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Adoption of Digital Business Solutions: Designing and Monitoring Critical Success Factors

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Abstract: The success of a business organization on its path to digital transformation depends on the success of the various stages of the project in order to adopt the selected digital business solutions. The success of this project is determined to a large extent by identifying and monitoring critical success factors (CSFs) for these stages. Based on the studies in the field of CSFs and consultations with experts from the ICT sector and academia, the paper presents a comprehensive framework for the overall management of CSFs (from CSFs' design to their monitoring). The framework helps business organizations conceptualize CSFs for different stages of a project for the adoption of a chosen digital business solution. Furthermore, the framework provides practical guidance in the form of a framework, a methodology on what organizations should do to identify, monitor and manage the proper CSFs so that they can take the most advantage of them. The proposed framework has broad practical application and can be used by companies implementing projects for the digitalization of their activity to improve the digital services offered and advance the organization's efficiency, etc. Currently, aiming to validate the presented framework, it will be applied for the adoption of a customer relationship management (CRM) digitalization solution, based on a cooperation agreement with a national company from the internet and TV service delivery industry. The framework can be further developed and applied to other project types.

Keywords: digital business solutions; adoption; project; CSFs; design; monitoring

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1. Introduction

The success of a business organization on its path to digital transformation depends on the success of the various stages of the project (such as adoption, implementation and use) in order to adopt the selected digital business solutions. The success of this project is determined to a large extent by identifying factors or prerequisites that are critical for these stages. These factors are known as critical success factors (CSFs).

Knowledge/identification of CSFs and understanding the interactions between them provides a positive, beneficial effect on the results of such innovative projects and the achievements of organizations [1–3].

CSFs for a company are such factors, the implementation of which allows the concentration of resources in areas where the company can achieve a significant benefit over its main competitors and gain a better position in the target market. The competitiveness of the company and the successful implementation of its various projects depend on the practical use of CSFs.

The concept of CSFs was proposed in the 1960s by R. Daniel [4]. Its main principles, steps for data collection and analysis needed to form the right set of CSFs, sources and goals of CSFs applications have been developed in detail by Rockart and his team at the Massachusetts Institute of Technology [5]. They define CSFs as a small number of key activity areas (issues, factors) in which achieving satisfactory results would ensure competitive success for an individual employee, unit or the entire organization. Their

distinguishing feature is their small number—only really important, "critical" to the success areas of activity on which to focus.

The following main goals of the application of CSFs can be formulated as follows:

- to identify the individual information needs of top managers;
- for the needs of the strategic, long-term and annual planning process;
- when it is planned, to create an information system for the organization that meets the information needs of top managers.

Bullen and Rockart [5] assign to the fundamental sources of CSFs the characteristics of the general environment (political, social and technological) and the economic sector, the competitive strategy and the competitive position of the company, the time factors and the specifics of the company management structure. They propose a procedure for CSF formation, which requires a series of interviews with the organization's top management to be conducted. Initially, individual interviews are conducted with the top management to reveal their views on CSFs. Then, the results are analyzed and summarized by compiling a preliminary list of success factors. The list of CSFs is discussed, and based on this, the final set of CSFs is determined, which operate on a company-wide scale. Then, the management information systems, which are oriented to facilitate the work with the information related to these factors, are developed. It is important to note that in their studies in the field, Rockart and his team have focused mainly on identifying the information needs of managers and planning the development of information systems to meet these needs.

Over time, CSFs are used for more and more other application purposes related to the activities of economic subjects [6–10], e.g., in the process of strategic planning and analysis, to identify opportunities and threats to business, to measure people's productivity, as a tool used from the top management of organizations to achieve high efficiency [11–17] or in project management (incl. projects for the adoption of business applications, e.g., ERP systems [2,3,14,18,19], CRM systems [20–22], projects for digitalization and adoption of advanced manufacturing technologies [23–29], etc.). As a rule, CSFs are associated with various areas of the company's activity, such as technology, production, marketing, sales, management, and staff training. Moreover, the term CSF is adapted according to its application area, i.e., it is defined in the context of a specific domain. For example, some standards and documents in the field of Information Technology (IT) should be mentioned, (e.g., CobiT and ITIL [30]). The framework for IT management CobiT (Control Objectives for Information and Related Technologies) examines CFCs that identify the most important actions of managers to achieve control over IT processes [31]. The engines, goals, success factors and consequences of digital transformation are studied in [32] with a focus on information systems.

In regard to the various purposes of the application of CSFs, different methods and sources suitable for CSFs identification are proposed, e.g., analysis of the external environment, analysis of the industry structure, analysis of competition, expert surveys, internal analysis, and comparative research [5,12,13,33–35].

The literature addresses another significant problem related to CSFs: the usefulness of identified CFCs remains questionable if they are not monitored and managed [36]. The latter requires planning a logical sequence of activities (called a model for CSFs monitoring in this paper) to provide the process to ensure their management and impact on the improvement of the results and/or project success in the company [37]. Most often, the issue of monitoring and periodic evaluation of CSFs is considered in connection with the strategic management of companies [38]. However, a literature review indicates a lack of sufficient general studies in this area.

All the information mentioned thus far shows that at the moment, no universal (in terms of the purpose of application of CSFs, the business domain of the company and its areas of activity) way to determine CSFs, nor to monitor them cannot be specified. Therefore, the management of each company must be able to diagnose accurately and manage overtime factors that are most important for the company's success as a whole

or for the success of a project based on the specific characteristics of its area and goals to which CFCs will apply.

