THE EMERGENCE OF THE FOURTH INDUSTRIAL REVOLUTION

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An Historical Introduction to Knowledge Management and the Innovation Economy

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Contents

Preface

In this book we use the constructs such as innovation economy, knowledge society and knowledge economy representing the same phenomenon, the emergence of the fourth industrial revolution.

This book is divided into five chapters.

In Chapter 1 we look at the following problem: it is difficult to identify wealth-creation processes in the knowledge economy because our way of thinking is so strongly rooted in the industrial economy. The question discussed in Chapter 1 is: what wealth-creation processes are driving the knowledge society? The knowledge society is the prelude to the fourth industrial revolution. If we can answer this question, we can say something about the emergence of the fourth industrial revolution. The objective of Chapter 1 is to develop an analytical model capable of explaining various aspects of globalization and the knowledge society. The finding in Chapter 1 is an analytical model that shows drivers towards the fourth industrial revolution:

- Three drivers for the technology;
- Two drivers for new organizational logic.
- Two drivers for new collaborative networks.
- Five drivers for the knowledge worker's performance.

In Chapter 2 we investigate the following problem: we know little about how robots, informats and infostructure will affect wealth-creation processes in the knowledge society.

The question we examine is: what factors will promote technological innovations in the knowledge society? The objective of Chapter 2 is to develop policies to ensure a continued rise in living standards in the knowledge society. The findings in Chapter 2 are four categories and 15 factors that will promote technological innovations in the knowledge society.

The problem raised in Chapter 3 is: innovation leads to economic, social and political crises. The question examined in Chapter 3 is: how are new ways of organizing work affecting value-creation processes in the knowledge society? The objective is to conceptualize factors that affect value-creation processes in the knowledge economy. The findings in Chapter 3 are three main categories of drivers of value-creation processes in the knowledge society, together with 15 types of drivers for each category.

In Chapter 4 we investigate the following problem: the knowledge economy is changing the ways in which we are accustomed to co-operating. The question examined is: which new structures for cooperation are affecting the development of value-creation processes in the knowledge economy? The objective of Chapter 4 is to develop concepts and models that will enable us to better

understand and exploit the new global division of labour which is driven by the knowledge economy, so that value creation is promoted.

The findings in Chapter 4 can be stated like this: value-creation processes are influenced by four sub-systems and three primary processes. In addition, in each of the various nations, the state plays a decisive role in promoting processes of innovation.

The problem examined in Chapter 5 is that the number of knowledge workers continues to grow, but we know little about what factors will promote knowledge workers' productivity.

The question investigated is: how can managers promote knowledge workers' productivity? The purpose of Chapter 5 is to develop aspects of a theory to promote knowledge workers' productivity. The findings in Chapter 5 are seven propositions (a mini-theory) for knowledge worker productivity.

Chapter 1

The Dominant Logic in the Emergence of the Fourth Industrial Revolution

Introduction

The knowledge society is a result of growth in education, new technology, faster and more wide-reaching dissemination of information and the globalization of the economy and political, cultural and human relations (Abd, 2017; Ford, 2016). Social systems in the knowledge society are under pressure from two directions: market forces and a demand for stronger control of financial capital (Antonelli, 2001; Janeway, 2018). The underlying causes of these two factors are increased individualization, neo-liberalism and the decline of collective solutions (Gupta, Habjan, & Tutek, 2016).

The rationality of the economic sub-system, that is, how one thinks about economic issues, seems to have invaded the cultural and political systems and to a large extent interpersonal relations (the 'collaborative system') (Baird & Henderson, 2001).

Governance structures as we know them have been developed to a large extent for the modern project, that is, industrialization. When industrial workers become technicians, whose job is to control robots based on computer technology, we see the emergence of a new type of governance and a new type of worker, and a new kind of organization, also in enterprises in traditional industries (Barrat, 2015).

Identity seems to diverge away from the collective, towards the development of the individual's own expertise and needs, based on the demands and expectations that new technology imposes regarding the development of new knowledge (see Bleuer, Bouri, & Mandada, 2017; Drucker, 1999a; Mataric, 2007). In such a situation, social contracts based on collective responsibility will become less significant (McGill, 2016).

