Role of virtual reality (VR) in managing e-work

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Abstract

This paper outlines a framework for managing e-Work processes using virtual reality tools. The paper also identifies the generic activities in eWork processes, which are integrative with VR environments. A model for managing eWork processes in VR environments is proposed. In addition this paper introduces new concepts, processes and models that can be used to define e-Work architecture. The model presented in this paper identifies the generic activities in e-Work processes and their collaborative nature. This paper also introduces new concepts, processes and models that can be used to define the strategic value of e-Work architecture.

1 Introduction

Innovative applications combined with next generation research in information technology and cultural heritage are all major drivers for the emergent Internet-knowledge-based economy [1]. However, as competition intensifies, many organisations find that they need to strengthen their strategic focus on visionary long term/high risk activities supportive of their objectives. In doing so, they need to understand better the social, economic, industrial, technological and legal aspects of new developments such as e-Work. Organisations also need to develop models and scenarios that can help shape their future policies, technology development and deployment strategies.

In contrast to previous economies, this digital-knowledge-based economy is characterised by higher degrees of uncertainties and risks. Accordingly, it is more important than ever that organisations have a clear sense of what they are trying to accomplish from implementing e-Work practices.

According to Soliman [2], e-Work is a cyclical and evolutionary process that seeks to integrate many activities within and between enterprises. For instance,
in a typical organisation the *front-end* deals with customers while the *back-end* deals with suppliers. Clearly integrating the *front-end* with the *back-end* enhances the strategic position of organisations [3]. E-Work is much more than easy access to the Internet and e-mail; in fact it is everything that business does and needs to be doing [4]. Further, e-Work practices are significantly different in meaning and requirements. In other words each organisation may implement different type of e-Work practices and processes. For example, in financial companies, e-Work could mean extending services to global markets or migrating legacy systems into a Web-enabled environments. However in manufacturing industries, e-Work could encompass giving customers access to networks, strengthening relationships, connecting supply chains and integrating logistics, order entry, distribution etc.

2 Emergence of the e-worked organisation

Recent advances in IT and in particular the Internet have facilitated the development of mobile and ubiquitous (anywhere, anytime) such as e-Work and e-Commerce solutions. For these solutions to be useful they need to be visionary, multidisciplinary efforts that bring together expertise in portable and wireless systems with that of people working in areas such as cognitive psychology, human factors, organisational behaviour, architecture/design and public facilities management [5].

Most analysts agree that information and communication technologies have led to wholesale changes in work organisation and a shift towards ‘knowledge work’. It should be noted that e-Work is on the increase and has become a major factor in the flexibilisation of work which has led to increasing focus on user centred concepts in useful areas such as:

- Work outside normal offices (e.g. in public spaces, shopping centres, airports, hotels).
- Environments for open, seamless and secure integration of heterogeneous context-sensitive (e.g. time, location, or task-sensitive) e-Work services and business processes.
- Intuitive e-Work/e-Commerce solutions and environments that support novel useful interactions between people (e.g. customers, employees), smart artefacts and services.

3 The evolving themes of e-work

According to Soliman [2], one of the aims of e-Work practices is enabling both individuals and organisations to innovate and be more effective and efficient in their work and businesses. This will ultimately increase their competitiveness while improving the quality of the individual's working life and consumer confidence. Soliman [2] also identified the following as additional aims of e-Work practices:
a) Supporting the identification of new organisational paradigms made possible through the convergence of information and communications technology,
b) Enhancing trust and cooperation between staff, suppliers and consumers across the value network, and
c) Assisting in developing tools required by individuals and groups to operate in new organisational environments.

The rapid convergence of mobile communication, digital broadcasting and network infrastructures calls for systems that are adaptive and responsive to the needs of people, businesses and organisations [1]. These systems are foreseen to encourage co-ordination across organisational disciplines with the aim of: a) advancing integration and convergence by forging alliances between staff, suppliers and consumers, b) providing online and interactive mobile services to a wide array of public and private users. In doing so, the e-worked organisation must focus on the following four inter-linked themes:

- Encouraging paradigm shifts likely to affect services in the future, including next generation digital libraries and e-learning.
- Promoting innovation and creativity in the work place with a greater focus on Teleworking and remote interactive e-Self Services.
- Empowering the workforce to adapt to rapidly changing skills profiles through novel personal training solutions.
- Improving natural and user friendly interaction between humans and the universe of digital services, especially in non-expert, home and mobile environments.

