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# A model of virtual organisations

**Y. P. Shao**

*BizIT Consulting, Toronto, Canada*

**S.Y. Liao**

*City University of Hong Kong*

**H.Q. Wang**

*City University of Hong Kong*

Received 8 December 1997

Revised 9 June 1998

## **Abstract.**

**A model is presented of a virtual organisation that contains four variables: connectivity, purpose, technology and boundary. Four cases are analysed to illustrate the applicability and usefulness of the model. Based on the model, we make predictions for the stability of virtual organisations and creations of new forms of this organisational type.**

## **Background of virtual organisations and overview of the model**

The virtual organisation was seen 15–20 years ago, when working at home was made possible by the use of technology [17, 22]. Since then, terms such as *virtual office*, *virtual classroom*, and *virtual corporation* have appeared in the literature (e.g. [6, 10, 14]).

There are three generic types of virtual organisations discussed in the literature. The first are organisations that outsource some of their business activities, forming virtual alliances to achieve organisational objectives. The term *virtual organisation* can be traced back to the early days of computer technology, when 'virtual memory' was used to describe 'a way of making a computer

act as if it had more storage capacity than it really possessed' [2]. Such virtual organisations may be formed by integrating several companies' core competencies and resources. A virtual company, then, is a collection of several companies organised to behave as if it were a larger, multifaceted organisation. Chesbrough and Teece [4] analysed the practice of businesses in the marketplace and discussed the problems and concerns with firms going virtual. In fact, the coordination of these virtual activities among organisations benefits extensively from information technology (IT) applications. Virtual corporation is then described as a temporary network of independent companies – suppliers, customers and even rivals – linked by IT to share skills, costs and access to one another's markets [2, 24].

The second description of a virtual organisation is related to a conceptual organisation that is 'abstract, unseeing and existing within the minds of those who form a particular organization' [9]. The framework of virtual organisations is often subjective and open to many different perceptual interpretations. Virtual organisation is thus the antithesis of the physical organisation with which we are familiar.

The third type includes organisations that are built up by virtual links through use of IT. Earlier work in the area of IT and organisations points to a general direction in which IT contributes to organisational structures and provides an increasingly virtual mechanism for realising organisational objectives (e.g. [5, 7, 13, 15, 16]).

Virtual organisations described as such have been with us for a long time, but have not been rigorously studied in terms of technology contribution, organisational formation and market competition. There has been continued pressure on business enterprises. The pressure may come from competition, customer turnover or the general economic situation. In order to survive and develop, many organisations have become faster, leaner, more customer-oriented and more conscious of cost than they have ever been before. As a result, many organisations have become virtual and going virtual is currently one of the key elements that increase business competitiveness. How can organisations become virtual and how different are virtual organisations from conventional organisations in terms

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*Correspondence to:* Dr S.Y. Liao, Department of Information Systems, Faculty of Business, City University of Hong Kong, Hong Kong. Fax: +852 27888694. E-mail: ishongko@cityu.edu.hk

of structure and design, markets and products? An appropriate description for the virtual organisation is needed to explain the phenomenon and guide virtual practice. Our research suggests that we need to tackle this from four key aspects: connectivity, purpose, technology and boundary.

The concept of virtuality has captured people's minds for a very long time. Plato's cave dweller, who does not know whether the shadows he sees on the cave wall are those of a real world, presents an early example of *virtual reality* over 2,000 years ago. More relevant for our discussions here, however, are thoughts on virtuality that have influenced ideas of organisational design and management practice, frequently described through terms such as the *virtual corporation* [2, 14], the *virtual organization* [16] or the *virtual office* [1]. Virtuality denotes that an object/actor is acting as something else, or that an object/actor is something in fact but not in name. For human organisations, which are, by and large, artifacts (and therefore already virtual, to some extent), this usually means a structural change (breaking of constraints) in one of the following dimensions: space, time, asset use or legal status to achieve a new unity. For example, companies that are legally separate but work together as if they were a single corporation become a virtual corporation. Similarly, employees who are not co-located in the same physical space, but work together as if they were, become part of a virtual office. In addition, customers or clients who do not visit the 'physical office', but receive the goods and services as if they were there, also become associated with the virtual business. This type of *connectivity*, that leads to the breaking of constraints, creates structural change and enables physically separated people to interact as if they were at the same place, is the first characteristic of the virtual organisation to be considered in our model.

