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NEWS ITEM

Where is the human got to go? Artificial intelligence, machine learning, big data, digitalisation, and human–robot interaction in Industry 4.0 and 5.0

Review Comment on: Bauer, M. (2020). Preise kalkulieren mit KI-gestützter Onlineplattform BAM GmbH, Weiden, Bavaria, Germany

Joachim Vogt[1]

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Recently, Mr. Bauer (2020), CEO of BAM, a human resources service provider, reported about the introduction of a continuous change process using artificial intelligence. From this as a starting point, the article defines and discusses change processes, transformation management, and organisational development. The cudgels are taken up on behalf of the human-in-the-loop. It is argued, that the so-called "weak" artificial intelligence, including the human, is superior to the black box approach, hiding the system state as well as its dynamics from the user and deciding itself. Long-sightedness and employee orientation as well as open communication was the key in Industry 1.0 and it still is in Industry 5.0.

According to Janes, Prammer and Schulte-Derne (2001), change processes follow exclusively an external logic, and they happen rapidly, with disruptions, leaps and bounds. Information, analyses, and decisions are taken outside the organisation, if need be, against employees' interests and desires. Transformation management is not quite as strict. The organisation's own logic is combined with external logic. Partly and distinguished participation of employees in some phases is possible. Implementation, however, is enforced also against employees' interests and desires, if need be. Thus, in most organisations, change and transformation processes are kicked off in the truest sense of the word: often only a project, i.e., with a defined end, voted with feet, motivated by panic, imprudently, and hastily. Employees, therefore, frequently oppose the change (Kotter 1996) and this with good reason. Due to the crises already prevalent, bankruptcy, reduced working hours and wages, early retirement, and dismissals are to be expected in the new situation. As Menges and Bruch (2008) state, the way out is first to acknowledge the crisis and secondly to honestly and comprehensively communicate it.

Most recently, Industry 4.0 and 5.0 were considered possible solutions to overcome problems. However, artificial intelligence, machine learning, big data, digitalisation and internet of things (Industry 4.0) are overestimated by many politicians and CEOs, so is direct Human–Robot-Interaction with many degrees of freedom as the core innovation of Industry 5.0. The early robots were different from the Industry 5.0 robots in that the former had only few degrees of freedom and were often encapsulated to protect humans. 1951 saw the first robot as teleoperating arm to deal with radioactive material.

Communication in crisis is often down prioritised and thus insufficient (Menges and Bruch 2008). Many managers in their day-to-day operating salami swindle and postpone briefings of the workforce until they cannot conceal the obvious any more. Unfortunately, they sometimes even are educated to do so and exit, when the quarterly key performance indicators still are fine. Certainly, employees notice very early that things go wrong which in the past usually went right. Innovation must happen well before the crises to be effective.

Innovation (Vogt 2019) per definition is successful. Change-, restructuring- and transformation processes are not. 50–80% fail to attain their goals, even in the progressive

✉ Joachim Vogt
joachim.vogt@tu-darmstadt.de
https://www.arbing.psychologie.tu-darmstadt.de

[1] Work and Engineering Psychology Research Group (Forschungsgruppe Arbeits- und Ingenieurpsychologie), Department of Human Sciences, Darmstadt University of Technology, Alexanderstr. 10, 64283 Darmstadt, Germany

Scandinavian countries (see, as an example, Hovgesen 2008). The workforce often opposes as described above; frequently, this happens in secrecy; employees do not dare to speak out openly, for good reasons, as whistle-blowers often are prosecuted and fired (although they are precious drivers of change); some hardliner-managers delude and prejudice themselves by speaking of "taming of the shrew". Staff feels run over instead of being involved.

1932, after industrialisation, Elton Majo and team resumed the problems of their time, which still are prevalent today with respect to psychological stress at work due to poor leadership:

"…problems arise from people not having adjusted to industrialised society; the managers role is to help the employee adjust through a nursing attitude."

Elton Majo was in charge of the Hawthorne Studies. General Electrics in Hawthorne, USA, noticed ergonomic problems with production lines and piece-rate work. The Hawthorne Studies were launched with the goal to increase productivity by ergonomic improvements, for example, work place illumination. The most important result was, however, the discovery of the Hawthorne-Effect: No matter, whether light was optimised or worsened, employees continuously produced more relays and other electrical components. The reason was the continuous attention and appreciation of the experimenters. The utmost importance of leadership during change, i.e., employee-oriented management and open communication is also true today, a century later and in Industry 4.0 and 5.0. Inspired by Sigmund Freud Majo et al. coined the term „Industrial Psychiatry ".

