BMBF tries to ensure that research projects, including ones focusing on advanced manufacturing, have direct value for the industry. Accordingly, the current call underlines with its name that research has to get connected with the production hall floor.

Guidelines for data protection in the advanced manufacturing context, which go beyond the law, are currently hardly available. The few that are available are provided by data protection authorities. Best practices are expected to play an important role as soon as the legislative framework is more harmonized.

## **'Well doing' of *de facto* governance practices**

De facto governance practices, which are usually determined by the interaction of characteristics of governance arrangements, the actor landscape and previous achievements, are considered 'well-doing' if the underlying instruments and procedures are legitimated and effective. The conditions by which legitimacy and effectiveness are accomplished in the context of advanced manufacturing are investigated with regard to both responsabilisation and managing contestation. In line with the ResAGorA research model, apart from inputs in terms of characteristics of governance arrangements or capabilities and actors (constructive interactions) also outputs in terms of transformations in governance arrangements and the behaviour or attitude of actors (productive interactions) are taken into account. With respect to responsabilisation, the focus was on aspects such as actor inclusion, robustness of the knowledge base, capacities for learning and embedding of responsibility, whereas managing contestation required studying procedures and 'rules of the game', transparency, and trust in the de facto governance process.

Specifying normative requirements is difficult as long as the vision behind the buzzword Industrie 4.0 is neither fully understood and defined nor accepted. Many companies, in particular small and medium sized ones, still show signs of reservation and scepticism against the promises of the Industrie 4.0. Moreover many stakeholders encounter problems describing the novelty of the concept, because many buildings blocks such as Internet of Things or ubiquitous computing, are subject of discussions for several years. Additionally, Industrie 4.0 is still an evolving concept with a horizon of ten years and beyond and similar to other the other



industrial revolutions it is more of an evolutionary instead of a disruptive character due to the investment cycles for machine equipment and uncertainties. Altogether, this underlines that the main ideas behind Industrie 4.0 go beyond technological aspects and are more directed at value chains and networks or business models. While this refers to the underlying structure of economy and society including aspects like conditions of work, data protection, the actual debate is more focussed on the technical aspects. This clearly shows some serious flaws in the robustness of the knowledge base, which becomes easily obvious in case of data protection. Though all stakeholders confirm the importance of the topic and the necessity to actively deal with it in order to ensure acceptance for the underlying ideas of Industrie 4.0, many actual projects and test avoid dealing with them. This discrepancy reveals one general problem in the de facto governance process. However, it is also difficult to make assessments of well doing of de facto processes given the fact that the arrangements and processes are also still in a statu nascendi and many external influences like the European regulation on data protection or internal developments such as a sharpening of business models may will result in changes. Consequently, all assessments are based on an evolving, partly still incomplete or flux situation.

Another point is the actual legitimacy of platform. In this context the first problem is the composition of the platform. Though it is officially driven by the three industry associations, which each claim to represent their industry as a whole, the contributions of industrial partners show that mainly key industrial player, most likely bigger companies, are actively involved in the platform. Small and medium sized companies which are considered to be the backbone of these industries are only loosely connected to the platform. Though there are discussions on the integration of them, some suggestions such as promotion activities or inclusion in the advisory board may have the tendency to serve only the legitimacy instead of a real inclusion. The second problem regarding legitimacy evolves directly from this de facto arrangement of actors, because it also raises questions regarding the transparency of the process, which directly influences the legitimacy. Not only the lack of small and medium sized companies, but also the lack of integration of further stakeholders beside an scientific advisory board bear problems. The reason is that the influence on the actual work in the executive bodies is low, i.e. the scientific advisory board has one member in it, and the composition of the working groups is not open and transparent.

These arrangements and processes also impact the effectiveness in several ways. First of all, the scientific advisory board is only loosely connected to the actual work of the working groups or even projects. Therefore the inclusion of issues such as data protection in this work is not automatically given. This can impact the effectiveness of the platform by lowering the potential acceptance of solutions. Secondly, the low inclusion of small and medium sized companies does not only affect the legitimacy, but also the effectiveness, because it may lower the acceptance of solutions and self-regulations. Especially, given the point that many smaller companies neither have the capabilities to understand the legal aspects nor have capabilities to implement solutions correctly. Moreover based on the assumption that the number of data processing companies will strongly grew with Industrie 4.0 data protection authorities and

courts will not be able to control all data of them. The resulting problems or even misuses will negatively impact the societal acceptance. A third point is given the composition the platform can be easily seen as mean of a specific group of German machine equipment producers and IT companies pursuing their interests, in particular in relation to standard setting. The “branding” as a national initiative can be an advantage given the credit for German machine manufacturers, but it also bears risks. Especially the limited openness can lead to solutions that are not accepted globally, especially since other important actors, in particular internet and technology companies, now started the Industrial Internet Consortium (IIC), which states to be an international and open society, though many of the founding members are of US origin. The problem of acceptance is in particular in case of the data protection standards very ambiguous. While sometimes the high standards in Germany are seen as an advantage, the related burdens may make other solutions more attractive. This would in the end result in lower standards for all.

