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Automation in the IT Field

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1. Introduction

To begin with, what is Information Technology (IT)? If you ask any person not related to IT you would most likely receive an answer that the term IT means any activity related to computers, software and communications. According to the definition adopted by UNESCO, the IT is “a set of interrelated scientific, technological and engineering disciplines are studying methods of effective labor organization of people employed information processing and storage, computing, and methods of organization and interaction with people and manufacturing facilities, their practical applications, as well as associated with all these social, economic and cultural issues.”.

This formal definition does not give a complete picture of the IT industry as a whole, since it does not enumerate specific areas of activity usually included in the concept of IT: design and development of computer technology, software development, testing, technical support, customer care, communication services etc.

Over the last three decades IT has made a qualitative and quantitative leap. Everything started with the first attempts of informational support of production, bulky scientific computers and the first simple personal computers. Over time the IT industry has made a huge step toward with modern technologies: supercomputers, mobile computers, virtualization of calculations, the Internet and many others. Computing performance has increased by hundreds of thousands of times, while the cost of computers has decreased significantly, making information technologies available to billions of people all over the planet.

The progress of IT is impressive. Things that until recently seemed fantastic, such as a device transferring mental signals to a computer, systems of three-dimensional printing and android robots hardly distinguishable from a human, have already been created and are operating.

But still automation of daily human activities remains one of the main objectives of IT. Computer systems and robotized lines perform routine, complex and dangerous operations instead of human staff. Activity fields where it was formerly impossible to manage without human control nowadays are operated by robots and unmanned machines operating with jeweller accuracy.

Having freed millions of people from the necessity to work manually, at the same time IT has opened up a huge market for intellectual labour for millions of IT specialists. Moreover,

the IT industry constantly acquires new areas and technologies, generating deeper division of labour between experts.

Year on year the IT industry faces an increased array of problems, starting with technological restrictions and finishing with solutions with moral and ethical implications. Some problems are solved, while others constantly appear. Among them there is a big and important issue: who can automate the work of the one who automates the work of others?

There is no universal solution. Ironic as it may be, many IT processes are extremely difficult to be automated. As an example, the process of software development, testing and support is quite creative work, despite the continuing tendency to automate the processes. This is what makes programmers, testers and support staff much like street artists. The initial requirements are a little like a client who wants a portrait painted, and the result, i.e., a finished portrait, depends on the client's preferences and mood, as well as on the artist's style of painting.

The issue of automation of IT processes is too complex and it is extremely difficult to cover this area completely, however, in this chapter we will try to examine the possibilities and specific features of automation in the main areas IT.

2. Features of the IT business

Let's consider a significant difference between the IT business and a classic industry, such as heavy industry. This is well illustrated by two giants: GM and IBM.

Company	Turnover	Revenue	Total number of employees
IBM	\$ 99.9 billion	\$ 14.8 billion	~400,000
GM	\$ 137 billion	\$ 6.5 billion	~202,000

Table 1. Activity indicators of IBM and GM in 2010.

Both of them have comparable turnovers (\$137 billion and \$100 billion in 2010, respectively), but the number of IBM employees is twice that of GM. At the same, the revenue of IBM is twice that of GM (\$14.8 billion vs. \$6.5 billion in 2010, respectively).

Most of IBM's revenue is provided by Global Services. This is the largest division of IBM (with over 190,000 employees) and is the world's largest business and technology services provider. Second place in IBM's revenue structure is Software. Therefore, most of the services and products offered by IBM are intellectual products created directly by the employees. There are no automated assembly lines, no conveyors and no additional costs for any resources (except for electricity maybe).

At the same time, GM's main income is still provided by car sales and sales of car parts. The production of car parts and the assembly of complete vehicles have a high degree of automation. In addition, there are high costs for raw materials and resources (such as steel, electricity, etc.).

