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Research Article

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Strategies for Managing Technological Change: Insights from Practitioners

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Abstract: Technology is vital to most organisations and, hence, the ability to change this element is essential for their future success. Change will contribute to the fulfilment of customer or service user needs, via enhancement of the technological basis for these entities. An efficient and effective delivery of organisational objectives can depend on this ability to achieve successful technological change. This paper examines the change process for technology, considering the techniques for delivering change and the types of change in this sphere. The objective is to obtain an enhanced understanding of how technology can be amended in organisations and also consider the types of change identified by managers. The latter will inform the range of techniques that are recommended for use with the breadth of technologies, existing in organisations. The paper, thus, addresses this critical activity and offers insights into the practice of technology management, formulating recommendations for practice and providing a contribution to academic theory in this subject area. A review of the literature was undertaken, in order to establish the key themes in this area. An empirical study was also enacted, in the form of a survey of a sample of UK-based, current practitioners. The requirements for technological change were obtained from these managers. The data from the literature and empirical study was examined via thematic analysis. The principal themes were discerned using a grounded approach. A framework, comprising a model of the required change, was then constructed to contribute to practice and academic theory, as well as summarise this research.

Keywords: Technology Management, Change Management, Technological Change, Grounded Approach, Change Framework



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1. INTRODUCTION

The use of technology is critical to most organisations. The speed of technological adoption can be essential to the provision of service and, possibly, the survival of the enterprise. The pandemic has exacerbated this requirement, as technology solutions have been employed in order to continue with operations, accommodating the restrictions on the movement of population to inhibit the spread of the virus. The use of communications technologies, for example, has permitted such

business continuity under these abnormal conditions. The post-pandemic era has brought new challenges, as hastily implemented technologies are adapted for more long-term usage and an altered business environment, impacted by a series of major global events and policy decisions.

The ability to change technology to correct and improve its effects is, therefore, a vital attribute of any successful organisation. This research examines the critical elements in the technology change management process, embracing theory and practice to derive a contribution to this sphere.

2. METHODOLOGY

The research for the paper comprised an empirical contribution and study of the academic literature in this area. Key themes were discerned from literature on the topic of technology management, selected from the principal journals that address this subject. An empirical study was undertaken, in the form of a survey of a selected number of UK-based technology managers. The sample embraced personnel who worked in public and private organisations of various sizes, from large multinationals to relatively small companies. The respondents' statements in respect of recommendations for change in their organisations were collected and summarised in terms of the key themes. A grounded approach was used, in respect of the results from the literature and empirical studies. The aggregation into a hierarchy of themes was, therefore, enacted, utilising an 'open' coding scheme, namely without a predetermined structure [1, 2].

A suggested framework for delivering change to technology in organisations was created from this research (as per [3]). The objective was to potentially provide assistance to practitioners who have a role in implementing such amendments as well as an addition to theory in this area of change management. The latter outcomes could also serve as a summary of knowledge gained in this sphere, thus comprising an initial position for future research into technology management in practice.

3. LITERATURE REVIEW

A range of literature was considered, using a sample of the principal journals in the subject area. A thematic analysis was undertaken in order to discern the key learning facets from the selected literature.

The seminal Change Management Models can be considered. These provide general frameworks for organising change and can, therefore, be applied to technological change in organisations. More recent change management literature was also reviewed, especially articles with a focus on aspects of technological change.

The objective was to comprehend the current status of knowledge in the area of technology change management.

3.1 'Unfreezing' Change Model

Lewin's model [4] suggests that there are three main stages of change:

- The first is termed 'unfreezing' and comprises the preparation of the organisation for change. Notification is given that the relevant area will be subject to change and so the existing arrangements, such as rules, norms, procedures, structures and even jobs and job descriptions will be subject to change. This will embrace technology and its organisational context;
- The next phase is when the change occurs and the organisational norms are reset, aligned with this new configuration. The technology is implemented during this stage, with the accommodating amendments to the organisation being enacted;
- The final stage is 'refreezing', which comprises the establishment of the new procedures and standards, accompanying the changes. This constitutes the embedding of the amendments in the organisational arrangements. This means that the required changes are valid in ongoing usage. These are, thus, changes to technology that are now in effect, namely switched from development to maintenance.