Greater attention will be paid in this kind of context to the needs of the individual and to the individual him- or herself, whereas less attention to participation in, and commitment to, collective considerations (Brynjolfsson & McAfee, 2011). Although there will be more focus on the individual, this will not necessarily lead to greater respect for the individual (Sennett, 1999, 2009, 2013).

The industrial society was based on other values and norms than those that seem to predominate in the knowledge society (Brynjolfsson & McAfee, 2014). A key feature of the industrial society was the concept of fairness, which was

understood as the relatively equal distribution of material resources, equal access to cultural institutions, equal rights to participate in politics and a strong commitment to counter at every opportunity the distinction between master and servant (Bauman, 2013; Sennett, 2013; Standing, 2014a, 2014b). The concept of fairness was linked to a large extent to industrial workers. The identity of this group was linked to industrial workers as a whole, that is, the industrial working class. Differences came to be expressed as the conflict between labour and capital.

In the knowledge society, there is a significant possibility that this dichotomy will change, although it will continue to exist. Knowledge workers own their means of production, that is, their knowledge. Similarly, industrial workers own their manpower. Accordingly, both industrial and knowledge workers own the main factor that they contribute to the wealth-creation process. The difference is that one type of worker is linked to manual labour, while the other is linked to mental labour. Their identity will in all likelihood be different since knowledge workers do not identify themselves with a class of knowledge workers. They identify themselves with their own results, opportunities and expectations (Catmull, 2014; Charnock & Starosta, 2016).

In the knowledge society, we also see indicators that financial capital is becoming even more centralized at the global level (Charnock & Starosta, 2016). In the knowledge society, conflicts between labour and capital will in all likelihood not follow the same pattern as in the industrial society (Case, 2016; Piketty, 2014, 2016). While in the industrial society the concept of fairness was synonymous with collective attitudes and the downplaying of individual and private solutions, there is a great probability that the knowledge society will be characterized by basic norms that are almost the opposite (Brynjolfsson & Saunders, 2013; McGill, 2016).

A significant challenge in the knowledge society will be to link treating other people with respect, responsibility and dignity to the collective solutions that naturally form much of the foundation for the individual's possibilities for self-development (Chomsky, 2012; Sennett, 1999, 2009). This may be understood as meaning that there will be more focus on meaning and existential innovations in the future.

Another challenge will be to integrate global knowledge capital in such a way that a global competence network can be developed and used by individuals. At the same time, it will be necessary to develop mechanisms that can balance financial capital, so that it promotes wealth creation for social systems and does not trigger economic crises (Dickinson, 2016; Johannessen, 2016). If financial capital operates within short-term horizons, it may damage the development of competence within specific national borders and promote undesirable social consequences (Coates & Morrison, 2016; Locke & Wellhausen, 2015).

The geographical impact area of the knowledge society is the global economy. Accordingly, the problem of globalization is crucial to the understanding of the knowledge society (Christensen, 2016). Globalization has been demonstrated in several empirical sources through growth in multinational businesses, growth in world trade, growth in foreign investment, new international division

of labour, increased mobility of cross-border capital, increased international competition and the trend towards a single integrated world market (Christensen, 2010).

Equally important factors for the development of globalization are the existence, however, of a serviceable infrastructure and a serviceable infostructure (Miller, 1978). Infrastructure is crucial for the transport of goods and energy. Infostructure is important for information, communication and knowledge processes. A serviceable infostructure will contribute, among other things, to reduce the significance of distance and borders. This applies to geographical, psychological, cultural and social distances and borders. Accordingly, the infostructure will have a direct impact on transactions within and between organizations. Through the impact of transaction costs, the infostructure will also affect the structuring of activities within and between organizations (Christensen & Raynor, 2003).

