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Networked organizations have an increasing importance today. As the basic characteristic of these systems is the communication and cooperation via networks, the new networking technologies influence the operation parameters, possibilities of the cooperation and the production itself in the networked organization as well. The paper introduces shortly the main characteristics of the different types of communication networks and gives a short survey on the impacts of novel networking technologies on work processes, security policy/strategy, organization structure, cooperation policy, human resource behavior/education (role of trust) of networked enterprises as well.

1. INTRODUCTION

Today the market needs very quick, high quality and cost-saving answers from the production sphere.

A number of innovative forms of organizations have emerged in recent years to address these new demands, e.g. extended enterprise, virtual enterprise, networked organization, virtual organization, virtual networked organization, smart organization, collaborative networked organization (CNO). These new forms have been developed to overcome the formality and rigidity of hierarchical, bureaucratic organizational structures and to enable more creative, emergent, and spontaneous responses to problems and opportunities. Functional integration, lean organization, and trust building are in the main stream of changes. These changes increase the adaptability of the organization, but only when accompanied by changes in management and communication systems.

Novel networking technologies (like Powerline Communication, GRID technology, wireless and mobile) help in a great extent to give good answers for the market challenges. The main advantages of wireless and mobile communication are that anybody, from anywhere at anytime can make contacts. According to market researcher Gartner, 45 percent of the American workforce is using mobile

technology of some kind, including laptops, Personal Digital Assistants (PDA), and new sensor networks (Gartner Symposium, 2003). By 2007 more than 50 percent of enterprises with more than 1,000 employees will make use of at least five wireless networking technologies.

The structure, the communication systems and the collaborating people/teams/organizations that define today's organizations characteristics must be harmonized to accomplish complex, demanding tasks.

2. MAIN CHARACTERISTICS OF CNO

Networked organization is a form of structure, where independent people, groups and/or organizations act as independent nodes, link across boundaries, to work together for a common goal. A networked organization has multiple leaders, lots of informal links and interacting levels.

The links are the various coordination and "agreement" mechanisms. In a network, high degrees of informal communications (both face-to-face and over electronic networks) achieve success where formal authority and communications in hierarchical organizations often fail. Mutual links and reciprocity across the links are what makes networks work.

Collaboration means working together. Effective collaborative means working together efficiently and effectively. It has become a critical success factor that applies to all the relationships that create a business, including those with customers, business allies, suppliers, divisions, departments, functions, projects, specialties, vertical levels, and employees.

"The collaborative organization is designed for effective coordination, shared decision making, and decision implementation. The emphasis is on a collaborative approach, because that provides an opportunity to utilize multiple perspectives and generate synergies and commitment. The collaboration occurs across both vertical and horizontal boundaries, so flow of information, people, co-ordination, and materials escape the constraints of silos. The collaboration rests on a culture of shared responsibility, authority, and accountability for results." (Beyerlein et al, 2001)

While traditional organizations tend to keep decision-making, information, rewards, and power at the top, a collaborative networked organization requires significant changes.

3. ICT TECHNOLOGIES IN CNO

3.1 Role of networks in CNO

The main requirements in case of novel networks are as follows:

- great communication speed,
- shared access to files, data/knowledge bases,
- exchange of picture, voice – multimedia applications,
- on line/real-time access,
- access for anybody, from anywhere, at any time – mobility,
- reliable, secure exchange of information,
- intelligent user interfaces,
- easy and cheap installation.

Today the main characteristics listed above can't be represented by one network type yet, so there are different approaches that cover partially the demands of the market; namely the Wireless technology (Satellite communication (SC), Wireless Wide Area Networks (WWAN), Wireless Local Area Networks (WLAN) and Wireless Personal Area (or Pico) Network (WPAN)), and some novel wired technologies as Powerline communication (PLC) and the GRID technology.

These networks can be connected/integrated according to the actual needs, developing very complex and powerful networks for the networked organizations. The new networking technologies extend company data, back-end information systems, and email to mobile employees, broadens the accessibility of mission critical data. Mobile access modifies the way workers interact with colleagues, customers, and suppliers.