Thomas Frick (2020) described Industry 1.0 as the introduction of mass production, starting around 1800 and lasting about one century. The following Industry 2.0 contained the development of production lines and piece-rate work, the motivation for the Hawthorne-Studies. Industry 3.0 was the introduction of the first functional computer Z3 by Konrad Ernst Otto Zuse in 1941. Industry 4.0 saw fully atomized productions, supply chains, and mobility processes in the IoT "Internet of Things", for example, smart homes with their privacy, safety, and security problems (Zimmermann et al. 2019). Finally, Industry 5.0 develops increasingly effective and satisfying direct Human–Robot-Interactions, Artificial Intelligence, and Machine Learning.

Not only psychiatric diseases as discovered firstly by Majo and team, also other health problems accompany the change and transformation processes in all Industries x.0. Thomson and Michel (2018) summarise the impact of change- and transformation processes on health as: delays in sleeping in, no sleeping through the night, quality impairments of sleep; increased stress experience; cardiovascular problems; psychopharmaceutic and other medication use, overdosing, and misuse for enhancement; smoking and alcohol misuse; musculoskeletal complaints; doubling of granted disability pensions; inability of unwinding after work.

As Kotter (1996) stated, humans are resistant to change, at work and also in private life. We often talk about "good old times" and wish them back. Unions insist on acquired rights and social achievements. Although we know, certain behaviour is very unhealthy, we have difficulties in crossing the river Rubicon. Despite better knowledge, we go on smoking, eat unhealthily, and miss physical exercise. The steps from knowing and wanting to behave healthy, do and routinise it, often fail.

Engineers and computer scientists have difficulties in realising, understanding, and accepting human inconsistency. Psychologists are necessary, to explain to them the different and changing needs and social contexts, making humans behave these ways. Also, in IT use, we find such paradoxes. Prominent example is the Privacy Paradox, i.e. users stating to prioritise data protection and privacy in surveys, while at another occasion they share pictures, recension, and comments in social media (Schürmann et al. 2020). Moreover, despite security concerns, many use weak authentication, as they fear to forget passwords (Zimmermann et al. 2019). Most employees do not use computer generated passwords, although these are safer. Letting staff set their own information security goals is a good improvement measure, since this participation is effective via increased motivation and welcomed by employees (Mayer et al. 2017). Participation is the key in general change and in IT development especially.

Transformation and change management mostly have project organisation, i.e., they have a defined start and end. In crisis, most employees are overloaded and scared stiff, among others, because the change was not strategically planned, early communicated, explained, and motivated. The workforce thus has neither the capacity nor the nerve for change. Negative emotions are induced, they prevail and persist; only authentic, open, democratic, employee- and health-oriented leadership is able to heal this (Menges and Bruch 2008). Since democratic and employee-oriented leadership requires time, it must start well ahead the crisis.

Humans are smart—irrespective of the doubt's engineers in general and computer scientists in particular have facing the attitude–behaviour discrepancies. People realise dead ends of their organisation and cleverly find work-arounds. Only exceptionally, like in BAM, the organisation's leaders are long-sighted internal stakeholders. Very often, shareholders or change managers from outside decide and frequently offend staff sensibilities. At this stage, the workforce has suffered a long time from the lack of leadership and strategy. Many employees developed interventive, preventive, and innovative ideas to change for the better, yet they weren't heard. Change managers are mostly educated and trained to firstly reduce fix costs rapidly and massively,

which often means firing people. Dismissals are considered the method of choice to increase shares. However, as one-fits-all they are false, short-term friends, as the fundamental problems persist, and waves of termination notices do not solve them.

The only ways out of the dead-end point backwards or bottom-up. Backwards might be an option, for employees and the public: bottom-up back to the roots and the core business. In most cases, for managers, it is a no go. Too embarrassing is the acknowledgement of failure.

The bottom-up approach needs unconventional management. For example, General Electrics introduced the reputational "Work-Out" programme to overcome organisational bureaucracy by inviting employees and managers from different levels and functions of the organisation to discuss and solve problems in unconventional ways. This programme has been very successful (Ulrich et al., 2002, as quoted in Zhou et al., 2019). In addition, Strøbæk and Vogt (2013) demonstrated for the example of the reorganisation of civil registry offices, how crises can be successfully transformed into chances.

Unlike these examples, transformation management and change processes are usually designed as projects with less staff participation. They have a start (acknowledgement of the crisis) and they have an end. The end often is a bankruptcy, sometimes a consumed project budget, and rarely a sustainable solution. In better times, most managers and employees as well usually see no need for enhancements. At many universities, they are trimmed for the short-term key performance indicators, the quarterly results. "Never change a proven system" is the conservative motto. However, the system has only proven successful in the past, maybe it is still functioning in the present. Mastering the future, certainly, is another matter, because it requires continuous change and innovation in a line-process organisation. Nothing but change is for sure (Heraklit, ca. 500 B.C.). Initiating change as a response to a recently acknowledged crisis is far too late. This is only intervention, not prevention, and much less innovation (Vogt, 2019).

