METHODS OF EVALUATION OF THE ECONOMIC EFFECT IN MOBILE APPLICATION DEVELOPMENT PROJECTS

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Abstract. *There is analyzed the methods for determining the economic effect in mobile application development projects. Implementing an IT project can be considered an investment project, but the economic result is less obvious and higher risks. IT project is much higher, as it has in mind not only the initial investment of financial resources, but also after implementation stages. It must be a mandatory requirement before the implementation of any business case project, finding an effect that can be determined using an appropriate evaluation method. The practical significance of the paper is that the research results obtained can be used in various IT projects.*

Key words: *quality, efficiency criteria, basic indices, efficiency of investment, mobile application.*

JEL CLASSIFICATION : M310, M370, M150, C61

INTRODUCTION

The penetration of Information and Communication Technologies (ICT) led to major economic and social changes, due to the rapid development of new ways of communication, processing and storage of information. The evolution in question imposed the notion of Information Society, which is considered a post-industrial society, which also appears as a result of globalization, and information and knowledge, as well as the degree of their penetration is one of the basic competitive advantages of countries. As a result, many of the underlying transformations are undoubtedly associated with a set of interdependent and, more recently, convergent technologies that have come to be known as ICT. The ICT sector includes four types of industries: information technology, telecommunications, production and trade. The sector provides the country's infrastructure, contributes directly (the activity itself) and indirectly (through the created infrastructure) to the creation of GDP, and respectively to the well-being of the population. The success of any business depends on the quality of the management of its resources. The issue of efficient management is more current in the conditions of limited resources, which are more acute in times of crisis. The efficiency of ICT management is important not only for the companies operating in the sector, but also for the economy of the country as a whole. The costs they incur and, in particular, the way in which they are managed have a direct impact on the formation of tariffs and the costs of ICT services, which as a result have an impact on the degree of their use.

In recent years, mobile applications have found use in various fields such as health, business, social networks, leisure, travel, news, etc. The popularity of mobile applications is due to the mobility with which these devices are activated that provide services regardless of the user's location. But, mobility is associated with a number of problems, such as: reduced resources, limited energy and poor connection [1].

The development trends of Information Technologies (IT) have led to the situation that nowadays, the modern generation is oriented, first of all, on the use of mobile devices, which have become more and more powerful and are available for humans in all activities. Nowadays, it is difficult to imagine a person without a mobile device. Whether it's a phone, smartphone or another communicator.

With the advent of new mobile devices, the variety of platforms on which mobile applications are developed (Android, Symbian, Bada, iOS, iPhone) have begun to develop.

Due to the rapid evolution of technology and the need of people to have as close as possible all the necessary applications, the use of mobile applications has become very widespread. These, by their size and the need to realize as a citizen-oriented application represent a new category of applications as opposed to the usual ones for computers or laptops, or web applications. Mobile applications depend very much on the features of the device, the device platform, and the operating system deployed on the mobile device.

The functions of mobile applications do not differ much from the functions of sites, both provide information about the proposed company goods and services. The main difference between the mobile application is that it offers many more opportunities to present information to consumers. The mobile phone is always with the user, and if it is connected to the Internet, the owner of the mobile device may always be interested in a specific business offer. And the user does not have to go to the site, open a browser, enter the address, instead of clicking on the shortcut of the mobile application.

The active growth of the mobile device market contributes to the growth of another market, namely mobile applications. The global economy of mobile applications is growing every year. At present, according to statistics [2] for 2020, more transactions have already been evaluated than in 2019.

The purpose of the article is to evaluate the efficiency of investments in mobile application development projects. To achieve this goal, it is necessary:

- analysis of types of applications for mobile devices;
- technologies for creating mobile applications and technological constraints in the development of mobile applications;
- how to evaluate the effectiveness of mobile application creation projects.

COPNCEPT AND MOBILE APPS CATEGORIES

Starting with 1990's different operating systems are developed that could support mobile devices as phone, watch, tablet etc. Shortly different mobile operating system release candidates began to be promoted, as well as other type of applications that were incorporated. Such small attempts gave the beginning of mobile apps development direction, later on the current mobile apps markets.

