Toward the Essence of E-Businesses

Huaglory Tianfield
School of Computing and Mathematical Sciences
Glasgow Caledonian University
70 Cowcaddens Road, Glasgow G4 0BA, United Kingdom
Tel: +44 141 331 8025, Fax: +44 141 331 8445
E-mail: h.tianfield@gcal.ac.uk

Abstract. This paper illustrates three typical instances of e-variants, i.e., e-enterprise, e-government and e-health. The conclusion is that the essence of e-variants is the computer technology being embedded and integrated in the traditional business processes.

1. Introduction

These days there have been emerging a variety of "e-variants", such as e-business, e-commerce, e-enterprise, e-government, and e-health. And there does not seem to be an end of enumerating them.

A basic question is what the essence is for e-variants? What's the re-engineering and revolution from traditional ones to e-variants? How can IT/computing effectively facilitate and realize e-everything? This paper will illustrate the essence of e-variants is the computer technology being embedded and integrated in the traditional business processes. E-this, e-that, the essence is the enabling by IT and computing. A number of typical instances of e-variants will be studied, including e-enterprise via computer integrated manufacturing systems, e-government via computer integrated office systems, and e-health via computer integrated co-operative medical diagnosis.

2. E-Enterprise via Computer Integrated Manufacturing Systems

Enterprise' operation is the most substantial section of supply chain. E-enterprise means the e-tization of all the business processes within an enterprise, involving the management of information flows, materials flows and financial flows.

Traditionally, processes related with product development are performed within one enterprise. Product development is realized by use of resources of one enterprise, as depicted in Fig. 1.

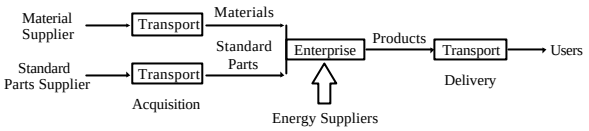


Fig. 1. Non-partnership enterprise engineering of product development

However, situation changes in current societies and technologies. Processes related with product development are or have to be performed across a group of partner enterprises. Product development is realized by use of resources of a group of partner enterprises, as depicted in Fig. 2.

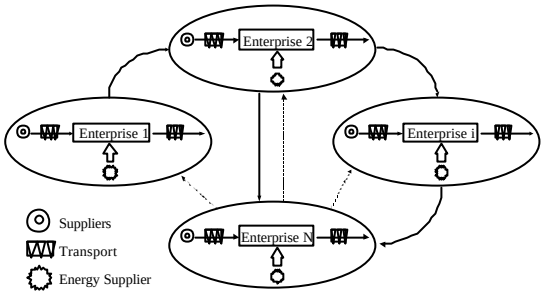


Fig. 2. Partnership enterprise engineering of product development

E-tization of business processes may have different emphases in partnership and non-partnership enterprise engineering.

2.1 Enterprise Information Integration

From the view of decisional behaviors executed in various functional departments, an enterprise has a decision behavioral pyramid, as depicted in Fig. 3. The bigger bottom of the pyramid means a bigger number of autonomous sub-processes, and the smaller top of the pyramid means aggregation of groups of sub-processes.

Information spreads throughout all organizational structures and functional departments, and throughout all levels of decisional behaviors in an enterprise. Typical information systems in an enterprise can be depicted in Fig. 4.

One of the contemporary paradigms for enterprise operations and management is concurrent engineering.

What concurrent engineering pursues is right to achieve the success of complex product development on (nearly) one time of physical-resource-consumption dominated implementation at the cost of multiple evolution of information-processing dominated design/planning.

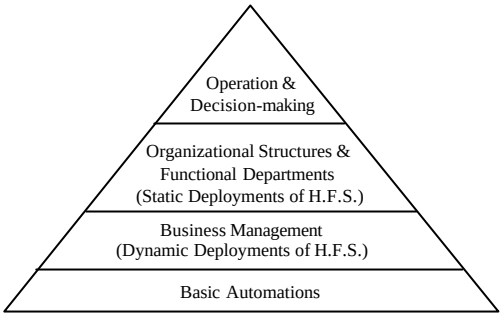


Fig. 3. Decision behavioral pyramid in an enterprise (H. F. S. humans, finance, and substances including both means and objects of production)

