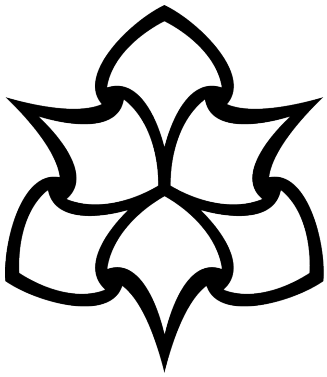

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Review Article

Technology and the Environment – A Framework for a Symbiotic Relationship

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A B S T R A C T

Technology pervades every aspect of modern life and the recent pandemic has increased our reliance on and usage of technology to overcome the constraints of movement that have necessarily been imposed on populations. This has allowed society to proceed with business and social activity via the virtual world. Most of the major advances of society have been driven by technology to form new paradigms. However, these have brought their own problems, with the creation of pollution, waste, depletion of natural resources, exploitation of the workforce, and destruction of the natural world. This paper aims to consider the requisite changes to use technology to sustain our environment, highlighting the attempts to reverse the destructive trends driven by technological advancement. The required contingency framework for technology is discussed, in respect of its central aspects.

The principal theme is that technology, in terms of the creation of tools for human usage, is neutral, however, the focus of society towards investing in technologies and the manner in which technologies are used is not neutral. The potential for political, social, and economic agenda exists, underpinning decisions in these spheres, so human interest drives this technological change. This article outlines the key themes leading to the development of a symbiotic approach to the relationship between technology and environment.

The requisite change drivers for technology projects are considered, such as the 'triple bottom line' approach that encompasses society and the environment together with profit as factors in decision-making and the use of global virtual teams, to run and maintain such projects and their resultant products and services.

The article uses a review of a range of literature to consider these central themes to enable and encourage technological change that sustains the environment, in respect of the natural and social worlds. A framework is proposed in order to provide an initial consideration of the topic and as a vehicle for future research into this area.

Keywords: Technology, Environment, Sustainability, Triple Bottom Line, Global Virtual Teams

Introduction

Technology can be defined as the "methods, systems and devices which are the result of scientific knowledge being used for practical purposes." (Collins Dictionary)[16] These 'technical tools' are neutral, in the sense that their meaning is not embodied but is assigned by use. Meaning is thus attributed. Technology is, therefore, influenced by funding and usage. The funding of technology to achieve desirable ends, in the context of society, creates a bias in development. The profit motivation, for example, can encourage the development of technological change devoted to this purpose. Society, organisations, and individuals can bias the development of technology for their own purposes. This may lead to uses that are not beneficial for the environment and sections within the population, who are then exploited.

The history of technological change has been characterised by the use of natural resources, pollution of the environment, and social exploitation.

Objective of the Study

The aim of this article is to examine the themes in key works of literature, in order to consider a possible framework for technology and the environment to exist in a symbiotic relationship, a way of mutually beneficial co-existence. The key question is, 'how can technology be employed to help the environment?' The nature of this framework for change is also considered, in respect of the key elements.

Methodology

This is a review study in which content analysis and field-based experience have been applied to reveal the co-existence of a symbiotic relationship between environment and technology. A literature review is continuously done, that is why a separate section is not made.

Result and Discussion

Change Model

Either favourable or unfavourable change is continuously creating a challenge on sustainability where the co-existence of environment, society, and economy should be balanced by adopting a suitable technology.[1] The use of an appropriate change model can be proposed, in order to assist in analysing this area. Lyytinen and Newman's model[2] has been adapted for this purpose, as it is derived from a technology background in IS/ IT. The main components of change are defined as:

- Technology - the technical tools of the business
- People - the workforce and all stakeholders
- Organisation - the structure of the business
- Task - the core purpose of the business
- Environment - comprises the context of the organisation that provides resources, competition, users and customers

If one of these elements experiences change then the equilibrium is disturbed until the change has been accommodated and hence the system's equilibrium is restored. Different changes lead to disruptions over time and each time the system is adjusted to reach a new equilibrium. The change model operates in an environment that supplies sources of change to the organisation and receives changes from it.

The main premise is that positive and negative changes to the environment can be generated both from within and external to the organisation.

Two Examples are Detailed Below:

Example of state intervention - the UK government's ban on new petrol and diesel cars in 2030. This is an example of an enforced change to technology, in order to protect the environment.

Example of voluntary organisational change - home working becomes part of the organisational contract for employees. This is a change generated from within organisations, which will affect the environment by reducing the daily commute and the requirement for office space and facilities.

