WHITEPAPER

»SOCIAL NETWORKED INDUSTRY«

The Fraunhofer Lead Project: E³-Produktion

PROF. MICHAEL TEN HOMPEL | PROF. MATTHIAS PUTZ | ANDREAS NETTSTRÄTER
A POSITIVE VISION FOR INDUSTRY 4.0
SUMMARY
THE NEW EQUATION: PEOPLE + INDUSTRY 4.0 = SOCIAL NETWORKED INDUSTRY

In their efforts to drive ahead the development of innovations and policy in the context of the key topic of Industry 4.0, the business and science communities have frequently focused more on technological aspects in recent years. This has led to the fact that today the vision of Industry 4.0 – at least the public perception of it – is associated with a factory empty of people. This vision has now begun to raise concerns among representatives from the worlds of business, science, society and politics. But it has now becoming clear that people can and will have to take up a new role in this system. With that in mind, the researchers in the Fraunhofer lighthouse project E3 production have developed a vision for socially networked industry: »Social Networked Industry«. The social networks of today, with their high levels of networking and the possibilities they are equipped with for organising themselves and acting in a target-oriented way, serve as an important role model for a factory scenario where humans and machines work together as a team.

The »Social Networked Industry« brings people back into the picture at the centre of production and logistics and anticipates their specific abilities and requirements – and particularly the way they communicate and interact with the autonomously interacting cyber physical systems in Industry 4.0. A »Social Networked Industry« stands for industry-oriented forms of social networks in which people and cyber physical systems cooperate with each other within a company (vertical networking), but it also stands for new forms of networking in which companies cooperate extensively with each other (horizontal networking).

The term »Social Networked Industry« particularly indicates that Industry 4.0 has to be understood as a socio-technical system. Today, the »Machine Dimension« is the one which is most developed. Cyber physical systems are already well established in industry – even if they are often isolated and not networked comprehensively and/or strategically. The »Human Dimension«, and particularly the social factor of creative problem-solving skills, has to be considered as an inherent aspect and needs to be connected inseparably with Industry 4.0. The »Network Dimension « – humans work with machines, companies with other companies – is one of the biggest challenges for »Social Networked Industry«.

To implement the vision of a »Social Networked Industry«, five fields of action have to be considered where the role of humans has not been sufficiently investigated yet. These are:

- Agility & changeability
- Management & organisation
- Business models & innovation
- Efficiency & energy
- Standards & norms
Industry 4.0 is of immense importance for the business location of Germany. Linking the data levels which are connected via the internet with real factory processes means fundamentally new potentials can be opened up for the planning, control and organisation of production processes and supply chains. For businesses that means higher flexibility and, at the same time, increases efficiency for production and resources.

In their efforts to drive ahead the development of innovations and policy based on the key topic of Industry 4.0, the business and science communities have frequently focused on the technological aspects in recent years. This is (part of) the reason why the vision of Industry 4.0 – at least the public perception of it – is currently associated with a factory empty of people. Because of the low costs involved, this concept of (fully) automated production was, for a long time, seen to be a way for guaranteeing high performance and efficiency, which in turn has also led to increasing concerns among representatives from the worlds of business, science, society and politics. The threat of job losses and the diminishing importance of human skills are the most worrying factors here. This is particularly significant because we now know that the flexibility of production can quickly fall by the wayside in a factory empty of people – even though this is an essential factor for the future and competitiveness of any industry. There is growing awareness that people can and will have to take up a new role within this system. Finally, it is one of our undoubted strengths that humans are able to react flexibly and quickly to changed processes, procedures and spaces. It is evident that a high proportion of manual activities allow for high flexibility. There is also the question of whether in general there are sufficiently qualified employees for the increasing number of more demanding jobs. However, the idea of a factory empty of people is not really correct anyway – neither from a business nor a social perspective.

With the E3 production project, the Fraunhofer-Gesellschaft has initiated a lighthouse project that covers the different dimensions of production for the future. In this lighthouse project researchers develop solutions for production in the future taking account of innovative manufacturing technology, process engineering and Industry 4.0 solutions, sustainable logistics concepts and a modern and inspiring work environment. E3 is also all about achieving efficiency in production technology, efficient production sites and working efficiently.