These mobile applications were limited, mostly because of limited hardware resources and battery optimization. Due to different types and big amount of these apps, there were agreed to make some categories for each of them. In current mobile markets they are as in the following Figure 1.

Figure 1. Major mobile apps categories

Source: developed by authors

The number of mobile applications on some categories is systematized in Figure 2 [2]. As we can observe, the most popular is the Games category.

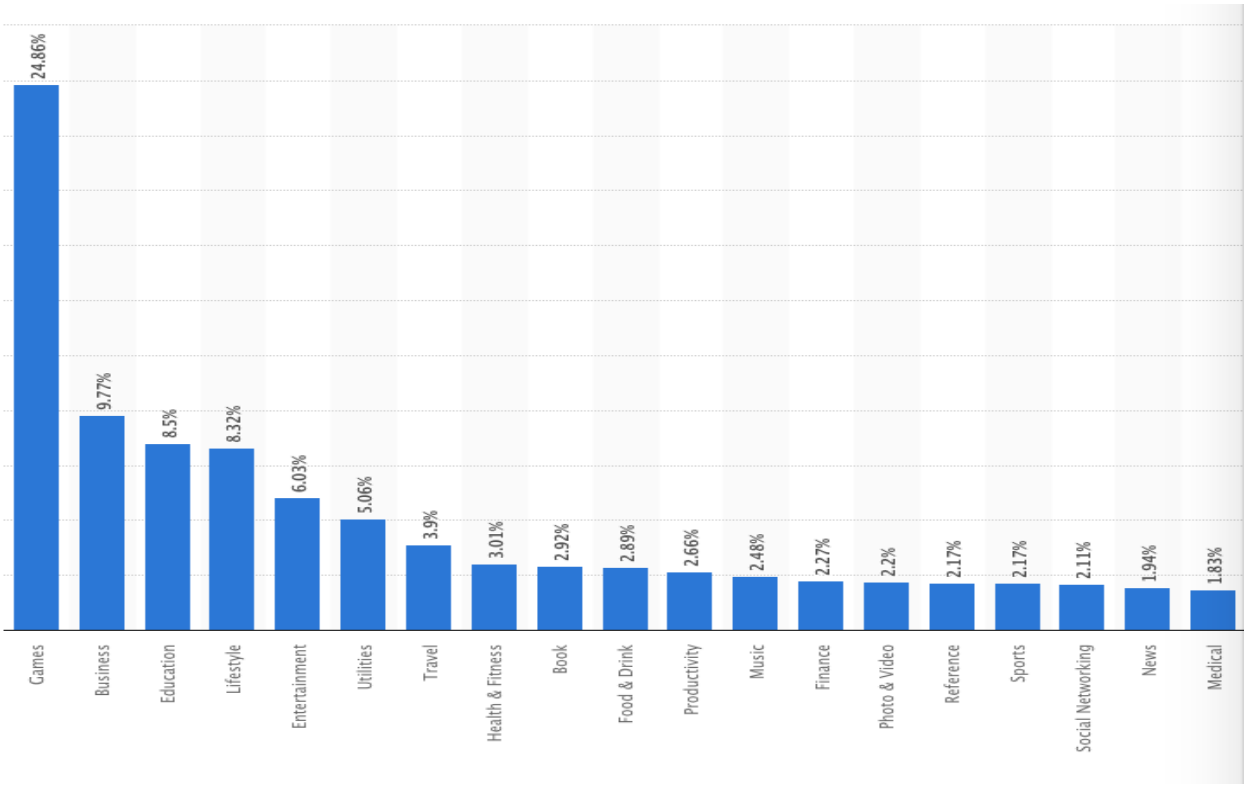

Figure 2. Mobile apps categories

Source: https://buildfire.com/app-statistics/[2]

A. Lifestyle

Mobile applications in this category are a strong and widespread source of influence. They can attract users of different ages, from minors to the elderly. The most common subcategories are music applications, dating, proper nutrition, fitness and travel. For example, this category includes applications such as: Spotify, TripAdvisor and Uber.

B. Social Media

Social media applications are some of the most popular. Many social network users access them every day. Facebook alone reports over a billion active users daily.

Of course, many would like the ease of access offered by mobile applications. Social media applications need to be fun, fast, and continuously integrate the expanding features of the social networks they support.