The paper aims to answer the above need by proposing a comprehensive framework for the overall management of CSFs—from CSFs' design to their monitoring. The framework is dedicated to CSFs with a specific purpose, namely, the management of projects for the adoption of ICT solutions for digitalization. The framework helps business organizations conceptualize CSFs for different project stages for the adoption of a chosen digital business solution. Furthermore, the framework provides practical guidance, and a methodology on what organizations should do to identify, monitor and manage the proper CSFs so that they can take the most advantage of them. The type of projects to which the framework is applicable was not randomly chosen because the success of any company in today's digital transformation depends on the success of the almost daily implementation of various ICT digitalization solutions. The research and the resulting framework for designing and monitoring the CSFs presented here are based on the review of research in the field of CSFs, but the specifics of the digitalization on projects are also consulted with experts from the ICT sector and academia.

The following sections of the paper present the framework in two parts. Part 1 "CSFs Design" of the framework contains specific guidelines for identifying CSFs and their overall design (Section 2). Part 2 "CSFs Monitoring" is dedicated to the proper organization of the CSFs management and monitoring process (Section 3). A methodology for implementing the framework is also proposed (Section 4). The conclusion summarizes the research contribution and implications in the field, the limitations of the presented study and plans for future studies.

2. Framework Part 1. CSFs Design

Undoubtedly, the best business practices are evolving towards the use of CSFs. Since there is no unambiguous answer to the question of which internal factors are decisive for the success of the adoption of a chosen digital business solution, this section presents an approach that companies can follow to identify the sources and determine the right set of CSFs that would ensure the success of the individual stages of such a complex project.

2.1. CSFs Sources

Based on the research in the field of CSFs (see Section 1), the following primary sources of CSFs can be proposed in the adoption of a project for digital business solutions (Figure 1):

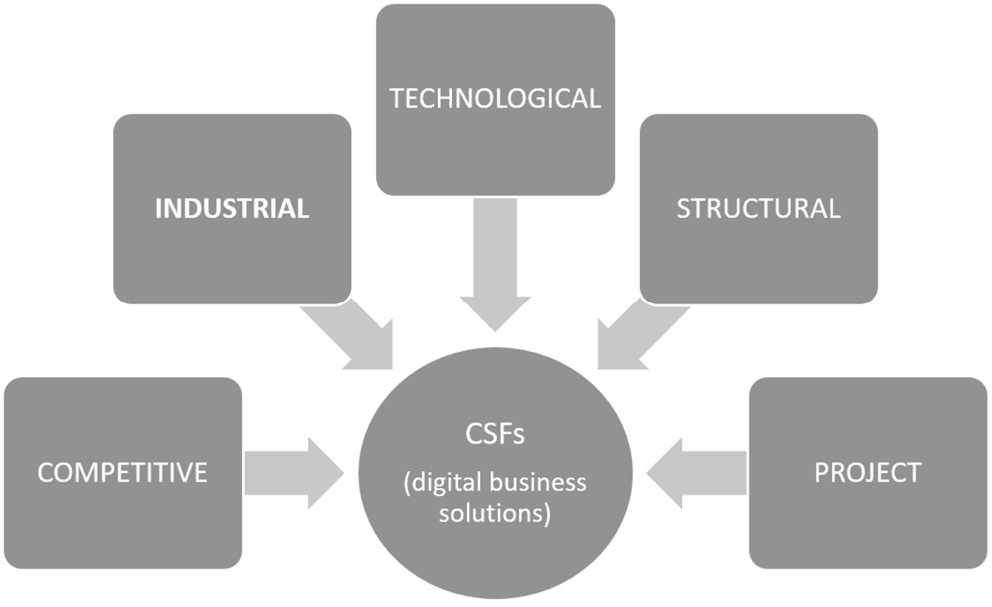


Figure 1. CSFs sources.

The characteristics of the industry/business domain of the company (industrial). Each industry has its CSFs, which must be realized and taken into account when developing the business strategy and projects for the company's digitalization. The organization's managers should focus their attention on these factors because the implementation of the branch CSFs largely determines the company's competitiveness. However, we should not forget that overtime sectoral CSFs may change under the influence of changes in the general situation in the industry.

- The competitive strategy and competitive position of the business organization to partners (competitive/partner). CSFs depend on the organization's rate in the industry compared to its competitors, its history and competitive strategies.
- The characteristics of the technological environment (technological)—in the classical theory related to CSFs, characteristics of the general environment (economic, political, social and technological) are taken into account here. However, the proposed framework mainly considers technological innovations in the digitalization field. These innovations should be important particularly in this case and have a significant impact on the adoption of projects for digital business solutions.
- The peculiarities of the management structure(structural)—this source determines the factors that depend on the internal organization's management structure and the managers' responsibilities at different levels (specific to the direction of the industry in which the organization operates).
- Requirements for the success of the project(project)—this source determines the internal factors (competencies and resources) that determine the success of the project and the related stages and activities.

In some cases, the so-called time factors can be considered. There may be periods in the company's operations when certain areas of activity prove be critical due to some exceptional circumstances, such as during a merger/separation of companies, when the company begins to operate in other areas or enters a new market. If the period of strategic planning of the organization, which is associated with the determination of CSFs, implies such circumstances, then the relevant CSFs must be determined. Under normal conditions, as in this case, CSFs are not determined in these areas.

The proposed set of CSFs sources is too general. It could be expanded to consider the specifics of a particular company.

To better understand the company's control capabilities and ensure the achievement of its goals, it is important to classify the sources and their respective CSFs into internal and external.

External sources of CSFs include the structure and general condition of the market; the current business climate; the economic, political and social situation; the level of demand/competence of the society concerning the product/service offered by the company; trends in the development of the industry.

The internal sources of CSFs can include the company's competitive strategy and position, time factors, the specifics of the company's management structure and the specifics of the direction of the industry in which the organization operates.

The macro-environment determines external CSFs, but the specific business organization must consider and ensure their availability to achieve its goals and fulfil the company's mission.

The micro-environment determines internal CSFs. They are in the field of issues on which decision-making is influenced significantly by the management activities of the company's governance.

CSFs can also be divided into factors oriented towards the monitoring of ongoing activities of the organization or improving and developing the business direction.

