

Sociological Viewpoints on Technology: General Assumptions and Framework

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ABSTRAK

Makalah ini meneliti andaian umum dan kerangka konseptual teknologi daripada sudut sosiologi. Penulis berusaha membincangkan 'determinisme teknologi' dan 'determinisme sosial' teknologi yang diambil kira dalam pembentukan sistem, struktur, sosio-budaya dan pembinaan realiti berasaskan teknologi. Wacana yang terdapat kini berkaitan teknologi cenderung berasaskan perspektif determinisme teknologi. Walau bagaimanapun, berbeza daripada pemikiran arus perdana, makalah ini mencadangkan bahawa kita perlu meneliti bagaimana masyarakat dan budaya (determinisme sosial) memberi kesan terhadap kemajuan teknologi. Makalah ini meneliti realiti sosial dan pembinaan teknologi dalam konteks sosial Malaysia, dan review human forces yang dinamik, tetapi tersembunyi dalam pendekatan determinisme teknologi, yang sendirinya merupakan satu pembinaan sosial mengenai realiti.

ABSTRACT

This article explores the general assumptions and conceptual framework of technology from the perspective of sociology. It attempts to discuss the 'technological determinism' and 'social determinism' of technology in the creation of systems, structures, social-cultural and the technological construction of reality. The present discourse on technology tends to be based on the perspective of technological determinism. However, contrary to mainstream thinking, this article suggests that we need to explore how society and culture (social determinism) impact on technology development. It explores the social realities and construction of technology in Malaysia's social context, and reviews the hidden but dynamic human forces embedded in the approach of technological determinism which, in itself is a social construction of reality.

INTRODUCTION

The digital world constructs different meanings in communication and working style. In today's world of globalization, technology is one of the popular means used to facilitate and define human communication.

Generally, technology is used to meet the challenges of globalization, the control of two key concepts, 'time and space' in human communication. Technical communicators develop ways and means to control and compress 'time and space' to meet the global challenges. One such good example is the chairman and chief software architect, Microsoft U.S.A, Bill Gates (*Fortune* 2006: 30) who relates,

At Microsoft, email is the medium of choice, more than phone calls, documents, logs, bulletin boards, or even meetings. I get about 100 e-mails a day. We apply filtering to keep it to that level – email comes straight to me from anyone I've ever corresponded with, anyone from Microsoft, Intel, HP, and all the other partner companies, and anyone I know. And I always see a write-up from my assistant of any other email, from companies that aren't on my permission list or individuals I don't know. That way I know what people are praising us for, what they are complaining about, and what they are asking.

More so, the digital working style challenges oneself in the 'content' of communication and obtaining the 'right' information as mentioned by Bill Gates (*Fortune* 2006: 31),

We're at the point now where the challenge isn't how to communicate effectively with email; it's ensuring that you spend your time on the email that matters most. I use tools like "in-box rules" and search folders to mark and group messages based on their content and importance... staying focused is one issue; that's the problem of information overload. The other problem is information under load. Being flooded with information doesn't mean we have the right information or that we're in touch with the right people. I deal with this by using SharePoint, a tool that creates websites for collaboration on specific projects.

Undeniable, the digital world brings great global transformation and social changes. The significance and impact of these changes are being experienced and observed directly and indirectly in everyday human life's experiences. Sociologically, in the context of developmental process in Malaysia, what does it mean? What does it represent?

GENERAL ASSUMPTION IN DEFINING 'TECHNOLOGY'

What is 'technology'? In the 21st century of our everyday life, technology is another jargon we used to celebrate development and modern lifestyle, thinking and behaviour. Generally, we understand technology in its 'utility' and 'economical' roles and values as quoted below,

Technology is the technical means people use to improve their surroundings and it is also a knowledge of using tools and machines to do tasks efficiently. We use technology to control the world in which we live. People use technology to improve their ability to do work. Through technology, people communicate better. Technology allows them to make more and better products. (<http://www.bergen.org/technology/defin.html>)

This is one of the ways in understanding technology; however, it is not the ONLY definition and human's understanding on technology should not be narrowed by this aspect. However, having said that, the above definition on technology has become mainstream knowledge and a major control forces in directing and determining human reality in the society. Technology, as such, is not merely an object or thing on human living lifestyle anymore; it is slowly influencing and growing within 'us', the process of cyborgization.