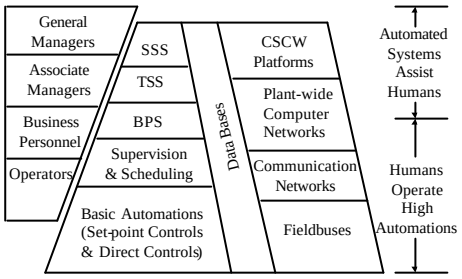


Fig. 4. Information systems in an enterprise (SSS / TSS: strategic/tactic support systems, BPS: business processing systems, CSCW: computer supported co-operative work)

The core of concurrent engineering is information-substitutive concurrency [1]. That is, design/planning of downstream life-cycle stages and life-cycle-through processes proceeds and intertwines concurrently with upstream life-cycle stages. Thus, concurrent engineering is making an information-substitutive expansion of all processes related with product development, right before the start of physical-resource-consumption dominated implementations, i.e. only within upstream reach of product life cycle, as depicted in Fig. 5.

By this way, various factors arising from all life-cycle stages are simultaneously taken into comprehensive consideration, get integrated and intertwined with each other, and become simultaneously unified and resolved, right from the beginning of product development, within upstream reach of product life cycle.

Other paradigms for enterprise operations and management are, e.g., MRP II (manufacturing resource planning), cost management, TQM (total quality management), decision support system (DSS), etc.

Enterprise systems are nowadays becoming increasingly complex and as a result, the information processing required in enterprises has become much more complicated and difficult to handle than ever. A computer integrated manufacturing system (CIMS) is an enterprise-wide computer information management system, as depicted in Fig. 6.

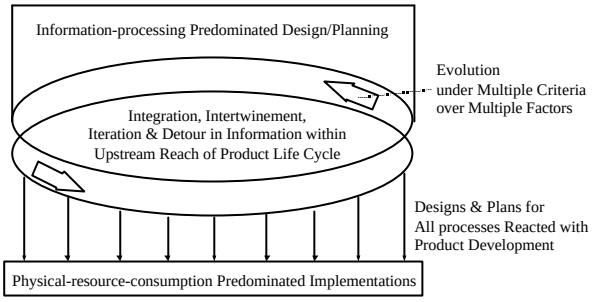


Fig. 5. Information-substitutive expansion of all processes related with product development

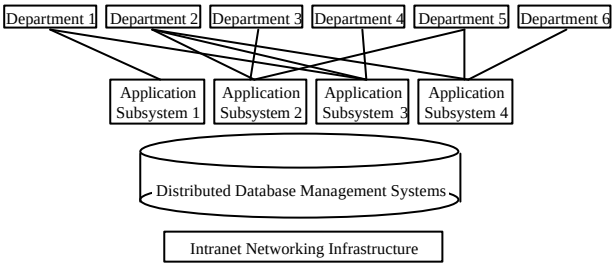


Fig. 6. Logical and physical relationships between subsystems of CIMS

An overall development planning was carried out for PBW-CIMS after requirement investigation, concluding that incremental paradigm be applied to the development of PBW-CIMS, as sketched in Fig. 7. Development phases are identified.

Markets are changing instantaneously. Therefore, as a strategy / tactics for enterprise operations and management, it is inevitably changeable, which requires information integration in enterprises have sufficient restructurability correspondingly. Here a hierarchy is put forward for information integration in enterprises, as shown in Fig. 8.

2.2 Enterprise partnerships

Enterprise partnerships raise new topics such as enterprise integration and enterprise federation. Recently many novel concepts have been put forward, e.g.

- Virtual enterprises,
- Extended enterprises,
- Global enterprises,
- Agile enterprises,
- Network of (partner) enterprises,
- Project consortiums.

