The alignment of internal control with the ERP system: the proposal of a qualitative approach based on the ERP implementation course

KHIARI Mounir[1*], BENKARA Imene[2]
[1]Faculty of economics and management BADJI Mokhtar ANNABA university, Research laboratory in innovation, economic and financial analysis "LARIEF" (Algeria), Mounir.khiari@univ-annaba.org ,
[2]Faculty of economics and management BADJI Mokhtar ANNABA university, Research laboratory in innovation, economic and financial analysis "LARIEF" (Algeria), benkaraimene1@gmail.com

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Abstract

The purpose of this study is to propose a qualitative approach to align the internal control under the ERP system by using the ERP implementation course. A deductive method was used to achieve this aim, and it was concluded that the analysis of the current practices showed inconsistencies in the succession of control activities between the periods of ERP in phase project and ERP in its operational phase. The characteristics of different stages of the ERP life cycle influence the state of internal control. Based on these findings, the researchers propose a qualitative approach, recommending the alignment of both internal control and risk management with the ERP implementation course.

Keywords: *ERP system; internal control; ERP implementation course; ERP life cycle.*

[*] ***Corresponding author***

1. INTRODUCTION

The utilization of the ERP systems started in the early 90s, contributing to the adoption of new organizational cultures within the entities and announcing a new challenge for the internal control (IC) designers who are familiar with manual information systems (legacy systems) or automated ones. These types of systems are used in only one domain of activity (production, accounting, and human resources) or even integrated together via interfaces.

The ERP system makes the entity dependent on its technological environment and exposes it to risks, some of which may affect the business sustainability. For that reason, the entity should assess its ERP system attentively. To that end, COSO recommends using technical frameworks like COBIT (Control Objectives for Information and Related Technology) to ensure that this environment is under control.

The predominance of this vision in existing practices makes the evaluation of the entity IC devoid of qualitative aspects that are essential when choosing the appropriate method for this process. One of these qualitative aspects is the ERP implementation course, presented as a chronological axis, encompassing all the ERP life cycle (ERPLC) and allowing the entity to see the sequence of control activities over several phases.

Since the qualitative aspects are considered essential for the assessment of the IC, **is it necessary to align the internal control with the ERP system by adopting a qualitative approach based on the ERP implementation course?**

Research objective:

The study aims to propose a qualitative approach to aligning the IC with the ERP system by using the ERP implementation course as a qualitative criterion.

Research method:

To achieve the objective of this study, the researchers started by analyzing the current practices of IC that deal with ERP systems through a qualitative criterion (ERP implementation course). They used the COSO internal control framework alongside the approach of the ERP Life Cycle redefined by (Huang & Yasuda, 2016) as a reference. The researchers opted for the deductive method, which goes from general facts to undefined particularities through a series of deductions and analysis. Then, they developed a qualitative approach as a solution to the incoherencies,

developing key-success factors (deliverables) for each phase of the ERP implementation course and aligning both the project risk management and risk management policies set by the entity to manage risks during the exploitation phase of the ERP system.

Previous studies:

The previous studies cover the period from 2011 to 2017 and focus on IC characteristics under the ERP system and the key-success factors ensuring the IC under that system:

- **The precaution of enterprise internal control under the ERP system, Xu Wei-Hua, 2011:** This study illustrates the purchasing and payment systems in a Chinese commercial company (case study), the researcher analyzed the risks that may occur in this process and proposed six key controls to avid them.
- **The research on internal control of accounting information system based on-ERP, Xuesong Jiang, Yan Xu, 2011**: The study highlighted the changes and problems that occur in the accounting information system (AIS) within the ERP environment. In order to resolve those problems, the researchers suggested the concept of "data quality control" as a tool to support IC.
- **Investigating the relationship between Enterprise Resource Planning (ERP) system and internal control: an exploratory study, Hani Shaiti, YanqingDuan, Magdy Abdel-Kader, 2013:** This research aimed to investigate the effect of ERP system success in providing adequate IC procedures. The researchers used an exploratory field study method with a sample of 12 companies of different sizes (small, medium, and large) and included companies that have implemented ERP systems and those that have not. The study concluded that the ERP system supports the IC and that this support can be different from one company to another.
- **Internal control research of accounting information system based on the ERP environment, Guohui YAO; Ling YANG, 2014:** The objective of this study was to highlight IC characteristics in the ERP system environment and what the entity should do to meet with new control requirements of this system. To observe the changes, the researchers chose three factors (internal environment, risk assessment and control measure). It was concluded that the objects, methods and processes of the IC of the AIS needed to be adjusted based on the ERP system in order to adapt to the internal control requirements.