By treating this topic of production as a whole, it quickly became clear that it was necessary to integrate the human factor in flexible production and logistics systems in cooperative ways. Human skills – in particular cognitive and creative abilities – are in more demand than ever because Industry 4.0 and the fourth industrial revolution can only be successful if the significance of the human factor is recognised and if human potential is fully exploited.

Today, efficiency is much more than just a criteria for making technical decisions. Efficiency is the prerequisite for successful production in the future. When logistics and production are organised and networked efficiently they can form the basis for new, future-proof jobs. Efficient production and logistics also make it possible to create modern and inspiring work environments and environment-friendly production sites.

Networks are one of the key features behind Industry 4.0 – and intelligent networks create efficiency.

Admittedly, networks are often seen to be synonymous with automation, when we look at production and logistics today. But networks also stand for a form of communication that has long since established itself in society. By providing and using current technologies like smartphones and tablets and forms of cooperation we know from social networks, we create an
intuitively operated intersection between human and machine. Concepts and technologies inherent in communication platforms run by the social networks such as Facebook and Twitter will also influence professional environments.

In this context, the researchers at the Fraunhofer light-house project E3 production have developed the vision of a socially networked industry: the Social Networked Industry.

Production and logistics take on the responsibility of creating a real and positive picture to contest the picture of the factory empty of people. Both of these industries have been high-tech sectors for a long time now. They are also disciplines pushing forward technological developments which are not totally disconnected from society. The social networks of today, with their high levels of networking and the way they act and interact with each other, serve as important role models for factories where people and machines work together as a team.

The Social Networked Industry is therefore an industry

- in which humans and machines communicate with each other in a completely innovative way – i.e. in (digital) social networks. Social Networked Industry stands for industry-oriented forms of social networks in which humans and cyber physical systems cooperate with each other (vertical networking).

- in which humans and machines communicate with each other within companies and with other companies – in a networked industry. So, Social Networked Industry stands for innovative forms of networking in which companies cooperate with other companies (horizontal networking).

What exactly does Social Networked Industry stand for?

The term Social Networked Industry is to show that Industry 4.0 should be seen as a socio-technical system. In a socio-technical system, humans and machines work together as parts of a whole – in this case in a network. The social (further) development of advanced process innovations and their sustainable inclusion in German working environments within production and logistics is one of the clear objectives for Social Networked Industry. Interdisciplinary cooperation between engineering and social-sciences also plays a key role. This has resulted in the novel Social Networked Industry for Industry 4.0 which brings humans back into the focus of production and which makes full use of their specific (communication) capabilities.

A socio-technical system comprises a production unit that consists of interdependent technological, organisational and personnel subsystems. The technological subsystem restricts the scope of design of the other two subsystems. However, these also have their own autonomous characteristics based on occupational psychology, employment policy and organisation, which in turn retroact on the functionality of the technological subsystem.

BASED ON A DEFINITION FROM RICE (1963)
THE THREE DIMENSIONS OF SOCIAL NETWORKED INDUSTRY

The Human Dimension of Social Networked Industry –
the personnel subsystem.

Integrating humans in this system makes it even more complex and means different research disciplines from the fields of production technology and logistics as well as economics and sociology all have to be considered and interlinked. So far, many of these disciplines have been doing their own research in isolation or in small related groups. However, if we want to meet these new challenges successfully, an interdisciplinary approach will be needed – and the human factor will have to be at the focal point. Because of social developments and within prevailing social contexts, more and more people are becoming aware that the Human Dimension – and particularly its social factor of creative problem-solving skills – is inseparable from Industry 4.0.

The Machine Dimension of Social Networked Industry –
the technological subsystem.

Industry requirements for flexible systems, which enable structures to be changed quickly and simply, is leading to the dissolution of fixed processes at all levels of management, of responsibilities and competencies, and of sequences in production and logistics. This dissolution of structures calls classic production types such as cyclic synchronised production into question and increases the demand for alternatives. It seems inevitable that we will have factories without fixed cycles and that we will move away from cycles and conveyor belts. Cyber physical systems (CPS) can make that possible. Today, the Machine Dimension is the most developed because of technological progress. CPS have already established themselves within industry, even if they are often isolated systems.