An early (30 or so years ago) and quite extreme illustration of a virtual office was evident in the collaboration of the ground crew at mission control and astronauts on board the manned Apollo spacecraft. While extremely distantly separated from each other, these groups of people worked together as if they were in the same location, using technologies such as telecommunications, video, audio and computers to create closeness. Besides the breaking of the distance constraint to achieve a new unity, this example points to two other ingredients of a virtual organisation: a *technology* or set of technologies (here, communication and computer technologies) that enables the structural change and the *purpose* or goal (here, successful spaceflight) that provides the incentive to create the new virtual solution.

With the advancement of telecommunication and computer technology, today's spacecraft can be monitored, listened to, and even viewed on screen by Internet users or amateur radio operators. Have they become part of the virtual office that links NASA's mission control on the ground and the space crew? Obviously not. They may listen and watch, but will not cooperate. In other words, the virtual office may have open windows and doors, but, nevertheless, has clear boundaries that limit access to it. Hence, there exist limits that prevent non-members of the virtual organisation from receiving unauthorised benefits or from tampering with the organisation. *Boundary* will be another important characteristic in our model of the virtual organisation.

To summarise, the model of virtual organisations that we discuss in this paper will focus on the aspects shown in Table 1.

In stressing these characteristics, we do not wish to say that they are the only ones defining virtual organisations. However, as our subsequent discussion will illustrate, they provide a useful classification framework with which to recognise virtual organisations and to predict part of the behaviour of virtual organisations.

The next section gives four examples of virtual organisations, highlighting their different characteristics in accordance with the four aspects illustrated above. That section will be followed by a detailed discussion of each characteristic and its impact on the form and functions of the virtual organisation. We conclude with speculations about their future.

Table 1  
Virtual organisation variables

<b>Connectivity</b>	– the creation of unity or linkage through structural change, breaking of constraints or overcoming of previously existing barriers;
<b>Purpose</b>	– the objective that provides the incentive for creating the new organisation and which serves as the cohesive force to hold the virtual organisation components at least temporarily together;
<b>Technology</b>	– the enabling factor that allows the breakthrough and makes the virtual form possible; and
<b>Boundary</b>	– the separation of those who are part of the virtual organisation and those who are not, in the absence of any clearly visible physical border lines. It defines who can share its activities and who receives benefits.

## Virtual organisations

### *Security First Network Bank* [18]

When asked about their bank, most people will probably tell the name of their banking institution, yet then associate 'the' bank with the branch office at which they keep their accounts, cash cheques and the like. Once they start thinking about a bank more abstractly, however, namely as a marketplace that coordinates lenders and borrowers of money, or as a clearinghouse for payment transactions, they can more quickly recognise the possibility for virtual banking. The first such solely virtual and federally approved bank in the USA, Security First Network Bank (SFNB), was established in late 1995. Customers of SFNB write cheques and pay bills electronically in addition to having access to all current rates and promotions. Since all transactions are completed online in real time, bank customers enjoy continuously balanced bank accounts.

The bank applies encryption technologies, firewall and filtering router technologies and its 'Trusted Operating Systems'. The Trusted OS secures customers' data in a 'virtual vault' and prevents anyone from gaining unauthorised access. The operating system also includes many other layers of security from the network to the browser, and sophisticated encryption that protects from intrusion. The bank furthermore employs authentication software that identifies and checks customer service representatives and protects disclosure of customer information over the bank's internal network. The authentication software is integrated into the operating systems and hence cannot be bypassed. In this way, the bank exhibits different levels of boundaries to both its customers and employees.

SFNB is accessed via the World Wide Web (WWW) through a home page that shows the image of a traditional bank lobby. It provides the bank customer with a scene featuring various desks and attendants, each labelled with a different banking task such as account set-up, personal finance and customer service. Customers simply point and click on their 'destination' and quickly move through menu-driven transactions. They can download from SFNB their bank account information into popular financial packages. Online help is also offered by account representatives via e-mail or telephone on a 24-hour-a-day, seven-day-a-week basis. In this way, the bank provides customers with an easy business connection point through the provision of Internet points that can be widely accessed. (See Table 2.)