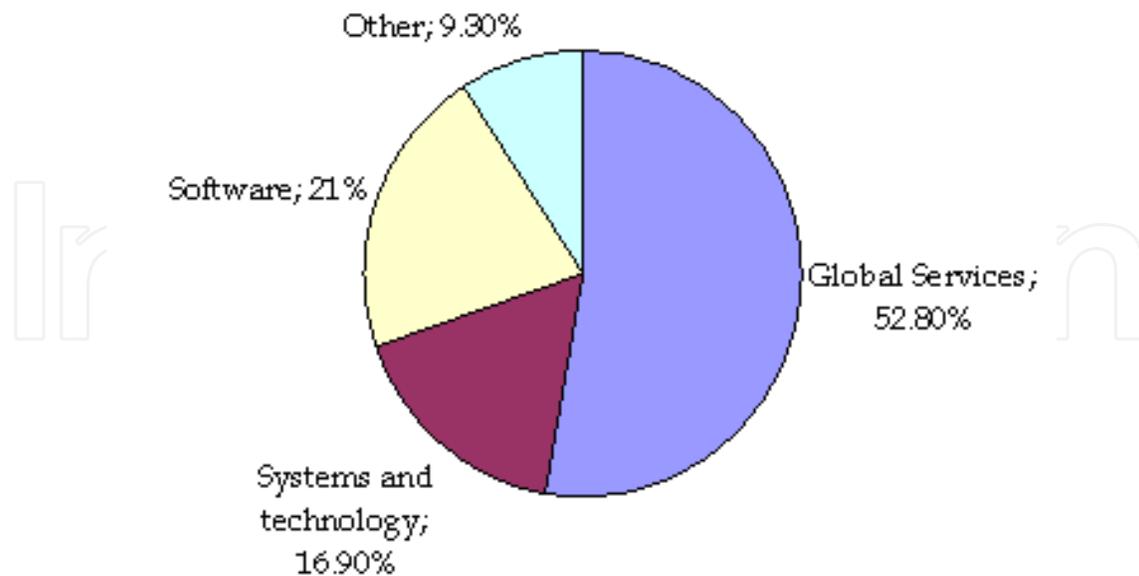


Fig. 1. Structure of IBM's income in 2010.

The main difference of the IT from industrial production is that industrial production requires complex organization of the product copies production (technological processes, components supply and quality control at the output). For software product copies production you only need to spend on the protection of intellectual property rights. In addition, there is a huge market for special products (tailor-made), where products can be used only by one or several clients without reaching the mass market. If we draw an analogy with car manufacturing, even big IT companies are more like workshops that produce hand-made automobiles rather than giant manufacturers.

At the same time the IT field is the driving force behind automation processes in any other industries. The work of IT specialists can be related to automated production processes, data collection systems, billing systems, etc. They produce products and solutions that reduce manual labour and calculations.

All this suggests a very different approach to automation in the IT business. In the IT business automation is an auxiliary tool. Many IT companies have a minimal set of automated processes (or have no automated processes), but their business is still successful. Of course IT professionals try to automate as many processes as possible.

3. Areas of the IT business

The IT business can be clearly divided into three areas:

- Software
- Hardware
- Services

The software production process includes many parts which starts from programming and finishes by software sales. Each process in the production of software looks like a brick in a wall. If one of the bricks is destroyed or removed then the entire building (production) will collapse. Each of these processes has its own characteristics and a degree of possible automation.

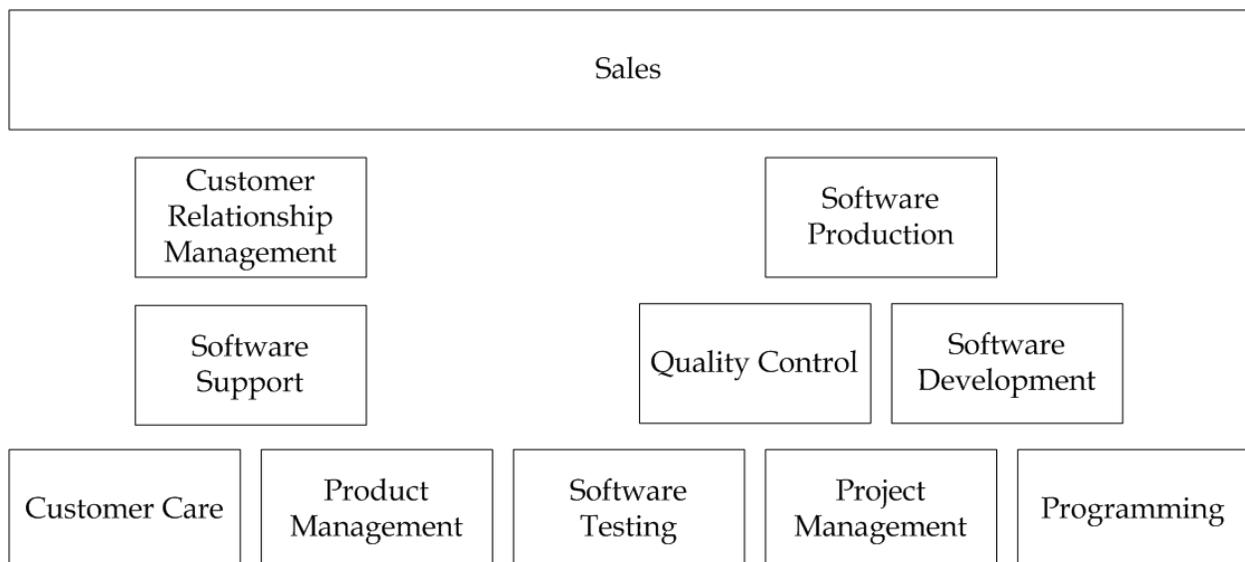


Fig. 2. Structure of software production

Hardware production has the same types of processes as software production (with minimal difference). Therefore, the approach to automate the development of hardware is not very different from the automation of software production. But it also includes direct production of components and computers (servers, network equipment, etc.). Since this process is a classic industrial production, it will not be considered in this chapter.

Providing services is an extensive part of the IT business. Some services may be provided in fully automatic mode, while others can only be provided directly by employees of the service division. Examples of services will be considered more below.

4. Software production

4.1 Software testing

Usually when people involved in IT business talk about automation in software production, they mean software testing. It is true that in software testing automation technology is most widely used. Historically, this was due to the rapid development of IT technology from the 1990s to the present.

The constant growth in the complexity of information systems on the one hand and appearance of new automation technologies on the other hand has pushed the development of testing automation over the last 20 years.

