

# COEVOLUTION OF TECHNOLOGY, BUSINESS AND SOCIETY

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## ABSTRACT

Social changes created during technological paradigm shifts in the past are reviewed with a view to establishing patterns of changes that can help in forecasting the social change that are likely to follow the current technological revolution.

*Keywords: Coevolution, Complexity, Emergence, Selforganisation.*

## 1 INTRODUCTION

Society invests into entrepreneurs and inventors who create new technology, which, in turn, induces structural changes into economy by creating demand for new jobs that require new skills, and in the process, destroying the old employment opportunities.

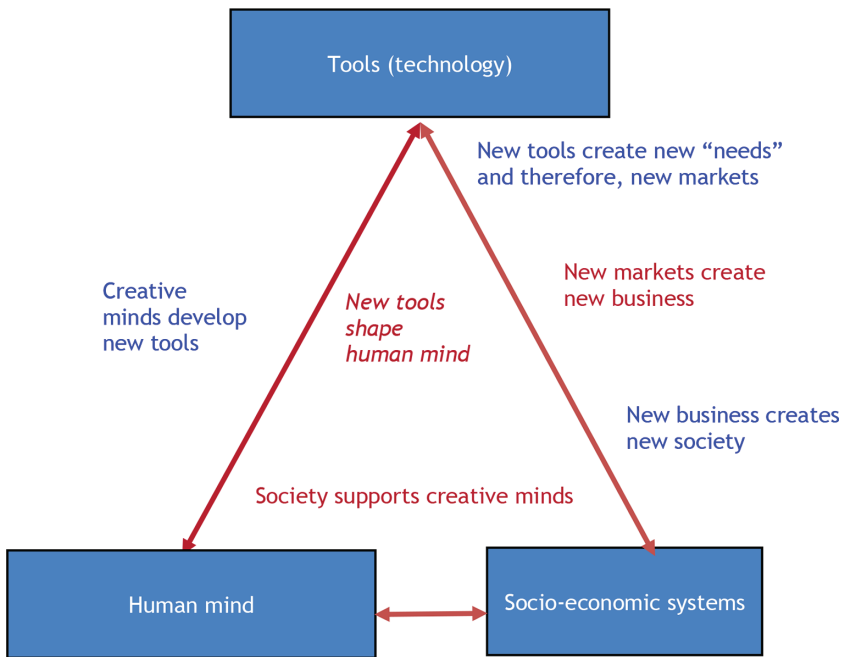


Figure 1: Interplay of creativity, technology and society.

## 2 COEVOLUTION: MAJOR STAGES

Historically, complexity of social systems increased in three very large steps, driven by the advances in technology, as depicted in Table 1. At each step, the impact on the way we lived and worked was dramatic – leading entrepreneurs and members of society who acquired new skills emerged as the new social elite.

Table 1: Coevolution of technology, business and society.

<b>STAGES</b>	<b>KEY RESOURCES</b>	<b>DISTRIBUTION</b>	<b>SCOPE</b>	<b>SUCCESS FACTORS</b>
Information Society Knowledge-based services Digital technology	Knowledge	Digital Networks	Global	Adaptability
Industrial Society Production of goods Mass-production technology	Capital	Railways Motorways	National	Economy of Scale
Agricultural Society Production of food Agricultural technology	Land	Local Roads	Local	Economy of scale
Hunter-gatherers Hunting for food Simple tools	Personal skills	None	Tribal	Teamwork

Perhaps the most dramatic structural social changes occurred during the transition from the *Society of Hunter-Gatherers* to the *Agricultural Society*, when the new technology for cultivating large fields enabled Homo Sapience to settle down into permanent rural communities. In the process, society changed from a large number of small groups of equals, continuously on the move, to a rich elite of landowners and a huge army of poor agricultural workers in permanent settlements.

The ownership of *Land* became the key class distinction, and the gap between rich and poor reached unprecedented levels [1].

During the transition from the *Agricultural Society* to the *Industrial Society* the rapid migration of the population from the countryside to the cities, to take advantage of new employment opportunities, increased the social connectivity in the densely populated cities and, as a result, raised the level of social complexity. The massive movement of population caused well-documented disturbances as a rigid, traditional social order based on land ownership was replaced by a chaotic transition, which then settled into a new social order based on ownership of *Capital*. According to Arnold Toynbee [2] “the essence of the Industrial Revolution” was “the substitution of competition for the medieval regulations which had previously controlled the production and distribution of wealth”. And, “the *Wealth of Nations* and the steam-engine...destroyed the old world and built a new one.”

Driven by the unprecedented advances in information technology (IT), the West is currently in the middle of the third significant socio-technological revolution, the transition from *Industrial Society*, dominated by trade in physical goods, to *Information Society*, characterised by widespread trading in knowledge-based services [3].

The rapid expansion of information technology is currently producing an unprecedented increase in complexity of markets [4], a drastic shift in employment opportunities and will, in time, bring important social changes. The research reported here was set to investigate direction of these changes.