Attention should be paid to the fact that business organizations can develop and implement CFCs in their activities with different scope. Some CSFs are determined by strategic goals (corporate). Other CSFs relate to the level of departments, units, project

teams or the level of individual heads of organizational units (collective). All of them are influenced by the more general, industrial CSFs.

2.2. Designing

When designing CSFs to successfully adopt a project for digital business solutions in a company, each of the above sources (see Section 2.1) is important to identify the correct set of CSFs. The company inherits a part of the CSFs from the industry in which it operates and the characteristics of the general environment. Another part of the CSFs is determined by internal sources. To be able to design CSFs and use them as a tool for managing success, it is important to systematize the factors identified by all these sources following four design stages (DS) and activities described below.

2.2.1. DS1. Defining the Scope of CSFs

There are two main activities at this stage (Figure 2). As CSFs exist for different levels of management in the organization, the scope of CSFs to be developed (i.e., corporate or for a separate operating unit) must be taken into account. Once the level of CSFs has been determined, participants who will be involved in the work on determining CSFs can be identified.

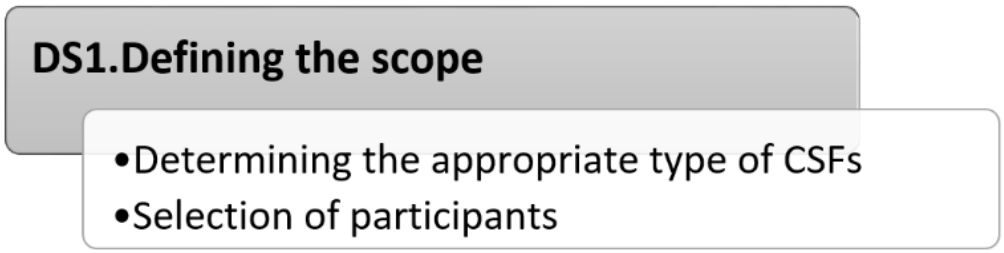


Figure 2. Design of CSFs: Stage 1.

The main reason for determining the scope of the designed CSFs in the discussed case is contained in the purpose of application of these CFCs (see Section 2)—for management of projects for the digital business solution adoption but also, in the nature of the particular solution itself. Depending on whether the solution chosen by the company aims to make changes in the whole company or only its separate unit/department/activity/team, it will need to develop corporate CFCs or collective CFCs, respectively.

Several other factors can be taken into account when determining the scope of CSFs:

- Corporate CSFs are strongly related to and are somewhat derived from the collective CSFs of the operational units of the organization. However, in the absence of time to determine the CSFs of each organization unit, a set of corporate CSFs may be created to be representative of all operational units.
- If the organization structure is flat (i.e., there are not many layers of management), a set of corporate CSFs can actually be highly representative and be applied instead of any necessary set of collective CSFs.
- On the other hand, the organization can have many layers of management and many divisions, sometimes even involved in different industries. Even in such cases, it is required to create corporate CSFs, it will be best to develop collective CSFs for individual divisions, as essentially each is a separate, functioning organization.

For example, if the digital business solution is related to digitalization and optimization of the company's internal processes to provide better products, the choice will be to develop collective CSFs. While if the digital business solution aims to improve the overall digital presence and company opportunities, then CSFs will have a corporate scope.

The type of CSFs strongly influences the decisions for selecting participants to be involved in their development.

For corporate CSFs, a more general view of CEOs and other organization's top managers is vital in creating a set of valid and representative CSFs.

The development of collective CFUs requires the involvement of high-level unit/team managers and top-level managers. It is also important to remember that the operational unit is part of a larger organization, so the involvement of some senior officials and roles can also be useful.

2.2.2. DS2. Providing the Necessary Data

At this stage (Figure 3), it is necessary to collect the raw data as a basis for CSFs extraction.

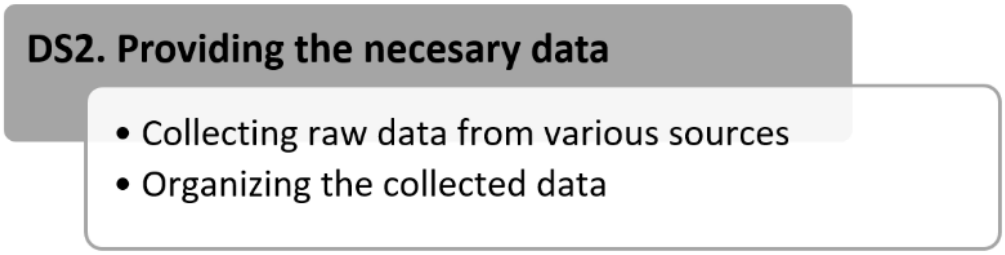


Figure 3. Design of CSFs: Stage 2.

Sources of relevant data to define CFUs may include the following:

- the stated, documented mission and vision of the organization and/or the operational unit;
- the indicated goals and tasks for the current year (fiscal or calendar) for the participants in the CSFs activities;
- performance indicators, collected about all stated goals and tasks;
- the short-term plan of the organization/operational unit or the long-term strategic plan;
- internal audit reports or other relevant documents;
- annual reports and other similar documents;
- industry reports for the primary industry to which the activity of the organization relates;
- scientific or technical literature representing existing related CSF sets or related analyses;
- CSFs of partner or branch organizations from the same branch;
- opinions on the CSFs of the staff of the company/unit.

All data collected from documents, interviews or other sources should be organized to facilitate subsequent analysis. This means grouping the same data type by certain characteristics, such as content, similar organizational functions, levels of management or problems. If notes are collected (e.g., from interviews), it is good to use a common format. To ensure that the collected data are ready for analysis, we have to check them for accuracy and completeness and, if necessary, to correct and supplement them.

Examples of approaches and sources for data collection to determine CSFs can be found in almost all literature sources cited in this paper. Although they do not affect projects for the adoption of digital business solutions, they can provide important guidance for the data collection phase in this particular case as well.

