



Transformation of Human Labour from Stone Age to Information Age

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Abstract. Over the past few years, the labour market in general has been caught up in different financial and economic crises worldwide. Unemployment has grown to record levels. Our life is an odd mixture of different moments of action and inaction, work and rest. Work provides us with inner creative joy. Usually, it saves us from the dullness and boredom of life, puts our energy to proper use, provides us with money for our livelihood, and makes our lives meaningful and peaceful. We think that two things are necessary for really useful and happy work: skill and constructiveness. Work is not only an important part of our daily lives, but we have come to a point where it has taken over our lives. It is also an important political issue at the present time. Human labour is changing according to socio-ecological and technological transitions. These transitions are expected to have many far-reaching implications for human labour. To understand this situation, we have evolved a simple scheme that can be applied to the timeline of human evolution from the Stone Age to the Information Age. Using this device, we have tried to explore the historical relationships between changed regimes and the changes in human labour.

Keywords: Work · Labour · Stone age · Information age

1 Introduction

Generally, work constitutes two separate activities: “paid” and “unpaid” work. Unpaid work can be understood to comprise all productive activities outside the official labour market done by individuals for their own households or for others [1]. This means that it occurs in a domestic context, such as housework (cooking, washing, ironing), care of children or members of the family, voluntary community work, help in family business and similar work. On the other hand, if the work is done in exchange for a salary or wage, it is usually called “labour”.

Work is not only an integral part of our lives, but also one of the most important topics of human concern throughout the world [2–5]. The future of labour history research has been discussed a great deal, for example through regime changes and demographic changes, oil crises and the transition from the use of fossil fuels, globalisation, the history of technology, and other milestones [6–8]. The majority of labour historians have occupied themselves with the era of industrialisation [9, 10], but we have to begin to focus on earlier periods.

We think that employment in the next decade will not only depend on demographic dynamics, the increasing or decreasing of active age, but also on macroeconomic conditions (GDP), technological advances (ICT development), education systems, and the transition away from fossil fuels (energy prices) and environment changes.

We emphasise the nature of changes in the workplace too. We believe that innovation in the workplace is a driving force for changes towards sustainable forms of increasing productivity e.g. flexible work, remote work, e-Work, alternative payment schemes, greater autonomy, job rotation, multi-skilling, teamwork and others. This brings about advantages not only for the economy, but also for society as a whole and for individuals, such as employees and employers.

To understand this phenomenon, we evolved a simple scheme that can be applied to the timeline of human evolution from the Stone Age to the Information Age. Historically, doing lots of backbreaking work is the way countries have become rich, and being rich means to do more pleasant work. Using this device, we tried to explore historical relationships between changed regimes and the changes in human labour e.g. the industrial revolutions in the 1760s, 1860s and 1990s [11], capitalism, democracy, globalisation [12] and digitisation [13]. We target the regimes, human lifetime spent on labour and institutional forms. Changes in technology, culture and economies are having an impact on the way people work at all levels around the world [14]. Generally, work became more pleasant for skilled workers. Getting work done is a fundamental concern for any business, and modern digital and communications technologies are changing this in different ways [15]. We believe that in the modern age of information technology and the Internet, artificial intelligence, computerised algorithms, mobile sensors, 3-D printing and other developments, virtual reality will play an important role in different organisations.

In the following sections, these two core questions will be addressed: (1) How is the world of human work evolving? (2) What could labour look like after the ongoing socio-ecological and technological transitions?

2 Meaning of Work and Labour

Work is a specific, complex activity of human beings, exclusively a human phenomenon that has been detached from the animal world. It is an economic, sociological and psychological category. Work is not a human *raison d'être*, yet we consider it a very important issue in our lives.

The term is a vague concept without a clear definition. The understanding of the aim and impact of work varies among individuals. Primarily we have to understand what work is, paid or unpaid. Under unpaid work we include work that usually occurs in the home environment (cooking, cleaning, washing, ironing or childcare) including also volunteer work. If the work activity is paid, it means it is done in exchange for salary and wages, and then it is usually called labour. This concept also includes independent business ranging from the simplest self-employment to international banking.