The debate about globalization is along two main axes. First, there is a debate about whether globalization can be explained by one factor or by many, and, in the latter case, which of these many factors should be seen as most important. Second, the debate is about the extent to which the consequences of globalization are positive or negative (Evans & Schmalensee, 2016). For example, if one considers globalization in the light of trade and the economy, the most important factor is the system of supply and demand, that is, the market. (Gans, 2016). In addition, there are various ways in which one may consider the market. The point we are making here is that one's basic viewpoint, perspective and approach may vary from person to person and from system to system. Considering the situation in the light of geopolitical considerations may highlight completely different consequences of globalization than if one were to approach the situation from, for example, a cultural or political viewpoint. Thus different viewpoints, perspectives and approaches reveal different aspects of globalization and make it possible to have a greater understanding of this phenomenon (Gaskarth, 2015; Janeway, 2018).

The problem we are investigating is as follows: what wealth-creation processes are driving forces in the knowledge society?

We have broken down this question into four sub-questions.

Question 1: How is new technology a driving force of the knowledge society?
Question 2: How is new organizational logic a driving force of the knowledge society?
Question 3: How are new structures of collaboration a driving force of the knowledge society?
Question 4: How is the performance of knowledge workers a driving force of the knowledge society?

Figure 1 summarizes the introduction to this chapter. It also shows how the chapter is structured.

This chapter is structured as follows. First, we provide a historical overview of the transition from an industrial society to a knowledge society. Next, we

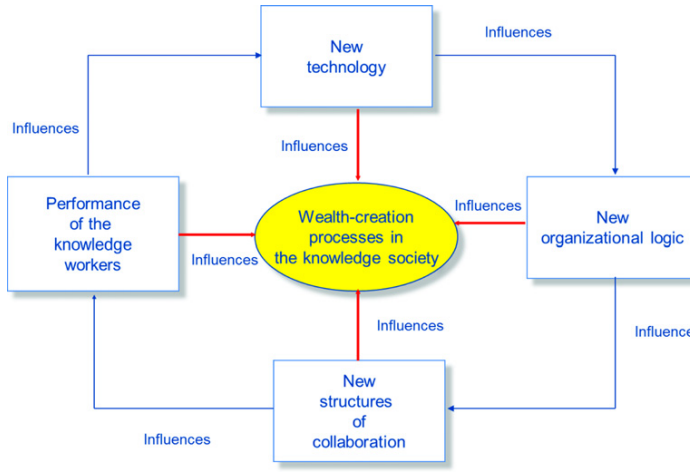

Figure 1. Wealth-creation Processes in the Knowledge Society.

describe the various driving forces of the knowledge society. Thereafter, we analyze these driving forces, which are as follows: new technology, new organizational logic, new structures of collaboration and knowledge workers' productivity. Finally, we discuss these driving forces in relation to wealth-creation processes in the knowledge society.

A Historical Introduction to the Knowledge Society

The knowledge society is a natural continuation of the industrial society, as represented by the technological revolution which is mainly comprised of the use of information and communication technology (ICT) and robots (Abd, 2017; Ford, 2016). Established and new enterprises have positioned themselves around this new technology with a focus on innovation (Christensen & Raynor, 2003).

In the global economy, costs have come under pressure and profits are expected to be very high for those enterprises that have survived the extreme competition (Gershuny & Fisher, 2014). Innovations create an imbalance in the economic system, which attracts both entrepreneurs and capital (Garza, 2013). This further reinforces the imbalance in the economy, and a type of creative destruction occurs where the old is destroyed and the new is created (Goodman, 2015). The creative processes in the knowledge economy are driven by visions and expectations of creating that which is new (Johannessen, 2016). Consequently, social systems are greatly changed as a result of these processes. Social earthquakes occur at both the local level of the individual and globally for larger groups of people (Mason, 2015).

If we view the recent development of ICT in a historical context as part of a larger evolution of information, we can trace roots back to the development of the art of writing in Mesopotamia, Mesoamerica, China and ancient Greece.

The exact dating is not entirely clear, but between 4000 BCE and 500 BCE, there occurred a transition to the art of writing in various places around the world (Havelock, 1982). The discovery of the art of writing enabled the transition from the oral tradition of stories and myths to written forms of communication. Further developments can be traced to the introduction of the printing press in the fifteenth century.