Today's society shares more information about everyday life than ever before. For this reason, even applications, which do not necessarily fall into the Social media category, may include social sharing features. For example, the popular running and cycling application, Strava, allows you to not only track activities, but also compare statistics with other people on the network. Essentially, a partnership or even an entire online running team can be formed.

Many other applications allow you to share a product, a high score, or a news article with the social network. They make it easy for users to share something they feel passionate about with other users without having to leave the app. For example, adding a user to social sharing features in the app, providing a service, or selling a product allows other users in the group to share it on their networks. This feature will keep users coming back again to share new information on their networks.

Some common social media applications are: Facebook, Instagram, Pinterest and Snapchat.

C. Utility

Utilities are mobile applications usually used without considering them applications. Many of them are pre-installed on the mobile device, performing a single function. Some examples of common types of Mobile Utilities applications are: Computer, Flashlight and Weather Forecast.

These are frequently used mobile applications, but for shorter periods of time. Normally, the Calculator utility will open only to perform an elementary calculation.

D. Games/Entertainment

Games are one of the most obvious categories of mobile applications, requiring less explanation. Applications related to this category are widely used and, as a rule, very competitive. They are also popular among developers, as they bring users back several times each week, and sometimes even several times a day.

In the most successful games, both the frequency and duration of the game are high. More "addictive" games are gaining ground, providing incentives for users to return daily or for a number of days in a row. Some examples of gaming applications are: Angry Birds, Clash of Clans, and Subway Surfer.

E. Productivity

Although Productivity mobile apps may seem more boring at first glance, they are incredibly popular. Such applications help users to perform a certain task quickly and efficiently. Well-known examples are many of Google and Apple products, such as Docs, Sheets and Wallet / Pay.

F. News/Information

News and information applications are relatively simple. They provide users with various news and topic-oriented information in an easy-to-understand form. Examples are the applications: Buzzfeed, Smartnews, Google News & Weather, Feedly, Flipboard, Yahoo News Digest, Reddit and Linkedin Pulse.

TECHNOLOGIES FOR CREATING MOBILE APPLICATIONS

There are many possibilities to create mobile applications. The world market is dominated by platforms based on **Android** operating systems, developed by the Open Handset Alliance, which is sponsored by Google, and **iOS**, developed by Apple. These two large platforms are based on mobile application development technologies that can be grouped into three categories: Native, Hybrid and Web.

Native Technology by name intuits that it uses the same programming tools and languages as those used by the creators of these platforms. Usually, to develop an application, you need two native developers or one, but who possess both programming technologies.

For the Android platform, such basic tools are used as:

- IDEA Android Studio (provided by Google itself and IntelliJ);
- C / C ++ / Java / Kotlin programming languages.

For the iOS platform, such basic tools are used as:

- XCode (provided by Apple itself);
- C / C ++ / Objective-C / Swift programming languages;
- A workstation running on OSX provided by Apple (for example Mac, Macbook, Mac Mini, etc.).

Hybrid technology is a platform that allows the development of Android and iOS applications in parallel, using the same code base. This platform is a bridge between components developed using

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native technology and the interface to other technologies, usually the Web. There are a lot of such platforms, supported by such companies as: React Native - Facebook, Flutter - Google, Xamarin - Microsoft, Ionic and others. The biggest advantage of Hybrid technology is the support and maintenance of a single project; another advantage may be lower development costs depending on the task developed. But after performance it gives way to Native technology.

Web technology is represented by technologies used in Web applications that can run on screens with small dimensions and resolutions, usually presented through an iFrame of an elementary mobile application.

METHODS OF EVALUATION OF THE EFFICIENCY OF MOBILE APPLICATIONS

IT projects can be optimized by accelerating the process of implementing new information technologies (IT) and reducing current costs. Using modern IT in the realization of IT projects, including in mobile application development projects ensures the achievement of the stated goal, but at the same time unforeseen expenses may occur, associated with underestimation of risks.

Therefore, for the initiation and execution of any project for the development of mobile applications and not only, it is necessary to optimize the activities and tasks of the project, performing a competent approach of financial analysis of all resources.

