



# Closing Words: Quo vadis Manufacturing 4.0

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How should we understand and explain the fundamental changes that take place in the manufacturing industry, when the ways of manufacturing change—advanced robots and other types of automation replace human workers, and advanced analytics are used to optimize and control what autonomous machines are doing? Are we in the early phase of the transformation or have we already passed the turning point where there is no turning back? These questions are troubling scholars, policy makers, and business managers. Nobody seems to have a clear vision of future and the confusion affects industrial, technology, economic, and social policy-making not only in Finland, but also in Europe and beyond.

This book takes a multidisciplinary approach to the complex issue that is Manufacturing 4.0—multidisciplinarity is something that the “original Industry 4.0” vision was full of, we must remember that it was a holistic vision of where the society is going as a whole. It is not an easy task to combine technical, economic and social aspects of Manufacturing in a scientifically credible narrative—there are too many contradictions and uncertainties. There are also too many positive expectations and promises

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of technological advances and still relatively few concrete solutions to point at. And yet, nobody can deny the ongoing technological revolution that is changing the industrial and economic landscapes. Modern industrial and post-industrial societies are affected by radical new technologies even before they are fully implemented to and adopted by the industry.

This book reveals at least four important messages. First, Manufacturing 4.0 is today a predominantly technological issue and in that it is not one-sided—both the methods and materials of manufacturing are experiencing profound changes with additive manufacturing changing the way structures can be constructed, and new advanced materials are becoming available to be exploited in the future. When automation of industry, advanced robotics, and digitalization of manufacturing information are added to this mix, what can be seen is a complex multi-level transformation, a revolution, in how industrial systems are changing.

Second, the changes happening in the technologies propel changes in the business models that companies use—these in turn cause a shift in the architecture of businesses in the field of manufacturing to become more networked in those niches, where the networked architecture is more competitive than the traditional “factory”. We are still taking the initial steps of this revolution from the point of view of business architectures, but history tells us that evolution of how business is being conducted carries a strong resemblance to natural evolution—the strong and the competitive will survive, while the weak perish. When business architecture needs start forcing changes in the development of technology and new technologies in manufacturing that carry great business-power emerge, then the speed of change will most likely pick up.

Third, Manufacturing 4.0 is also a social “program” that must try to tame the otherwise chaotic future that will be caused by the technological change. The Fourth Industrial Revolution continues on the evolution path that started more than two centuries ago. Industrial societies have adapted to the radical technological changes and created social and economic structures, which are flexible and resilient. Radical technologies of Manufacturing 4.0 challenge the current social and economic structures and promise futures, which are more efficient, more productive, and perhaps also more sustainable. Technology changes society, but technology is simultaneously changed by changes in the society. As this book points out, a likely outcome of this interaction is not a purely technologically deterministic future, but a “new society”, which still carries forward sturdy structures from the past industrial revolutions, but also exhibits new structures, which force societies to make difficult policy decisions.

Fourth, Manufacturing 4.0 is a political program that tries to derail the current industrial path that for the past decades has concentrated on the manufacturing industries in the low-cost developing countries. Manufacturing 4.0 builds on an age-old scientific and technological tradition, which is the cornerstone of Western culture and seems to promise to bring the manufacturing industry back to the developing world in a new transformed form and to anew create a competitive edge for industry-based business, in what we now think of as post-industrial societies. In order for manufacturing to make a come-back to the Western world the society must provide it “food and nourishment” in terms of not only “allowing” this change to happen, but also by way of supporting it by providing a workforce with a relevant know-how and by adjusting how the society works.

It remains to be seen how massive the actual societal changes driven by the Industry 4.0 and Manufacturing 4.0 are—most likely we can understand it only after decades from today. Whether the fabric of the societies is flexible and able to withstand the changes, or whether the fabric will break and cause chaos is also an open question. What remains to be said here is that the only sure constant is change itself.

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