Table 2

The variables related to a virtual bank

<b>Connectivity</b>	Creation of a marketplace for borrowers and lenders; creation of a clearinghouse for payment transactions.
<b>Purpose</b>	Provision of any-time, any-place, real-time banking, with better economies (lower costs, higher yields) both for customers and for the company.
<b>Technology</b>	Telecommunications allow any-place access. Database provides the memory to record transactions and keeps money in the virtual vault. Multimedia creates a familiar user interface.
<b>Boundary</b>	Security measures to prevent unauthorised access via the Internet. At the same time, the Internet serves as a wide-and-open medium for access by authorised users and for advertising.

### *World Cup USA, Inc.* [21]

This virtual organisation was built as a partnership between Sybase, EDS, Sun and Sprint, forming a corporation in which each partner took responsibility for a major part of the IT mission of the World Cup event. The new corporation existed only for the single event: the World Cup. Partners became extensions of the organisation and worked together on an equal basis rather than in the traditional customer/vendor relationship. The corporation was expected to grow from infancy to a Fortune 200 class firm in three years and then to disappear. IT issues were at the centre of the organisation, from the process of planning for rapid deployment and implementation to setting up over 900 networked workstations nationwide.

World Cup USA, Inc. evaluated most of the IT work. Sun assisted in setting up workstations, deployment and training, in addition to supplying the hardware and network management software. Sprint took the responsibility for telecommunications. EDS acted as the systems integrator and was responsible for the project development and operations. The main server is at EDS' Dallas data centre. Sybase provided both its SQL Server database and its Gain Momentum application development software.

The major job was to create an effective and efficient environment to support 20,000 volunteers, staff and stadium personnel with an intuitive system that does not require much training. The team started from scratch and developed the prototype of a high-bandwidth distributed client/server application plus multimedia

Table 3  
The variables related to World Cup USA, Inc.

<b>Connectivity</b>	Creation of a company by connecting a number of different corporations; the resultant company provides easy connection capabilities for a large number of people involved in the World Cup.
<b>Purpose</b>	Low set-up cost. Provision of sport service by combining strengths from various parties, making profit for them, provision of easy access to sports news for customers. The purpose was temporal, not for longevity.
<b>Technology</b>	High-bandwidth distributed client/server applications, multimedia client applications. Technology management.
<b>Boundary</b>	The boundary of the virtual organisation with each partner clearly defined through an agreement among the partners. Boundaries for company personnel, media people or others are implemented by the broadcasting system supported by the partners.

Table 4  
The variables related to the Ernst & Young 'mobile office'

<b>Connectivity</b>	Collaboration of employees and sharing of knowledge, even if distant from each other. 'Plug-and-play' connectivity to company resources, including data, printers, office space and personal telephone numbers.
<b>Purpose</b>	Cost saving (office space) and closeness to customers, without loss of productivity levels.
<b>Technology</b>	Telecommunications allow any-place access. Database permits knowledge sharing, memory for office allocation. Intelligent systems allow on-the-spot reallocation of telephone numbers. Touch-screen monitors make changing office allocations transparent.
<b>Boundary</b>	Security measures enable only Ernst & Young members to have access to organisational memory (e.g. Lotus Notes). Organisation members benefit from collective knowledge.

client application development with beta software in about three months.

World Cup USA, Inc. has shown the importance of building organisations on original business processes and suggests a new way for future events and other enterprises. The company so created relies dominantly on the employment of IT. (See Table 3.)

*Ernst & Young* [12]

In 1992, Ernst & Young decided to reduce office space allocations in the Chicago office for audit team members and consultants who spent a significant portion of their daily work hours at client sites.

Ernst & Young members now take 'their' office on the road by having access to company data through notebooks with modems and group software such as Lotus Notes. Should employees require physical space at the Sears Tower office, they are required to call into a reservation desk to make a reservation. The mobile computing technologies that employees take with them on the road are actually only a small portion of the overall infrastructure that makes this solution possible. At headquarters, the fully distributed local area network allows people to connect their portable computers to the firm's network, gain access to any electronic files, receive and send e-mail and make use of nearby printers from ports in any office. Telephones at each desk can be re-programmed to accept the varying

personal office numbers. The system automatically records a visiting employee's assigned location and makes the information available to anyone on the firm's premises by means of touch-screen computer monitors at strategic locations.