3.2 Change Equilibrium

Harold Leavitt's scheme of change [5] comprises four elements, bound together in a balanced relationship. These are: task, technology, people, and structure. The premise is that these elements exist in equilibrium when an organisation is in a static state. A change to any of these will affect this equilibrium and will, hence, cause a change in one or more of the other elements. An illustration is the installation of a new system, hence a change to the prevailing technology, that is accompanied by a revised organisational structure and work procedures, promotion and recruitment of personnel and an enhanced task, in the form of improved, extended services.

This was further updated by Lyytinen and Newman [6], who utilised research into IT to extend Leavitt's model. This comprised the perspective of an equilibrium that was periodically disturbed by change before resetting to a new equilibrium, as the organisation accommodates the adjustments to these elements. This represents the disruptive change of new systems, which apply a major shock to organisations before settling to more incremental

change, as adjustments are made to the new systems, in order to align with their procedures and resources.

3.3 Experiential Learning Model

The experiential learning model, as proposed by Kolb [7], suggests that there should be several phases to implement change in an organisation. One phase is to have the experience, so make the change to the organisation then, in the next phase, reflect on this experience, by gathering and studying the information from this action. The subsequent phase comprises conceptualisation, namely learning from this experience. This entails consideration of all of the options available, which is followed by experimentation, to determine the selection of the perceived optimum action then implementing this further change, to initiate the cycle. These actions are then repeated to form another cycle of experiential learning.

The actions here will constitute those that result, directly or indirectly, in a change to the technology of the organisation.

3.4 Strategies for Change

One useful framework for selecting strategies for change in organisations is provided by Kotter and Schlesinger [8]. This addresses the tactics needed to implement change. These concern treatment of the principal stakeholders and range from avoidance and coercion to education, collaboration and concession. The selection of the appropriate tactic will depend on the type of change, in this case focussed on technology and the prevailing circumstances inside and outside the organisation. The objective is to manage conflict arising from the change. Mechanisms can be implemented to address this potential conflict, for example by empowering individuals or groups and establishing rules to resolve any issues.

The status or relative status of the stakeholders associated with this change will also affect this selection decision and the possible outcome. The requirement to consider the appropriate tactics, in respect of stakeholder groups in a technology project, is thus indicated.

3.5 Project Management Change Delivery

Project management techniques can be used as a mechanism for change, according to research by Lannon and Walsh [9]. This comprised a study of African international development programmes. The

research suggests that change can occur at all levels, driven by projects. The requirement is to facilitate this change in order to successfully complete the project. The change needs to be enacted in a comprehensive manner, from institutions to individuals via programmes. The aim is to establish partnerships with institutions, who can supply resources to the individual projects that comprise the programmes. Local capacity can be built by trusted partners. A mechanism for knowledge retention and dissemination is needed, to facilitate the requisite learning at all of the levels of this project. This learning needs to be captured and reported through the linkages of local to global resources, thus ensuring that knowledge is retained and progress reported. The required development can thus be achieved at the local level.

3.6 Persuasion to Change

Techniques for persuading organisations to implement change are considered [10]. Failure here can cause major issues through maintaining obsolete systems, practices and thinking. The problem of gathering information that indicates change is needed is cited, as the accumulation of more information reduces the opportunity for action because other organisations will have implemented change already, thus reducing the potential gains from the market, for instance. The contrast between a smaller organisation that is relatively new to the sector, which can implement change without a large amount of evidence, is mentioned. The latter will probably have fewer stakeholders to consult and less or no established business to protect, hence, can elect for major change without the requirement for a large volume of evidence. A large, corporate organisation will be in the opposite situation, with the need to consider the risk to established business and to consult many important stakeholders prior to a change decision. The example of an Australian law firm, an established practice with a low propensity for change, was used to illustrate the requisite initiation techniques. New technologies and techniques were introduced via: the use of private data, such as customer feedback, to convince senior managers of the need for change; applying initial change to a specific area, namely new staff; training personnel to champion the changes; amending the current business model (of chargeable staff time to more 'fixed price' services). This allowed a large business to successfully adopt new technologies and

practices, thus assisting in maintaining its position within its sector.