There are a number of techniques and methods of financial management analysis that can be used to evaluate the content of IT projects in general, as well as for various mobile and individual application development projects in particular. The main indicators that can determine the efficiency of mobile application development projects are the data on the costs of carrying out the project and its implementation as well as the sales forecasts.

Thus, for an initial evaluation of mobile application development projects, such activities as:

- determining the target group (potential customers) as well as its demographic and economic characteristics;
- determining the percentage of customers in the target group who would need to use the mobile application;
- determining the percentage of failures of other applications and mobile devices;
- determining the percentage of repeated visits from mobile devices and stationary computers;
- questioning the customers of the target group and identifying the need for a new mobile application that would contribute to further sales growth as an innovative approach in organizing the promotion of services, for processing business transaction estimates, etc.

The evaluation of mobile application projects can be performed using such indicators as [4, 5, 7]: Total Cost of Ownership (TCO), Economic Value Added (EVA), Total Economic Impact (TEI), Scorecard (BSC), Rapid Economic Justification (REJ), Information Economics (IE), etc.

Total Cost of Ownership

The most effective mechanism for estimating the IT infrastructure cost of IT projects is the "Total Cost of Ownership" (TCO) [3, 6]. This technique was created by the Garther Group in the 1980s' [6], although some experts believe that the concept (term) dates back to Napoleon's time when "engineers began to pay close attention to issues such as the effectiveness of cannons and how easy they are. were moved and repaired and how long they lasted in active use "[6].

The total cost of ownership involves determining the cost of software implementation and maintenance, cost analysis for the IT structure and its individual components. The TCO indicator is

a calculation designed to help people make better-informed financial decisions by analyzing the total cost from purchase to disposal, including expected costs that will arise over the life of the product, such as services, repairs, and insurance.

TCO is an analysis designed to discover all the living costs of a project. As a result, TCO is sometimes called "life cycle cost analysis".

When assessing TCO, there are four types of costs [3, 10] that need to be considered:

1) Purchase costs

The category of acquisition costs includes direct costs related to the costs of procuring the hardware and software resources required to carry out the IT project. It is usually accounted for as a capital expenditure in the project budget and may be impaired over time. In order to determine the total acquisition cost, human resources (specialists) are needed to evaluate different suppliers or solutions.

In addition, the acquisition cost may include the prerequisites to allow the new technology to function properly, such as new equipment to support a new software platform or the purchase of upgrades to existing software and equipment. In fact, any single purchase should be accounted for at the cost of acquiring the technology.

2) Implementation costs

The costs in this category generally consist of installing equipment, software and connecting to the network. Usually, most of the implementation costs are offset by the project staff. In some cases, people may be hired to oversee the implementation and maintenance of software and equipment and necessary.

Also in the category of implementation costs are included the costs of training users with the new technologies used in the implementation of the project.

Depending on the accounting interpretations, a large part of the implementation cost can be treated as a capital expenditure and is often the highest visible cost of a project, especially when external consultants are used to carry out the implementation.

For the implementation of IT projects are borne costs related to the payment of various fees to be considered, the procurement of additional licenses for implementing partners, as they will need their own login details.

As with acquisition costs, implementation costs are generally one-off expenses.

3) Operating costs

Although often not very visible but in the planning of IT projects, there are permanent costs incurred to maintain a new solution and long-term operation, as well as to reduce it to additional users. These are known as operating costs.

Operating costs include warranties, support contracts with external suppliers, ongoing license costs and, occasionally, upgrade costs. Any IT project must be able to anticipate these recurring costs based not only on current data but also on the future state of the organization.

In addition to the licenses required to implement hardware and software solutions, there may be a need for licenses for other applications. This could include a form solution, a payment processing solution, an email marketing solution and more.

In addition, the planning of future costs must take into account the staff resources needed to meet the needs of the IT project.

4) Improvement costs

The use of new functionalities, arrived in IT or additional projects, the transition to a higher level of the project, the implementation of several features can generate improvement costs. Custom development and integration with older systems also create necessary costs.

An easy-to-implement solution would be to take a certain percentage of the operating costs that are budgeted as improvement costs, because it corresponds to reality.

To estimate the TCO for a project, the sum of all costs to be taken into account for each year of the chosen lifetime is calculated.