4 Challenges facing the e-worked organisation

Clearly new technologies offer the promise of redefining completely relations between suppliers and consumers across the value network, leading to a global digital economy where consumers and businesses can seamlessly and dynamically come together. These value constellations need to be assembled dynamically in response to constantly changing, highly customised market demands. On one hand, e-Work brings users and technologists together with experts from areas as diverse as workplace design, human computer interaction, human factors, social sciences, psychology or architecture. However, on the other hand, e-Work present organisations with many challenges such as:

- How to increase participation in knowledge work and making it more accessible to people marginalized by the digital divide?
- How to develop attractive, safe workplace designs in which integrated information and communication systems are easy to use and reduce information overload?
- How to promote sustainable development through novel workplace concepts and novel work practices that improve efficiency of resource use, both in workplace equipment and in the built environment itself.
- How to develop innovative shared e-Work facilities, including multi-purpose tele-centres in local communities?
How to integrate emerging technologies such as wireless, multi-modal, wearable, or embedded ones with innovative office and workplace designs to create and demonstrate creative work environments and practices suitable for all?

In addition, the information revolution, globalisation and the dramatic increase in telecommunications have been key factors behind changing the traditional layout of the macroeconomic figures of most national economies. This in turn has created two choices for organisations:

- Either to re-orient (re-train) staff in order to fill knowledge gaps; or
- To use more and more workers from other countries to fill strategic gaps.

According to Soliman and Spooner [6], organisations must overcome their knowledge and strategic gaps if they want to retain and/or enhance their position in the industry. Filling knowledge and strategic gaps may be achieved, either by subcontracting fragments of projects to foreign companies or by collaborating with tele-workers.

The work model in the e-Work-based economy is changing to a much more open situation, in which the office is not any more located in one place, but the physical location is replaced by a logical location, distributed across all staff. In addition, the e-Work model needs to be supported by e-learning tools.

According to Soliman [4], e-Work processes cannot be implemented as separate or isolated entities. Furthermore, for e-work to succeed the enterprise must closely control and coordinate the implementation and must create appropriate environments for effective collaborative and teamwork approach.

5 Dimensions of the e-work model

According to Soliman [2], e-Work practices are significantly different in meaning and requirements. In other words each organisation may implement different e-Work practices. For example, in financial companies, e-Work could mean extending services to global markets or migrating legacy systems into a Web-enabled environment. However in manufacturing industries, e-Work could encompass giving customers access to networks, strengthening relationships, connecting supply chains and integrating logistics, order entry, distribution etc.

In contrast to previous economies, this digital economy is characterised by higher degrees of uncertainties and risks. Accordingly, it is more important than ever that organisations have a clear sense of what they are trying to accomplish from implementing e-Work processes. In general, the implementation of e-Work processes begins with formalising business objectives and then defining and refining business strategies.

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closely control and coordinate the implementation and must create appropriate environments for effective collaborative and teamwork approach.

The e-Work model (the 3P Model) can be described in terms of three dimensions (people, processes and products) as follows:

1. The **people** dimension: This dimension consists of the following three segments:

   a) **eCR or e-Customer Relationships**: eCR is about giving customers direct access to information on products and services where possible and practical. eCR is also concerned with increasing the quality of contact with the customer (customers’ touch points).

   b) **eSR (Supplier Relationships)**: eSR provides an opportunity to create a Supply Web which can give all businesses involved with developing, manufacturing, distributing, and inventorying products access to the critical information they need to plan their operations whenever and wherever they need it.

   c) **eER (Employee Relationships)**: eER provides employees with access to wider resources such as sales-force automation (SFA), customer resource management (CRM), and enterprise resource planning (ERP).