2.2.3. DS3. Data Analysis

This stage aims to categorize and analyze the raw data so that they can be used to extract CSFs. This requires some formatting and conversion of the raw data to the main components of CSFs. This "normalization" process prepares the data to meet the following requirements:

- independence—not to indicate which of the staff provided them (to avoid bias or influence);
- condensation—to be shortened to the level of their essential meaning or idea (to remove ambiguity);
- shape—to be converted into controllable pieces or units that can be analyzed.

The most basic approach that can be used for this stage is the direct analysis of the raw data by the participants in the development of CSFs, relying on their experience and intuition.

However, the above approach does not apply to CSFs related to larger and more complex companies, units or projects, such as the discussed digitalization project. In such cases, various structured tools, models, frameworks and methods are used to "normalize" the data, such as the method of interpretive structural modelling [11,39–42] or structured similarity analysis [43].

Based on the structured approaches to raw data analysis found in the literature and practice, this paper proposes a method for converting raw data to key components of CSFs for the success of a project for digital business solutions, which is an iterative process consisting of two recurring activities (Figure 4).

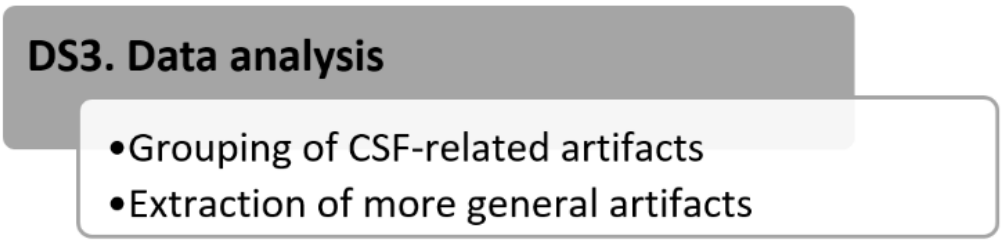


Figure 4. Design of CSFs: Stage 3.

At each step of the iteration, the available CSF-related artefacts are grouped by similarity (according to general characteristics or qualities) to reduce them by extracting more common artefacts from each group. In the first step, the available artefacts are all that can be found by reviewing the data collected (from documents, interviews, etc.) in the previous stage. The resulting (more general) artefacts from each step represent CSFs candidates and are input to the next step of the analysis.

The specific goal of the developed CSFs application and related basic concepts, intentions, etc., are leading in this categorization process. In this case, the subjects of this framework are digital business solutions, project management, and digital changes in the company or its unit. Business and operational goals and activities of their management in general and in connection with the chosen digital business solution must be added to them.

This iterative process continues until a sufficiently small number of artefacts are retrieved at a given step, which ultimately represents the desired set of CSFs candidates.

An example is considered (Table 1) for extracting artefacts from the mission of a randomly selected company (Legal Advice Company, Progressive Lawyers, https://progressive.legal/bg/nashata-misia-vision-and-values/ accessed on 1 October 2022) to illustrate the steps of the raw data analysis. The artefacts that are related to CSFs (for strategic management) are marked in the text of the mission (left column of Table 1), and more general artefacts that are candidates for CSFs (right column of Table 1) are derived from them.

Table 1. Design of CSFs: Illustration of Stage 3.

Mission	CSFs Artefacts (Candidates for CSFs)
Our mission is *to help our clients achieve their goals* by taking into account their interests, understanding their needs and meeting and even exceeding their expectations.	Customer relationship management.
We dare to *offer creative, practical and effective solutions*, with an emphasis on *effective communication*, responsiveness and attention to details.	Attracting and developing human resources (staff).
We dare to work hard for the success of our clients to *provide timely legal services* while *maintaining the highest standards of professional integrity*.	Provide high quality products and services to customers.
We dare to commit ourselves by *providing efficient and appropriate legal services*, applying *the advantages of modern technologies*.	Using modern IT strategically.

2.2.4. DS4. CSFs Identification

According to theoretical research on CSFs, they have greater clarity, usability and impact when they can be reduced to short and concise sentences that reflect the main intentions and essence of CSFs. In this direction, the last stage (Stage 4) of the CSFs' design is carried out. This stage includes two main activities (Figure 5). At this stage, to determine the final set of CSFs, it is recommended to perform a survey among top managers and/or heads of structural units to analyze the candidates for CSFs obtained as a result of Stage 3. Then, the final set of CSFs can be derived, and this set is to be used as a tool to ensure the successful adoption of a project for digital business solutions.

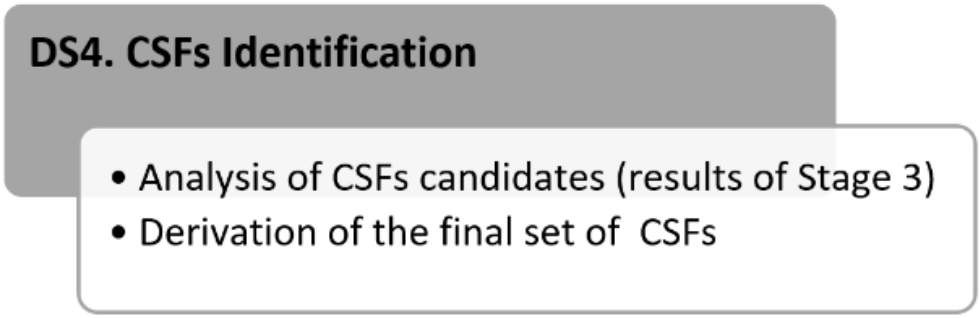


Figure 5. Design of CSFs: Stage 4.

The starting point for implementing these activities is considering the qualities that define CSF as excellent. To be considered as a qualitative, the CSF must:

- be worded clearly, concisely and be easy to understand. Interpretations by different managers are not relied upon to understand the CSFs' meaning;
- propose specific actions or activities performed by the organization/unit, typical for the operational work or the business domain;
- suggest improvements or recommendations which have to be made;
- begin with verbs describing actions or activities—attract, perform, expand, observe, manage, expand, etc.