Generally, it is easier to define what work is not. When a person wakes in the morning and prepares for the day ahead, it is generally considered that he/she has not done any

work activity during this day yet. Morning hygiene, breakfast, and other personal rituals are not considered work, but for those who have to dress children, prepare their breakfast and take them to school, the workday has begun.

Giddens [16, p. 176] says, “most pre-modern societies seem to have no word for work, presumably because working wasn’t readily distinguishable from other activities”. Chris and Charles Tilly [17, p. 22] described work as follows, “work includes any human effort adding use value to goods and services”. More precisely, the personal use of one’s own free time would also be included, and Tilly and Tilly [17] took this aspect into consideration in their definition. Therefore, the alternative to work would be personal care, where sleep would be included, but both leisure and personal care should definitely differ from work. Schwimmer [18, p. 287] emphasises that “work as a concept is based on the assumption that, from a certain view-point, all economically useful activities are fully comparable by a yardstick transcending their diversity, in other words, that labour has become a commodity and that the technical and administrative direction of that labour become part of the same kind of commodity”.

Giddens [19, p. 505] identified six key characteristics of paid work, which are essentially connected with the economic and professional achievements of human beings: *money (wages, salary)*, *activity level*, *diversity of life*, *temporal structure*, *social contacts* and *personal identity*. The degree of saturation of human needs subsequently affects an individual’s relationship with work, and his/her impact is wide-ranging (relationship with colleagues, relationship with clients, workplace relationships, relationship with the organisation and others).

3 From Stone Age to Information Age

As most people would no doubt agree, the world of human work is an extremely multifaceted and dynamically changing field of study. In a first, extremely simplified approximation, we may model the historical development of human labour evolution trying to set out some of the important milestones. Hands, hand tools, machines, computers, digitisation, smartphones, cloud computing and virtual organisation are the main features of the evolution of work.

Stone Age began at the beginning of what would become human civilization till the discovery of smelting. Smelting allowed people to create tools made out of metal and stone tools become obsolete. In Table 1 we summarized the main Stone Age Technologies.

Stone Age humans satisfied their basic needs by hunting, gathering and preparing the food for consumption, which did not require much time, and constructing human artefacts such as hand tools. As humans lived in social groups (at most a dozen or so people), they cooperated to survive by implementing various forms of division of labour. The increase in working time under such conditions, however, could be self-defeating, because the increased hunting and gathering in the same area would tend to exhaust the food resources, thereby forcing the community to migrate. As documented in cultural anthropology research, the hunting/gathering regime requires the least amount of human work from its members [20, 21]. Polanyi [22] stressed that the first human work relations

Table 1. Stone age technology.

Technology	
Stone	Most tools were created to help humans to survive using the technique flint knapping;
Fire	It may seem primitive but million years ago it was necessary to survive, allowed early humans to control the environment;
Wheel	Used this to move more quickly through the use of wheeled vehicles;
Clothing	Used the pelts of animals;
Bow and Arrow	Was a very useful tool allowed to kill the food from longer ranges much easier and safer;
Boat	Created primitive boats for short distance;
Pottery	Allowed prehistoric humans to store food for longer periods.

Source: Author

were in this sense direct, and thereby reciprocal. The people of this regime worked according to a timescale norm reminiscent of the work of animals in order to survive.

The evolution of agriculture (farming) through modern technology tools and mechanisation, the exchange of goods and services between people, an increase in the amount of work and an increase in the intensification of traditional agriculture [23, 24] then started. Farmers produced surpluses, made possible the formation of substantial reserves and achieved progress with work specialisation. The industrialisation of agriculture helped people to reduce working time using fossil-fuel technologies. In the agricultural period, work became a much more significant feature of human existence, both quantitatively and qualitatively.