3.7 Environment for Change

The environment for the change can be considered [11]. Research into the institutional framework for collaborative projects between public and private organisations, in China, was undertaken. Informal institutions were viewed as the initiator here, in the form of cultural systems, which embrace customs, norms and religions. Formal institutions, in terms of laws, comprising regulations and legal rights, are the next strata to influence the projects. These determine the nature of the agreements, including contractual rules, that are formulated to enact these projects. The context for the change, delivered by these projects, is thus determined by these societal 'layers' of formal and informal rules.

3.8 Change Champions

The role of leader or champion of change can be considered (in a study that was located in a healthcare environment, [12]). This research emphasised the social and cultural role of such champions, who should be trusted, credible individuals in respect of their social and professional status. The importance of network connections and the requirement to disseminate knowledge, after the initial phase of change, were detailed. The need for this change leadership to be shared by a number of personnel, after the initial phase, was also mentioned. The impact of the lone champion was said to diminish after this phase, thus necessitating dissemination of the change amongst the staff. This should encourage the change, for instance, of a technological nature, to be accepted and embedded in the organisation.

3.9 Projects as Interventions

Whyte & Mottee [13] suggested that projects should be viewed as 'interventions' in nature. The impact on the natural environment should be given primacy, above any short-term project objectives. This research stated that the traditional view of project managers seeking to meet time, budget and risk targets was too limited. Projects should, ideally, contribute to the United Nations' Sustainable Development Goals. The aspiration was to go beyond the scope of considering social and environmental aspects, as well as economic criteria, in terms of project rationale (as per the 'triple bottom line' [14]. This concern for impact on the natural

world should be central to project selection and delivery decisions, according to this work.

This is especially relevant to the technology sector, as a leading consumer of resources. Cloud computing, for example, has financial and functional benefits, in terms of economies of scale, for instance. Cloud providers, though, use data storage facilities that require power and cooling, thus increasing resource usage. The requirement to consider natural resources, therefore, actively protect the environment, for example by reducing carbon emissions and curtailing power production from fossil fuels, should be present in technology project decisions, according to these authors (see also [15]).

3.10 Change Agility

Michels and Murphy [16] examined companies' ability to change quickly to accommodate environmental issues. They developed measures of an organisation's ability to change. This comprised the activities of leading, accelerating and organising change, focussed on the organisation's purpose, capacity and flexibility, for instance. The main method of achieving this agility was through obtaining the relevant data, possibly via experimentation, being prepared to disrupt current methods and brief the company leaders on the change, persuading them to support and promote the changes, according to this research. This is especially important in respect of technology, in order to introduce vital changes to allow organisations to improve performance. The ability to introduce change quickly may be essential for an organisation to survive and thrive in its operating environment.

3.11 Change to Digital Systems

The creation of digital culture is viewed as a key element in moving from traditional IT based capabilities to digital businesses [17]. The need for this focus to take advantage of the opportunities in the digital environment are stated. The notion of organisations with dual aspects is mentioned, where traditional IT based operations exist alongside emerging digital developments. The suggestion is that organisations need to formulate digital capabilities to create value for their customers on cloud-based platforms, fostered by a digital culture. This is termed 'digital agility', which is required to take advantage of the prevailing digital opportunities. The restrictions of the pandemic have

accelerated this move to more digital systems in organisations, in order to facilitate communications and service delivery. The example was given of a business that provided a platform to link suppliers with customers. This is a 'network' business, which is 'asset-light', with the revenue generated from its ability to link supply with demand in the chosen area.

3.12 Team Resilience

The requirement for teams to be resilient in order to successfully deliver innovative projects is discussed [18]. This research states that resilience in these teams increases the chances of success in terms of project outcomes. Resilience is defined as the ability to overcome setbacks or obstacles to delivering the project. Success is viewed as: implementation, namely within time, budget and quality constraints; outcomes, such as product or service, with stakeholder satisfaction; and learning, such as knowledge acquisition and transfer. This study of project teams suggested that resilience had several traits, namely: work to prevent failure; aim to understand and address any complexity; commitment to delivering the project objectives; dedication to the project and determination to solve any problems that may arise; giving priority to knowledge rather than management hierarchy in the team and external personnel. The authors utilised a survey in a large German multinational logistics company, focusing on team members who were involved in innovative projects.