SOCIOLOGICAL PERSPECTIVE IN DEFINING TECHNOLOGY

According to Cordray, (<http://oregonstate.edu/instruction/soc456/home/introduction/index.cfm>) the general sense of defining technology is very much referred to the 'material aspects' of technology, the 'non-material' aspect has been overlooked in its definition of technology. The 'non-material' aspect suggests that the word 'technology' refer to concepts, not to things. And a good starting point to define technology is to look at science and technology as parts of a social system; technology is the product or outcome of human activity; technology has been around since the beginning of humankind and it is a part of culture and interacts with social change. This brief introduction on sociological perspective in defining technology leads us to re-examine several assumptions related to how the technical communicators in inventing technology.

THE MYTH OF TECHNOLOGICAL DETERMINISM

Technological creations happen rampantly and rapidly and the underlying technological knowledge obsolesces within couples of months or years as witnessed in the evolution of computer chip. The evolution of technological knowledge is also believed to be the 'determinist' factor in human communication, working style and productivity. Bill Gates noted (*Fortune* 2006: 30),

It's pretty incredible to look back 30 years to when Microsoft was starting and realize how work has been transformed. We're finally getting close to what I call the digital work style. If you look at this office, there isn't much paper in it. On my desk I have three screens, synchronized to form a single desktop. I can drag items from one screen to the next. Once you have that large display area, you'll never go back, because it has a direct impact on productivity.

This is an example of popular way of looking at things based on the 'technological determinism'. This perspective argued that it was the features of the technology that determined its use, and the role of a progressive society was to adapt to (and benefit from) technological change (Green 2001).

Social beings, without much realization in the utilization of technology, making real the existence of technology in everyday mundane life, subtly going through a process of cyborgization; a nurturing and learning process by the force of technological and computer literacy, and it has and is becoming a major part of our social creation and reality.

Cyborgization comes from the word Cyborg (1960), is short for cybernetic organism and it refers to an organism that is part-human, part-robot. However, a more relevant concept related to this paper is *fyborg*. Gregory Stock, the director of the Program on Medicine, Technology, and Society at the UCLA School of Medicine, argued that ‘we are more likely to become “fyborgs” (functional cyborgs) by developing extracorporeal electromechanical devices to improve and widen the scope of existing sense and effectors organs (<http://www.wordspy.com/words/fyborg.asp>).

In the feminist thinking, Donna Haraway, explains that the cyborg theory becomes a starting metaphor for exploring ways of breaking down the nature/culture binary (<http://en.wikipedia.org/wiki/cyborg>). She demonstrates how the desire to separate these two aspects of the world is becoming increasingly difficult and attempts to utilize this confusion of borders to create new ways of acting politically.

Another author, Alexander Chislenko (<http://www.wordspy.com/words/fyborg.asp>) coined *fyborg* to differentiate between the man-machine creations of science fiction and the everyday ways that we extend ourselves using technologies such as eyeglasses, hearing aids, and cell phones.

The phenomenon of ‘*fyborg*’ is happening now and the question asked is ‘what are we creating, the so-called ‘technology’? Do we understand our creation and the impact to the social and cultural ramification of technology – how it shapes society and how society shapes it? What direction are we heading?

This leads the writer to examine the fundamental basic assumption, ‘technological determinism’ again. Clearly, it suggested that the ‘social actor’ (the users and society) acts as a dependant variable or an ‘object’ in a linear (one dimensional) relationship with the independent variable, ‘technology’. The ‘social actor’ is passive in this sense; it is, in the eyes of the sociologists, the technological ‘myth’. However, in popular culture, the mythologizing of technology has become a norm and a groupthink (tendency for members of social groups to maintain a consensus to the extent of ignoring the truth) to relate stories about how technologies started and the people who invented them. In the words of Green (2001), the role of the myth is to celebrate these developments as important in our life and they are created to be sustainable within our popular culture.

The power of sustainable myth has become a practicing reality to be materialized by social actor in the popular culture without questioning much the myth and the missing social facts hidden in the journey of mythologizing of technology. Fundamentally, it is much more complex than it seems to be. From

the sociological viewpoint, this approach is being critically questioned on the absent of the 'social environment' in which scientific discoveries are made. As Green (2001: 2) mentioned,

...it is as if the advances happen in a vacuum, as if Newton were the first person to be hit on the head by a falling apple. Newton's flash of insight into the principle of gravity had more to do with the time and culture in which he was working than with him being bopped by a piece of fruit.

