

# The Evolution of Information Technology Management

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**Abstract:** Information technology (IT) management methods are changing with time. The main methodological shifts can be observed in management authority and responsibility distribution within a company. Four characteristic stages: the stage of spontaneous responsibility delegation, monopoly over information stage, business into business stage, and the stage of information economy. However, some serious dilemmas regarding the future of IT management remain.

**JEL Classification:** M1, M14

**Keywords:** IT management, management responsibility distribution, information economy

## Introduction

More than a half of a century long experience derived from information technology (IT) application witnesses its dramatic impact on design of human activities, behaviour of economic entities and market functions. IT involves a wide variety of computer and telecommunication hardware and software that can be used as a means of business support and development.

But, something that is still not fully recognised and observed, as a common law, is the fact that *changes in the manner of IT management are correspondingly deep and massive*. To put it simply, management responsibilities for many information processes and services are delegated from higher to lower levels of organisational

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structure, from corporate to executive business units. This is the reason why the activities mediated by IT are penetrating the tiniest pores of business operation and management procedures.

## **Four Stages in IT Management Evolution**

It is at times forgotten that most of today's respect-worthy and powerful companies world-wide have less than a century long experience with *any kind* of information management. Their time horizon of computer-based IT use reaches, in many cases, not more than few decades in the past. During these years, technology advances transformed IT products from astonishing but expensive and exotic but constrained to inevitable and commonly accessible business and management tools used in almost all phases of doing business. And the rate of development and growth of technological innovations in this field is exponentially accelerated.

In the time span mentioned, significant moves ahead towards establishment of better means of IT management are prominent. Investigation of changes in IT management manner and recognition of respective trends lead to distinction of four stages in IT management evolution:

Stage 1 - Spontaneous responsibility delegation

Stage 2 - Monopoly over information

Stage 3 - Business within business

Stage 4 - Information economy

As it will be seen later in this paper, these stages are sequencing and substituting each other in nearly regular time intervals – from 10 to 15 years. It is the matter of discussion whether such a comprehension is of any prognostic value, but the fact is that empirical insight proves regularity of IT management evolutionary changes during its fifty years long history.

### **Stage 1 – Spontaneous Responsibility Delegation**

From the very beginning of the computer era (ENIAC, USA, 1944) to late fifties, the phenomenon of non-planned, non-coordinated, and, in some cases, non-controlled distribution of IT management and development activities can be observed. Computers were often used by operational and, in management perspective, low-positioned staff. Initiative for this given by highly educated and enthusiastic managers, engineers and professionals of the other kind, who were able to identify IT potentials in the accomplishment of simple tasks, dealing with massive data processing. Because of that, responsibility for IT management was spontaneously

delegated to those individuals who knew, could and wanted to apply IT products and methods of use in their day-to-day work.

Table 1 presents the list of organisational units in which were placed the original 'development kernels' of IT application in 45 US firms in 1957. It should be noticed that most frequently IT resources and methods application was concentrated in those organisational units in which exactly *massive data processing was the basic modus operandi*.

Table 1: Initiate IT application development kernel (USA, 1957)

Location	No. of Cases
Accounting	5
Planning	2
Manufacturing	3
Control & Audit	10
Finance	10
Administration	8
Standalone EDP Unit	7

Source: Ein-Dor, P., et al (1982)

In these early days of computer usage there was a little use of rather few application programmes developed by even fewer information processing professionals (e.g., system analysts and programmers). Managers, professionals and operations personnel were writing programmes, preparing and entering data, operating and controlling computer equipment, and distributing data processing outputs. Everything mentioned was done in an atmosphere of endless enthusiasm and a lot of creative tension.

As the number of computer applications throughout organisational units and working areas grew, the need for opening of new working positions and staffing new employees expanded, too. Highly educated computer specialists, like programmers, analysts, computer operators, and information managers were extremely respected. In most cases, they were directly responsible to line managers above them in the management hierarchy.

But, the first signs of organisational and managerial non-stability appeared soon. They were manifested as communication difficulties, as misunderstandings about responsibility division and, in common sense, as inadequate information system operation and outputs.

These signals were the alarm bells that triggered the process of IT management redefinition and redesign.

## Stage 2 – Monopoly over Information

Benefits of business information flows automation were the reasons why many companies started out on speculation about the need for integration of the most computer-based business application kernels. The implementation of this idea is the clearly recognisable trend during sixties and early seventies. Because these intentions confronted merely low-quality systems software (primarily, computer operating systems), non-standard application software, and incompatible hardware platforms, a need for engagement of specialists skilled in dealing with different hardware and software environments took place. Growing complexity of computerised data processing was the main motive to its centralisation, while the most of (if not all) management responsibilities were summarised in relatively autonomous data processing department.