Finally, it can be stated that the consequences of these de facto governance processes culminate in the current developments. At the moment many companies and experiment with new technologies and business models in the context of advanced manufacturing. It is obvious that a considerable number of the experiments and tests have the potential to conflict with the current data protection regime though nearly all state that in general they are aware of the problem. Reasons for this contradiction can be manifold. It might be that in particular small firms driven by day-to-day business perspective are not aware of future conflicts. Another reason might lay in the fact that practioneers in particular in industries with less experience in data protection issues do not understand the legal requirements. Finally it might be that companies come to the conclusion that institutions such as the platform will take care of such cross-functional themes. In this worst case scenario the platform would serve as an excuse for practices that do not comply to existing laws. It underlines that governance arrangement such as an industry driven platform may fail in responsabilisation in such evolving, future developments. Thereby it emphasises the need for clear solutions that may can not only provided by self-regulation, in particular not if strong public partly contradicting interests such as competitiveness and human rights exist. In such a case policy and regulation is needed as well.

## **Lessons for Res-AGorA**

With regard to the Res-AGorA research model, the following lessons can be drawn from the case study:

*The Plattform Industrie 4.0 plays a minor role in establishing governance arrangements ensuring that product and value networks qualifying as advanced manufacturing are convincing in terms of data protection.* The German government specifying the legislative framework as well as data protection authorities are considerably more important. There are hardly any agreements on objectives available that go beyond the law.

*There are governance arrangements facilitating data protection across global product and value networks.* The framework conditions with respect to data protection differ considerably from one country to another, even within the European Union. Respecting the conditions of several countries makes research and development in the context of advanced manufacturing more complex but nevertheless is unavoidable to exploit the full potential that global networks promise. The most relevant governance arrangements are the existing Data Protection Directive and the future GDPR. Both provide instruments to facilitate data protection across global product and value networks.

*De facto governance practices lack both legitimacy and effectiveness with respect to both the German and the international dimension.* Legitimacy is subliminally called into question when business models are proposed which collide with the applicable legislative framework. To some extent, this can be attributed to the fact that what advanced manufacturing proclaims is not yet common practice and that engineers typically focus rather on technical than on legal feasibility. Lack of effectiveness results from gaps in knowledge – organizations have difficulties interpreting the applicable laws – and law enforcement deficits.

*It is rather unlikely that data protection will be sacrificed for a stronger competitive position.* Due to its leading position in the manufacturing engineering industry, Germany is under great pressure to succeed and Germany's relatively high level of data protection is sometimes considered a handicap rather than an achievement. However, in the long run, it is likely that a higher level of data protection will prevail internationally. In the short to medium run it may be that data protection issues will stifle innovation.

## **Conclusion**

The journey towards advanced manufacturing requires Germany to put a huge amount of effort into research and development. Governance arrangements in terms of adequate instruments and procedures are critical to ensure that this effort results in research and innovation processes and achievements which are in line with fundamental rights as well as social values and standards. The de facto practices of governance which evolved over time are linked to but different from the governance arrangements which capture the formal aspects of instruments and procedures.

The case study does not only allow further refining the ResAGorA research model to better explain responsible research and innovation with respect to emerging technologies which are considered very promising in commercial terms but also contributes to ResAGorA by putting limelight on a highly complex area of research and innovation where governance arrangements are still in the making and have neither proven legitimated nor effective.

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# Towards Anticipatory Governance of Responsible Research and Innovation



The objective of the Res-AGorA project is to develop a comprehensive governance framework for responsible research and innovation (RRI). This will be a contribution to the EU ambition of becoming a genuine Innovation Union by 2020 striving for excellent science, a competitive industry and a better society without compromising on sustainability goals as well as ethically acceptable and socially desirable conditions.

The goal of the Res-AGorA project will be achieved through extensive case study research about existing RRI governance across different scientific technological areas, continuous monitoring of RRI trends in 16 European countries, and constructive negotiations and deliberation between key stakeholders. This comprehensive empirical work will be the building blocks of the creation of a governance framework for RRI.

The case study summarised in this document is output of Res-AGorA's extensive empirical programme (Work Package 3).

More information at [www.res-adora.eu](http://www.res-adora.eu)

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