Knowledge System

The requirement is to educate, inform, and instruct in respect of the environment. Technology is required in the form of systems to collect and disseminate knowledge. These 'lessons' are learnt and transmitted via appropriate forums. This informs cultural values to embed the knowledge in standards of behaviour, either voluntarily or imposed. This knowledge can be gleaned by direct or received experience. The Knowledge System, at the organisational or societal level, will receive this knowledge and disseminate it to its members. The use of forums, intranets, data processing, and reporting tools will constitute this system.[3]

Big Data Links and Information Management

Information on the environment and determination of appropriate responses will determine policy and practice in this area. The technical tools to acquire and process 'big data' can be used for this purpose.[4] Unstructured data can be gathered and processed, in order to determine the requisite information on the environment. The internet permits the generation of large volumes of unstructured data, principally via social media platforms. This can be processed to provide useful information (via filters and dashboards, for example). The information becomes an asset of the organisations, enhancing knowledge in the area under review. This can be combined with other data sources, via the appropriate system linkages. The objective is to capture the data and render it usable, in a form that can be analysed for the purposes of the business. The use of unstructured data from the public, generated on social

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media platforms, is used to inform data gathering for news and weather reporting, to give examples of usage. The use of business analytics tools is usually required to synthesise this data into relevant information for the organisation. The aim is to filter the important data items or discern key trends, in order to ensure informed decision-making in business. This is especially valuable in complex projects that require an enhanced level of information-gathering in order to verify, guide, and formulate decisions.

Digital Business Ecosystem

The requirement is to allow society to operate virtually in order to facilitate interaction. This will allow normal organisational processes to occur without utilising physical resources and having a negative effect on the environment. This trend has been exacerbated by the global pandemic, which has restricted population movement. The need is to have a robust digital environment to permit secure transactions and other interactions between individuals and organisations.

The e-business regulatory environment[5] should promote trust so that a secure forum for business interaction is created. The use of e-signatures and appropriate security measures, to permit secure transactions in the name of the designated individuals, is a necessary prerequisite of this form of ecosystem. The principles of data privacy and protection of consumer rights are also preconditions of such an environment. The latter regulates transactions, in that it provides secure mechanisms for valid transactions in respect of digital business enterprise. The use of blockchain technology could be employed in order to assist these transactions, with the example being the facilitation of 'smart' contracts, where the fulfilment of the contract via agreed metrics will automatically trigger payment to the suppliers' accounts in a secure network that validates the transaction.

This use of technology in a digital ecosystem has been promoted by the conditions of the pandemic, where online trading has increased due to the prescribed restrictions on the movement of the population and trading from physical premises. This can provide environmental savings by reducing the potential need for travel, movement of goods, and physical payment devices. Under developing countries have a greater requirement to utilize their budget under the situation of the pandemic as they are less equipped with technology.[6]

Projects in the Ecosystem Economy

The creation of a digital ecosystem enables the implementation of projects in this sphere. The principal theme is the creation of value through collaboration, in terms of the enterprise.[7] Organisations form partnerships to deliver complementary products (for example, Apple and the iPhone Apps developers), so their roles are designated as primary and secondary (Apple is primary and Apps developers are secondary). This comprises the primary product supplier and secondary supplier, whose products are complementary 'add-ons' to enhance the value of the primary products. The type of partnership determines the type of access granted by the former. This can be 'open' where a range of suppliers have open access to supplying complementary products or 'exclusive', where only designated companies (or one company) have access to the business for these products or accessories. Organisations need to be adaptive in this environment. They should be prepared to change collaborations and, if required, engage in multiple partnerships in the ecosystem economy. This is to maximise their economic potential and utility in such a business environment. The features of the latter comprise a reduction of regulatory protections (to enable flexible partnerships), products and services being merged via digitisation, and technology changing how organisations can provide services for their customers.

Policies on Power and Recycling

Recommendations for changes in respect of power supply can be provided, at the level of national policy.[8] The national portfolio of energy sources should be broadened, to include sources of renewable power. Targets for the latter should also be set, in terms of achieving conversion of traditional energy sources to those providing renewable power. Access to energy markets should be improved, so competitive options can be considered. A charge should be levied for carbon emissions, in order to ensure that businesses and individuals are encouraged to reduce the production of 'greenhouse gases' on a collective and personal level. The funding of energy research should be focussed on 'clean' sources of power, for example, hydro, solar, and wind-generated electricity. The optimum mechanisms for such policies are viewed as being incentive-based rather than dictated practice. The recommendation for the nation to sign up for international sustainable development and trade products is provided, as well as target-setting in respect of agreements to reduce emissions and preserve the environment on a global scale.