2. The **processes** dimension: Similarly, the **processes** dimension consists of the following three segments:

   a) **eMK (Marketing Functions)**: eMK is about enabling marketers to inexpensively attract consumers into one-to-one relationships fuelled by two-way conversations played out via mouse clicks on a computer. Through his iterative process, prospective buyers are able to collaborate with marketers to fashion the product or service being sold. This also could help marketers to earn loyalty by inviting each prospect to join in a uniquely responsive and tailored dialogue. The eMK function matches buyers with sellers in a virtual marketplace.

   b) **eOP (Operations Functions)**: eOP can create opportunities for e-procurement, e-bill presentment and e-operations. eOP has transformed the functions of operations by streamlining and automating each stage of its processes, from searching for a product or service to ordering, approval, tracking and payment.

   c) **eSA (Sales Functions)**: eSA can create opportunities for e-bid procurement and e-bill presentment. By unifying sales operations, organisations not only achieve economies of scale and increased convenience for customers; but also customers will have a self-service option that could remove a heavy volume of transactional tasks from the sales force while increasing convenience for customers.

3. The **product** dimension: The **product** dimension also consists of three segments as follows:
a) ePR (Products Required): ePR function facilitates the acquisition of products and services required for the company to fill its obligation to customers. While the eOP function creates opportunities for e-procurement, the ePR actually executes the purchase orders and ensures that goods and services are made available for operations. The ePR function provides a framework for e-logistics efforts and gives suppliers a self-service option.

b) ePP (Products Produced): ePP function enables each product to become an invaluable point of presence for the company and provides opportunities for creative sales and value-added services. While the eOP function creates opportunities for dispatch of goods and services to customers, the ePP actually ensures that goods and services are delivered to customers as per contractual obligations. The ePP function makes each product an invaluable point of presence. The ePP function provides a framework for rethinking development efforts, create more personalised and customisable products and services, generate revenue from existing product features and to give customers a self-service option. While eCR is concerned customers feedback through customers’ touch points, the ePP is actually the function responsible for marinating the touch points, obtaining customers feedback and e-bill presentment.

c) ePD (Products Data): The ePD function is regarded as the lifeblood of organisations. This function could assist in transforming volumes of raw data into practical information and business intelligence. In the digital economy, organisations can no longer afford to treat storage systems, servers, and networks as separate, discreet entities, these resources must be integrated and unified under centralised management approach. The ePD function is about managing the company’s virtual assets centrally for the purpose of saving time and maximising resource utilisation.

6 Types of e-work processes

According to Soliman [4], the Internet has changed the rules of most organisational work practices and has led to the creation of new types of e-Work processes. However, all e-Work processes share many common characteristics i.e. e-Work processes:

1. are based on well-defined, public interfaces which enable them to use and be used by other services in order to deliver their functionality across multiple and remote sites,
2. can be shared and reused by multiple sites, end users, and service providers,
3. can provide a coherent and complete set of functionality,
4. can be brokered, billed, administered, monitored, advertised, or syndicated,
5. can be combined to create new services,
6. are location-and system-independent, and
7. can be deployed in one of the following three modes: a) One to One, b), Many to One and c) One to Many basis.

Soliman [2] identified the following six types of e-Work services:
1. Device services: Manage the display and input of e-Work services.

2. Content services: Prepare content for delivery to the full range of required devices. This may include content transformation and other related services.

3. Presentation services: Personalise content services, which entails the assembly of content, formatting, conversions, and content transformations i.e. anything that has to do with the physical appearance of files and information used by the end user.

4. Business services: Execute business logic and manage transactions (which contain the business rules of the enterprise). This type of e-Work services also includes process automation and workflow.

5. Integration services: Integrate with other services and combine external resources to provide business services such as database access, publish/subscribe communication, and synchronous or asynchronous messaging.

6. Application services: Determine actual applications the business deploys on the network e.g. ERP, CRM, Supply Chain Management (SCM), Sales Force Automation (SFA), and other applications.

In general, operating each of the above e-Work processes may require the user to interact with the electronic and physical part of each process. In other words operators of e-Work processes would be involved in a mixed reality applications.

7 Application of virtual reality (VR) in e-work

In general, mixed realities may be appropriate where interaction is required with both physical and electronic data within a single application. Obvious examples are where a physical object has an electronic counterpart and both need to be considered side by side. For example, supply chain processes can be either: a) physical processes (non-electronic or non-e-processes), or b) non-physical processes (electronic or e-processes). Physical processes are concerned with the delivery of physical or raw material to the factory while electronic processes would be concerned with schedules, invoices, shipping details and so forth. Electronic or e-processes are also known as virtual processes.