Such a centralised data processing unit, often called *information system department*, was operating like a *manufacturing unit*, configured and managed as some kind of *manufacturing plant*, based upon large mainframe computers. It produced large amounts of its own ('domestic') *application software*.

Typically, the information system department was composed of four functional parts (Benjamin, 1977)

- operations
- systems development
- technical support, services & maintenance
- administration

Table 2 gives a list of activities performed by each of these four units.

Table 2: Activities of information system department units

Unit	Activities
<b>Operations</b>	Data preparation/entry
	Data/information distribution
	Input/output control
	Hardware acquisition
	Hardware maintenance

**Systems Development**

Data filing

Job scheduling

Systems planning

Feasibility studies

Systems analysis/design

Application programming

Ready-made application software

acquisition

Systems conversion

User education &amp; training

Applications maintenance

**Technical Support, Services & Maintenance**

System software acquisition

Systems software installation

System software maintenance

Communications analysis/design

Communications equipment installation

Communications equipment maintenance

Communications management

Data base analysis/design

Data base implementation/installation

Data base conversion

Data base management

**Administration**

Capacity planning

Data processing cost budgeting

Systems personnel management

Systems personnel education &amp; training

Data processing standardisation

As the information system department could satisfy almost all corporate information needs, such a centralised organisational unit exhibited at least virtual, if not even real *monopoly over information*. This caused many negative consequences for conceived overall business processes – from small frauds of 'delicate' information to planned wide-range manipulations and different forms of computer crime.

### Stage 3 – Business within Business

Introduction of microprocessors and microcomputers at the beginning of seventies resulted in extensive and significant changes in IT environment, and their intensity did not cease until the middle of eighties. IT is being more and more exploited with the aim of offering better information support to managers and professionals in decision making processes and widening application horizon beyond company boundaries.

Although a manufacturing role of information systems departments remains important, two new targets appeared: *distribution of information and transfer of technology*.

*Information distribution* role grew out from consciousness that there were many optional channels available for IT products and services acquisition. For example, application software could be developed by company's own information processing professionals or by employment of so-called end user computing tools. In the latter case users themselves constructed computer programmes to satisfy their own information needs. Furthermore, there were abilities to procure (buy or lease) ready-made software packages or, eventually, use external time-sharing services, etc.

The role of *technology transfer* emerged from the organisational efforts to develop the consciousness about availability of new IT products and services, about the need to experiment with them, and about the possibilities of their active and creative use in routine business operations. There are numerous examples of companies of that time which have organised expert teams for implementation, e.g., Office Automation (OA) or Computer Integrated Manufacturing (CIM) applications. These expert teams developed plans, strategies, and variety of supporting services intended to simplify and catalyse diffusion of such IT applications throughout companies.

Table 3 gives an overview of broader set of activities referring to IT management in described manner.

Table 3: The broader set of IT management activities

Subfunction	Activity
<b>Systems Services</b>	Operating activities (see Table 2) End user resources support End user teamwork support Quality assurance Data base support Communications support Hardware maintenance System software maintenance Capacity planning Technological infrastructure development & maintenance
<b>Systems Development</b>	Systems design Software development
<b>Consulting</b>	Organisational consulting Decision making support consulting Feasibility studies Systems analysis
<b>Information Center</b>	Hardware procurement Ready-made application software acquisition External data processing services procurement End user training End user tools acquisition
<b>Technology Surveillance</b>	Technological innovation surveillance Technology forecasting New technology potential investigation
<b>Technology Transfer</b>	Pilot projects planning and conducting New technologies implementation planning and management

	Applications transfer to organisational units planning and management
<b>Planning</b>	Corporate strategic plans coordination Strategic systems feasibility studies Global information flow planning IT resources usage evaluation IT applications standardisation IT application policy definition
<b>Quality Assurance</b>	Security measures planning and standardisation Standards evaluation Standards keeping evaluation
<b>Administration</b>	Information services cost budgeting Systems human resources management Systems documentation management

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Important among many changes resulting from the modified nature of IT management in this evolutionary stages are as follows:

- all of IT resources (e.g., computers, communication equipment, memory devices, etc.) were brought under unique control and management system.
- IT technology was viewed as a potentially important element that has impact on business strategies formulation.
- IT resources were physically distributed throughout the company.
- Proportion of external sources in IT products and services procurement volume was significantly enlarged.
- information system department and its management status in organisational hierarchy was highly improved.
- information processing professionals began to believe and view themselves as a kind of 'service centre'.
- as a service centre, they started to function as a 'company within company' or 'business within business'.