In short, 'technology' alone is not an 'independent' variable; it is insufficient to understand changes and advances induced by technology without relating or putting it in the social environment characterized by time and culture. The time and culture fill the 'vacuum' of which technology is induced.

SOCIAL DETERMINISM OF TECHNOLOGY

Sociological perspective highlighted the 'vacuum' of which technology is created, it is timely to balance the focus of our understanding on 'technological determinism' to a more encompassing factor, as suggested by Green (2001: 3),

... the new way of looking at technology is *social determinism*. This suggests that society is responsible for the development and deployment of particular technologies. The technocultures in which we participate reflect the choices of elites in our societies, the people who have most say in how we plan for the future and how we allocate our resources.

Exploring the 'social determinism' of technology opens different windows of social reality and approaches in close connection with research knowledge in social sciences and humanities. One of the windows of query is the question of the 'neutrality' of technology. It has always been assumed that technological advancement in the 21st century is inevitable. No country would be able to stop the advancement of technology. Those countries which are not able to catch up with the transformation of technology, it is no fault of that country or its people. Thus, technological advancement is 'neutral' in that sense.

From the lens of the technological determinism, technological advancement is 'neutral'. However, from the sociological perspective, it is about the technology's relationship to power and privilege. It is not 'neutral' at all. MacKenzie and Wajcman's (1999, cited in Green 2001) argument is that a technology is only neutral insofar as no one knows what the technology is used for, and insofar as it is never used. Technology is just a physical object or a tool, the physical 'object' is neutral; however, as soon as knowledge of what the technology was used for and/or how it worked, it would be a 'subject' on how social actors are able to implicate patterns of privilege and exclusion.

Once knowledge comes into play, technology is implicated in social processes, and there is nothing neutral about society. Differences of gender, wealth, power and education – to say nothing of the First World/Third World divide – all determine that knowledge

is political. Where knowledge is associated with power – such as with new technologies – it is vigorously protected. The knowledge of how to create and enhance technology, and of how to use technology, is *socially bound knowledge*. Each society operates to determine who will acquire this knowledge, and in which circumstances. Knowledge is no more neutral than technology (Green 2001: 5-6).

In simple words, to make an analogy to the piece of paper called ‘money’ in our daily life, ‘money’ is neutral in its very basic physical technological form, that is, a piece of paper (an object). However, it is not ‘neutral’ when it is embedded with economic, politic, socio-cultural and psychological forces, a construction of human values supported by legitimate institutionalized process. Hence, technology as a lifeless ‘object’ had been questioned. The question now turns into researching the ‘subject’ or the ‘social facts’ of technology as presented in the above. This element of ‘social facts’ (Bruno Latour) has to be explored further in the ‘social determinism’ of technology.

In the article, *When Things Strike Back: A Possible Contribution of Science Studies’ To The Social Sciences*, Bruno Latour ([http://taylorandfrancis.metapress.com/\(bla5qm55y13motm211kvviit/app/home/contribut\)](http://taylorandfrancis.metapress.com/(bla5qm55y13motm211kvviit/app/home/contribut))) commented that there is a misunderstanding in the contribution of science and technology studies (STS) to the mainstream sociology, which is, that the science and technology escapes sociological explanation. In other words, the type of explanation possible for religion, art or popular culture no longer works in the case of hard science or technology. In fact, according to Latour, it is simply a misunderstanding in what it means to provide a deep re-description of a social explanation of a piece of science or an artifact.

INVESTIGATING TECHNOLOGY AS A CULTURAL CONSTRUCT: THE SOCIOLOGIST’S APPROACH

Similar to Bruno Latour viewpoint, the journeys by sociologists and other social scientists into investigating technology studies occurred in the early 1980s. Several conferences and workshops held by a small group of researchers explored the possibility of “sociology of technology”. One of the early attempts initiated by Donald MacKenzie and Judy Wacjman (Robert 1998: 8) came up with three characteristics as a starting point to define what we mean by technology:

First, there is the level of physical objects or artifacts, for example, bicycles, lamps, and bakelite; second, “technology” may refer to activities and processes, such as steel making or molding; third, “technology” may refer to what people know as well as what they do; an example is the “know-how” that goes into designing a bicycle or operating an ultrasound device in the obstetrics clinic. This definition of their subject of study had multiple purposes. It was meant, on one level, to move away from traditional approaches of studying technology. Specifically, they wanted to define their research as 1) not the study of individual inventors or geniuses, 2) not the analyses of technologically

deterministic phenomena (many of these researches see determinism as a socially constructed concept that can be “interpreted out” of existence).