ICT viewed in the context of these developments enables the globalization of the writing culture, where verbal, visual and written expressions merge into one system (Williams, 1988). This will inevitably affect the global culture (McLuhan & Powers, 1989; Monbiot, 2016), and how we organize the production, distribution and consumption of goods and services. The organization of work will also be affected by these new technological developments.

Figure 2 shows an overview of the dominant logics in the various historical epochs.

The writing culture evolved with the creation of alphabets. The radio and television media may be said to have represented a renaissance for the spoken word. However, the new ICT may be said to represent a renaissance for the written language, although it also integrates oral and written language, and images in new and different ways.

The introduction of letterpress printing had the greatest impact on those who held the greatest power at the time, namely the Church. The importance of the new printing press technology for the Protestant Reformation cannot be underestimated. Furthermore, these developments coincided with the 'Age of Discovery', when European sailors charted extensive areas of the globe to an extent previously unknown. The new sea routes to India and China and the 'discovery' of America were in part due to access to information made possible by

EPOCHS	PERIOD	DRIVING FORCES	DOMINATING LOGIC	SOCIAL CONSEQUENCES
Mercantilism (Trade-capitalism)	c. 1500–1800	Transport	Logic of trade	Integration
Industrialization (Industrial-capitalism)	c. 1750–1970/90	Machines	Logic of production	Centralization
Knowledge society (Information-capitalism)	c. 1990–	ICT	Logic of information, communication and networks	Inclusion and exclusion

Figure 2. The Dominant Logics in the Various Historical Epochs.

the new printing presses (McLuhan, 1964). The printers were the 'IT specialists' of the day. Similarly, education was made possible on a completely different scale than previously, which had huge consequences for the exploitation of the human intellect. After a period of time printing costs were reduced, not unlike how the prices of computers fell sharply from their introduction in the 1950s up until today. More and more people had the opportunity to buy books. Eventually, the focus turned away from the actual aspects of the letterpress printing craft towards aspects of information and the creation of meaning in society. The monopoly on knowledge, held to a great extent by the Church, was gradually broken down.

One consequence of the information revolution (since 1950) is that the focus is now turning away from the technological aspects of ICT and focusing more on the information and communication aspects. ICT enables the availability of information in completely different ways than before. The new means of communication enable greater interaction between people, and new organizational and collaborative ways are being developed (Brynjolfsson & Saunders, 2013).

The integration of oral and written language and visual imagery does not necessarily follow McLuhan's rhetorical assumption that 'the medium is the message' (McLuhan, 1964). On the contrary, today one can imagine that different messages choose different media, that is, the message selects its medium. This may be viewed as a return to the importance of classical rhetoric, namely oratory.

The TV medium largely promotes associative, emotional and rhetorical elements of communication. Email is used extensively as an informative medium. The telephone is used largely as an interactive media and the book may be said to be a reflective medium (Postman, 1985).

A future integration of ICT in a global and freely accessible multimedia system will result in the message being the master over the medium. This will result in human reflection with the whole of its affective register and rhetorical aspects coming into focus, which is not the case with today's 'entertainment technology'. In such a new situation, the technology will be the tool of the message rather than the other way around as suggested by McLuhan's (1964) 'the medium is the message'. One objection to such an idealization is that new technologies and especially the television media have largely been, and partly still determine, the agenda of the aspects of reality that people's attention are focused on (Catmull, 2014).

The new ICT will segment social systems in relation to various global networks. This will occur because specialized information will categorize people in relation to current prevailing cultural values and because different ideologies characterize different political groupings. Further, the needs for closeness and relationships, and not least local economic conditions, will have an impact (Coates & Morrison, 2016). However, one should not underestimate the interests of big capital and their need to control the new technology, and perhaps especially the television media because it is instrumental in shaping people's focus on certain aspects of the world (Ellul, 1964).

The Internet was, and still is to some extent, a state-driven innovation, and this has developed into a technology that has freed the creation of meaning on a global scale. The Internet originated from Arpanet, which was basically a military invention. After a period of time, it was used as a means of communication by scientists. With the advent of personal computers (and the reduction in cost of these) along with the use of modems in conjunction with regular telephone lines for data transmission, the Internet gradually became accessible to the general public (Rheinhold, 1993).