Software testing includes a set of different operations, some of which are recurrent while others are unique and product/line specific. It is quite obvious that routine recurrent processes are much easier to be automated. Testing is the easiest part of the software

development for automation, since it consists of many such processes. Let's consider the most typical parts of the testing process.

4.1.1 Functional testing

Functional testing can be partly automated. It especially refers to recurrent basic functionality check-ups from one version to another, which is known as "regression" testing. Such automation is only justified when the product development (several versions production) is guaranteed and the product life cycle lasts at least one year. Besides, there are tools that permit conducting automated user interface testing. Functional testing consists of three phases: unit-testing, complex testing and regression testing.

4.1.1.1 Smoke-testing and unit-testing

As a rule, these tests are made by the developer. They consist of a set of calls of concrete modules with a defined set of parameters. Usually, developers do not have enough time to generate the necessary data sets and to make complex tests. In addition, tools which the developer has do not allow proper control of the quality of an output. There is another problem: while performing a module check, the developer is determined to prove the functionality of this module (a psychological feature of most developers). The testers have different motivation - their goal is to prove that the module does not meet the accepted requirements. The tester also looks at the working capacity of the unit from the user's point of view. Therefore, the most reasonable solution to this dilemma is to leave developers to generate and to make smoke-testing independent, assigning the making of unit-tests to testers. Meanwhile, in order to save testers' time, developers can carry out automatic unit-tests during a development cycle and correct errors at once, without activating the bug tracking process and thus keeping testers free of the tens of iterations of checks.

Meanwhile, it is very important that developed unit-tests could to be used, in the same or modified form, on complex or regression testing in the sequel.

4.1.1.2 Complex (system) testing

Complex testing tests the complete system (bundled software) to check its working capacity. If autotests were not used at earlier stages of testing, development of autotests just for complex testing does not always justify itself. A good case in point is the application of the modified autotests used on unit-testing.

4.1.1.3 Regression testing

At this stage the autotests developed earlier for other stages of testing (for current or earlier versions of the product) should be used. If the scale regression testing of system is significant, but special regression autotests are not available, their creation makes sense only if the "full regress" would be done again several times (in the case of enduring product life cycle).

4.1.2 Load testing

Load testing is a check of the system capability in the real world. Usually, the "real world" is understood like productive volume and composition of the processed data. It helps to define the limit of system performance or compliance of performance requirements.

Load testing is the easiest and the most effective process to automate. Load testing uses systems that imitate simultaneous work of thousands of users. Also to simulate the real content of the database, testers use data generators. This is quite natural and 100% justified, since it is pretty difficult to module the functioning of a popular Internet service or hundreds of user calls coming into a call centre in any other way.

Stress testing. Stress testing is a kind of load testing. It is usually applied to software and hardware complexes, and critical information systems (such as a hardware and software complexes of aircraft). This testing includes verification of complex systems as a whole under extreme conditions far from the operational environment. As part of this test, resistance to extreme environmental conditions, component redundancy, alarm systems and disaster recovery capabilities are checked. Sometimes, the conditions for a stress test can be simulated only by automation.

Integration testing. This is type of testing verifies the interaction of the object under test with adjacent systems or complexes. In practice, manual integration testing with external systems is much more effective than automatic testing. Firstly, this is because the majority of man-hours (up to 50%) within the limits of integration testing are spent on various options and interaction adjustments between adjacent systems. Practically, this work cannot be automated.

4.1.3 Advantages of automated testing

4.1.3.1 Cost

- Decrease of man-hours spent on testing;
- Reduce to a minimum time for each test-iteration after bug fixing;
- Automatic creation of test-reporting, tester does not waste time on reports;
- Automatic registration of issues in bug tracking systems;
- After hours performance of autotests (overnight or over weekend).

4.1.3.2 Quality

- Reduced human factor;
- More tests per unit of time make testing more qualitative.

4.1.3.3 Productivity

- More iterations in time unit;
- Higher productivity than in manual testing;
- Limitation on the number of tests by system performance only, not on the available float time of a tester.

4.1.3.4 Employee motivation

In many IT companies testers have a less profitable position with respect of both prestige and wages than developers. Naturally, some of them are not satisfied and view the position of tester as an intermediate step in their career. Instead of the development of testing skills, they prefer to improve their software development skills in order to switch to more profitable positions in the current company or find a job as a developer in another company. As a result, the quality of work of both testers and developers may be affected.

Participation in the automation of the testing process is an excellent chance for career growth for these workers. A good specialist in the field of automated tests is more valuable to a company than an ordinary developer or tester. In addition, they can develop their skills and build a career without leaving the testing process or without changing their place of work. Anyway, the making of automated tests is a more creative process than manual testing. It brings more satisfaction to workers, increasing their motivation.

4.1.3.5 Other

Efficiency of autotesting is expressed not only in the saving of man-hours on testing. One of the main advantages of the autotest is earlier error detection and lower total cost for their correction.