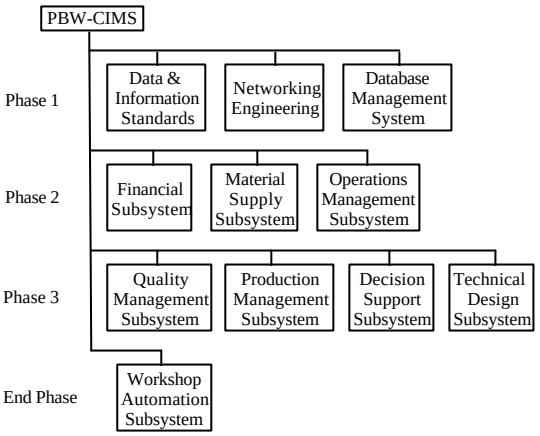


Fig. 7. Development phases of PBW-CIMS

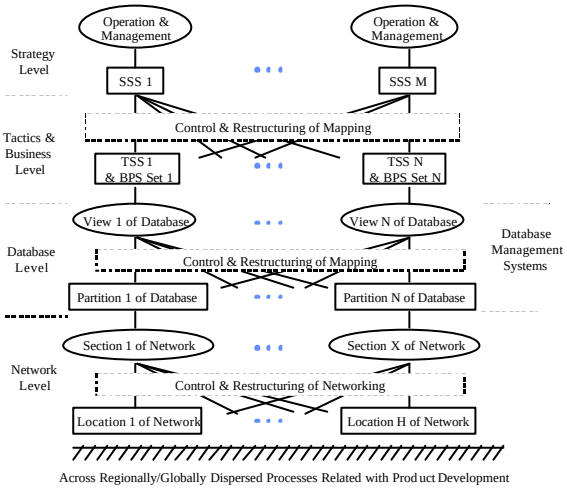


Fig. 8. Hierarchy of information integration underpinning enterprise integration. Legend: Ellipse: logic collection, Rectangle: physical entity, SSS/TSS: strategic/tactic support systems, BPS: business processing systems (Ellipse: logic collection, Rectangle: physical entity)

Enterprise partnerships can be classified as product-homogenous and product-heterogeneous ones. Product-homogenous partnership is for quantity and variety of one kind of products, say to occupy markets overwhelmingly by monopolizing one kind of products. Common product-homogenous partnerships are investment-type, i.e. joint ventures, e.g.

- Capital/stock investment,
- Labor investment,

- R&D/design investment,
- Technology (machine/equipment/production line/workshop) investment,
- Managerial investment (management modes inputted or managers immigrated),
- Logo/brand investment.

Product-heterogeneous partnership mainly aims at complex product developments, say to monopolize the latitude of markets by broad kinds of products. Product-heterogeneous partnerships further distinguish two different types: integration type partnerships and federation type partnership.

Integration type partnership is close and relatively fixed alliance among partner enterprises. It typically takes the form of trust, group corporate, etc. For instance, while its partner enterprises can remain independent to some extent, a group corporate is an enterprise, and there is a headquarters in the group corporate to issue commands to component enterprises.

The core of enterprise integration is information integration. Modern communication technologies and computer technologies have offered sufficient preparations and prerequisites for information integration in enterprises. Information integration becomes more difficult and important if processes related with product development, performed by the partner enterprises under integration, are regionally/globally dispersed.

On the contrary, federation type partnership is relatively loose alliance and temporary project consortium among partner enterprises, and is evolving, only existing over one or several projects, depending on market situations, never fixed.

Enterprise federation means an alliance where partner enterprises remain independent. Specifically, with the purpose of fulfilling specific projects emerging from markets, independent partner enterprises are federated to form an agile and self-organizing network, which is capable of unifying two opposite ends in current societies and technologies, i.e. more and more complex product developments versus more and more specialized and miniaturized enterprises [2]. Strictly speaking, enterprise federation is not an enterprise already, but a way of business doing.

Primary problem of configuration of enterprise federation is how partner enterprises can be facilitated for the data interchange and business process co-operation that enterprise federation requires. Usually a new operations management paradigm of product development requires a business process re-engineering to be implemented in the enterprise. However, re-engineering of underlying business processes within partner enterprises is expensive, and also unnecessary since enterprise federation is evolving, never fixed. For a universal implementation strategy for enterprise federation, a partner enterprise needs only to be facilitated for the data interchange and business process co-operation to the degree that enterprise federation requires.

Here, a conception of federation-ware is proposed. A federation-ware refers to a collection of hardware, software, databases, groupware, middleware, specifications and protocols to facilitate data interchange and database management among federated partner enterprises. Federation-ware enables partner enterprises to become nodes on the federation network of partner enterprises, and enables partner enterprises to be

uniformly data interchangeable and business process co-operative, as depicted in Fig. 9.