The development of the new ICT and laptop PCs, where the telephone and computer are integrated systems with intelligent network features, will affect our collaborative and organizational structures. The telephone, which revolutionized contemporary communication, maintained and reinforced social relationships (Fisher, 1992). Similarly, it can also be imagined that the new ICT will reinforce established social relationships, and help to maintain existing social structures rather than bring about changes to social structures to any significant degree.

Explanation of the Driving Forces in the Knowledge Society

Globalization has many aspects, one of which is the expansion of free trade (Harvey, 2007). Another is the emergence of new spheres of knowledge (Lima, 2017). One way of viewing the expansion of free trade and the development of new knowledge is that our analytical models based on the nation-state are undergoing change (Bauman, 1992, p. 65; OECD, 2014). Marr (1995) proposes that the deregulation of the money market during the 1980s accelerated globalization because it ended national autonomy. However, Hirst (1993) and Hutton (1995) take a different view; they see the expanding market as an important driving force in the development of globalization.

Castells (1996, pp. 21–23) lists four critical factors for success in the global economy:

(1) the degree of technological capacity in the production structure;
(2) access to large expanding markets;
(3) the difference between production costs[1] at the production site and market prices at the destination; and
(4) political strategy, that is, strategic ability to integrate technology, costs and market.

It is our view that the interaction between the four elements – new technology, a new organizational logic, new structures of collaboration and knowledge

[1]Included in the concept of production costs are labour costs, taxes, duties, land rent and capital, etc.

workers'[2] performance – that promotes wealth creation in the knowledge economy, and constitutes strong forces in globalization. We find support for this view in the study by Noonan and Nadkarny (2016), Abd (2017), Drucker (1999a, 1999b) and Brynjolfsson and McAfee (2014).

Expertise in the knowledge society is a significant factor in the production process (Boisot, 1998; Case, 2016). This expertise is largely rooted in global networks (Brynjolfsson & Saunders, 2013; Shapro & Varian, 1999) in which there is a greater focus on core processes and expertise than previously (Catmull, 2014; Coyle, 1998). The control of the development, exchange and integration of knowledge is, as a result, a central management mechanism for wealth-creation processes in the knowledge economy (Charnock & Starosta, 2016).

In the industrial society, control and management was exercised using hierarchical structures, regulations, bureaucracy and clear functional areas. However, in the knowledge society, with its global information and communications structures, it is difficult to use this control and management mode due to increased complexity, greater turbulence and more ambiguity (Petras & Veltmeyer, 2001; Smil, 2012).

However, at the end of the twentieth century and the beginning of the twenty-first century, we have seen a new type of technology that is changing the economic landscape. Stability and predictability, which the industrial society had created despite all its turbulence, has been replaced by greater uncertainty, less predictability, greater ambiguity and complexity, and demands for progressively more information and knowledge to cope with these new processes (Kelly & Allison, 1999; Roat, 2016).

The industrial society had gradually acquired balancing mechanisms that were established between nations, often as the result of economic, political, social and cultural crises. However, the knowledge society still lacks such balancing mechanisms in the context of governance. This problem of 'balance' exists today both on the national and global levels (Pilger, 2016; Reinert & Rogoff, 2009).

Consequently, there is a lack of basic values, regulations and balancing mechanisms, or they have not gained acceptance in relation to the prevailing norms and values. The importance of establishing such balancing mechanisms has been underlined by Soros (1998), one of the foremost exponents of global capital; he expresses that such mechanisms should be introduced to avoid excessive damage to the various social systems.

While globalization progresses, there are also other parallel developments, such as the fragmentation of nations into smaller, integrated areas[3] on the one hand, and regional integration on the other, such as the EU. Similar dual

[2]The term knowledge worker covers 'people whose occupations deal with the production and distribution of symbolic knowledge'.

[3]The split of Czechoslovakia into the Czech Republic and Slovakia; Yugoslavia split into 6–7 new countries; in Canada, Quebec proposes greater autonomy; autonomist movements in Italy involving the north and south; conflicts in Spain regarding the Basques and the Catalans; Flanders in Belgium wish to be more independent, and so on and the dissolution of the Soviet Union into many independent states.