4.1.4 Automated testing is not advantageous in the following cases

- The scale of an autotest's covering of the system is incorrectly estimated. In such cases, the cost of producing autotests is many times greater than the benefit of its use;
- Employees don't have appropriate qualifications. In this case, autotest quality is low and the cost of their creation exceeds that planned;
- Autotests cannot be used in a sequel. Usually, if autotests cannot be re-used as is or with minimal modification, the cost of their creation will never be paid back (except in special cases, e.g., load testing);
- The cost of licensing the autotesting tools exceeds the economic profit engendered from using autotesting in projects in the first place. It is necessary to remember that autotesting tools often require separate servers that have to be purchased.

4.2 Software development

At first sight you might think that the term "software development automation" belies common sense. It sounds pretty much like "novel-writing automation" or "picture-painting automation". But if we look closer at the process of software development over the last two or three decades, we will see that it makes total sense. Yes, the artistic part of programming cannot be automated by the existing means of automation, but they can provide the developers with handy tools that multiply the speed and efficiency of their work. There is a reason why the development tools market is worth billions of dollars and still continues to grow (\$6.9 billion in 2007, \$7.3 billion in 2008 according to Gartner).

The automation of software development is generally intended for reducing the required qualification level of the workers and for speeding up the software development process. This is clearly shown by the programming languages, technologies and platforms evolution.

Many environments with possibilities in visual development permit minimizing the expenses on user interface routine operations. Frameworks serve as components and protocols connectors. Automated syntax checks, code formatting and debugging make the programmer's job significantly easier. To help developers there are tools to ensure the normal functioning of the development team, such as version control systems, tools and team coding. Modern means of communication and techniques of project management allow constructing the distributed team, staffed by specialists from different countries and areas of programming. Thus, the developers have more time for the artistic part of programming and experience exchange.

The same process of natural evolution led to the creation of business integration systems and technologies. Also these systems can hardly be called automated, but the aim of their creation was to reduce man-hours during corporate applications development and integration. Practically these systems made it possible to delegate part of the corporate applications development and integration job to analysts and integrators who do not need any special knowledge of programming languages or technologies to perform their jobs. In addition, this helps to reduce time spent on worker communication with each other in the course of software product development.

4.2.1 An approach to the development of a program code

The possibility of applying autotests depends very strongly on the methods of development of a program code. Therefore, the use of test automation can strongly influence the development. Implementation of some principles of development makes autotest using easier and reduces time for autotest development. The features of adaptation of a program code for autotests depend on technology and testing tools used. The following basic manoeuvres can be used:

- Option of quick rollback of changes for great volumes of data (this is especially important for databases);
- Functionality switches. Flags or the parameters that limit a set of operations of standard modules;
- “Hidden” parameters of a test mode, including additional logging or emulation of any operations;
- System messages (logs, warnings etc.) that should be easy for parse in the software tools;
- Option to fix a unit’s state at the intermediate stages of work.

Testers can put up additional requirements to a program code, based on the selection of the available tools of testing and features of the testing process. Usually, compliance to these requirements does not consume lots of developer man-hours, but it makes autotest making easier and decreases the number of total man-hours on development and testing. The majority of tester’s requirements should probably be included as a part of the process of program code development.

4.3 Automation of project management

It is often said about project management that it is ‘The Art and Science of Getting Things Done’. In fact, the process of project management cannot be automated, as with any of the arts. There are only auxiliary tools which can help the project manager, like an easel or a palette for the artist.

Among the tools the project manager can identify the main ones are: a planning tool and means of gathering information.

At the moment there are lots of tools for planning projects. The criterion for selecting a planning tool is ease of use.

In general, useful information provided by the ERP system makes the work of the project manager more automated. The keyword is “useful”, since just the multiplicity of information in the ERP system is not the key to success.

At present, there are comfortable online tools of project management that combine the following features:

- Ability to manage requirements;
- Possibility of automatic notification to interested parties on changes to the project;
- Ease of use;
- Assigning and tracking tasks;
- Storing, categorization and versioning of files;
- Forums to discuss tasks and projects;
- Project planning;
- Tracking the progress of the project by all participants;
- Tracking time spent;
- Report about the project state at any time;
- Implementation of communication on the project with reference to the aims and objectives (comments).

Currently, among such solutions the best known are Basecamp and TeamLab.

4.4 An adhesive force of the processes within an IT company

It makes no sense to consider further the automation of processes involved in software development without mention of the force capable to link these processes together.

Lack of integration can negate the benefits of automation of individual processes. Therefore, the task of information exchange between processes is one of the most important in the construction of software production.