In doing so, information system staff and, especially, management became trapped in a cardinal mistake i.e. they lost necessary binding and interaction with the



rest of the company as well as a sense of their belonging to company's community. That is what made things imperatively change once again.

#### **Stage 4 – Information economy**

Changes that took place were oriented towards better understanding of the true meaning and role of IT in modern business. Research work done in many today's active companies shows evidently that their organisational units try hard, thought out and intentionally to draw out, in a physical and managerial sense, as much as possible from available IT resources. Executive managers, professionals of all types and even top level management profited the needed strong impetus to IT applications development and implementation.

However, it can be conceived as a reaction to competitors' actions, sometimes carried out in co-ordination with computer specialists, and sometimes independently by management. Simply said, IT resources and actions related to them are dispersed throughout companies and in each their part they are seen as a means of possible business processes improvement.

Environment in which IT is treated in such a way may be best qualified as the *information economy in business* (Zmund et al., pp. 17-23). In this context, *information business unit is defined as each and every manufacturing or working unit that generates usable information product or service by application of IT resources it owns and manages.*

Many of the managers and non-computer professionals become more skilful in application of technologies like Computer Aided Design & Computer Aided Manufacturing (CAD/CAM), financial modelling software systems, data base management software, decision support systems and local area networks (LAN) technology. Not so rare they become experts for specific technology development and implementation. With such an expertise, managers and professionals have attempted and are able to identify possibilities of IT application and to implement them efficiently.

#### **Modern IT Management Patterns**

It is our strong belief that modern IT management patterns are not by far enough theoretically and empirically investigated and proved. But some starting steps towards assumptions of what are modern IT management pattern are already made. To support this assertion, we can refer to two relatively recent researches and comment on their findings.

First of them was conducted by MIT Center for Information Systems Research (CISR) in 1994, and its results are presented in table 4.

Table 4: CISR research results

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**Corporate Information Activities**

Strategic information systems planning  
 Technological changes review and forecasting  
 IT products and standards evaluation  
 Telecommunication equipment and standards evaluation  
 Information systems life cycle standards definition  
 National/international equipment producers contracting  
 Data security and privacy standards development  
 Consulting services & technical expertise  
 Top management education  
 User education  
 Executive management support  
 Internal time-sharing

**Organisational Unit Information Activities**

Middle and short term financial planning  
 Middle and short term projects planning  
 Application architecture planning  
 Applications planning  
 Computer operations  
 Personal computers evaluation  
 Personal computers selection  
 System life cycle implementation  
 Application software selection  
 Application software evaluation  
 Application software standardisation  
 End user support

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Source: MIT CISR Report No. 11, 1994

From the results shown, derived from the representative sample of leading industrial companies in the US, it is possible to observe that:

- a strong decentralisation of development and operating activities regarding IT application is taking place almost everywhere.

- centralised information system development role is gradually ceasing, especially in the field of the overall IT application cost control (e.g., on an average, information system departments monitor less than 48 percent of IT application total cost).
- managerial responsibilities are much more oriented towards human rather than business processes operation.

Another report (La Belle, 1977) presents results of deeply penetrating and comprehensive research of information activities reorganisation done in Manufacturers Hanover Corporation (MHC). In April 1995, MHC announced reorganisation in terms of division in five business branch offices. The objectives were to assure branch office executives an opportunity of maximum control over resources needed, including IT resources, and over resource usage efficiency.

In this new organisational environment, centralised information system department was given a mandate to promote competitive technology usage and procure common, cost-effective IT resources. At the same time, operation and technical risks should be minimised, and organisational flexibility maximised. The 'common resources' category included commonly used computer equipment, generic applications (such as payroll), technical consulting services and support, and warehousing space, etc.

Table 5 shows the distribution of information activities between the central information system department and local functional organisational units. As it can be seen, implemented re-organisational interventions match the main trends derived from CISR research (Table 4) in an evident manner.

Table 5: IT management responsibilities distribution at MHC

Activities	IS dept.	Shared	Local
<b>Strategic</b>			
Strategic planning and control		X	
Market intelligence and technology surveillance	X		
Architecture planning			X
<b>Tactic</b>			
Resources planning and procurement			X
Systems development			X
Computer and telecommunication operation			X
Common resources	X		

### Infrastructural

Policy and standards management	X	
Human resources management		X
Risk management	X	

### The Croatian Case

In Croatia, in spite of war and post-war problems a progress towards the information economy stage can be noted. Practically simultaneously, during 1996, three major Croatian companies, one each in food, pharmaceuticals, chemicals industry, started similar projects of rebuilding their information systems.