Other additional general characteristics of CSFs of a project or organization are that they are specific, measurable, achievable, relevant and time-bounded [44].

Unfortunately, the number of existing literature sources addressing this topic is small. A large number of them are popular publications on online platforms, mostly dedicated to strategic CSFs for successful digital business transformation (e.g., Critical Success Factors for Each Phase of Digital Transformation [45]). The author has identified 14 CSFs (rather recommendations) for the successful implementing planning, design and development

phases of the overall digital transformation of a company that seeks to make the transition from standard software systems to intelligent platforms to provide a modern level of connectivity with people, business networks, technologies such as the internet of things, big data and everything new that the future has to offer:

1. Planning:
    - Starting with the end in mind;
    - Identifying value drivers;
    - Discovering your potential;
    - Developing a plan for digital transformation;
    - Deploying in the cloud, on-premise, or hybrid;
    - Choosing greenfield or brownfield project investment;
    - Partnering to move ahead;
2. Design:
    - Jump-starting the design process;
    - Get a seat at the table;
    - Controlling complexity;
3. Development:
    - Sprinting to the finish line;
    - Taking a factory-like approach to configuration;
    - Automating the testing process;
    - Transitioning to operations.

Other publications on the subject are [46–52]. A specific example of CSFs that have a similar subject for development of those of this framework—digital business solutions—are the 10 CSFs identified for the needs of introduction of electronic payment systems in the bank sector [42]: coherence, complexity, customer demand, support from senior management, infrastructure, expert selection, security, cultural factors, government policies, awareness.

Adherence to the four main stages and the activities included in them (Figure 6) would ensure the design of the right set of CSFs for any CSF initiative, including the case covered by this paper.

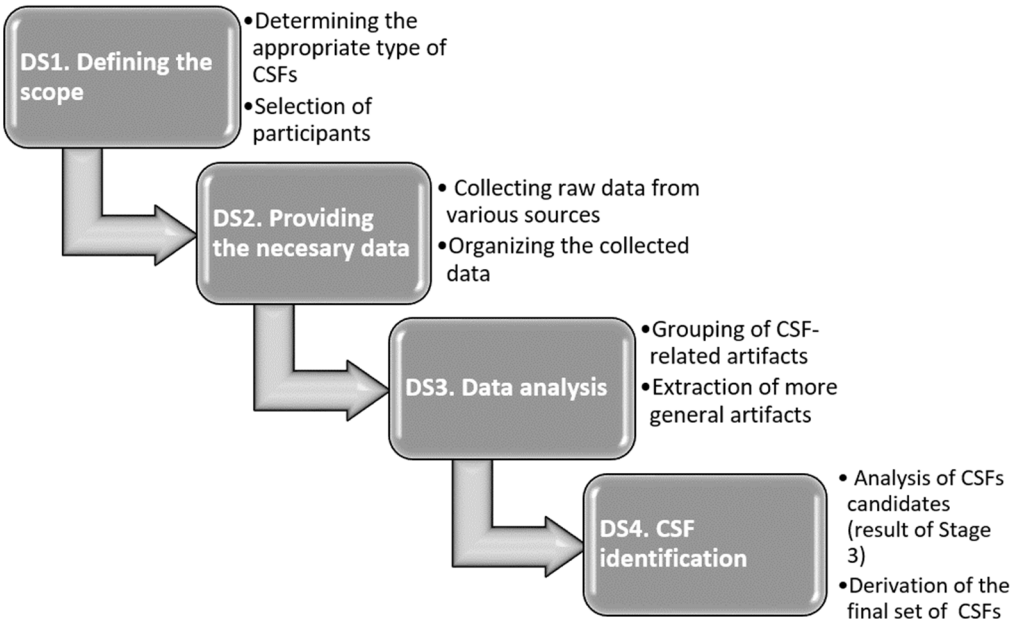


Figure 6. Design of CSFs: Stages 1–4.

3. Framework Part 2. CSFs Monitoring

The identification of CSFs is not enough—it is only part of the complete process of their establishment, management and monitoring to achieve the desired benefits and objectives for which they are developed. Undoubtedly, the advantages of CSFs would be "incomplete" without following a predetermined process of CSFs management and monitoring [37].

The literature review of the available sources indicates a lack of empirical and theoretically oriented research on CSFs management. This fact leads to a limited understanding of the actual benefit of CSFs, as the focus is only on identifying them. However, experts widely recognize the crucial importance and the need to provide such guidance to managers of organizations/units/projects that apply the methods of CSFs to achieve the goals of their initiatives.

It is necessary to go beyond the typical approach of simply identifying CFCs, providing resources and guidance on what action plan to follow in the process of management interventions based on CSFs to deploy the potential of the practical benefit of CSFs.

This section presents a theoretical model (see Section 1) for CSFs monitoring and overall management of the process for ensuring their impact on improving the results and (or) success of the venture/project of the company. The model covers four monitoring stages (MS) of activities (Figure 7), which are a natural continuation of the stages for CSFs design. Therefore, the monitoring process starts from the last stage of the CSFs design.