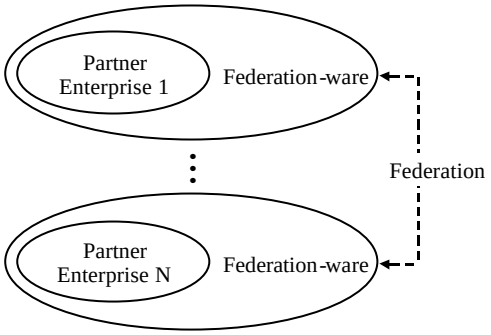


Fig. 9. Partner enterprises facilitated with federation-ware

Enterprise federation is already well prepared technologically by today's information societies. Essential technical supports to enterprise federation, i.e. federated data interchange, federated database management and federated information systems, etc., are fully offered by modern information and communication technologies. Enterprises can be federated regardless of geographic dispersal and further globalization of trades and businesses. Information and communication technology overcomes geographic dispersal and lowers cost for organization among partner enterprises.

On the other hand, even geographically nearby, since they are independent, partner enterprises of enterprise federation need supports of federated data interchange, federated database management and federated information systems.

Operation phase is the core of the organization of enterprise federation. Enterprise operation moves from non-partnership variants into federated ones. Blueprints of operation phase of enterprise federation are as follows:

- Co-ordination among partner enterprises,
- Federated marketing and sales management,
- Federated order management,
- Federated through-penetration planning, production planning and control,
- Federated cost control,
- Federated total quality management and control,
- Federated project management.

Operation phase of enterprise federation also performs:

- Operations evaluation of enterprise federation,
- Warning deficiencies of partner enterprises,
- Adequate adjustments of federation network of partner enterprises,
- Reconfiguration of federation network of partner enterprises.

Interactions among nodes on the federation network of partner enterprises can uniformly be modeled as multi-agent systems [3, 4]. Network and its self-organizing is a topic of operations research.

3. Computer Integrated Office System ----- an E-Government Instantiation

Terms such as ‘e-government’ and ‘e-democracy’ are being used to describe the new emerging patterns of electronic governance. E-government refers to the use of technology to facilitate the process of government, both in terms of delivery of services to the citizen and in improving the internal processes of government. One example of this is the UK government’s portal, UKOnline. E-democracy is associated with attempts to increase political participation by exploiting the technology available. It is about cementing the links between government and citizen, the ‘G2C’ (government-to-citizen) relationship and how it can be enhanced by the possible use of e-business technologies.

Here is the development of a computer integrated office system for government offices. Functional requirements of the government office workflow system can be depicted as in Fig. 10.

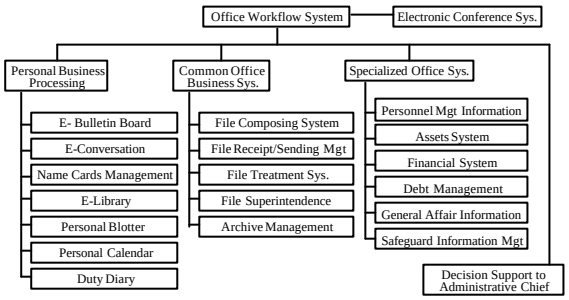


Fig. 10. Functional decomposition diagram of the requirements of the government office workflow system

The development of the government office workflow system is organized as depicted in Fig. 11.

4. Computer Integrated Co-operative Medical Diagnosis ------ an E-Health Instantiation

Co-operative medical diagnosis is of great significance in modern societies. It enables world-wide dispersed human/software resources of medical knowledge to be able to be properly combined for the diagnosis of rare diseases.

Typical related areas are medical informatics and medical information systems. Medical informatics is a very general term and may also cover medical information systems. Examples of medical informatics are:

- Medical database/knowledge bases,
- Physicians’ knowledge acquisition,

- Clinical data interpretation and analysis,
- Radiological image processing and analysis.