Costs, which must be taken into account in the evaluation of any IT project, can in turn be classified into: direct costs and indirect costs. These two classifications are useful for separating expenses in order to determine the various types of cost (production, complete), respectively for presenting the information in the profit and loss account with the classification of expenses by function.

Direct costs are the costs that are directly related to the realization of the IT project. A project to create a mobile application includes such direct costs as: remuneration of employee work, software costs and basic equipment and raw material costs that can be directly associated in the production of the mobile application.

At the same time, financial costs may arise during the implementation and development of IT projects; such costs are called **indirect costs.** Indirect costs cannot be directly associated with the process of developing an IT project or with the production of goods and services, but with the entire business operation.

All IT project costs are recorded in the accounts based on the primary documents and, in part, in the IT project development budget (Fig. 3).

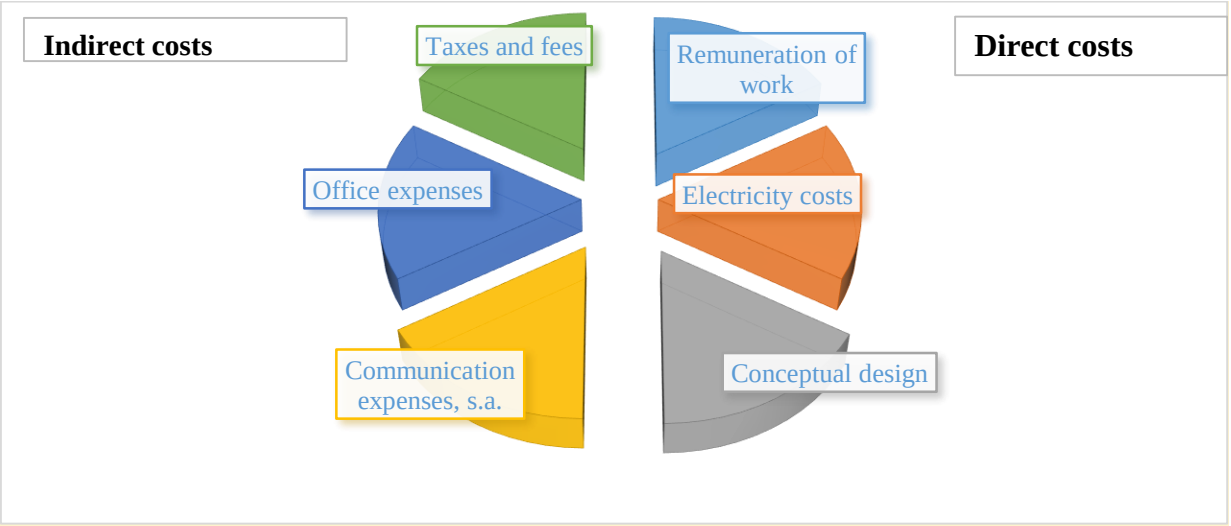

Figure 3. Cost constituents of IT projects

Source: prepared by the authors

Overall, the indirect costs for a mobile application project include:

- user self-training if the company's computer systems are used;
- computer and software usage service, providing assistance to colleagues working on the project;
- expenses for securing the related equipment purchased;
- office and communication expenses;

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- rental expenses;
- taxes and afferent taxes, etc.

This technique of direct and indirect cost analysis is the main or integral part of the significant number of quantitative methods, thus offering the possibility to carry out a qualitative evaluation of the efficiency of the IT project infrastructure.

A. Economic Value Added

In recent years, traditional management, based on the analysis and interpretation of accounting data, has proven its inability to evaluate and express, in the clearest and most accurate way the real performance of projects. The root cause is that accounting data have been shown to be characterized by subjectivism and lack of transparency and do not provide certainty in making the best investment decisions when taken as a decision-making basis [7, 8].

Under these conditions, a change was imposed in the attitude of project managers towards emphasizing from maximizing revenues to maximizing the value of IT projects, from the use of accounting data to the use of cash flow dynamics.

Economic value added (EVA) is the surplus value, created by an investment or an investment portfolio; it is determined by the excess return obtained by exploiting an investment in relation to the size of the total cost attracted to finance that investment. Thus, EVA is equal to the difference between a company's net operating profit (after taxes) and expenses incurred as a result of implementing or improving IT infrastructure:

$$\mathbf{EVA = NOPAT - CMPC \times Total\ capital}, \quad (1)$$

where:

NOPAT – net operating profit after tax;
CMPC – weighted average cost of capital.