A brief example is the Social Construction of Technological Systems (SCOT) pioneered by Trevor Pinch and Wiebe Bijker. Again, as noted by Robert (1998: 9),

Instead of designating invention as the moment when the genius inventor succeeds in stabilizing an artifact, Pinch and Bijker turn to the concept of relevant social groups that played a role in the development and dissemination of an artifact. These groups can be formal, like existing institutions or organizations, or they can be informal groups whose bond is the result of some common aspect of the artifact’s existence. In the case of the bicycle, they activate this method by first identifying large social groups, such as consumers of producers. Next, they narrow the definitions of the groups to provide a sharper focus for analysis. For instance, they examine women and men cyclists to see how they viewed the use of bicycles. They argue that women’s clothing, and the social mores attached to the wearing of skirts and dresses, forced a bicycle design which was lower to the ground, thus keeping women’s legs or undergarments from public view. For men, the riding of bicycles was seen as a “manly pursuit” –an attitude which for a time dissuaded the development of the inflated tire as these softer tires were not as dangerous, and therefore not as “manly”.

TECHNOLOGY: SOME ASPECTS OF E-LEARNING IN MALAYSIA

In the social context of science and technology development (S&T) in Malaysia, just like other developing countries, Malaysia has directly and indirectly begun its struggle between the two forces, as discussed above at the conceptual level. At one level of the struggle, Malaysia has not escaped the driven forces of technological determinism. And on a deeper level, in the unpacking of the technological determinism forces itself, it reviews subtle hidden forces of politic, economy, socio-cultural forces of everyday life experiences.

The technological determinism approach has a history of closed inter-related connection with the dynamic forces of economic and political power of a country, both nationally and globally, and it is not a new phenomenon in the 21st century. In the writer’s view, it can be traced back to the significant debate between the interplay of ‘infrastructure’ and ‘superstructure’ (historical materialism) by the famous German philosopher, economist and socialist, Karl Marx.

According to Marx, the ‘infrastructure’ or base economy such as ‘technological force’ was the primary economic force to determine the ‘superstructure forces’, i.e., education, religion, media, ideology of a society. In short, the ‘technological force’ molds or shapes the society (Elwell 2005). It means, for example, in education, (one of the superstructure entities), its system; structure and ideology of education will be constructed in such a way as to support the ‘existence’ of a ‘technological’ culture. This approach was the macro perspective of studying the ‘one way impact’ on how technological forces always

bring new changes to the kind of system, structure, relations in production and the economy values needed for the survival of material capitalism. The debate manifested in the struggle between capitalist class and the working class, the making of a 'modern hierarchical society' based on technological materialism.

However, Max Weber (1864-1920), a major classical German sociologist, notwithstanding the notion of how technology impacts the society in general, he highlighted the needs to understand (*Verstehen*) how social actors (at individual level or micro level) in their daily interaction added the values and ideas beyond the reach of the macro technological economic forces. As such, it was not a simple causal relationship between technology and society, as noted by Elwell (2005: 62),

...Weber attempted to show that the relations between ideas and social structures were multiple and varied, and the causal connections went in both directions. While Weber basically agreed with Marx the economic factors were key in understanding the social system, he gave much greater emphasis to the influence and interaction of ideas and values on socio-cultural evolution.

He unpacked the analysis on the level of how changes in values and interpretation of meanings influence economy activity and reality; in other words, how the 'superstructure' shapes the 'infrastructure'. This reflected in his book entitled the 'The Protestant Ethic and the Spirit of Capitalism' especially under the concept on 'Wertrational',

... Wertrational, or value-oriented rationality, is characterized by striving for a goal that in itself may not be rational, but which is pursued through rational means. The values come from within an ethical, religious, philosophical or even holistic context—they are not rationally "chosen". The traditional example in the literature is of an individual seeking salvation through following the teachings of a prophet. A more secular example is of a person who attends the university because they value the life of the mind - a value that was instilled in them by parents, previous teachers, or chance encounter' (Elwell 2005: 55).