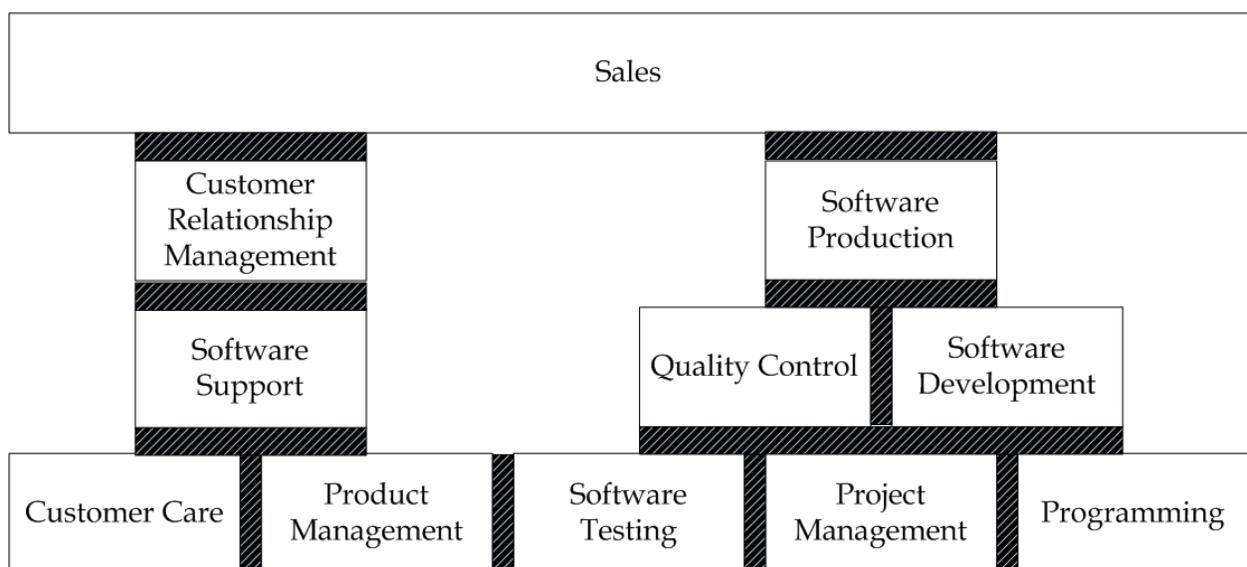


Fig. 3. Areas of IT business. Integrated processes of software production.

4.5 Enterprise resource planning

ERP it is an information system used to manage information flows in the organization and to automate the various areas of the company. In 1990 Gartner Group first employed the

acronym ERP as an extension of material requirements planning (MRP), later manufacturing resource planning and computer-integrated manufacturing. Not all ERP packages were developed from a manufacturing core. Vendors of ERP solutions variously began with accounting, maintenance and human resources. By the mid-1990s ERP systems were adjusted to all core functions of enterprises. Naturally, IT companies widely use ERP systems to automate their processes. Moreover, many IT companies are trying to automate all internal and external processes in order to reduce the influence of human factors on the quality and outcome of their work.

Implementation of ERP systems allows automating the many workflows in the IT company. Conventionally, these processes can be divided into two groups: major (productive activities of the company) and minor (non-productive activities of the company).

Major workflows are:

- Manufacturing (engineering, work orders, manufacturing process, manufacturing projects, manufacturing flow, activity-based costs);
- Project management (human resource planning, costing, billing, time and expense, performance units, activity management, risk management);
- Product management (capacity planning, workflow management, quality control, cost management, product lifecycle management);
- Customer relationship management (sales and marketing, commissions, service, customer contact, call centre support, demand management, customer care);
- Data services (self-care, knowledge base).

Minor workflows are aimed at the support of normal functioning of the company and not directly aimed at the production or provision of services:

- Finance/Accounting (general ledger, payables, cash management, budgeting);
- Human resources (payroll, training, recruiting, time tracking);
- Communications and business structure (business structure, integrated channels of communication, document repository, access control, planning meetings and events);
- Supply chain management (order to cash, inventory, order entry, purchasing, supply chain planning, supplier scheduling, inspection of goods, claim processing, commissions).

Different ERP systems can include support of different sets of workflows or components, but the characteristic feature of all of these systems is the tight integration between the components. These solutions also support the common protocols, interfaces and integration tools. Thus, companies can integrate multiple solutions to meet the requirements for automation.

There are some difficulties in the implementation of generic ERP solutions around the world that relate to the peculiarities of doing business, the laws and taxation in each country. This allows local markets of similar solutions to exist. Due to this, specific solutions of local vendors can compete with solutions offered by industry giants such as SAP, Oracle or Microsoft. A good example is the company 1C (Russia), which in 2008 took second place (after SAP) in the ERP market in Russia, increasing its stake to 18.7% in monetary terms. Among them, many Russian IT companies prefer to use some components of the solutions 1C for running their businesses.

4.6 Automating the minor enterprise workflows

4.6.1 Finance

Accounting for financial operations, budgeting, accounting, financial planning and other financial operations are all critical to the business of any company. The complexity of their implementation within the information system in part relates to complex laws (in many countries the law requires a special licence for similar systems) and increased requirements for accuracy and reliability; also finance is a complex subject area and without the help of financial advisors a similar system cannot be properly developed.

For these reasons, the range of existing solutions automating finances is not so wide. The implementation and development of such systems produces qualified professionals. Even in IT, there are not many companies that have their own solutions of full automation for financial operations.

4.6.2 Human resources, communications, business structure and supply chain management

These workflows of any company (including IT) are very easily automated. To do this, there are many solutions in complex ERP systems and in single solutions (including free solutions). Here are just some processes of these workflows that can be automated by existing ERP solutions:

- Maintaining a register of positions and instructions;
- Management of the structure of the company;
- Maintaining personnel files;
- Time management (tracking and registration);
- Calculation of the efficiency of staff;
- Training of employees;
- Registration of skills, experiences and work results of staff;
- Planning of meetings;
- Control of room reservation;
- Accounting of inventory;
- Document circulation;
- Maintenance of purchasing equipment and supplies;
- Maintaining a register of vendors;
- Recruitment of staff;
- Control of authority staff (up to integration with access control system).