This research also considered the optimum environment to create the required results. The teams should, thus, develop the safety aspect, to permit freedom of expression. This environment should encourage knowledge acquisition and exchange. These attributes will help foster resilience in the teams, thus leading to an increased rate of success in project delivery.

This research is especially relevant to technology projects, which often occur in challenging circumstances and require considerable aptitude for problem-solving.

4. FINDINGS

A survey of a selected sample of UK-based technology managers and professionals was held in the post pandemic period. These personnel worked for a diverse range of organisations, including public and private sector, as well as a variety of sizes, from

large multinationals to small companies. Eighty responses were obtained to the following question, 'what is the aspect of technology in your organisation that requires most improvement?' The comments were analysed and organised into the principal themes with their accompanying sub-themes. They were also compared with the themes in the literature, in order to give academic context to this work.

4.1 Technology

Technology was the main theme, with around 50% of the entries. These focussed on suggested changes to the technology employed by their organisations. Several sub-themes were discerned and are mentioned below.

4.1.1 Replacement of Outdated Systems

The removal of previous generations of systems was indicated, as they were viewed as being no longer viable. These systems were perceived as being inefficient and difficult to use and maintain. One respondent stated, 'our legacy systems are obsolete.' This clearly summarised the viewpoint of these personnel.

4.1.2 Automation of Manual Systems

'We need to replace the manual systems,' stated a respondent. The requirement to automate manual work systems was emphasised in several responses.

4.1.3 Replacing Substandard Programs

The replacement of old, inefficient systems work was indicated as a priority. This could also include programming work that was implemented rapidly to provide facilities during the restrictions of the pandemic. These systems now require replacing, due to factors such as inefficiency, lack of security features and reduced standards. 'The priority is to remove the technical debt,' stated a respondent, thus summarising this theme.

4.1.4 Integration and Coordination

A response was: 'The older systems don't link to the new - we need to consolidate.' It highlighted the need to link systems to avoid duplication of data and reduce manual procedures in this area. The aim of having 'a single point of truth' was stated, namely the avoidance of duplication of data across several systems. Improved integration of systems was viewed as an essential requirement, so that seamless interfacing exists between the different functions.

4.1.5 Modern Systems

The need to move to more modern systems, away from the older, more traditional technologies was stated. 'Cloud migration is required' was an example response. The implementation of cloud systems to replace traditional IT was indicated in several responses.

These comments relate to the literature on the technology life cycle (such as [19]).

4.2 Management

A principal theme indicated in this survey was that of 'management', with around 20% of the entries. The sub-themes are shown in the following sections.

4.2.1 Working in Separate Units

'Working in silos - many teams in different areas' was mentioned, indicating issues with the organisation of the teams, which hampered collaborative working. The requirement for improved communications was stated by several respondents. This is reflected in the academic sources (such as [20]).

4.2.2 Improved Resource Allocation

'Coordination needed - too many shouting for limited resources', was mentioned. This indicates an improvement required to the system of resource allocation in organisations. The prioritisation of technology resources and its accompanying funding was, therefore, highlighted.

This theme is present in the academic literature on strategy, for example [21].

4.3 Procurement

A further major theme was discerned, in respect of 'procurement', with around 15% of the total responses. The sub-themes are listed below.

4.3.1 Improved Request System

An 'improved request system' was highlighted as a potential area for improvement. This addressed the system for obtaining new technology and technology services. The general requirement was to facilitate the request, evaluation and acceptance of such new acquisitions. The suggestion was that this would improve the organisation by updating this area for both systems and user personnel.

4.3.2 Obstacles to New Technology Approval

One area that received comments, in respect of the procurement process, was that of the obstacles to

the approval of new technology. A typical response was that there were, 'too many stages for approving new technology'. This refers to the length of time and amount of effort needed to get the final agreement on technology expenditure. This was viewed as an obstacle to progress in these organisations.

The literature on contracts and outsourcing provides a context for these themes, for instance [22].

4.4 People and Processes

A major theme in respect of 'people and processes' was identified and this constituted 15% of the total responses. The main sub-themes are noted below.

4.4.1 Resistance to Automation

'Resistance to automation' was cited by several respondents. The problem of staff opposing the change to computerised systems was emphasised, especially where this entailed the removal of manual systems. The issues of deskilling and removal of areas of competence and expertise, together with insecurity concerning change, were all implied in these responses.