- **Internal control framework for a compliant ERP system, She-I Chang; David C Yen; I-Cheng chang; Derek Jan; 2014:** This study developed an IC framework that can be applied within the ERP system. The researchers proposed 12 dimensions that contain 37 control items aimed at helping auditors perform effective audits by inspecting essential IC points in ERP systems. The proposed framework allows companies to enhance IT audit efficiency and mitigate control risk.
- **The study about the internal financial control of power enterprise under the ERP environment, Yijing Liang, 2015:** This paper discussed the role of ERP in the internal financial control of a Chinese electric power enterprise (case study). It also analyzed the main problem in the implementation of ERP, in order to propose solutions to improve IC in this enterprise. The study concluded that the ERP system does not only influence financial management but also the contents and the form of IC. As a result, the researchers suggested the implementation of diverse controls measures in order to strengthen the IC.
- **An applicable approach for internal control testing in ERP, Wan Jianguo; Li Tinglio, 2016:** This study proposed an approach based on "control data" to test IC effectiveness. The researchers used a type of parameterized control called "control data" and checked the applicability of this approach in a company by using a case study method. The study revealed few systematic problems and consistent errors in the system.
- **Research on internal control of accounting information System in ERP Environment, Jun Feng, 2017:** This study aimed to investigate factors that help the entity establish the IC system of accounting information system under the ERP environment. The internal environment, risk assessment, control measures, information and communication, as well as a series of deductions and analysis, were used by the study researcher to improve IC practices.

The present research agreed with the research literature on the necessity to improve the concepts of IC under the ERP system. However, this literature takes a different direction by considering that IC under the ERP systems starts after the ERP go-live, omitting the prior phases of the ERPLC (pre-implementation and implementation phase) and the characteristics of the post-implementation phase (the different stages of this phase). Furthermore, (Xu, 2011), (Shaiti, Duan, & Abdel-kader, 2013), (Yao & Yang, 2014) and (Jianguo & Tingliao, 2016) attempted to find the contributions of the ERP system to the IC and identify risks that may appear.

On the other hand, (Jiang & Xu, 2011), (Chang, Yen, Chang, & Jan, 2014), (Liang, 2015) and (Feng, 2017) focused on giving solutions to problems occurring in IC under the ERP system and suggesting recommendations for improved control practices. Nevertheless, none of them has proposed new approaches or methods that treat IC under the ERP system.

The (Yao & Yang, 2014) study revealed that the objects, methods, and processes of the IC of the AIS needed to be adjusted based on the ERP system to adapt to IC requirements. The exception is made by (Jiang & Xu, 2011), who proposed an approach based on a qualitative standard of "data quality" and used it to prepare parameterized controls. Later, he was joined by (Chang, Yen, Chang, & Jan, 2014) who integrated this type of control into their IC framework for assessment purposes.

In the absence of other qualitative criteria, the researchers intend to study all ERP phases, including pre-implementation and implementation phases (knowledge gap), through a qualitative criterion (ERP implementation course) and seek to propose a qualitative approach that aligns IC to all ERP phases.

The importance of the research:

The proposed approach is set to help entities align their internal control with the ERP system and to assist other interested parties (internal and external auditors and researchers) in understanding the IC particularities of ERP systems.

Research limits

The proposed approach was developed based on a single qualitative criterion (ERP implementation course), marginalizing the other qualitative criteria (criteria relating to the entity specifications, criteria relating to the ERP particularities, etc.).

Research structure

In order to answer the main question of this study, the researchers structured this study into three axes:

- An introduction to internal control and the ERP system;
- The current internal control activities under the ERP system;
- The framework of the qualitative approach.

2. An introduction to internal control and the ERP system:

In this section, the researchers provided definitions of the major key concepts of the study, including the IC, ERP system, ERP project features, ERP implementation course, and the ERP life cycle "ERPLC".