3.2 Wired technologies

In the followings two novel, wired technologies will be introduced as they offer technical and service possibilities competitive with wireless technologies. PLC offers very low cost, flexible, reliable, secure communication inside buildings or limited areas. The latest results of GRID technology make possible the very easy, integrated and user-friendly access to databases, programs and other computing resources.

3.2.1 Powerline Communications

The idea is to connect the Internet and network computers in a LAN, by using the world's largest existing network, the electricity distribution grid, the power grid. PLC works by transmitting data signals through the same power cables that transmit

electricity, but it uses a different frequency. To do this, every PC needs to be attached with a PLC adapter, which also functions as a modem (Highspeed, 2003).

The powerline technology applied today transmits data at 4.5 Megabits per second (Mbit/s) via the electricity supply grid – in the medium-term rates of up to 20 Mbit/s are possible – and provides permanent high speed access to the Internet (always online) from every mains voltage supply socket in a building, and makes broadband capacity cost-efficiently available over the “last mile”. It is no longer necessary to install additional cabling within a building, so PLC is also an interesting alternative for an in-house data network. PLC boasts a superior distance of 300m (without using repeaters).

3.2.2 *The Grid computing*

“Grid” computing can be defined as a hardware and software infrastructure that provides dependable, consistent, pervasive and inexpensive access to high-end computational capabilities resulting flexible, secure, coordinated resource sharing among dynamic collections of individuals, institutions, and resources—to sum up them as virtual organizations (Foster, 2003).

The sharing is not primarily file exchange but rather direct access to computers, software, data, and other resources, as is required by a range of collaborative problem-solving and resource brokering strategies emerging in industry, science, and engineering. Furthermore, sharing is about more than simply document exchange (as in “virtual enterprises”): it can involve direct access to remote software, computers, data, sensors, and other resources.

As the Grid is built on the existing Internet, it will share its capabilities, such as simple data retrieval and transfer, as well as the basic file sharing functions provided by peer-to peer applications. The prospects for the future, however, are far greater, and could not only change the way of sharing information, but also the way computers interpret information and even, by integrating developing technologies such as Jini and Bluetooth, how this technology can involve the daily life.

3.3 **Wireless technologies**

Wireless networks (WN) serve as the transport mechanism between devices and among devices and the traditional wired networks (enterprise networks and the Internet). Wireless networks are many and diverse, but can be categorized into four groups based on their coverage range; Satellite Communication, Wireless Wide Area Networks, Wireless Local Area Networks, and Wireless Personal Area Networks.

3.3.1 Satellite communication

Satellite communication systems offer the users really independent and reliable communication with any chosen subscriber in the world, offering high quality telephone calls, fax transmissions, high-speed data access and e-mail messaging. Today satellite communication providers purchase services and phone sets that appropriate for dual mode, e.g. Satellite-GSM Phones.

These handheld satellite telephones provide voice, fax, Internet access, short messaging and remote location determination services (GPS) in the covered area. All of this is provided through geosynchronous satellites, but when satellite coverage is not necessary, the handset can also access the GSM cellular network. Fax and digital data is transmitted with at 9600 Bps throughputs, but in case users need high speed Internet access (144 kbps) this also can be achieved by using special lightweight terminals.

A satellite phone can fulfill all the requirements regarding mobile communications in many application fields. Interdisciplinary applications are paralleled with equipment functionality - currently available satellite phones have the size of a standard notebook computer. Their use does not require complicated procedures, activation and call charging is done similarly to cellular phone networks.

3.3.2 Wireless Wide Area Networks

Mobile communication is connected to using mobile phones. Mobile phone is the device that offers for a great number of people the possibility to make contact with others from anywhere, at anytime and for anybody. Mobile phone is the device, that realize the mobility on society level as in many countries more then 70 % of the population has mobile phone.