In the period of Aristotle and Xenophon in Ancient Greece and Cicero in Ancient Rome, it may have been considered unworthy for a free man to be working, because all men valued a life of leisure and service to the polis as a free self-determined citizen, and working under somebody else’s command was incompatible with personal dignity. However, the concept of work depends on social formation and differs throughout the genesis of human society. We illustrate the following broad historical classifications of the various institutional forms:

- *family work* with interdependent systems and mutual obligations, such as survival and subsistence agriculture.
- *first professionals* such as potters, spinners, weavers, carpenters, brick makers, masons, transporters, smiths and priests began to make their appearance in Neolithic evolution [25].
- the beginning of the exchange of goods and services between specialists, which led to the formation of arrangements and models, such as the *jajmani system* which was founded in Indian villages, where goods and services were exchanged for grain at roughly constant exchange rates [26]. We understand this system to have been a durable relation between a land-owning family and the landless families that supply it with goods and services. According to Wiser [27], this system served to maintain the Indian village as a self-supporting community. Beidelman [26] is of the opinion that the *jajmani system* maintained the higher caste’s prestige.

- *creation of first cities* in Eridu, Uruk in Southern Iraq, Hemudu in China; the cities of the Nile and Indus valley created tributary labour relations [22], documented in Eurasia and in South and Central America.
- with the emergence of states, two models of working relationship developed: *slavery* and *wage labour*. We believe that both originated contemporaneously, as recorded in the examples of soldiers. At the same time, slaves were taken as hostages who were not killed, as is later described explicitly in the inscription on the statue of Justinian written in 528–534: “*Servi autem ex eo appellati sunt, quod imperatores captivos vendere iubent ac per hoc servare, nec occidere solent; qui etiam mancipia dicti sunt, quod ab hostibus manu capiuntur*” [28, pp. 18], (*Slaves are called by that name, because it is customary that commanders order the prisoners to be sold and in that way save them and do not kill them*, author’s translation). Obviously, wars occupied a central place in the history of labour. Sargon of Akkad (2334–2279 BC) was the first ruler who established a large state in world history with recorded slaves and professional soldiers, namely in Mesopotamia [29].
- *labour markets* emerged next to the cities, states and temples, and subcontractors began to act as employers of labour. Meanwhile, commodity markets were needed on a regular basis [30]. In these markets, we can find two kinds of buyers: independent producers who bought and sold from and to each other, and professional soldiers or others who produced food partly or not at all, or used money for buying.
- *independent labour* included family business arrangements in which women already played an early role [31].
- from the subcontractors of the temples and other central organisations there also emerged the first *employers of labour*.

Physical power was the main feature of human labour during the agrarian epoch. The ruling classes were not interested in the majority of the population who were engaged in agricultural production, nor were they interested in improving the skills and knowledge of this sector of the population as long as they fed themselves and paid their tithes and taxes. During the course of industrialisation, the working time needed for production was very much reduced, allowing for the development of a highly differentiated labour market, together with the further development of the division of labour within and between countries. According to Geser [32], the concept of industrialisation denotes the fusion of mechanisation and bureaucratisation (Fordism and Taylorism), and mechanised and formalised plants.

Work in the coal-based industrial age multiplied the demand for labour characterised by physical power and development of modern technologies (e.g. steam engines). In this period, the reduction in daily working hours and the introduction of child labour were established [33]. Most countries started to offer public-funded compulsory school education for children [34], which created a demand for professional teachers. One can also observe an increasing cultural differentiation by gender.

After World War II, the use of oil and other fossil-fuel sources became dominant. This era is characterised by a rise of energy consumption in the economy, decreasing working hours, and rapidly rising energy intensity. In households, we can observe the same changes, e.g. electrical equipment, which substitutes for physical effort at home, raises the intellectual requirements for handling it. Technological development,

increasing consumption of fossil fuels and electric motors have replaced a large portion of physical labour.

Information and communication technology (ICT) of the 1970s has acted as a substitute for the knowledge work component of human labour. ICT has replaced the knowledge-based human labour component. Replacing knowledge is basically less energy consuming than replacing physical work. Nevertheless, the production of knowledge and the control of knowledge remain a key feature of human labour. At the same time, with the First-World oil crisis of 1973, there was a structural change in the relationship between energy and labour. The industrial revolution brought employees from their homes to the factories. With ICT, the reverse is possible, with employees now able to move back to their homes [35].