2.1 Definitions of CI and ERP concepts

In 1992, the Treadway Commission (known as COSO) defined the IC as a “process implemented by the entity’s board of directors, management, and other personnel, which is designed to provide reasonable assurance regarding the achievement of objectives relating to the following categories: the realization and optimization of operations, the reliability of financial information (reporting); and compliance with laws and regulations. (KHELASSI, 2013, p. 30)”; this definition remains unchanged.

During the same period, (early in the 90s), the developers of software solutions [intensified their work on the MRP II manufacturing resources planning system, adding the principle of (supply chain) (Feng, 2017, p. 1549)] aimed at developing an integrated management software, called “Enterprise Resources Planning” or “ERP system”. This system is also known in the French lexicon as “Progiciel de gestion intégré” or “PGI”.

This integrated solution represents the idea of oriented management towards an "improvement of efficiency and the gain of a competitive advantage by the realization of an optimal allocation of resources (Yao & Yang, 2014, p. 5790)", and “intent to cover most of the needs of the management information system of the company (BLONDEL, 2009, p. 11)”. This system is characterized by: (LEQUEUX, 2002, p. 33)

- The management of several enterprise domains;
- A unique data warehouse;
- Standardization of rules;
- The management of multiple applications within the same system at the same time;
- A unique form of interface;
- The existence of development tools (the possibility that this system accepts future modifications).

2.2 Features of an ERP project

The ERP project has characteristics that are different from ordinary projects. Table n° (01) below summarizes the different points of convergence and divergence between an ERP project and an ordinary project.

Table N° (01): The points of convergence and divergence between an ERP project and an ordinary project

Points of convergence between an ordinary project and an ERP project	Points of divergence between an ordinary project and an ERP project
▪ Planning and management ; ▪ Temporary processes ; ▪ Complex and non-repetitive actions ; ▪ achievement of a goal(s); ▪ Delivering during a precise mission, a unique product; ▪ Risk management	▪ An information system (IS) with an open architecture; ▪ An "IS" that is open in time and space.

Source: established by the researchers.

The ERP project has the basic characteristics of an ordinary project but differs from other ordinary projects in the following points:

- An IS with an open architecture (an open system) means that the end of the project work does not mark the end of the modifications;
- An IS that is open in time (the possibility to add during the ERP life cycle, multiple applications);
- An IS that is open in space (the possibility that the entity extends the scope of the IS covered by its ERP system).

Moreover, the ERP project has essential constraints (LEQUEUX, 2002, p. 177) :

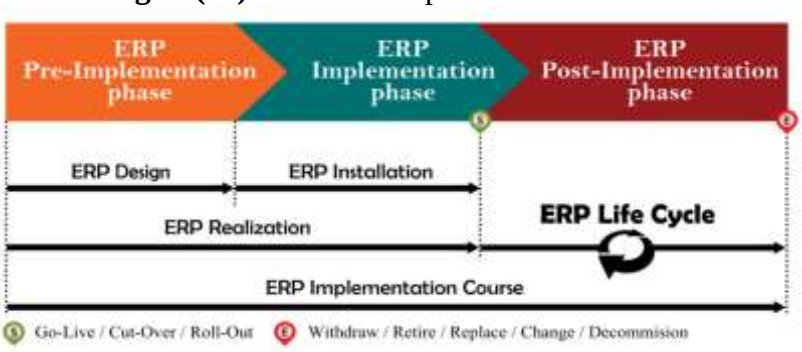
- The ERP is a market product that has not necessarily been customized, especially for the entity;
- The ERP system should fulfill the needs of the entity.

2.3 The ERP implementation course and the ERP life cycle

Many researchers had proposed ERPLC models over the previous years, but none of them had agreed on a specific model. In this study, the chosen model belongs to (Huang & Yasuda, 2016) who:

- Redefined the ERPLC model through a reclassification of 26 previous ERPLC models, published between 1996-2013;
- Analyzed the ERPLC through performance criteria, selected to separate each ERPLC stage.