WWAN includes wide coverage area technologies such as, Global System for Mobile Communications (GSM), 3G/UMTS (Universal Mobile Telecommunications System), iMode (multimedia applications). These systems use different mobile system/network protocols, which have different characteristics concerning the applied frequency and data transmission rate (Frequency range: 800-2200 MHz, Data rates: max. 2.2 Mbps).

The introduction of WAP (Wireless Application Protocol) was a big step forward for the mobile communication as this protocol made possible to connect mobile devices to the Internet. By enabling WAP applications, a full range of wireless devices, including mobile phones, smart-phones, PDAs and handheld PCs, gain a common method for accessing Internet information. The spread of WAP became even more intensive as mobile phone industry actively supported WAP by installing it into the new devices.

3.3.3 *Wireless Local Area Networks*

Wireless local area wireless networking, generally called Wi-Fi (also known as 802.11b Ethernet) is a hot topic. Wi-Fi connects the user to others and to the Internet without the restriction of wires, cables or fixed connections. Wi-Fi gives the user freedom to change locations (mobility)— and to have full access to files, office and network connections wherever she/he is (Wi-Fi Revolution, 2003).

WLAN, representing wireless local area networks, includes IEEE 802.11/a/b/g, HiperLAN, Wireless 1394, etc. WLAN use radio technologies called IEEE 802.11b, 802.11a or 802.11g standards to provide secure, reliable and fast wireless connectivity. A Wi-Fi network can be used to connect computers to each other, to the Internet, and to wired networks (which use IEEE 802.3 or Ethernet). Wi-Fi networks operate in the 2.4 (802.11b) and 5 GHz (802.11a) radio bands, with an 11 Mbps (802.11b) or 54 Mbps (802.11a) data rate or with products that contain both bands (dual band). 802.11b has a range of approximately 100 meter.

3.3.4 *Wireless Personal Area (or Pico) Network*

WPAN, represents wireless personal area network technologies such as Ultra-wideband (UWB), ZigBee, Bluetooth, WiMedia and IrDA.

Designed for data and voice transmission, low data rate standards include e.g. ZigBee, (IEEE 802.15.4), Bluetooth (IEEE 802.15.1), enables wireless personal area networks to communicate over short distances, generating a new way of interacting with our personal and business environment. ZigBee provides ultra-low cost solutions for applications requiring low data rates and long battery-life such as remote controls and sensor applications (free frequency bands including 2.4 GHz, 915 MHz and 868 MHz, transmission ranges of 30–100 m are possible). In the home, this will mean a single remote control device will operate TVs, DVD players, audio systems and other entertainment and computing equipment, as well as controlling lights, heating, home appliances, security systems and even toys.

Bluetooth chipsets, now on their third and fourth generation, are targeted primarily at the cell phone and PC peripheral industries (2.4 GHz band, peak data throughput of 720 KBps, distances about 10 m).

4. IMPACTS OF WIRELESS NETWORKING TECHNOLOGIES ON CNO

4.1 Main impacts

The first big change on enterprise information systems was caused by the application of Internet, the introduction of the global network. The next step forward was caused by the WEB-based technologies and in less extend but the mobile technology also has appeared on the scene. The latest effect on organizations (both in structures and operation) is caused by the different advanced wireless technologies. The result of their integration can be really called as “cyberspace”.

Mobile technology affects both the structure and the operation of enterprises. The main reasons to develop a mobile solution in the organization can be to provide access to company email and to Intranet applications, to develop specific company applications, to keep permanent contact with service workers, to improve work scheduling and offers possibility for mobile commerce (this is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and PDA).

The interactions among organizations become easier and more transparent. Wireless technologies simplify the processes of maintaining visibility and control over transactions within a networked organization and allow real-time collaboration.

The change from wired to wireless technology is probably even harder then the change in the previous cases as the application of these technologies and means (e.g. mobile phones) alters not only work processes but the social and cultural environments as well.

The paper reflects only the impacts of wireless technologies. The listed influences are general ones as their effects can vary according to the application field (service company, automated manufacturing company using sensors), size of the organization, the cultural environment and many other factors. In the followings only the main areas of impacts will be listed.

