Productive Teaming – a vision far beyond Industry 4.0

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Abstract — Automation is one of the pillars of our modern industrial societies. Without it, it would never been possible to even closely achieve our modern levels of productivity. However, this comes at a heavy price. Since the start of the industrial revolution – more than 100 years ago - automation forced human workers to fully adapt to processes and workflows of machines. We belief that the time is ripe for a fundamental revolution to change this fundamentally.
We envision a world, where machines can be augmented to team up with human workers' processes – to become a machine team mate. Machines will not longer just be "tools", don't need to be specifally, programmed, but can directly interact with humans on a problem solving level, adapt cognitively and socially to humans.

More precisely, the vision of productive teaming is to allow for a new generation of intelligent production systems, which dynamically form productive teams. Productive means in this context, that work efficiency and quality is increased. Teaming means in this context, that both partners - humans and machines - understand each other's processes, intentions and actions. So a productive team between machine and human would act on the level of interaction (almost) exactly the same way a human team would do. On the level of problem solving such a team outperforms previous human-machine production systems.

➢ The way to productive teaming

The goal of productive teaming requires an interdisciplinary approach. To achieve the mentioned goals, machines need to be first adaptive to and in the visible future even understand human thinking – in particular their informational or practical needs in the production process, desires, and goals. As a consequence, this will be an interdisciplinary challenge. It focuses on three main domains of knowledge:

- Cognitive sciences - for building models of action, intentions and goals of humans

How humans are making their decisions is focus of many projects in cognitive sciences. For productive teaming, this difficult problem has to be solved at least for the context of working in an industrial context.

- Artificial Intelligence – for engineering trustworthy decision algorithms

Artificial intelligence is making tremendous advances as an enabler technology in many domains. For productive teaming, AI methods must be developed, which are for humans trustworthy and are based on both – cognitive models of humans and process specifications of engineers.

- Intelligent sensorics - for acquiring live information and behavioral context

Intelligent sensorics are the basis for many digital improvements. For productive teaming, it will be necessary to design (multi-)sensor systems such that they are (mostly) transparent for humans and at the same time capable of gathering enough information in real-time, such that cognitive models of humans in productive environments can be derived

Each of these challenges is currently neither solved in general nor do we think the questions can be answered finally in the next years. However, restricting the problem space to work in industrial scenarios and production, we believe that solutions can and will be reached if a significant and excellent group of experts is brought together solving these challenges for the domain of production. We envision the results to be a spark for a whole new generation of socio-technical, which might influence the next decades of technical products and services.

➢ First steps

In mid 2022, a group of more than 25 interdisciplinary researchers – mostly from Technical University of Chemnitz (TUC), Otto-von-Guericke-University Magdeburg (OVGU), and Technical University of Illmenau (TUI) – committed themselves to the vision of productive teaming. We are convinced that this might be a lightning spark comparable to the "Agile Manifesto" in 2002. Thus, we invite researchers and collaborators from all over the world to join us making this vision come true.