The main criteria for successful application of such solutions are flexibility and ease of use. These two requirements usually mean a flexible adjustment of the instrument according to the company's business processes, user-friendly interface and easy integration with other solutions.

4.7 Integration of minor processes with major processes

Information obtained by an ERP system with the support of secondary processes is often used to adjust the main processes and vice versa. The relationship between internal and external processes within the company's ERP system is just as important as it is in real life. As example, information of results and quality of work of employees are aggregated and

can be used for calculation of wages or benefits. Another example, the statistics obtained from the accounting systems of work are used in project planning and information about the skills and productivity of employees helps planning of the project.

4.8 Customer care (self-care systems)

Customer care organization is one of the most important processes. The customer care service quality reflects a lot on the reputation of the product and the company itself. At the same time it is quite difficult to forecast the quantity and content of the user calls which makes it necessary for IT companies to reserve a lot of support staff or resort to the services of external call centres. In addition, the higher the level of the customer care service, the more expensive it gets, which in the end reflects on the price of the software product.

Customer care automated systems can handle a great part of user calls, transferring them to operator only if necessary. The processing cost of such a self-care system, licence and technical support inclusive, is ten times lower than having it processed by operators. Besides, modern automated systems can integrate many channels of call processing like email, telephone, IP telephony, SMS, Internet portals, etc., which makes it possible to create customer care solutions with higher capacity than a standard help desk.

At the same time it is necessary to take into account that most users (45% according to Forrester) still prefer to be attended by a real person on the telephone, rather than by an automated system. Modern systems offer compromises in the form of IVR¹ services and animated digital characters integrated into customer care portals. However, these systems cannot process even half of the calls entering.

Therefore, despite the successful experience of implementation of self-care solutions in many large companies, the developers of such systems must still solve many difficult problems in the future, such as:

- Increasing intellectualization of these systems;
- Implementation of new technologies (speech recognition, the formation of visual images, etc.);
- Increase the capacity of self-care systems;
- Support for customers with disabilities, etc.

The successful solution to these problems can raise the level of user confidence in these systems, expand their range of applications and improve the quality of the automated service. That in turn may reduce costs and increase CSI² of customers.

4.9 Customer relationship management

Despite the fact that the term customer relationship management (CRM) has only arisen recently, it is based on systematic studies in marketing relationships that have been carried out systematically for more than 20 years.

Today it is very difficult to sustain an IT business with many thousands of customers without the help of automated customer interaction. Automated information systems CRM is now

¹ IVR (Interactive Voice Response) is system of pre-recorded voice messages, performing the function of routing calls within the call-center, using the information entered by the client using tone dialing.

² Customer Satisfaction Index

firmly established in the business processes of many companies. IT companies are also very widely using similar solutions for their businesses. Basically, these systems are used by companies operating in the business to customer (B2C) sector. These companies have many customers, a wide range of products and many partners around the world. Additionally it is these companies who obtain greater benefit from an automation of processes of interaction with customers. It is especially effective if such systems are integrated with the company's business processes and existing information systems, such as self-care and bug tracking.

The implementation and development of CRM systems in companies may vary. CRM systems are very complex and critical to the business, therefore, most non-IT companies prefer to use third-party solutions. Only a few companies are willing to create their own departments to develop and implement CRM solutions. However, many IT companies, with large resources of specialists and experience in developing complex solutions, decide to create their own solutions. Some companies start to develop their own CRM solutions based on experience in the use of automated CRM third-party solutions.

An example of the successful implementation of a self-made solution is the experience of Microsoft. This company has millions of customers and hundreds of thousands of partners. For such a big company automating routine tasks is critical to ensure the efficient operation of sales. For a long time Microsoft used a third-party CRM solution, but this solution was too complex and inconvenient for business users. In addition, this solution has sufficiently high TCO³, because it requires high maintenance costs, extension of warranty, licensing and acquisition of equipment. The procedure of adding new features to the old platform was too long.

This had a negative effect on the company's flexibility, which is necessary in order for the company to be at the forefront of the software industry.

To remove these problems and improve the efficiency of sales, in 2009, Microsoft implemented Global Sales Experience (GSX) solution based on Microsoft Dynamics CRM, Microsoft SQL Server and other Microsoft products. The effect of the implementation of the solution has been very positive:

- Time spent on training sales managers was reduced;
- Total time savings amounted to about of 3 hours per week;
- More user friendly interface made users' CSI higher (CSI has grown by 25% as of 2009);
- Total cost of ownership of the CRM system was decreased.

In 2011 Microsoft was recognized by Gartner⁴ as a "leader" and "visionary" in sales force automation.

4.10 Automation of product management

Product management is an extremely important component of any IT business. It includes management of the image of products, pricing and management of user satisfaction. Product management is often viewed as an integral part of CRM, but in the IT business this process is particularly important, so it should be considered separately.

³ TCO (total cost of ownership)

⁴ According Gartner's Magic Quadrant. Gartner rates vendors upon two criteria: completeness of vision and ability to execute. "Leaders" score higher on both criteria. "Visionaries" score higher on the completeness of vision only.