4.1.1 Impacts on Organization (structure and work processes)

- a) Organizational structure has to change to flat, open, lean structure with a 24-hour 365-day availability.
- b) Traditional functional and hierarchical barriers have to be eliminated while supporting teamwork and open access to people and information.
- c) Clear responsibilities for basic and auxiliary activities.
- d) The whole organization has to change to customer-oriented – real-time information collaboration among the participants. Benefits: innovative and agile work process.

4.1.2 *Impacts on working technology*

- a) It is important to separate basic/core activities from auxiliary activities. A basic activity is which contributes to the competitive advantage of the organization. Auxiliary activities don't contribute directly to the competitive edge (e.g. administration). The right selection and the balance of the two activities are essential for the organization (Sifonis, 2003).
- b) The significance of teamwork is growing.
- c) Remote meetings of different groups on different levels help collaboration.

4.1.3 *Impacts on information technology*

- a) Besides standard word processing and spreadsheet applications, groupware technologies are also included which require not only new technical skills but also the development of new ways of working.
- b) Technologies such as shared databases and a calendaring/scheduling tool support asynchronous group work, networked electronic whiteboard (which allows for shared viewing and manipulation of files between multiple sites), remote video linkages across multiple sites, and desktop conferencing (joint use of a single application running on two desktops) support synchronous group work.
- c) The different databases have an outstanding role. The various databases encompass routine and non-routine work, and form a kind of glue that holds different groups together.
- d) Secure communication is a very important demand in a system continuously connected as in case of wireless networks, so WNs need stronger security as wired systems (e.g. VPN). This enhanced security demand needs modification in system infrastructure and in architecture as well. Other security related services like e.g. access right structure, archiving of documents also has to be modified (Mezgár, 2004).

4.1.4 *Standardization*

The development of wireless technologies is very fast, there are solutions that even didn't existed a year before. These technologies converge data, voice, graphics and video over a single network; they allow each member of the network to access them without any space and time limitation. The representation form all of these descriptions have to be standardized otherwise their access would not be possible for the different systems.

4.1.5 Impacts on Human resources

- a) For the management it is important to redefine authorities and responsibilities more clearly.
- b) Organizing remote meetings on different level help to better solve integrated problems task and these videoconferences also help trust building among the teams and members of the organization.
- c) For the staff continuous training is important in order to use the new technology effective, so for them the motivation for learning is a basic must.

4.2 Role of trust and security

In spite of the application of high-tech approaches, tools and methodologies, there is common point in all of the organizations; human beings make most of the important decisions and they operate and use the systems. According to experiences the improper application of this human factor can make the operation very inefficient even in the case of technically most advanced systems. The lowest level of connection among systems/organizations is made through protocols; the highest contact level is among the decision-makers, the users, among the human beings.

A very important element of this human contact is the trust. In a networked organization, trust is the atmosphere, the medium in which actors are moving (Castelfranchi and Yao-Hua Tan, 2001). Only trust can bridge cultural, geographical and organizational distances of team members (and even of whole organizations) from turning to unmanageable psychological distances. Trust is the base of cooperation, the normal behavior of the human being in the society. The ability of enterprises to form networked systems depends on the existing level of trust in the society and on the capital of society (Fukuyama, 1995). As the rate of cooperation is increasing in all fields of life, the importance of trust is evolving even faster.

5. CONCLUSIONS

The keen market competition pushes organizations in the direction of continuous change. Parallel with this line the demands the information-communication technology develops extremely fast and offers new possibilities for reengineering the organizations, making their operation more effective, cost saving. The changes of the organizational form and the changes in the ways of communication are going on parallel causing the evolution of organizational structures.

The new generations of networking technologies, the different types of wireless communications make significant changes not only in the operation of organizations but in their cultural and social environments as well. The paper introduced shortly

the main groups of WT and their effects on networked organizations. The conclusion is that the novel networking technologies can cause remarkable modifications in the structure, in the operation, in the collaboration techniques, as well as in the cost structure and in business processes of any type of organizations.

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