Following the successful experiment in Chicago, Ernst & Young has implemented the system in a number of locations. The firm claims that this scheme has reduced its space requirements by some 30%, from 6.6 million to 4.5 million square feet. (See Table 4.)

*Douglass, Rosewater & Brown* [19]

The fourth case is a 'virtual' advertising and public relations agency in Silicon Valley, USA. Since 1985, Douglass, Rosewater & Brown (DRB) has operated with a network of public relations and advertising specialists on an 'as-needed' basis with its core staff of strategic marketers, communicators, administration and support staff. The independent specialists are market or task-specific professionals. Linked by telecommunications technology, they are brought into agency teams. Formed as a team, they interact directly with clients. 'Virtual' employees perform about half of the agency's business. Two-thirds of the agency's virtual business is in public relations. The virtual employees are pulled from an informal network built up over many years. They are given business cards identifying them as associates of DRB and also use DRB's billing software. (See Table 5.)

Table 5  
The variables related to the Douglass, Rosewater & Brown  
'mobile office'

<b>Connectivity</b>	Creation of a unity by connecting its 'employees' with the corporation and among themselves through 'work-on-demand' contracts.
<b>Purpose</b>	Flexible staffing arrangements and lower overheads. Competent customer service through flexible arrangements with expert professionals.
<b>Technology</b>	Telecommunication technologies are used to connect independent specialists into agency teams; databases keep records of agency's business and specialists.
<b>Boundary</b>	Those who are not in the 'connected' circle will not benefit. The circle, in the form of computer files, is based on contracts between the agency, specialists and its clients.

## A detailed look at the characteristics of the virtual organisation

The four mini-case illustrations have given us some food for thought on how different virtual organisations look with respect to the key characteristics. In this section, each characteristic will be explained in some additional detail.

### *Connectivity*

When we think of connectivity, we have to ask ourselves which barrier has been broken, which structural change has been achieved and what new unity has been generated. Many virtual organisations break distance barriers (through technologies that make distance irrelevant). This is a fairly obvious and often a simple undertaking. Another barrier to be broken is legal separation, i.e. separate legal entities operating as if they were a single legal unit (the virtual corporation). A less obvious, but important, form of connectivity is the creation of a unity between different parties with significantly different goals, e.g. two or more 'players' in a competitive situation who decide to set aside their win/lose conflict in order to fend off another party. A good example was the creation of Somerset [20], a virtual organisation that integrates three world-leading computer manufacturers, IBM, Apple and Motorola, to produce a new powerful chip, the PowerPC. In this

virtual organisation, the three competitors united with a strong purpose to maximise benefits by joining, despite the fact that Motorola and IBM are competitors in the central processing unit (CPU) market and despite Apple's and IBM's competition in the personal computer market.

An additional issue of connectivity is the degree of being connected by internal (within certain boundaries) and external parties such as customers or contractors of the organisation. This degree of connectivity explains the value of the virtual organisation to its various parties. A high degree of connectivity represents strong connection capability; a low degree of connectivity represents weak connection capability.

Clearly, the more difficult it is to break the barrier, the more difficult will it be to create the virtual organisation or to keep it in existence. On the other hand, if creating the link between the separate units is the only way to achieve the common purpose, it will help the virtual organisation's creation and maintenance. For example, in spaceflight, where physical 'office' space in the craft is at a very high premium, locating only the essential in manpower and computing power into one capsule is essential. Then the only way to augment that manpower and computing capability is through physical separation and virtual closeness. This was particularly true for the cramped spacecraft 30 years ago and the prevalent computing technology at the time. Nevertheless, this virtual office form has endured until today. Thus, we need to look at connectivity both in terms of *selectivity* (how important the connectivity is for success) and in terms of *difficulty* (how difficult it is to achieve). Selectivity will foster a virtual organisation; difficulty will hinder it.

### *Purpose*

Purpose addresses the issue of value of the virtual organisation. It answers the question of what benefits are to be derived from the virtual organisation arrangement. For example, space savings or speed advantages are quantifiable aspects of this category. Satisfaction of clients, partners and employees is less quantifiable but nevertheless an important aspect of the purpose, as one previous example illustrated. Purpose is the basic drive for virtual organisational creation.