Thus, based on the writer's observation, history repeats itself on a new platform with regard to the concept of 'e-learning' at the tertiary education in Malaysia. If one takes a simple approach of causal relation from the 'technological determinism' or the notion of 'infrastructure' determines 'superstructure', one has to admit that only half of the challenge for Malaysia to create a 'knowledge society' by 2020 is addressed. A good example to illustrate this phenomenon is the challenges faced by UNITAR (Universiti Tunku Abdul Razak 1997-1998), the first e-learning university in Malaysia. In the light of analyzing the interplay between the 'superstructure' (social determinism of technology) and 'infrastructure' (technological determinism), the following are some challenges noted by Syed Othman Alhabshi (2005: 12-13). The challenges show clearly why the forces of 'superstructure' cannot be taken lightly.

1. The first problem that was encountered was to achieve a reasonable balance between commercial and academic objectives. Whilst commercial objectives require high revenue through rapid increase in student numbers and reduced costs (by having a high lecturer to student ratio, less face-to-face meetings and more e-learning) the academic objectives may require just the opposite.
2. The assumption that e-learning will quickly catch on was not true at all. The students who joined UNITAR, a private institution, are those who may not have a chance to join a public university whose fees are cheaper and whose facilities are much better. These are students who require more face-to-face teaching than independent learning through the internet. Even after almost eight years of operation, very few IT savvy students have enrolled.
3. It was also thought that working adults who intend to improve themselves through higher qualification would prefer not to attend classes. This seems true only among a small number of individuals. The majority still hopes to have the face-to-face interaction with the lecturers.
4. The so-called teaching CD's developed by UNITAR was not fully utilized by the students. Some lecturers would not even use them because they feel they could produce something better. Whilst the cost of producing such CD's is very high and that the time taken for development is too long, the effective use of them is very minimal.
5. Most of lecturers themselves went through the conventional mode of education and hence are not very comfortable with the e-learning mode. Some of them would prefer to conduct the normal classes instead. If the lecturers are allowed a free hand, probably, they would abandon the OLT, the CD's etc. and the e-learning will eventually be thrown out of the window.
6. The commercial objectives of trying to show positive results would hamper improvement in e-learning methodology, especially through research and training. Academic activities may have to be curtailed to show some success in commercial objectives.

On the global level, according to Abbott (2004:43), challenges at the global economy in the 1980s and 1990s, the entry of the low-wage economies such as Vietnam and China, depreciation of Chinese currency (renmimbi) became the pressing factors for Malaysian government to diversify its economy development from export-oriented industrialization to technological development, producing goods of higher value-added end. Most importantly, as noted by Abbott,

The belief that the promotion of ICT can lead to an acceleration of economic development is strongly supported by a myriad of organizations and institutions worldwide ranging

from the International Monetary Fund (IMF) and World Bank to the International Labour Organization (ILO) and numerous developmental non-governmental organizations (NGOs). The assumption arguably rests on the “technological foundation... (that) through wireless applications, developing countries can bypass more costly and time-consuming fixed-wire telecoms infrastructures.

It reflected the pervasive and persistent technological determinism forces is institutionalized and supported by the powerful global institutions such as IMF, ILO and NGOs. This seems like the way for nations to move forward. There is no other alternative to adopt despite the impact of the leapfrogging effect of ICT; an emerging phenomenon where, for instance, India’s army of engineers (world-class skills and educated working forces) had mostly been used as cheap contract labor from the southern Indian city of Bangalore. Not only were the white color working forces affected, as noted by Abbott (2004:44), the physical infrastructure of Bangalore has also been transformed tremendously:

While the city of Bangalore has already attracted software development work from Silicon Valley worth approximately US\$280 million (*The Economist* 1997), the biggest obstacle to further growth of the industry in India is the appalling state of its physical infrastructure. As the *Economist* notes, “Thanks to over-regulation and a lack of competition in the telecoms sector... most Indians have no access to telephones or the internet, and capacity bottlenecks mean that phone lines are often jammed (*The Economist* 2000). As a consequence, India has four times fewer telephone lines and Internet users per 1,000 people as China and 18 times less mobile phones.