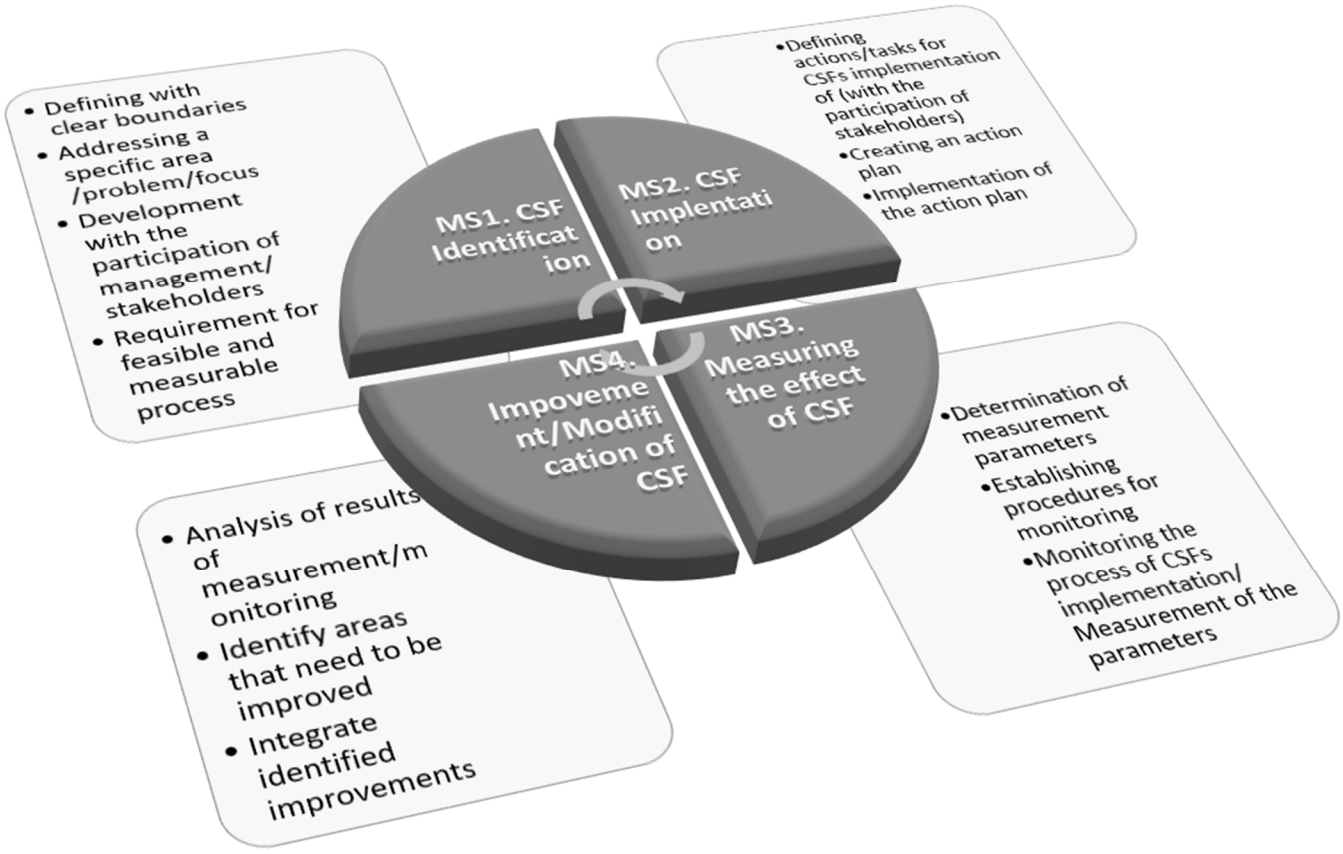


Figure 7. Model for monitoring of CSFs.

3.1. MS1. CSFs Identification

A crucial step in using the CSFs concept is CSFs identification. CFCs can be identified in many ways, some of which are described above. Several characteristics need special attention to improve the usefulness of CSFs from a monitoring point of view. In particular, each identified CSF must:

- have clear boundaries and a specific area of application, focus or problem to solve;

- allow the implementation of strategies and action plans of management/relevant stakeholders that address the underlying area/problem/focus;
- require a workable process with a measurable result regarding accepted benchmarks or performance criteria.

3.2. MS2. CSF Implementation

The second stage provides the actual benefit of CSFs. It requires planning and implementing who, what and when to take action to achieve the goals pursued in the process of CSFs identification. The issues that need attention at this stage are the definition of actions and (or) tasks to achieve the goals on which the CSFs are focused, involving relevant stakeholders in the discussions, creating an action plan with a schedule, necessary resources and people, and implementation of the action plan.

Taking a careful and thorough approach at this stage is vital to achieving the goals behind the CSFs identification.

3.3. MS3. Measuring the Effect of CSFs

In the first steps of this stage, the parameters (indicators) for measuring the effects of the implementation and appropriate procedures for monitoring the CSFs should be determined.

To assess whether the requirements of CSFs are met, as well as whether the set goals are achieved the so-called Key Performance Indicators (KPIs) [38,53] can be used. KPIs are specific and measurable criteria that managers use to assess the achievement of goals. For example, an organization may define the following as its CSF: "Increase sales of product X in the domestic market". Accordingly, the following can be identified as a KPI: "To increase sales of product X on the domestic market by 20% compared to the previous year".

Based on the measurement/evaluation of the defined parameters (e.g., KPIs), the actual monitoring of the CSF implementation process is carried out.

3.4. MS4. Improvement/Modification of CSF

The last stage in the monitoring process is related to the reassessment of the selected concept of CSFs. Based on the analysis of the results obtained from the measurement of the effects of CSFs application, according to defined goals and parameters, the areas in which CSFs should be improved/changed and even, if necessary, rejected should be identified. To integrate the identified improvements, the process of CSF monitoring and management must start again from the beginning, from MS1—the stage of CSFs identification.

The model for CSF monitoring described above can be illustrated briefly by the following example: often, the "Support from senior management" factor is involved in the identified CSFs. The model then requires the following: for this factor to be concretely defined, with a clear focus on attracting managerial attention; drawing up an action plan on how to look for and maintain support for its leadership; and assessing whether the perception of this factor as a CSF has achieved its goals.

The four stages from the model for monitoring, identification, implementation, measurement of efficiency and improvement of CSFs are repeated (Figure 7) periodically. This repetition ensures the maintenance of an always up-to-date set of CSFs (in unison with any change in the company's business goals, at the level of technology, etc.) that support the desired success.