In all three cases, primary aim of initiated projects was to adjust the means of satisfying management and end user information needs to new management structures and innovations in IT technology. Projects started with a definition of standards to which extent all other actions should be conducted. Setting up standards was the responsibility of central information system departments, which closely co-operated with top management levels. System of standards formed a kind of so-called 'roof' system.

The emphasis in roof systems was put on strategic aspects of IT management in a long run. The tactic aspects analysis and the definition of their solutions, i.e. implementation options were the responsibilities of executive managers in different manufacturing and business areas. The roof systems were worked out in details and a number of decision support and executive information systems were derived from them.

At the lowest, operational level of management, executive information systems were split into numerous transactional systems aimed to support routine continuous manufacturing and business operations. These systems varied very much from case to case, so that some of them were targeted to administrative support, some others to manufacturing processes control, some to warehouse management, etc.

Development of the roof systems primarily involved negotiations with software suppliers from abroad because it was conclude that in Croatia there were no adequate genuine software systems of this kind available. And, in all three cases, the same - European - software supplier was selected. As it will be shown later, this was not a good choice, or, better to say, it was rather a big mistake.

At the beginning of projects everything seemed brilliant. The roof software packages were installed and implemented on a fairly good hardware platform. Some minor problems occurred when the projects moved down to the executive information systems level, but they were rather easy and quickly solved.

Complications emerged when transactional systems had to be developed. The roof systems appeared to be of little worth, because they were not compatible with transactional systems standards and the lowest level systems could not be suspended for a long period of time to be redesigned and fit to requirements of roof systems.

The main source of problems, which are, by the way, not yet solved, was the lack of management discipline because of inadequate management responsibility distribution within the organisational structures of involved companies.

Thus, a conclusion can be drawn: information economy is a necessity, but it implies a change in general managerial discipline, style and responsibility. But, changes in IT management are not enough and the same have to be a part of global management changes.

However, such a conclusion opens way to some serious dilemmas.

CISR research results and MHC experiences without doubt indicate that the fourth stage of IT management evolution is a reality. But, information economy paradigm, accepted as an imperative of today's directing and practising day-to-day business operations, imposes some important questions and raises dilemmas.

The most important among them, of course, is the one that arises from existing relationships between central top management and executive management at local organisational units level. Namely, a need for centralised direction and co-ordination of activities endures parallel to the cognition of the worth of discretion rights concerning decision making processes about IT usage at lower hierarchical management levels.

Centralised direction and control over different IT products and services, along with their application *schemas* are inevitable activities (Dearden et al, 1996) because of the strong need for thorough and comprehensive investigation of future IT application opportunities. On the other hand, many line and branch office executives express the will and have abilities for acquisition, development, and implementation of IT products and services without excessive consultations with the top management structures. And they act in such a way.

The situation presented above gives rise to an important question i.e. is it possible to disperse IT management responsibilities throughout the organisational structure and at the same time make a good use of, on the one hand, all advantages attributed to centralised co-ordination, and on the other, discretion rights for decision making at executive management levels?

It is clearly obvious that the right approach is neither to insist on a monopoly role of central information system department within decision making processes dealing with IT planning, procurement, operation and use, nor to force conditions in which each organisation unit would be able to 'tailor' autonomously its own future, and, in fact, make the future of the company as a whole rather uncertain.

It is also easy to understand that each IT management responsibility dispersion should take into consideration previously practised behavioural habits and organisational culture, but, in the same way, actual internal and external ingredients that have certain impact on authority and responsibility distribution, too.

There are lots of items that should be investigated in depth to obtain good insight into, and knowledge about, possible means of solving the crucial IT management dilemma. It seems, the most important questions to be answered are as follows:

- what is the actual IT management responsibilities distribution state-of-the-art in a given organisation?
- in what proportion such a distribution depends on company size, its global managerial orientation and actual practice of IT usage?
- may, or will, the IT management authority and responsibility diffusion towards lower levels of management follow the tendencies of management activities distribution in other business areas?
- in what fashion and to which extent IT products and services application efficiency depends upon selected modes of management activities scattering in given organisation?
- finally, is there any evidences that that shifts in structure and IT management responsibilities distribution could positively contribute to global effects of running business?

Because these *questions*, and the further ones arising from them, *are multidimensional*, the process of *searching the right answers must definitively be multicriterial*. It must take into account a whole complex of impact issues, weight their importance and define their scope.

As the first steps into the fourth stage of IT management evolution – in the stage marked up by the information economy paradigm – are already done, it will surely be no waste of time to grapple with detailed investigation of possible approaches to resolution of addressed dilemmas.

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