The above implication revealed that the global institutionalized technological determinism forces was one-sided, and in itself, it was not sufficient to sustain the materialism reality of the digital world without an underlying socio-cultural and psychological forces on digital ideological values. The challenges face by the social scientists, in the viewpoint of the writer, is to explore and uncover these dynamic hidden forces embedded in its own unique sociological context. This attempt in itself is an effort on how the social determinism forces of technology contributes to the holistic understanding of technology to /and for society, both nationally and globally.

The global ideology of technological determinism serves as an influential ideological force to shape the policy making of the nations. Malaysia, is one of the nations. This could be illustrated by the two scenarios concerning the nature of S&T development in Malaysia. According to Mohd Hazim Shah (2004: 59), first scenario, is the driven forces of political cum economic will power of the Malaysian government. The role and efforts taken by the Malaysian government to make S&T an integral part of the country’s overall economic development plan, including both the industrial as well as the agricultural sector.

At this level, it is important to place the technological infrastructure in line with the global development of S&T. This is the approach of technological determinism, where, assumptions on what and how S&T as a ‘determinist factor’ could benefit and change Malaysian society is answered.

Nevertheless, in the second scenario, there are “voices of dissent” (Mohd Hazim Shah 2004:60 & 77) towards modern S&T, and represent a certain form of “undercurrent” in the thinking of certain Malay-Muslim intellectuals. This is a manifestation of social determinism of technology; a few significant issues had been raised under this approach. For example, the impact of S&T towards social and cultural impediment; the lack of “scientific attitude” based on Malaysian context of values and cultural change; these issues were not significantly explored before the process of institutionalization of science and technological development in Malaysia.

The writer is of the opinion that, the assumption that technological based modernization transforms all aspects of human life is, in fact, a fallacy; if it argues that the socio-cultural and psychological realms of human life naturally fit into their places respectively and progressing accordingly parallel to the pace of development with science and technology (in the case of UNITAR); and arguing that it is ‘out-there’ once the infrastructure of the information based-knowledge society is in place.

Malaysia is still in its ‘infancy’ state of venturing and exploring these issues through the trial and error approaches. Several attempts had been carried out by local social scientists and scholars. For instance, Cecelia Ng’s, explored the linkages between changing gender relations and technological diverse perspectives of the Asian region. It is a multi-disciplinary approach effort in studying women and men to institutions or government, on the basis of technology management. It also develops theory and practice of gender and technological define policy and programs in their political, economic and social context of the countries.

At a broader context, some social scientists in Malaysia namely, Norani Othman, Abdul Rahman Embong, the late Ishak Shari, Rustam A. Sani, Sumit K. Mandal, Clive S. Kessler had discussed some of the social, economy, culture and political phenomenon of globalization in Malaysia (2000). In its many facets of manifestations, and ‘technology’ is one of its manifestations, question had been posted to examine again what is the role and position of Malaysia to face the challenges of globalization forces? What is globalization in the name of ‘technology’ in Malaysian context? Is Malaysia to become a ‘participant’ or ‘victim’ in these global forces of technological determinism?

In short, more studies and research should be carried out to give feedback and response to the field of ‘technology’ and the ‘social shaping of technology’. Hence, a suggestion on the introduction of a multi-disciplinary approach and the ‘sociology of technology’ is timely to be recommended to Malaysia; in order to gain broader and valuable experiences and understanding on this issue.

CONCLUSION

The debate between technology determinism (infrastructure) and social determinist of technology (superstructure) is continued to a new platform of manifestation, i.e. 'e-learning'. In the decades of development after Malaysia's independence, Malaysia is facing greater economy, political, science and technological global forces and challenges. Focusing or concentrating on the forces of technological determinism approach to construct the social reality of Malaysia is not and should not be the only choice we have to be a 'participant' in the global forces. Learning from some local experiences and India's experiences in 'technology', Malaysia in its quest to gear towards a developed nation and achieving its Vision of 2020, should adopt more approaches, i.e., the social determinism of technology to explore further the social realities and meanings of 'technology' in Malaysia's own unique social context. However, in this article, it is not the intention to dismiss the approach of technological determinism, on contrary; it is to question again the assumptions behind this approach. And by doing so, it reviews the dynamic hidden forces (human forces) embedded in the technological deterministic approach, which, in itself is a social construction of technological reality.

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