Telework, also known as telecommuting, can be defined simply as when employees work at some place other than the traditional workplace. The concept of telework, more precisely telecommuting, was born during the oil crisis in the early 1970s, when American Jack Nilles and colleagues published their calculations on the savings to the national economy that would result from reduced commuting [36].

In Table 2 we compare the evolution of work from the past to the future for an understanding of how the world of work is changing.

Table 2. The evolution of work.

The past	The future
Hierarchy	Flattened structure
Fixed working hours	Flexible working hours
Hoarded information (top secret)	Shared information
Command & control and fear-based leadership	Engaging, empowering, and inspiring leadership
On-premise technology	Cloud technology
E-mail is primary form of communication	E-mail is secondary form of communication
Corporate ladder	Create the ladder
Siloed and fragmented company	Connected and engaged company
Work at office	Work from anywhere

Source: Author’s own compilation according to [37]

At present, workplace innovation refers to a number of specific actions, such as teleworking, telecommuting, remote-work, networking, digital nomadic work, flexi-place, networking and many other variants [38, 39], alternative payment schemes, employee empowerment and autonomy, task rotation, multi-skilling, teamwork and team autonomy. We believe that technology is an important enabler of workplace innovation.

The flexibility for jobholders to be able to work at any time in any place is technically feasible for many employees and has been for many years. In the literature, there seems to be an accepted category now: subject, working anywhere, for over forty years [40–42].

Using technological innovations, more and more organisations have started to redesign their approach to work. We feel strongly that central to this new approach is the fact that employees are asked to organise their work flexibly.

E-Work was defined by the PRISM Center as any collaborative, computer-supported and communication-enabled productive activities in highly distributed organisations of humans and/or robots or autonomous systems [43–45]. Basically, e-Work is based on e-activities, e.g. e-Business, e-Commerce, e-Government, e-Logistics, e-Learning and other, which rely on ICT. Some have defined e-Work as telework [39, 46], several conferences on e-Work as telework have taken place [47, 48].

The designation e-Work is a relatively new term, replacing different terms such as teleworking, telecommuting, networking, digital nomads, flexi-work, and various other variants that describe how ICT has made remote work possible. Huws [39] emphasises that although this term does not specifically refer to distance, it has the benefit that it avoids over-specificity and can apply across a range of activities without being restricted to a particular form (homeworking or mobile working).

We feel that the classic definition of remote work is actually obsolete. These days it is almost impossible to imagine any kind of office work that does not make use of one or other telecommunication medium. In our opinion, e-Work is no longer an exception, but is becoming more and more standard in the working process. E-Work is associated with working at a distance. We think that this term extends the definition of teleworking in all activities through information processing with the utilisation of ICT. This may involve individual or collective forms, internal corporate decentralisation and classic outsourcing. The scope of e-Work ranges from call centre or software development companies in decentralised locations to mobile working, homeworking and e-lancers [49].

In a very broad definition, e-Work “encompasses any work which is carried out away from an establishment and managed from that establishment using information technology and a telecommunications link for receipt or delivery of the work” [39, p. 22]. Eichmann et al. [50] define e-Work as “any mode of work organization within a country or between countries practicing: telemediated, controlled, remote work (individualized/ isolated or office-based and telemediated, collaborative work (tele-cooperation, virtual teams))”. When we use this definition, e-Work can be distinguished from similar concepts that are either more restricted or more widespread, such as **telework, e-Work, online work, knowledge-based work, and white-collar work**. We understand the concept of e-Work as a way to be an employee as well as a method and mechanism for performing a job in the modern, digitalised world because “to Do Good e-Business, Somebody Has to Do the e-Work” [51].

The workplace was merely a physical space employees occupied during regular office hours. Today’s permanently connected, instant-access environment has blurred the lines between the physical office and the place where work actually happens. The workplace has become a digital environment, and employees are communicating and collaborating in different ways. The green workplace is simply defined as a workplace that is environmentally sensitive, resource efficient and socially responsible [52]. The digital workplace encompasses all the technologies people use to get work done in today’s workplace – both the ones in operation and the ones yet to be implemented [53].