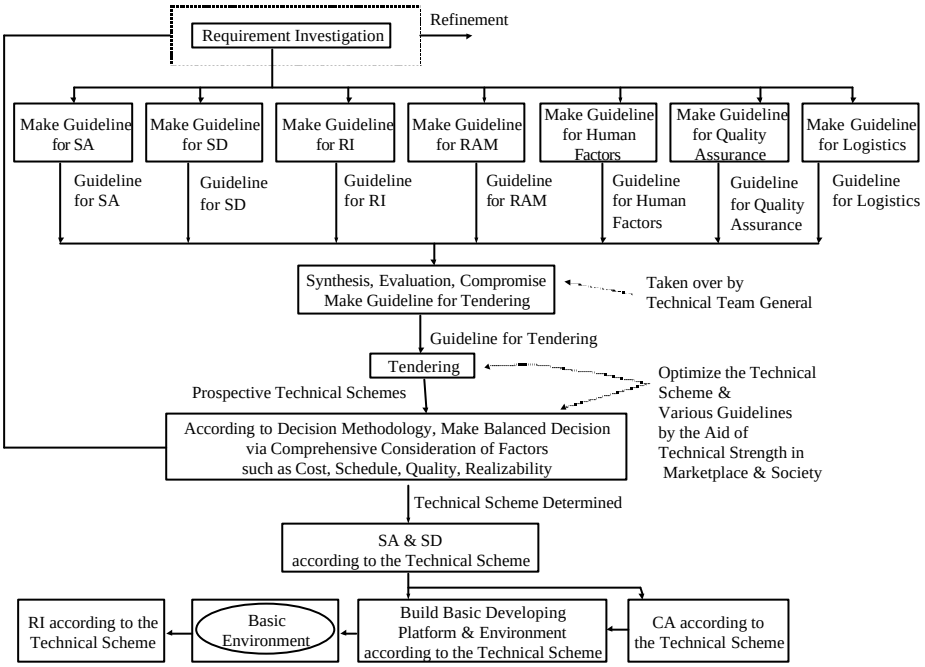


Fig. 11. Information-substitutive concurrency and detour in the project (SA - System Analysis; SD - System Design; RI – Software Realization, System Integration, Test; RAM - reliability, availability, and maintainability)

Typical methodological tools for medical informatics are time series analysis, statistics analysis, neural network data processing, data mining, etc.

Examples of medical information systems are:

- Hospital information systems,
- Health care/ services information systems,
- Patient management systems,
- Medicine and pharmacy management information systems,
- Decisions support systems for health economics.

Typical methodologies for medical information systems are workflow management/analysis systems (WfMS) and multi-agent systems construction framework. Essentially these methodologies are to combine medical and organizational knowledge and to computerize human business processes in the medical organizations.

Co-operative medical diagnosis is a complicated process of evolving, decision-making, reasoning, therapy planning, and/or guessing. This process is too sophisti-

cated, crucially relying upon actors' knowledge and the utilization of their knowledge. There is no general methodology applicable to co-operative medical diagnosis.

A methodological hint to co-operative medical diagnosis is that human physician/clinicians are conducting diagnoses very well both individually and co-operatively. So, co-operative medical diagnosis can be explored by at least partially computerizing the intellectual individual and co-operative processes of human physician/clinicians. In this sense, information system development methodology can still work to co-operative medical diagnosis.

Procedure of human co-operative medical diagnosis will constrain the modes of social communication among agents.

The development of co-operative medical diagnosis systems should be approached from below aspects:

- Process models of medical diagnosis under the support of multi-agent systems and computer supported collaborative work. This entails that before establishing process model of medical diagnosis under multi-agent systems and computer supported collaborative work, human medical diagnosis model should be established to be used as a first basis,
- Descriptive knowledge (digital library of medical diagnosis, historical records, databases, etc.), procedural knowledge of medical diagnosis, meta knowledge of facilitating searching: their representation (heterarchical & hierarchical relations among different categories of knowledge), organization (distributed and local) and management paradigm,
- Co-ordination mechanism of multi-agent system constrained by co-operative medical diagnosis procedures,
- Computer support technology for co-operative medical diagnosis, and how to customize existing general-propose agent software, agent platform and multi-agent social communication infrastructure into medical diagnosis. Social communication infrastructure involves two levels: agent communication language at abstract level, and architecture (CORBA) at specific level.

Decision making of medical diagnosis is a process of repeat, detour, verification, refinement, self-probing, converging, synthesis, etc. Generally, pattern classification is referred to for known patterns, and pattern determination for unknown patterns.

Procedure of co-operative medical diagnosis can typically divided into five decision steps, as depicted in Fig. 12.

- Clustering of patient's claims,
- Evidences finding via applications of medical instruments,
- Verification based on patient's claims and instrument-inspected evidences,
- Probing cures for more evidences,
- Refinement and synthesis.