The EVA indicator offers the possibility to measure the financial condition of an IT project, calculating the real economic income. The results of this indicator can be analyzed only by analyzing the EVA changes over time, depending on the nature of the activity carried out within the project and the efficiency of the use of the necessary resources in the execution of the project. Thus, in order to estimate this indicator, the market value of the capital invested in the IT project should be considered, excluding that part of the value that is supported by the investors' expectations regarding the future performances. For example, the result of the implementation of the Buzzfeed mobile application appeared after 2-6 months of operation. For all launched mobile applications, there is a significant temporary difference between when a particular system is launched or when existing business processes change and when the EVA indicator changes.

B. Total economic impact (TEI)

To calculate the cost of the IT application, it is appropriate to use the methodology for calculating the total economic impact (TEI), proposed by Forrester Research [8, 9]. The process in question is considered quite time consuming, and its use is more appropriate in a situation of evaluating the effectiveness of several alternative project plans. TEI evaluates the project of implementing the components of the company's IT system in terms of such parameters as "Cost", "Benefits" and "Flexibility" (Fig. 4).

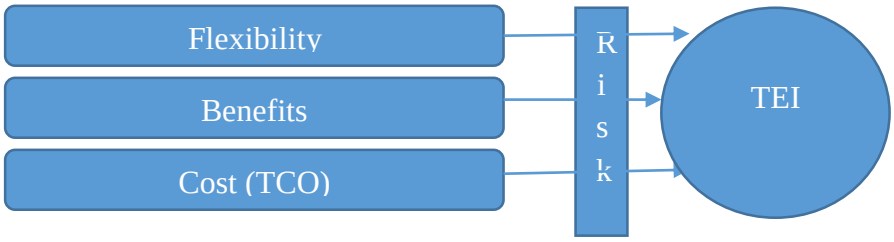

Figure 4. Method of determining the cost of the IT project

„**Cost**" is a quantitative unit of value calculated using the TCO method.

„**Benefits**" clearly shows whether the capabilities of the launched component of the IT system meet the requirements of the project.

Additional functions, which occur during the training of company staff as a result of the implementation of the IT project, should be subject to an objective assessment, such as increasing the productivity of workers involved in IT development processes and their influence in identifying project risks.

The "Flexibility" indicator characterizes the complexity of the IT project implementation process and estimates the costs required to add a new component to the project structure. For example, the need to change the organization system is analyzed if there are sufficient opportunities for settings and connections of its components to the existing system, the need to adapt it, etc.

The final stage of the TEI methodology consists in the analysis of the risks, resulting from the acquisition, implementation and operation of the components of the IT project.

Thus, the method of calculating the total economic impact is based on the formulation of the main and secondary objectives of the IT project and the elaboration of strategic development plans.

C. Scorecard

For the elaboration of strategic development plans, it is recommended to use a balanced score (Scorecard - BSC). This technique was developed by Robert Kaplan and David Norton from Harvard University, in order to create a qualitative approach for evaluating the effectiveness and infrastructure of the IT project as a whole [7].

The main steps in using the BSC method are the following:

- strategic formalization of ongoing project objectives;
- determining the direction of the activities necessary for the implementation of the strategic objectives of the projects;
- setting tasks that require decisions for each direction;
- determining the relationships between the tasks performed and their influence on the achievement of the objectives of the new implemented project;
- formalizing the performance criteria for each task: for example, the result of a certain task should lead to a 15% reduction in the deadline for the application of IT services;
- concretization of project implementation programs - allocation of financial and human resources, establishment of an area of responsibility for fulfilling tasks;
- project implementation;
- revision and correction of performance indicators (possible return situation from the stage of formalization of performance indicators to the stage of formalization of a strategic objective).

It should be noted that the BSC method is primarily a tool for training management strategy and can be used as part of an IT-oriented process management technique.

D. Rapid Economic Justification

The rapid economic justification, proposed by Microsoft [6, 8], is a development of the TCO methodology by establishing the conformity of expenditures with the IT project. The basic idea of the REJ method is to approach the IT project in terms of customer priorities, basic economic indicators and its strategic development plans (Fig. 5).