It is important to note that stages MS2 (CSF Implementation) and MS3 (Measuring the effect of CSFs) are mutually justified, because if CSFs are not applied in practice, then the measurement of their effects would be pointless and vice versa.

4. Methodology for Implementing the Framework

Undoubtedly, for the success of any business venture, an essential role play experience, qualities and even the intuition managers of the organization.

The section systematizes the methods and tools appropriate for use in the various stages of the overall process of CSFs design and monitoring (DS1–4 and MS1–4).

DS1. Defining the scope of CSFs and participants—the project managers should discuss the following issues:

- the type of CSFs that are being developed (corporate or collective);
- the structure of the organization (multi-layered or flat structure);
- the specific working conditions of the organization (international presence, size of divisions, industry structure, etc.);
- the goal for CSF development.

DS2. Providing the necessary data

Many data collection methods are known, such as conducting staff interviews, questionnaires and other survey techniques, reviewing key company documents, and reviewing literature from primary and secondary sources in the field (in some cases even automated).

Where possible, it is good to apply several of these data collection techniques because they complement each other. However, if only one technique should be used, the preferred method is staff interview, which provides a dialogue.

The collection of data from documents and literature sources requires their in-depth study and analysis to understand the focus and direction of development of the specific organization/operational unit, of short-term and long-term strategies and related staff goals to achieve these strategies at the level of theoretical and applied developments in the field. All this is decisive about the developed CSFs. The large volume of researched sources can complicate the data collection process. Since most modern written sources are digital, it is easy to apply tools and methods to automate their collection and analysis (incl. search engines, computational linguistics methods and big data).

In some cases, data collection from written sources is not possible because these sources are not available. Such a problem can be mitigated by proper planning and conducting interviews with staff.

Data collection methods based on survey techniques are well-known and established due to their application in many other areas. For them, automated conducting and analysis of the results is also possible and recommended.

The most commonly used and most effective method is to collect data by conducting interviews with staff. It is known that for an effective interview, it is necessary to prepare and specify in advance the interviewing team, the interviewed staff members, the time and order of interviews and the questions. Important recommendations regarding the content of this type of interview are:

- indicate the purpose of the interview;
- clarify the participant's idea of the mission of the organization or unit;
- clarify the participant's opinion about his/her role in the organization or operational unit;
- discuss the goals and tasks of the participant;
- Ask a series of open-ended questions to retrieve data on the required CSFs, including for their priority and measurement.

Bullen and Rockhart [5] offer detailed instructions for conducting a CSF interview. These include a set of questions that directly intend to extract CSF.

DS3. Data Analysis

Some existing classification techniques, as mentioned, are suitable for performing Stage 3 of the CSFs design process related to raw data analysis. The need to apply formal techniques depends on factors such as: how many artefacts related to the target CSFs were found during the review of the raw data; the number of persons participating in the activity; and the required accuracy, etc.

In general, due to the complexity of such innovative projects, the success of which depends on many internal and external factors and covers almost all areas of the company's activity, it is necessary to analyze a significant number of sources of relevant data to define CSFs, and from there to identify an extraordinary large number of primary artefacts. This is

well illustrated in the example in Table 1, where only in the mission of the company seven primary artefacts were found.

The Big Data technologies and specifically the MapReduce model for distributed processing of a large amount of data in computer clusters (where the internal and external sources of primary data are stored) are particularly suitable for carrying out Stage 3 according to the iterative method selected in this Framework. In this case, IT managers may predict developing a project to create a Hadoop MapReduce application providing automated extraction of the desired set of CSFs candidates through a series of MapReduce tasks. This would ensure the efficiency of the extraction process, the objectivity of analyses and the avoidance of bias.

DS4. CSF Identification

The basic approach that has been necessary to determine the final set of CSFs, i.e., for the implementation of the activities of DS4, is a survey among representatives of the top management related to the CSFs-initiative, concerning the actual applicability of the identified candidates for CSFs, as a final result of DS3.

This survey is often carried out based on one of the survey methods during a specially organized round table in which, in addition to representatives of the management of the organization/unit/project and the team who implement the CSFs initiative, it is good to use the help of experts in the business domain of the company. It is desirable that all participants be familiar in advance with the purpose of the digitalization project, the business goals and mission of the company/unit and the general requirements for the quality of CSFs (see DS4 in Section 2.2). Based on all this, they assess the extent to which each of the candidates for CSFs be included in the final set of factors, e.g., filling in the form developed for this purpose (see Table 2, where a short example of filling in is also given). In order to highlight the area of impact and the importance of individual CSFs, it is appropriate to group them according to the elements of appropriately selected leading signs (targeted improvements), which may vary depending on the purpose of the digitalization project. In this sense, the grouping can be according to the strategic goals of the company/unit, performance indicators, planned results, critical assets (in this case, these are mostly information assets and systems), the stages of the innovation process or the stages of the project life cycle.

Table 2. Design of CSFs: Form for DS4.

Leading Sign of CSF Grouping	Candidate for CSF	Should It Be Included in the Final Set of CSFs? (Yes/No)	Brief Justification
Sign 1. Customer satisfaction	CSF 1.1. Pricing and Services	Yes	Important factor
	CSF 1.2. Loyalty	Yes	Particularly important
	CSF 1.3. Honesty	No	Not important—it is part of the factor Loyalty
	...	...	
Sign 2.	CSF 2.1.	...	

In some cases, when there are pre-developed CSFs in the target area of application, it is possible to shorten the design process of CSFs and, after DS1, move directly to DS4. The developers of CSFs identified for implementing electronic payment systems in the banking sector [42] acted in a similar way (see the specific example of CSFs given at the end of Section 2.2).

Stages 1–4 of the CSF monitoring model (MS1–4)

In order to monitor CSFs identified with the goal of application discussed in this Framework, project managers who adopt digital business solutions must systematically follow a large number of interrelated activities of the CSF monitoring model (see Section 4).