In economic terms, the change is dramatic. *Knowledge* is replacing *Capital* as the main business resource [5]. The UK is a good example; whilst after the Second World War

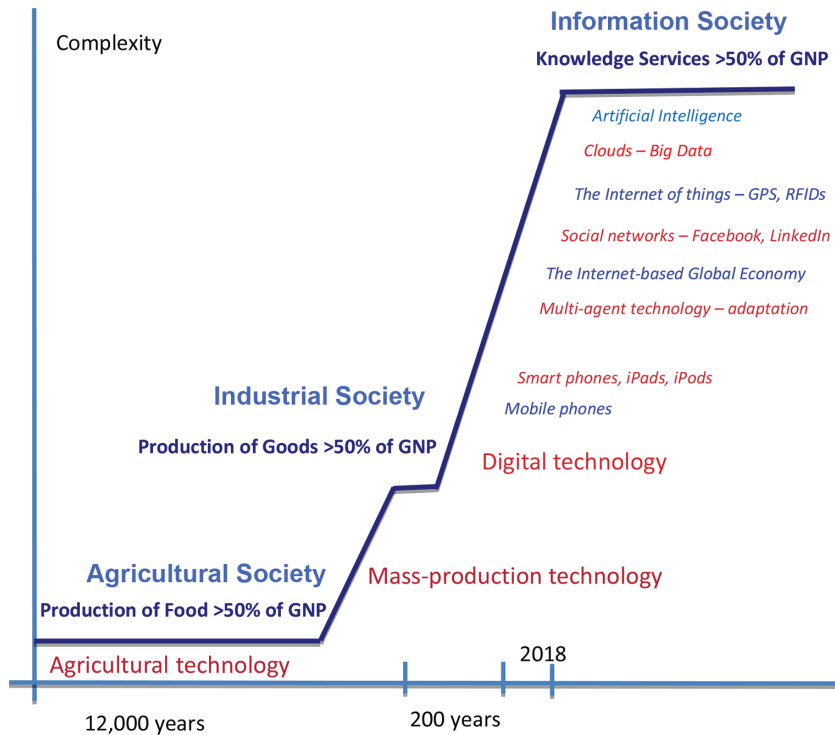


Figure 2: Complexity of technology, business and society increases at every mayor paradigm shift.

manufacturing generated around 50% of the UK GDP, its current contribution is below 15%. At present, the prime wealth generating engine is the service sector, which contributes over 75% to the UK GDP [6].

The US is leading the West into a brave new world of knowledge economy, as is evidenced by the new business elite – Apple, Google, Amazon, Facebook, YouTube and Twitter, which have pushed the car and oil giants (remnants from the industrial era) onto the B list and have propelled IT pioneers, like Bill Gates, to the top of the rich list.

### 3 THE POWER OF DIGITAL TECHNOLOGY

#### 3.1 Phase 1 – Digital Computation

The early beginnings of digital technology focused on increasing computational power of computers. The leaders, companies such as IBM, built larger and larger mainframe computers.

#### 3.2 Phase 2 – Digital Communication

Then came a transitional period focused on developing networks of smaller computers, thus combining computation with communication. The new technology of servers and workstations enabled new, innovative companies, such as Sun Microsystems and Microsoft, to rise to the top, forcing the previous generation of leaders to rethink their strategy.

Later on, the second phase almost completely focused on digital communication technology. Apple achieved prominence by supplying consumers with advanced digital communication devices such as smart phones and tablets, and by offering services such as data streaming.

### 3.3 Phase 3 – Digital Intelligence

The new phase is all about artificial intelligence (AI). Advances in AI are leading to a steep increase in the number of autonomous robots and driverless vehicles capable of performing better the tasks previously performed by human operators.

Much more importantly, intelligent software, capable of performing clerical, professional and managerial tasks more effectively than humans, will take over from human decision makers leaving them free to take up new, previously unknown, employment opportunities.

## 4 NEW BUSINESS

Digital communication technology increased social and economic *connectivity* and, as a consequence, socio-economic *complexity* reached new levels.

The Internet-based global market has become highly complex with billions of individuals and millions of businesses engaged in setting up, modifying, and/or cancelling business transactions with each other at great speeds and without geographical constraints. The volatility and unpredictability of demand and supply began to affect businesses and by now, it is well understood that businesses must develop capability to rapidly *adapt* to any disruptive event generated by markets. And since the frequency of disruptions is high, the decisions related to adaptability must be performed with speeds with which human decision makers cannot cope.

It follows that business must replace a large number of human operational decision makers with AI.

### **How Market Complexity Affects Business**

- Unpredictable and volatile demand
- Ever-changing competition
- Increased frequency of disruptive events such as:
  - Arrival of unexpected orders (claims)
  - Non-arrival of expected orders (claims)
  - Changes to accepted orders (claims)
  - Delays
  - Failures
- Increased frequency of incidents:
  - Fraud
  - Hacking
  - Electronic attacks
- Planning deliveries difficult, if not impossible
- Traditional resource scheduling methods obsolete

The following business processes (and many others) will be affected:

- supply chains,
- production
- purchasing
- order processing,
- distribution
- warehousing
- transportation
- water supply
- food supply
- project management

*We are facing an interesting paradox: complexity, caused by digital communication can be managed only by employing digital intelligence. In other words, digital technology is responsible for an issue, which can be resolved only by employing digital technology.*

### 5 CASE STUDY: NEW INSURANCE

A research conducted by the author in cooperation with a large insurance company revealed feasibility of converting a significant number of insurance-related business processes into autonomous mode, in which all operational decisions are made by AI systems. Few examples are given below.