The range of tasks in product management also includes forecasts for capacity, markets and user expectations. A proper product management strategy helps to increase user satisfaction of the products or services of the company and helps to extend the life cycle of products. It also avoids negative effects such as “requirements death spiral”⁵. In its turn it increases the range of proposed solutions, comprehensive income and enhances the company’s image.

So which tools exist for product management in IT companies? First of all, the market can offer a lot of solutions for product lifecycle, gathering of user’s expectations, products for market analysis and long-term forecasting. Typically, such solutions are already integrated into the existing complex ERP systems or can be added to them by a simple customization. Some single solutions also exist that can solve a separate task of product management or a wide range of those tasks.

However, small IT companies often rely on their abilities in the automation of product management. Automation of only a part of the process of product management allows those companies to make proper product policy and constantly improve products. Automated tools are also widely used to monitor usage and diagnose problems (such as those made by a third-party and those made by the company itself). In the case of corporate clients, these tools can be integrated with customer information systems (CRM, ERP). This can be beneficial for both the vendor and customer (the vendor’s reaction time is reduced and its awareness is increased).

4.11 Integration of Information systems

The effectiveness of implementing new information systems in the IT infrastructure of the company will drop sharply if they are not integrated with existing processes or solutions. IT companies as owners of a wide range of information systems must solve the problem of integration. IT companies are suitable to the tasks of integration in different ways.

4.11.1 Fragmented integration environment

The easiest way to integrate information systems is the creation of several integration applications that can convert data streams from different systems. Each such application has a simple logic. It’s easy and cheap to develop and maintain, but has some significant drawbacks:

- The complexity of the configuration. If the data format of the one of information systems has been changed then integration application must also be changed;
- The lack of uniformity in the technologies and techniques of development. Development of information technologies and changes in staff skills occur in parallel with the development of the IT infrastructure of a company. It often happens that in an environment of integration there are two types of applications running simultaneously: applications that use the old technologies and the latest solutions. This phenomenon has been called the “zoo”. This phenomenon is usually harmless, except in two situations:
 - The company has no experts in the old technology (specialists were fired or switched to using other technologies);
 - The solution based on the old technology can no longer cope with the increasing volumes of data.

⁵ Customer expectations permanently warm up by advertising and promises of management. At the same time production of goods and services cannot keep up with customer expectations.

Normally, the second problem entails the first one, since until there are no problems with the old solution, usually no one thinks about the lack of the necessary specialists. Therefore, this method of integrating information systems into a single space is practiced in small IT companies (because of the economy), or giving way to a common integration environment.

4.11.2 Common integration environment

The alternative is a single integration environment that is capable of taking on the task of integrating all of the company's information systems. This environment is the complex solution and has following abilities:

- Own internal data format;
- Ability to convert the output data formats of external systems into internal data format;
- Ability to convert the internal data format to output data formats of external systems;
- Ability to route internal data streams;
- Ability to build the simplest logical processes.

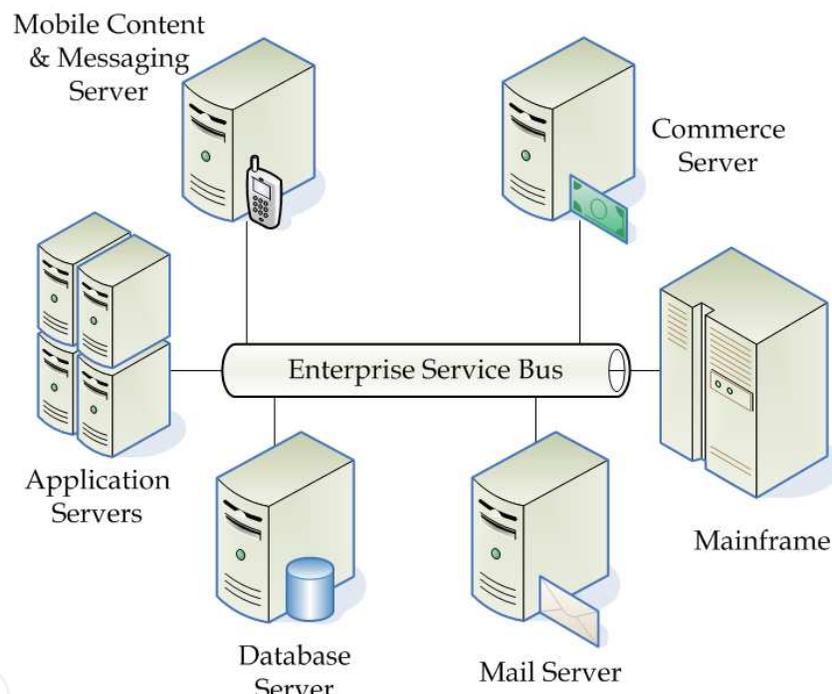


Fig. 4. Usage of enterprise service bus

This principle of interaction of information systems is called ESB (enterprise service bus). This concept has been developed in analogy to the bus concept found in computer hardware architecture combined with the modular and concurrent design of high-performance computer operating systems. Motivation was to find a standard, structured and general purpose concept for describing implementation of loosely coupled software components (called services) that are expected to be independently deployed, running, heterogeneous and disparate within a network.