The theme of resistance to change and requirement to apply suitable tactics is present in several academic sources ([20][8]).

4.4.2 Documentation

The need to document systems adequately was mentioned: 'Proper documentation required.' This links with the requirement to address issues with legacy systems and technical debt. Lack of proper documentation means that old or new systems are difficult to maintain and develop, in the future.

The need to document technology at all phases of the life cycle was noted in the literature [19].

4.4.3 Training

There were several comments on the need for training, both for systems and user personnel. This has been exacerbated by the rapid installation of faculties to accommodate the pandemic. 'Training required to accompany the transfer to Microsoft Teams' comprised one such comment. The switch to virtual working at home needed to be accompanied by further training, in order to consolidate and extend this change, in the future. The latter

requirement for virtual teams and training is present in several academic sources ([20] [23]).

The general need for the organisation's leadership to use successful change management [24] and risk management [25] techniques is reflected in the literature.

5. DISCUSSION

The themes from the literature review and empirical study have been used to construct a framework for addressing the area of technological change in organisations (in Diagram 1 below). These comprise the four main themes of: technology, management, procurement, people and processes. These are the recommended areas for attention, as derived from the empirical study.

Recommendations on change management practice have also been added to this framework, using the themes from the literature review.

Technology was the main theme from the study. The critical areas for improvement were indicated as the modernisation of systems, along with the removal of technical debt and replacement of legacy systems. The automation of manual systems was also viewed as a vital activity.

The management of the organisation was highlighted as a key area. The principal areas identified here concerned the organisation of teams

and communication as well as the prioritisation of resources in the organisation.

Procurement was a critical area. Problems with the approval of new systems and hardware were mentioned. The need for more efficient procurement processes was highlighted.

People and processes were indicated as a vital area to address. The requirement to address resistance to change was indicated. The need for proper documentation of systems and training of user and systems personnel were viewed as being key areas for attention.

Change management techniques, derived from the literature, were also illustrated.

These should assist in implementing the nominated changes. Strategies for implementing change, including the encouragement of teamworking and the use of 'change champions' were mentioned, as well as the consideration of the social and environmental impacts.

Nothing is permanent except change. Being in society 5.0, [26] we must be ready to adopt change. The change is being customized through web 3.0[27]. In all those changing conditions, we must maintain ethical constraints as permanent ethical fiber can only shape society as expected otherwise be ready to expect the unexpected [28,29].

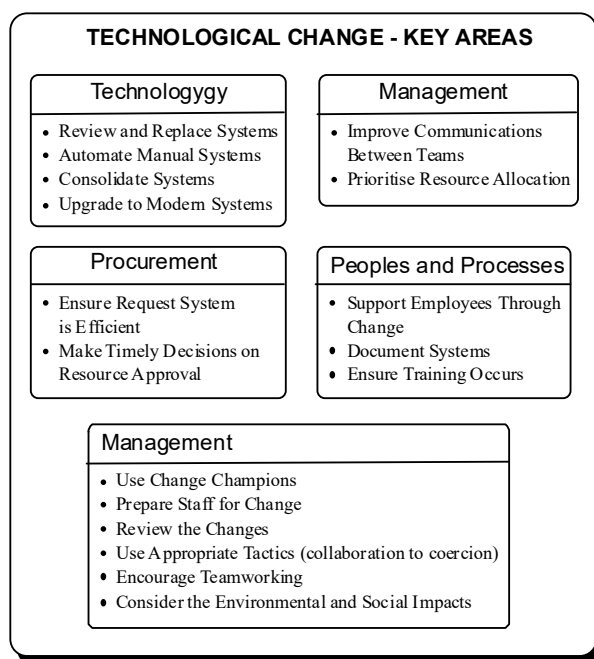


Diagram 1 – Key Areas for Managing Technological Change

6. CONCLUSION

This paper provides insights into technological change management in organisations, drawing from the literature and an empirical study of personnel who work in this area. The recommendations have been summarised in a framework, illustrating good practice in respect of this topic. This research could be extended via further research investigating change management from the perspective of technology professionals, for example, using a sample of those based outside the UK. The aim of this research is to contribute to the knowledge of this vital activity.

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