Together with connectivity, purpose describes the benefit side of the virtual organisation. The stronger the purpose (higher value) and the more selective the arrangement (only the virtual organisation form will achieve it), the more stable the virtual arrangement will be.

### Technology

Technology enables virtual organisations. Of course, there are other enablers, such as people's skills, changes in regulatory environments, and many more. These are readily recognised, but in this paper focus more specifically on technology, especially IT.

Among information technologies, three have resulted in the breaking of barriers:

- (1) telecommunications make distance irrelevant (any place);
- (2) databases provide an organisational memory and make time irrelevant (any time); and
- (3) multimedia (including animation, video and audio) creates a virtual reality through pictures and sounds.

While the first two are fundamental business process re-engineering technology [8], we expect multimedia to play a significant role in the realisation of future virtual organisations. Being the essence of video-conferencing, a more aggressive example of the role of multimedia is Nunamaker *et al.*'s Mirror room [3], a group support room for virtual groups, groups that are separated by large distances. Although electronic banking was a possibility several years ago, e.g. via e-mail, the WWW-based graphical representation of the virtual bank branch has brought significant extra 'look-and-feel' realism to the application to add to customer familiarity with, and trust in, this new form of banking.

The example of electronic banking points to two facets of the role of IT in virtual organisations. On the one hand, if technology is advanced and easy to use, it will help in the creation of virtual organisations such as electronic banks. On the other hand, complicated and expensive technologies will generally hamper adoption. In addition, if only little technology investment is required, while the tear-down and new set-up cost for the establishment of virtual organisation will be low, it may foster potential instability of the organisation. An example of a weak virtual organisation may be seen in a Californian flower company [13] that used low technologies (telephony and facsimile). The company may not be stable enough, in that the business can easily be copied by others. An instance of a strong virtual organisation is the virtual bank that used advanced technologies for electronic banking. The advanced security technology has prevented easy entry from different parties (especially companies other than American corporations).

### Boundary

As traditional physical boundaries become meaningless for virtual organisations, new and less physical, yet

similarly effective, boundaries have to be created to separate those who are part of the virtual organisation from those who are not. Only in this way can it be ensured that outsiders cannot tamper with the organisation or derive benefits from it that they are not entitled to. For example, an instructor who creates a 'virtual classroom' using Internet-based technologies has to make sure that only those who are supposedly part of that virtual classroom will have access; otherwise, the lack of differential benefits will ultimately destroy that organisation. After all, why should a student pay for an Internet-based course if everyone else in the world is able to receive the same information free of charge from the same site? Similarly, Internet-based banks will also have to ensure that unauthorised users cannot tamper with these facilities. For example, in its first several months of existence, SFNB reported 45,000 unsuccessful attempts to break into the electronic vault.

With the advancement of computer and telecommunication technologies, boundaries of virtual organisations have become stronger and, at the same time, less visible. The invisibility of a virtual organisation would be one of the important indicators to measure the virtuality of the organisation. The more invisible the boundary is, the more virtual the organisation will be. Less visible boundaries may result in more inviting business posture for organisations.

Boundaries of a virtual organisation can be installed by man-made conventions such as IDs, passwords, protocols, secret languages or the like or created by the technologies such as the one illustrated previously in SFNB. Even being and not being on the computerised mailing list (e.g. in DRB's case) can form an effective boundary.

## The model and the stability of virtual organisations

Research on IT-enabled organisational transformation [11, 13, 23] already provides the general background for organisational design. The authors believe that the model described in this paper may be useful both conceptually and practically in either establishing new virtual organisations or transforming existing ones. In particular, one aspect of the model is the power of predicting the stability (part of organisational behaviour) of virtual organisations.