Companies that have the ability to create these custom solutions typically use their own unified integration environment, but many IT companies prefer to use third-party solutions or do not use a single integration environment. The integration solutions market is

constantly growing (up to the 2008 crisis, the growth was about 10% per year, according to the Forrester report, 2008), existing solutions are also continuing to develop.

Integration solutions offer a variety of flexible solutions that are suitable for large and medium-sized businesses, but existing solutions that implement the concept of ESB have the same drawbacks (in comparison with fragmented environment integration):

- Low performance. Multiple transformations of data formats and the universalization of the components lead to significant reduction in overall system performance;
- High hardware requirements. Due to the fact that the system becomes a central part of the entire IT infrastructure of the company, its low performance is unacceptable, because this reduces the productiveness of all involved processes. In addition, such systems have special requirements for equipment reliability and redundancy.

In some companies, ESB solutions coexist with specialized simple applications of integration. The companies take these measures if eliminating the disadvantages of ESB (listed above) is impossible. This situation occurs also during the gradual implementation of a common integration environment. Such a principle of building the integration environment combines the drawbacks of both approaches with all of the possible negative effects.

5. Services

Services provided by IT companies can be divided into two groups: consulting and resources providing.

It is clear that consulting services principally cannot be provided automatically and the production of such services is always based on human activity. The exception may be a variety of specialized knowledge bases or guided help systems. But such services are closer to the second group - the provision of resources.

Providing of resources is a large group, which includes the following specific services:

- Hosting;
- Rental computing resources;
- Provision of communications services;
- Internet service providing;
- Data storage;
- Creation and storage of special accounts;
- Virtual cash;
- Social networks, etc.

All of these services have one major feature - they are provided by automated systems and solutions. The basis of any of these services is the product manufactured by the IT business. Therefore, the chain of automation of these services starts from the development of relevant IT products. A review of solutions and products to automate the providing of these services is beyond the scope of this chapter.

6. Conclusion

As we can see, automation of labour is widely used in the IT field, however, due to the inherent features of this area, there are a number of typical problems faced by the majority of IT companies during automation of its operations.

6.1 Common problems of automation in IT field

The capabilities of automation tools are considerably inferior to the flexibility of the human brain, so the main drawback is a necessity to add the ability of using automation tools to specific processes. The wider use of automation in the processes of developing and supporting software makes these processes less flexible.

Application of automation technologies reduces the influence of the human factor on the results, however, the total cost of a bug or failure in the automation process can be much higher than the price of an error in manual labour. This happens for several reasons: first, the result of an automatic process is more trusted than the result of human activity; in any case, failure of an automated process can stop all related processes, either manual or automatic.

Finally, the most important factor: automation is very expensive. Automation tools, hiring experts in automation, the necessity to adjust the company's processes for automation – all of these requires a significant investment. For this reason, management often looks sceptically at the benefits of automation.

IT companies often want “quick” profits, i.e., the investment paying off as soon as possible. But investment in automation looks like an investment in the basic research:

- It is too expensive;
- It gives no obvious benefit;
- It has a very long payback period.

6.2 How to minimize the impact of these problems?

Automation is not for the sake of automation, and not a passing fad. Automation offers convenience and time saving. The implementation of automation into a company's processes must be based on a principle that can be called RGB:

- Relevant, that need to be automated only those processes that need it;
- Gradual - the simultaneous and widespread introduction of automated technologies adversely affects the stability of the workflow in the company. Automation should be implemented from simple to complex;
- Balanced - an initiative to implement various processes must come from a place where it is required. Centralized implementation of automation processes in the company does not bring real benefits.

Building automated processes must be done by the most experienced staff that well understand the subject of automation. It is desirable for complex processes or calculations at the first introduction of automation to be duplicated manually. Also, you must have a backup scheme in case of failure.

6.3 A few words about automation tools

There is no standard tool for all possible problems in the market. Many IT areas deal with highly tailored tasks, but even if such a tool did exist, sometimes a company, especially a small one, could not afford it. Licensing costs for some automation products can be compared to the monthly turnover of a small company. In such cases a company has some possible alternatives:

- Continue using manual labour;

- Buy the expensive product;
- Use freeware tools or technologies;
- Develop the necessary product themselves.

The choice of a free tool seems the easiest, however, it is very difficult to find a free tool to automate a particular process, because most of them have a limited range of options.

Developing a good tool for automating is very expensive, therefore, among freeware automation tools there are few good or universal ones available.

Development of automation tools by the company itself seems quite reasonable, but in many cases it turns out to be a trap. The sum invested into the development of the tool can exceed many times the cost of the ones that already exist. This is quite logical, as it is impossible to create in just one week what has been developed by another company over many years. However, sometimes the risk pays off.

But what can we do if there is no tool on the market that could serve for a specific problem? Should the process be automated anyway? In any case, automation always pays off over the long-term. So the company management has to decide on whether the company is ready to start implementing automation right now to realize the profits in about a year's time or whether it is better to leave everything as it is. With the constantly changing market conditions, in a year a small company could change its specialization or reconstruct the whole development process, and therefore all the efforts would be wasted.

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