E-Work still in its infancy and so the research on the application of Virtual Reality (VR) technology in e-Work. For instance, there is little known about:

- How can VR tools be used in e-Work environments?
- Would VR tools enhance e-Work and provide advantage to businesses?
- How can an organisation prioritise its business functions using VR enabled e-Work practices?
- What business problems can an organisation solve by employing VR tools in e-Work processes?
- How would the application of VR in an e-Work setting help an organisation derive competitive advantages?
What would be the cost of not implementing e-Work practices enhanced by VR tools?

8 Model of VR enabled e-work

The recent spread of the Internet has created a situation where we need to deal with two parallel realities, the physical reality (PR) of everyday spaces and objects and the electronic or virtual reality (VR). These two realities were seen as quite separate and detached. However, Brown et al. [7], proposed the idea of mixed realities: systems which span both the physical and virtual realities and which combines both physical and synthetic data. The aim is of course to provide applications, which unify the virtual, and the physical reality and which help users manage the spread of their activity between them. Brown et al. [7], also presented the concept known as the Internet Foyer which provides an example of a system which links users of Collaborative Virtual Environments (CVEs), users browsing the World Wide Web (WWW) and people wandering through physical spaces.

It is widely accepted that in most organisations there exist two workspaces; namely the physical space and the electronic or virtual space. In other words, work can be conducted in the two foyers (the physical foyer and virtual foyer) concurrently. The collaborative virtual environments allow people to meet, interact with each other and conduct work in the combined physical foyer and virtual foyer. Linking the two foyers could be achieved using a combination of projected graphics and textured video tools. The link could lead to a unified entry point into both the organisation’s physical space and electronic space.

Within the virtual foyer a CVE user can see the visualisation of the WWW space, with 3D spheres representing web pages and arrows between them representing the hypertext links. On one side of the virtual foyer there is a virtual ‘window’, which gives a view into the physical foyer, affording the CVE users an awareness of the real world. The following are two examples of interacting with the two realities using the virtual ‘window’ in CVE environments:

- Production managers viewing real-time production schedule may simultaneously require a view of the physical raw material delivered.
- Process managers in a manufacturing plant may wish to see an image of the real factory floor when discussing the status of a production line and also.

Figure 1 below illustrates how a model of a typical supply chain can be represented in the two realities (the physical reality and virtual reality) within CVEs.

It is important to realise that any interaction in the virtual world may be potentially influenced by that in the real world and vice versa. Consequently, a degree of awareness and communication must flow between the two realities. A virtual environment, like the real world, requires the same cues, spatial definition
and order if it is to be understood by its inhabitants even if these are expressed in radically different ways [5].

![Conceptual view of a typical supply chain in the Physical Foyer](image)

![Conceptual view of the supply chain in the Virtual Foyer](image)

Figure 1: Representation of a typical supply chain in physical and virtual realities.

In trying to deal with the complexity of the Internet, the virtual process (and at a higher level, the virtual organisation) can provide a powerful, readily understood organisational system. Key to this understanding is sense of place or espousal loci [8]. A virtual world exists in abstract, infinite space. For the user to orient them in the world it must be placed geographically, even if this is a relative rather than absolute placing (a single building may appear continuous to the user but may be located across a variety of servers) [9].

9 Conclusions

E-Work is a continuous process of evolution and refinement. Research indicates that e-Work architecture is unique to individual organisations, and that organisations do not start from the same point and do not implement exactly the same e-Work practices. Techniques and tools are emerging to provide help in designing, implementing and managing to support organisational goals [10].

Virtual reality (VR) does offer exciting opportunities in managing e-businesses. Applications of VR in the e-worked organisation range from assessing conceptual designs, analysing and modifying products before they are manufactured, checking functionalities, and assessing organisational systems and
decision making processes [11]. The application of VR in management is relatively new techniques. However, there is no doubt that it will have a significant impact on e-Work is practices in modern organisations.

This paper presents an overview of the uses of VR in managing e-Worked organisations. The model presented in this paper highlights the pedagogical value of VR in the emerging economy.

References