- Extracting knowledge from data on individual clients
- Creating individual policies in interaction with individual clients
- Extracting knowledge from data on competition
- Dynamic risk assessment driven by risk affecting events
- Claim processing performed by AI without human involvement

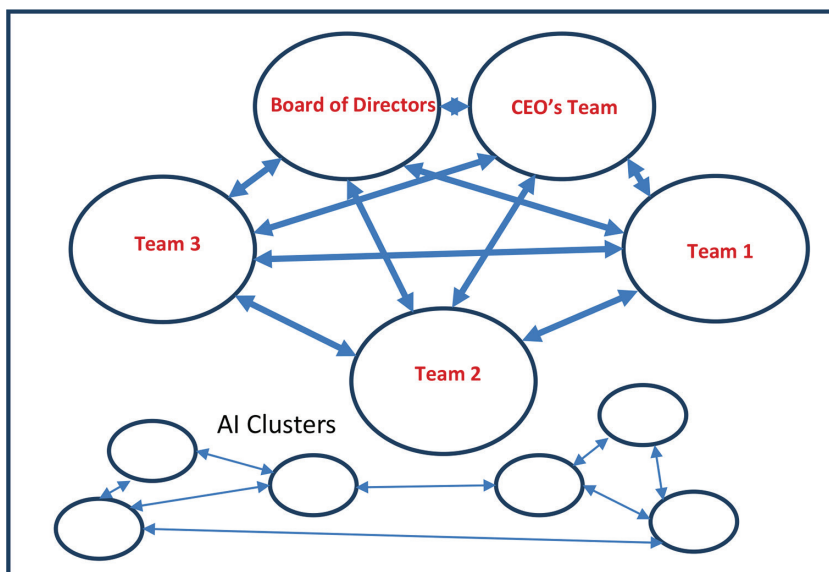


Figure 3: Cooperation of human and digital intelligence.

Human intelligence, working in cooperation with digital intelligence, would be responsible for generating and selecting strategic options, innovating, negotiating, advising, supervising, inspecting and servicing.

A prototype AI system is currently being developed to explore autonomous insurance claim management.

## 6 DIGITAL TECHNOLOGY AND SOCIETY

During the last two major technological paradigm shifts, we have experienced momentous social and political change. First time, when simple tools that were used by hunter-gatherers, were replaced by extensive agricultural technology, which enabled ever-moving tribes to settle into permanent residences; and second time, as agricultural technology was replaced by mass-production technology as a main economic driving force.

Can we expect less significant changes when, finally, digital technology completes the shift from industrial era, with its large, rigid corporations and the economy of scale, to more nimble, adaptive information economy? I doubt it.

## 7 NEW ESTABLISHMENT

We shall probably witness the demise of the current establishment and the emergence of socially-aware knowledge workers, such as Bill Gates, ready to spend huge sums of money accumulated during working life, on wellbeing of the disadvantaged.

Table 2: Transformation of Business & Society.

	<b>Society of Hunters and Gatherers</b>	<b>Agricultural Society</b>	<b>Industrial Society</b>	<b>Information Society</b>
<b>Main economic activity</b>	Providing resources for family/tribe	Production of food	Manufacturing of goods	Knowledge-based services
<b>Main technology</b>	Simple tools	Agricultural technology	Mass-production technology	Digital technology
<b>Main resource</b>	Personal skills	Land	Capital	Knowledge
<b>Key success factor</b>	Personal skills	Economy of scale	Economy of scale	Adaptability
<b>Distribution</b>	None	By roads	By railways and motorways	By digital networks
<b>Scope</b>	Family/tribe	Local	National	Global
<b>Dominant class</b>	None	Landowners	Bankers, lawyers, industrialists	Knowledge workers
<b>Management</b>	Coordination	Unconstrained command	Corporate hierarchies Command & control	Distributed decisions Use of artificial intelligence
<b>Governance/politics</b>	Wisdom of tribal elders	Feudal	Party-centred democracy	Digitally managed issue-centred democracy

Current predominance of bankers and lawyers in all walks of life is likely to disappear.

## 8 NEW DEMOCRACY

Democracy based on antagonistic political parties led by professional politicians, without any practical experience outside party politics, is likely to be replaced by issue-based democracy, where each important problem attracts attention of politically minded citizens who are prepared to pull their resources and, supported by powerful digital technology, collectively work on achieving the resolution.

## 9 CONCLUSIONS

As father of Complexity Science, Ilya Prigogine, stated [7]: “The future is not given”. It is perpetually constructed by decisions and actions of agents active in the known Universe. And yet, it is not random. It evolves following discernible patterns [8].

By understanding patterns of socio-economic changes that were caused by technological paradigm switches in the past, we can reasonably predict the impact of digital technology on business and society in the near future.

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