Artificial intelligence, machine learning, internet-of-things, Big Data (Industry 4.0) and direct human–robot-interaction (Industry 5.0) each at their times emerged as solutions. They all had teething troubles and some still have. Many of these approaches are not yet fully mature. It may be questioned, whether they ever will be, as the event space is infinite. Actual software like, for example, automation algorithms, reinforcement and deep learning, as well as hardware will never ever cover infinite event spaces. Quantum computing, which might have sufficient computing capacity, is still very far from everyday professional not to speak private use. There were many cases brutally grounding us to our limitations: a fully automated robot taxi did not detect a female cyclist who crossed the road pushing her bike outside a crossing; this event was not represented in the event space memory of the software; the cyclist died (ingenieur.de—2018). We have to bemoan two total aircraft losses (Hamby 2020). In the 1980s, a car manufacturer brought a new motor and automatic gearbox onto the marked; a kick-down was amplified by the system ("unleashed motor"); this was literally a kick in the back for many drivers; intuitively, they conducted an emergency brake with hot brakes and outbreaking cars; there were casualties, some fatal (Roedinger 2014).

AI, which is understandable and manageable by humans, which functions in very narrow event spaces, and solves clearly defined tasks, is called "weak AI" by computer scientists. However, the human "in the loop" definitely is a strength, as it fosters cooperation of man and machine, it survives degraded modes in case of equipment failure (Vogt and Kastner 2002) and enables ethical decisions (by the human)."Black Box AI", offering no insight and no control, unfortunately is considered the desirable solution by many politicians and most computer scientists, as they have difficulties in understanding and accepting human inconsistent behaviour. A fatal misconception, as above examples show. The aircraft crashes most probably had not occurred, if pilot and co-pilot had been familiarised with the problem which emerged from faulty sensors and subsequent adverse AI decisions. Authorities, airlines, and the manufacturer failed to immediately react and ground all aircraft of that type for further inspection. Data of the right-wing sensor in comparison with the left-wing sensor could have shown that a technical component, in this case the left-wing sensor, failed. A hold-to-run control button, immediately setting the AI-autopilot on hold and handing back the manual control to the pilots, could have prevented the disaster.

Manuals of unleashed motors must contain a warning information (what will happen?) and instruction (what is to be done?) for the drivers to overcome the intuition of an emergency break. Contra-intuitively running idle or interval breaking are the methods of choice in such situations. Machine learning should be used to teach the software, who is a dynamic driver and likes the unleashed motor and who is not. For the latter, not using unleashing for a longer time, the driving assistant should unlearn the automatic increase in acceleration.

Organisational development can and must be a continuous process in the line-organisation of the company. Bauer and BAM are role models for this approach. Participation of all stakeholder is mandatory. Especially employees, customers, but also communities and stakeholders beyond must be involved. Sense of Community (SOC) and Corporate Social Responsibility (CSR) are concepts to be applied. To achieve this, a bunch of measures is necessary, emerging both, bottom-up and top-down. Leadership and communication play key roles. Any single instrument will fall short

of expectations. However, as an example-tool among many others, the Balanced Scorecard (BSc) is recommended. It is well known among managers. It can be designed to consider all relevant stakeholders, especially employees (bottom-up) and leaders (top-down), as well as their communication. The BSc defines targets and indicators from four perspectives: first, potentials, e.g., know-how and patents (Pennig 2008); second, processes like production or maintaining, but also health-oriented leadership (Fröhlich et al. 2012); and third, the stakeholders are considered like, for example, customers, employees, and the public (SOC, CSR). Finally, the results of all prior perspectives and their interactions are monitored on the success level, where earnings before interests and taxes (ebit), but also quality of products and services are measured (Keil et al. 2016; Vogt and Nunes 2014). Since employees, customers, and other stakeholders are participating in the BSc development, they all pull together in one direction, namely according to the strategy they all had agreed upon. Nobody breaks out, nobody counter acts. The resistance Kotter (1996) predicted is prevented.

Via optimising potentials, processes, and stakeholder satisfaction, success is achieved. Safety and health of employees, customers, and the public must be involved in the BSc development. Health- and Safety-BScs can be defined like business BScs. They all can be networked by the success indicators, which are all the same for all undertakings. Docking any new BSc and networking them all is easy via the success level, which has corporate key performance indicators for all BScs. The development of a Safety-BSc is described by Vogt (2010). At the time of this publication, human safety, as product user or plant neighbour, was not discovered as a legitimate index on the Safety-BSc. As Zimmermann et al. (2017 or 2018) showed, it should be on the agenda, to develop the public value of a company. Starting point of a Health-BSc is a health strategy. Potentials are the education, qualification, and availability of occupational safety and health staff. Workplace health promotion and leadership are, for example, processes to be considered on this BSc level. Stakeholders here are the employees (Eckert et al. 2014; Schneider et al. 2014; Keil and Vogt 2012). Success manifests, for example, in reduced sick leave days. Good potentials and processes correlate also with sustainability (CSR), SOC, safety, product- (Keil et al. 2016), and service quality (Vogt and Nunes 2014). This is desirable for all of us.

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