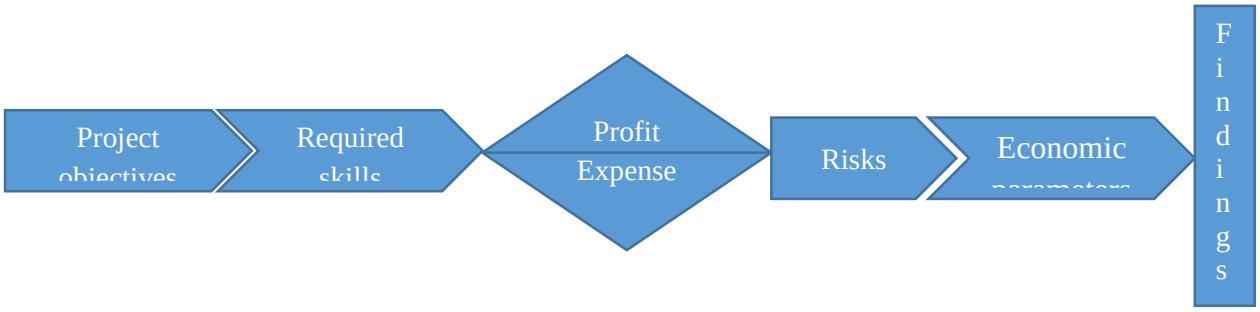

Figure 5. Rapid business case study

Source: prepared by the authors

The successive stages of the REJ technique are:

- determining the relationship with the objectives and basic parameters of the IT project to the business objectives of the company (this stage is similar to that of the BSC method);
- selecting a solution based on "Required Capacities";
- calculation of profit and expense, using the "Aggregate" methodology the cost of ownership;
- identification of project risks, depending on compliance parameters;
- calculation of the economic parameters of the implementation project with the involvement of the calculation method "Net Present Value" (NPV), "Internal Rate of Return" (IRR), "Economic Value Added" (Economic Value Added) - EVA), Return on Investment (ROI) etc.

The REJ technique more than just helps to find a common language for IT professionals and business, it is a tool that allows the evaluation of the IT contribution to the result of the company's business. However, this technique is a relatively complex assessment tool and also does not allow the assessment of the IT infrastructure as a whole.

E. Information Economics

If it is necessary to give priority to design criteria before considering an IT project, the method called Information Economics (IE) applies. IE is a qualitative method for evaluating an IT project or project portfolio, which involves the formation of specific project performance measures and their analysis in terms of potential benefits. This process involves organizing a group, including IT specialists, managers and risk managers, evaluating the effectiveness of the IT project. This group develops 10 key factors that determine the profitability of the proposed project. Next, an assessment is made of the relative significance of each of the factors ('plus') and risk for each of the factors ('minus'). As a result, a rating of the project is developed in terms of its importance for the main business processes of the organization.

Regarding the use of the IE method for project portfolios or the choice of an alternative implementation option, IE evaluations need to be compared.

CONCLUSIONS

This article reviewed the types of software used to produce mobile devices and the technologies used to create mobile applications, as well as how to evaluate the effectiveness of IT projects with regard to the development of mobile applications.

An IT project is considered acceptable for investment if it is reliable, financially feasible and meets certain well-established standards. When evaluating a project, a large number of indicators are used, some of which are mentioned in this article, which allows the correct evaluation of their effectiveness.

The use of indicators for the effectiveness of IT projects is necessary, as both the commercial efficiency of the project and the social impact can be identified, taking into account the assessment of the impact of inflation, risk and uncertainty on the success of the investment project.

It is clear that the existing methods and approaches for assessing the effectiveness of investment projects have their own shortcomings, even having common disadvantages, such as the description of methods for assessing effectiveness in too general terms, with the expectation of investment analysis professionals. Consequently, non-specialists in the field must study the scientific literature before they can make a qualitative assessment of the effectiveness of an investment project. In this sense, it becomes obvious that, nowadays, it is necessary to develop new models and methods to evaluate the feasibility of investing in a project, based on mathematical models in the form of an optimization problem.

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