This, in turn, would lead to meeting the requirements of and successfully implementing such a complex innovation project.

To ensure fully the process of CSFs monitoring and management, it is necessary to specify the activities/actions to be taken, the parameters for measuring the effect and all other preconditions determining the implementation of each of the four stages from the monitoring model for each of the identified CSFs. This includes:

- selection and use of formal methodologies, tools and techniques for project management;
- evaluation of the scope, location and necessary efforts for the project;
- judgement and decision-making on the approach for adoption of chosen digital business solutions;
- building knowledge by organizing joint teams of external consultants and experts in the field;
- constructing project team(s) that cover the organization and have a balance of business and IT skills;
- empowering the project team(s) to make changes.

In these activities, project managers can be facilitated, as there are already many software applications and tools that can automate one of the most time-consuming stages—measuring the effect of CSF (MS3). For example, BSC Designer is software that automates all elements of the so-called business continuity strategies, e.g., by automatically feeding KPI or generating analytical reports.

The entire process of CSFs design and monitoring of the framework with its eight stages (DS1–4 and MS1–4) is presented in Figure 8.

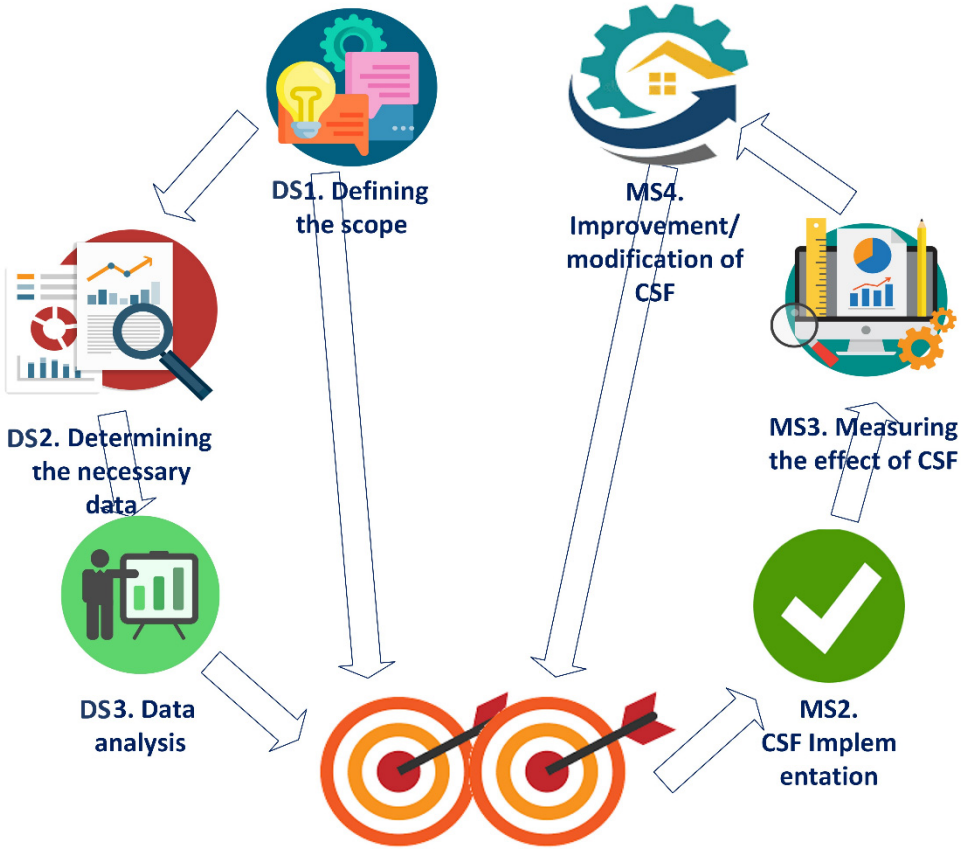


Figure 8. Methodology for application of the framework for design and monitoring of CSF.

5. Conclusions

The study presented in this paper aims to increase the understanding of how to identify and how to monitor CSFs affecting projects for the adoption of digital business

solutions. It seeks to assist organizations and their managers in taking initiatives related to such kinds of projects by providing guidance on the use of CSF methods to orient resources to those activities that can ensure the initiative's success.

Based on the extensive review of research in the CSF field and on consultations with experts from the ICT sector and academia on the specifics of the field of digitalization, the present study provides a comprehensive framework for managing all interrelated activities for the proper identification and monitoring of CSFs in the field of the projects under consideration. If these activities are systematically undertaken, they can lead to the achievement of the relevant CSFs and the operational implementation of the chosen digitalization solution. Thus, the proposed framework has a broad practical application and can be used by companies implementing projects for the digitalization of their activity to improve the digital services offered and advance the organization's efficiency, etc.

This study also contributes to the research on the use of CSF methods in the digitalization sector and the widely established approach of identifying CSFs by proposing a framework for overall managing CSFs and providing valuable guidance for project managers in the adoption of digital business solutions.

Currently, aiming to validate the presented framework, it will be applied for the adoption of a customer relationship management (CRM) digitalization solution, based on a cooperation agreement with a national company from the internet and TV service delivery industry.

The incomplete validation of the framework and, accordingly, the impossibility to present the validation results can be considered somewhat of a limitation of the study. The limited research that specifically addresses the topic under consideration can also be attributed here.

In this regard, the most promising prospect for future development of the research is to finish the framework validation and analyze its results regarding the applicability of the framework. From a more long-term perspective, the framework can be further developed and applied to other project types. However, the most ambitious future goal is to develop an integrated software platform that automates the entire process of CSFs design and monitoring (Figure 8) presented in the eight stages of the framework (DS1–4 and MS1–4). This implies combining the means of state-of-the-art IT achievements, including search engines, computational linguistics methods, big data, cloud technologies, and intelligent data analysis, etc.

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