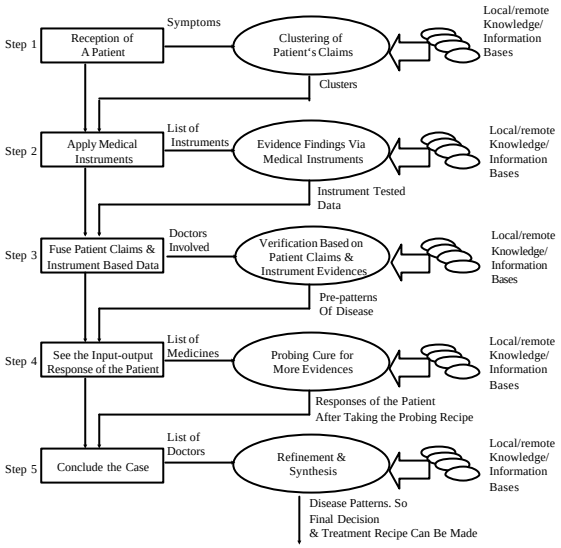


Fig. 12. Procedure of multi-agent medical-treatment/healthcare decision-making

5. Critical Comments

5.1 Distinction between e-Businesses and Telephone/Facsimile based Businesses

Business doing involves two major costs

- cost of managing/enabling information flows, i.e., the communication,
- cost of managing/enabling materiel flows, i.e., the transport.

The enabling of information flows can be by humans, telephones, facsimiles, and/or computers (Internets + webs).

In the case of telephones and facsimiles, although the communication is electronic and automated, the information processing necessary (e.g., databases management, search, match, archival, filtering, data mining, etc.) is still manual.

Differently, in the case of computers, both the communication and the necessary information processing are automated. This is the e-bushiness.

5.2 Virtual Organizations

Virtual organizations [5] are one of the results that have been brought forth and accelerated by contemporary globalized knowledge economy and information age society.

Information and Communication Technologies have the capacity to transcend organizational boundaries and allow work to be done in new ways on a distributed basis.

Virtual organization comes into existence in two cases: IT enabled co-localization and IT enabled de-localization [6].

IT enabled co-localization means that enterprise-resource independent small organizations, whose enterprise resources are geographically dispersed, are supported by IT to form a consortium and to act as a whole to the outside in performing the functions of a single big organization. IT enabled co-localization makes organizations be able to communicate and interact across geographical locations of and enterprise-resource partitions among different organizations. Geographic dispersion is eliminated and becomes the same as being geographically co-located.

IT enabled de-localization means that an organization, whose enterprise resources are co-located geographically in a single location, is transformed into being fully IT supported. IT enabled de-localization makes the functional components of the organization accessible from anywhere over the globe. Traditional geographically co-located work can now be undertaken from geographically dispersed locations.

In essence, both IT enabled co-localization and de-localization are IT enabling of conventional organizations and businesses. Through IT enabling, there is no difference either working in a geographically dispersed or co-located manner, no matter whether originally functional components of a big organization are co-located or a group of small organizations are geographically dispersed. Instantiations or synonyms of IT enabling include e-X's and digital X's, such as e-commerce, e-science, e-health, e-government, new ways of work, online/networked business, digital library, digital city, digital society, and so forth.

Virtual organization is a society-wide permeated technology. Some scenarios of virtual organizations are:

- E-government,
- Enterprise federation, supply chain management,
- Multi-robotic systems, robot soccer,
- Virtual banking and other financial services,
- Virtual corporation/enterprise, for software or manufacturing product developments, also including remote service support to product use and maintenance,
- Virtual collaborative product design, concurrent engineering,
- Virtual laboratory for collaborative scientific research,
- Virtual laboratory for remote collaborative medical diagnosis,
- Virtual office,
- Virtual university, unifying remote/distance learning/education, also including virtual classroom.

5.3 E-tization of Business Processes

The primary underpinning drive of supply chain is generate values to the society and making money, as depicted in Fig. 13. Fierce commercial competition forces enterprises

under social labor division come together to collaborate in the form of supply chains. It is rather true that the commercial competition nowadays lies much more among the supply chains than among individual enterprises, as depicted in Fig. 14.