The virtual workplace is one in which employees operate remotely from each other and from managers [54]. It means virtual work in different types of virtual workplaces (home office, teleworking centres, mobile office, office hotelling, etc.) is done in whole or in part via electronic communication requiring little or no daily face-to-face contact with co-workers or supervisors. It does, however, requires technology such as telephones, Internet tools and computers, and creates a work environment without geographical boundaries. In Table 3, we summarise the main differences between traditional and virtual work.

Table 3. Traditional work versus Virtual work.

Traditional work	Virtual work
Recruit and utilise employees at one location only	Recruit employees in any geographical location, to support projects
Communicate face to face and brainstorming	Communicate via telephone, e-mail/chat, videoconferencing, IM, blogs, social networking
Workdays defined	Flexibility of workdays
Work hours fixed	Work hours flexible
Work limited to the workplace	Work performed online from any location at any time

Source: Author

A global increase in alternative forms of work and employment is currently observed, entailing alternating working at home and in the main office. Flexibility profoundly changed the character of the modern workplace. Employers can benefit from flexi-time in a variety of ways. It is conceivable that individuals who are more open to new experiences will profit from working in the virtual world, experiencing more work, while spending less energy to adopt this new work design. Mobility in the workplace is increasingly emerging. By 2015, the results from IDC research showed that the world’s mobile working population had reached 1.3 billion, i.e. 37.2% of the total workforce, which is 300 million more than in 2010 [55].

Human work and energy policy are closely connected, therefore a new energy transition from fossil fuels will have an important role in shaping the future of work. Human labour is highly dependent on the fossil-fuel-based energy age. Technological and social forces are transforming how work gets done, who does it and even what work looks like. In our opinion, the effect of technology is that work will become increasingly more interesting and more creative, thereby offering a freer market for human skills. Generally our attitudes to work and to the changing the quality of it depend as much on our own disposition and the alternatives available on the market as on the jobs themselves.

4 Conclusions

All over the world, work is the most important source of income in modern society with its social role and its role in the lives of human beings. Human work has always been a fundamental need, an indispensable social bond and a source of ego. In the history of

work up to the present time, almost all the attention has been focused on work relations between slaveholder and slaves and employer and employee.

We often relate the world of work to making money. But work is perceived as an activity requiring effort, being autonomous and creative, paid employment, time spent finishing tasks, a tool that enables individuals to express themselves, establish contacts with others, develop human skills.

The historic milestones which we have discussed are obviously connected but are not self-explanatory. Of course the first market developed enormously at the expense of other institutions, such as trade unions, employers' organisations and the socio-economic policy of national states [56]. The global crisis during the evolution, globalisation and unification of Europe and other countries played an important role in this development too.

Across history, the longest period of time spent on labour was in the agriculture industry. The industrialisation of agriculture relieved labour time using modern fossil-fuel technologies. Physical power was the main key of human labour during the evolution. Since the 1970s, ICT has substituted for the knowledge work component of human labour. With the availability of liquid fossil fuels and electricity, physical human and also animal labour was replaced in economic sectors.

In conclusion, we can sum up by saying that the evolution of labour through the ages has been characterised by the following features:

- (1) Movement of the workplace from the home to the office/factory and back to the home. This, more recently, includes the fact that business owners can outsource certain tasks and no longer have to provide facilities such as office space, canteens, medical aid and pensions for employees. The workers, on the other hand, now not only have to take responsibility for these former benefits of fixed employment, but also have to act as their own "managers" by ensuring that the work is completed and that all the requirements for doing it are available.
- (2) Some jobs are lost, e.g. wainwright, wheelwright, farrier, and new jobs appear in especially ICT demanding new skills, which creates a demand for training for new job-seekers, but also for existing workers who have to move from one field to another (proving the truth of the saying that "most people will have three different careers during their lifetime"). This is also tied up with the move away from the use of fossil fuel.
- (3) Change in gender distribution. The traditional role of the man as the breadwinner and the woman staying at home to do the housekeeping and look after the children changed, and women entered the workplace too. This trend continued, and in later decades women started doing work that had traditionally been the preserve of men (bankers, doctors, senior managers) and even the more "masculine" jobs, such as in the police, army, firefighting, motor mechanics, bullfighting.

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