Sustainability and recycling strategies can also be formulated.[9] These can be created at a national or local level and will entail the setting of targets and incentives in these areas. Key personnel with suitable skills need to be included in this process. The principal stakeholders should be managed so that the targets are achieved via incentives or punishment (perhaps using fines, closure, or public disclosure of divergent behaviour). Sustainability policies should thus be set and enforced. Criteria in this factor can be utilised in project appraisals, in order to inform approval, objective-setting and review. Sustainability

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targets should be incorporated into project practice and technical systems, thereby encouraging the creation and use of recycling technologies and innovations, such as carbon offsetting schemes.

Global Virtual Projects

The environment can be improved via the use of global projects, run by global virtual teams.[10] The pandemic has led to a considerable increase in virtual working on web communications platforms, to overcome the restrictions imposed in the interests of global health. These are teams connected by technology running projects that span national boundaries. They enable optimum use of resources and may also permit entry to a larger market for goods or services. They can be used by public, private and charity organisations to achieve their objectives. The technology here enables collaborative working, saving the physical movement of staff as well as creating new opportunities for global collaboration. The global virtual teams can be used to enhance environmental efforts, by developing new technologies in this area and encouraging the dissemination of ideas and good practice, in respect of the environment. Cloud-based information technology can assist here, freeing organisations from managing technology and optimising the use of such resources, with an 'on-demand' model of usage. The move to cloud-based systems permits accessibility on a global scale and increases the potential resources at the disposal of the organisation and projects.[11] The use of Agile Project Management can also assist global projects by allowing more rapid prototyping techniques to develop products and services, thus comprising a more flexible approach to development.[12] This can potentially generate environmental savings by reducing resource usage by accelerating development time and improving the 'fit' to the client objectives.

The Triple Bottom Line and 'Dual' Objective Organisations

The requirement for projects to consider the environment as part of their justification was suggested by John Elkington in the 1990s.[13] The notion is that projects should have a 'triple bottom line' that embraces the factors of people (social equity), planet (environmental stewardship), and profit (economic prosperity). The central idea was that decisions should not be made using profit alone as the criterion for decision-making. This means that business is not conducted solely for the benefit of a few owners and investors, but should consider all of society with decisions being sustainable. These should not take a short-term perspective, driven by profit, but rather a long-term view, focusing on the protection of the environment and preservation of the planet for future generations. The social aspect is concerned with the welfare of people, and the environmental aspect includes the sustainable use of land, natural resources and managing waste, for instance.

An example of innovation in this area is the new 'dual objective' businesses, which attempt to balance financial gain against the impact on society.[14] They attempt to achieve financial and social objectives, thus reconciling any tensions between them in an organisational structure that accommodates this setup, with leadership and employees who embrace the philosophy underpinning the firm. These practices are becoming more accepted in organisations, with the addition of Corporate Social Responsibility policies and agenda for all kinds of enterprises. It should be promoted through foreign aid to provide its advantages to developing country also to make it capable of utilizing the technology for development.[15]

Framework for Technology/ Environment

A framework is proposed to assist our understanding of this area and direct potential action to address the issues and help create policy. This is based on the principal themes emerging from the literature, as detailed in this article.

The main factors are illustrated in Figure 1 and are considered below:

- Power - the energy sources used to power technology and the use of technology to help create that power
- Recycle - the reuse of materials to reduce waste and conserve materials, including technological developments to aid recycling
- Regulate - the use of regulation by government, local or state government and professional bodies, for example, to protect and preserve the environment
- Innovation - the employment of technological innovation to advance measures to assist the environment

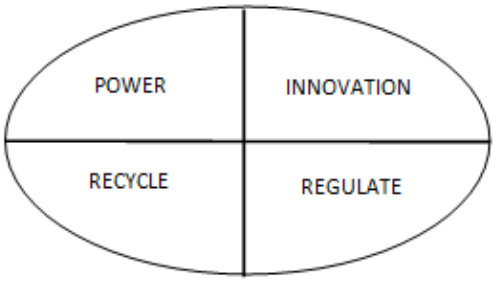

Figure 1.Framework for Technology/ Environment

Conclusion

These are the main areas on which policy change and resources should be focused, in order to utilise technology to improve the environment. All these areas can contribute significantly in respect of global, national, organisational, and individual efforts to address environmental concerns. The aim is to achieve a symbiotic relationship between technology and environment, thus creating a harmonious, and positive equilibrium.

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Recommendation

Empirical research should be conducted as a case study for further assuring the validity of theory for establishing a symbiotic relationship between technology and environment.

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