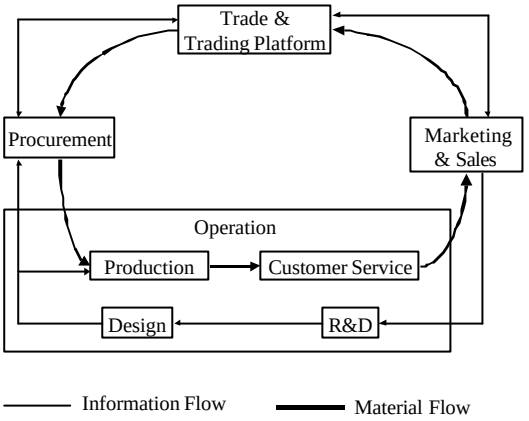


Fig. 13. Supply chain

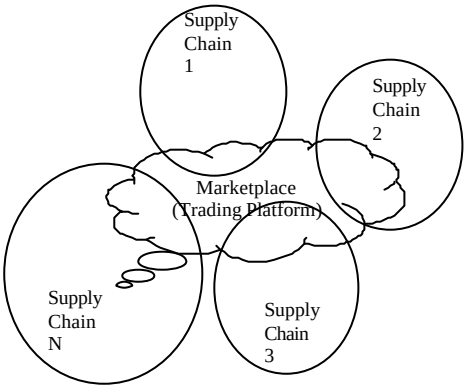


Fig. 14. Entire/socio-economic supply chain

For a time, e-commerce was viewed as mainly concerned about the e-tization of the trading sections of supply chains, and there is no prominent distinction between e-business and e-commerce. However, a more generalized view is that e-business refers to the e-tization of all the sections (businesses) involved in the supply chains, from procurement operation and from marketing/sales to trading platform.

5.4 Re-engineering of Business Processes

The essence of e-variants, such as e-enterprise, e-government, e-health, is the computer technology being embedded and integrated in the traditional business processes, i.e., the IT enabling of e-business, e-government and e-health, etc. Therefore, the development of e-variants will be the re-engineering of traditional business processes, as depicted in Fig. 15. There are two basic steps in such a development, i.e., firstly, understanding the traditional business process, and then re-engineering and revolutionizing them into the e-variants. This manifests that the essence of e-variants is the IT enabling of business processes via embedding and integrating computer systems.

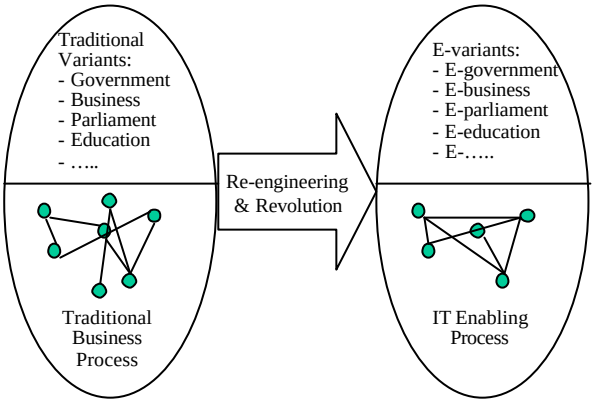


Fig. 15. Development of e-variants

Reference

1. Tianfield. H. Advanced life-cycle model for complex product development via stage-aligned information-substitutive concurrency and detour. International Journal of Computer Integrated Manufacturing, May-June 2001, 14(3): 281-303
2. Tianfield, H. Enterprise federation and its multi-agent modelization. In E-Commerce Agents: Marketplace Solutions, Security Issues, and Supply and Demand, (Jiming Liu and Yiming Ye, eds.). Lecture Notes in Artificial Intelligence, LNAI 2033, Springer-Verlag Berlin Heidelberg, 2001, 295-322
3. Tianfield, H. Agentization and coordination. Special Issue on “Multi-agent systems and mobile agents”, International Journal of Software Engineering and Knowledge Engineering, November 2001, 11(5): 503-507
4. Tianfield, H. Towards advanced applications of agent technology. Special Issue on “Agent technology applications”, International Journal of Knowledge-based Intelligent Engineering Systems, October 2001, 5(4a): 258-259

5. Virtual Organization Net http://www.virtual-organization.net/
6. Tianfield H. and Unland R. IT enabling ---- essence of virtual organizations. Special Issue on “Virtual organizations and e-commerce applications”, International Journal of Information Technology and Decision Making, September 2002, 1(3): 367-370