Taken together, the four key characteristics give guidance for the assessment of virtual organisation stability and for the design of new virtual organisations. The combination of these two values of four characteristics

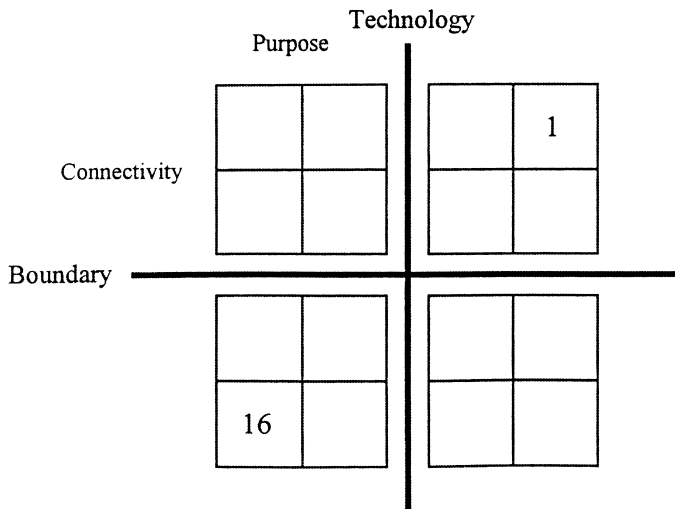


Fig. 1. Combinations of the variable values.

results in sixteen possible types of virtual organisation, such as one with high connectivity, high purpose, high technology and high boundary (strong invisibility).

Fig. 1 illustrates these sixteen possible types of virtual organisations. The vertical dark line represents *technology*, with the upper half with high value and the lower half with low value; the horizontal dark line represents *boundary*, with the right half with high value and the left half with low value. Similarly, in each of these larger squares, the vertical line represents *purpose*, with the upper half with high value and the lower half with low value; the horizontal line representing *connectivity*, with the right half with high value and the left half with low value. The figure is a schematic view of all four characteristics, with strong (high) and weak (low) values for each.

The most stable type of virtual organisation (quadrant 1) appears to be one that has high connectivity, high purpose, high boundary and high technology (e.g. NASA's virtual office between mission control and spacecraft). At the other end of the spectrum (quadrant 16), we may consider a combination of low connectivity, low in purpose, low technology and low boundary as the least stable form of virtual organisation. An example of such an unstable form would be a co-authoring scheme between researchers using traditional communication channels (e.g. 'snail mail') located at different and distant universities. The researchers can achieve their publication goals through several other means (single authorship, collaboration in their own environment). While the boundary is usually less visible, its combination with the other three weak

factors will be likely to result in very transient co-authoring schemes.

## Summary and outlook

Four key characteristic variables of virtual organisation are discussed in this paper. These four variables constitute a model of the virtual organisation that explains dominant features of virtual organisations and predicts aspects of virtual organisation behaviour. However, the authors do not wish to conclude that they are the only variables to describe and prescribe the virtual organisation, but they represent a key set of features that virtual organisations have exhibited so far.

There will be more virtual organisations in the future, because organisations may be forced by the market to run business virtually and it will become easier and easier to create them. For instance, marketing a product around the world without having a store, without capital and without a sales force is made possible through the Internet. However, longevity of virtual organisations may decrease, because they may be created for small, short-term benefits (having low set-up costs) and be disbanded when the benefits no longer accrue.

We will also need to attack new barriers through new technologies. For example, new virtual organisations across different countries may be created by removing language barriers between collaborators (automated translation tools). We also need to tackle issues related to the management of information. Information professionals will face new challenges to assist in building and running virtual organisations, since information plays an ever increasingly critical role in every aspect of the virtual organisation.

However, there might be some concerns regarding virtual organisations. Future research work is thus recommended. First, empirical studies are needed to test this model further and explore design and implementation characteristics of virtual organisations; although the model is related to both new and existing organisations for evolutionary building and transformation. This can be achieved through studies of new organisational design and the re-designing of part or all of existing organisations. Factors of culture, politics and behaviour may be uncovered. Technological support of virtual organisational design is also a challenging research area. We believe that the object-oriented approach would enhance this effort and provide one type of methodology. This may include new information systems development methodologies, software

engineering subjects and other technological issues for building virtual organisations. An additional aspect of future research is the search for suitable methodologies for the design of virtual organisations.

## Acknowledgements

The authors thank Dr Christian Wagner and Dr K. K. Wei for their comments on an earlier version of this manuscript. This research has been supported in part by a strategic grant (A700559) from the City University of Hong Kong.

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