The Network Dimension of Social Networked Industry –
the value adding subsystem.

People work with machines – and will have to rethink. Companies work with other companies – and will also have to rethink! This is because in Social Networked Industry it is not only industrial production which is changing, but also the management in Industry 4.0 companies. Linear business models with linear value adding are not compatible with networked structures. In fact, it is more than that; new business models just have to take networking into account. The Network Dimension is one of the biggest challenges for Social Networked Industry because new structures and business models are repeatedly put to the test as technology progresses. Companies have to react flexibly and quickly in line with this.
Our conviction, which we have expressed in this vision of Social Networked Industry, is that:

- »Social Networked Industry is there to serve people.« The so-called automatic transparency prevalent in the networked industry – i.e. recording and exchanging information and automatic interaction between goods, relieves people of manual – and potentially error-prone – activities.

- »Social Networked Industry needs people.« They contribute the knowledge and experience which machines do not have: Industry 4.0 requires high levels of flexibility and communication skills. People have these abilities as a matter of course, even if they will have to be utilized differently in future.

- »Social Networked Industry has to prepare people.« It is extremely important that people are appropriately prepared for this new role in the era of Industry 4.0 and that people are trained for their tasks in the new working world. Tasks and professional profiles will change in a networked industry. IT expertise and IT security will play a more and more extensive role. And encouraging technical acceptance is another significant factor when taking on these new responsibilities.
In order to implement this vision of the Social Networked Industry, various fields of action have to be considered. Basically — and necessarily — this means topics and terminologies already known from the environment of Industry 4.0. The role people play in these fields of action has been neglected so far. The special thing about this approach is that it takes account of the three dimensions — the human, machine and network dimensions — for each field of action.

2. Management & Organisation

Industry 4.0 is leading to an increase in the networking of decentral machines, facilities, measurement points, intelligent packaging, gates and organisation units across all company levels and ideally along the entire supply chain. The unlimited exchange of information can only work if the background functions within companies are flexible and are not bound to department-centred activities. Top level management has to make it possible for technically feasible data exchange to take place within the organisation. That means it is necessary to remove obstructive department boundaries and to create new hierarchical and management structures that support unlimited data flow rather than hindering it. These technical developments can only unfold to the extent that organisational conditions permit and foster them.

3. Business models & innovation

The increasing modular implementation of objects with responsibility for decentral processes makes it possible to reduce the central control authorities along the supply chains. In this concept, smart products and processes mostly control the material flow by themselves which leads to an increase in transparency and flexibility. Taking advantage of this paradigm shift now will help to apply this new flexibility of material flows to new business models that have a particular focus on the individual requirements of the customer. The technology makes it possible to open and utilize new markets with existing or new products.

4. Resource efficiency and energy

The rapid growth of technological change in the context of the third industrial revolution resulted from globalisation and the growing complexity of the environment that went along
with it. This led to a fundamentally different perception of
time and space in society and to a change in consumer beha-
viour. On the one hand, change manifests itself in the increa-
sing differentiation of customer-oriented services and on the
other hand in increasing urbanisation, which in turn leads to
production facilities being relocated. As consequences of this
we see very high demand for resources, increasing environ-
ment and noise pollution caused by urban (logistics) traffic
and higher demands being made on company staff as well.
Accordingly, one of the significant features of Social Networ-
ked Industry is the conception of added value systems to
allocate resources more efficiently in company networks. In
future, technological developments and the networking this
leads to will offer better opportunities for energy-efficient
controls in production and distribution and – in terms of
resources efficiency – for reprocessing and creating cycles for
reusable materials.

5. Standards & norms

Digital networking between people and machines makes it
possible to implement integrated information flows of data
from within and outside the company as well as to create
horizontal links for inter-company resources and processes
and vertical links between the different hierarchical levels wi-
thin a company. One important component which is required
to reach this goal is the need to generate compatibility bet-
ween technologies and processes and to provide legal compli-
ance for their implementation by determining (de-facto) stan-
dards and norms.