Fig N°(01): The ERP implementation course



Source :(Huang & Yasuda, 2016, p. 7)

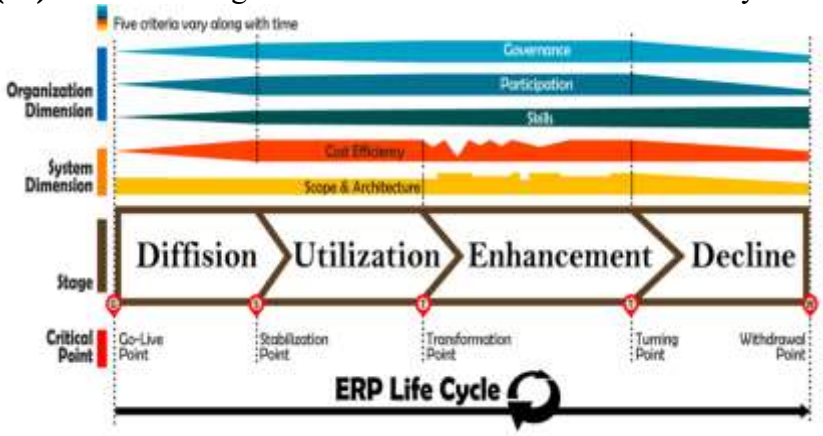
According to (Huang & Yasuda, 2016), the ERP implementation course consists of three phases (see Fig. N°01 above):

- The pre-implementation phase: in this phase, the ERP implementer starts by modeling the entity's needs and designing the ERP architecture according to those needs;
- The implementation phase: the entity validates the previous step and proceeds to the implementation of the ERP system within the entity;
- The post-implementation phase: marks the go-live of the ERP system.

The redefinition of the ERPLC is fixed according to performance criteria, which are regrouped into two major dimensions:

- Organizational dimension: governance, personnel participation, and users skills;
- The ERP system dimension: cost efficiency, scope, and system architecture.

Fig N°(02) : The main stages and characteristics of the ERP life cycle "ERPLC"



Source: (Huang & Yasuda, 2016, p. 13)

(Huang & Yasuda, 2016) Used a combination of critical points (Stabilization, Transformation, Turning Point) and performance criteria in order to divide the ERPLC into four essential stages (Fig N°02):

- The diffusion: This stage marks the going-live of the ERP system and the rapid development of all criteria except for the scope and system architecture;
- The utilization: entity personnel start to master the ERP system, and the majority of performance criteria start to stabilize;
- The enhancement: the organization criteria reach their maturity and the system criteria recognize significant movements. This stage is also characterized by the first actions of modification ;
- The decline: the ERP system no longer meets the emerging needs of the entity.

3. The current internal control activities under the ERP system

Internal control current practices consider the ERP system as a technological environment that needs to be treated carefully during the assessment of the IC. For years, these practices were considered as reference, until the COSO was structured, within its activity control component, the appropriate controls over the technology.

3.1 The ERP system under the COSO point of view

The IC has been developed in association with manual information systems that are now considered “legacy systems”. The development of IC continued with the emergence of automated information systems and integrated ones. The methodology used in assessing the IC has not changed completely and considers the ERP system as a technological environment. The assessment of this system is entrusted to conceptual frameworks that focus on the technological and IT environment, such as the COBIT framework.

The COSO states, "The two frameworks are well aligned. With COSO providing a high-level structure and COBIT providing details to support management in developing specific controls (The Updated COSO Internal Control Framework: Frequently Asked Questions, 2014, p. 28)”. This means that COBIT is used as a technical support to develop specific controls and help the entity strengthen its IT environment.

In 2013, COSO published its new update of its IC conceptual framework, which was marked by the institution of 17 principles and 77 points of focus within the 5 components of the conceptual framework. This new feature aims to help management set an effective IC. The new updates

give importance to the IT environment through:

- The introduction of Principle N°11 "General control over technology", which contains 4 points of focus, from point 44 to point 47 (see Table N°(01) below);
- A reminder of the importance of automated control activities in entities that rely on technology;
- The necessity to supervise and manage the risks that are associated with the IT environment.

Table N° (02): Points of focus associated with general controls over technology

Control activities			
principle		**Points of focus**	
11	The organization selects and develops general control activities over technology to support the achievement of objectives.	44	Determines dependency between the use of technology in business processes and technology general controls
		45	Establishes relevant technology infrastructure control activities.
		46	Establishes relevant security management process control activities.
		47	Establishes relevant technology acquisition, development, and maintenance processes control activities.

Source: Protiviti, 2014, page 9.

The table N° (02) above demonstrates the points of focus that are associated with the principle n°11 “general control activity over technology”. These points represent the best practices in terms of control, according to the COSO. They are not exhaustive, but they represent a minimum of control activities that should be set to ensure the functioning and existence of principle n°11.

The redeployment of these points under the ERP implementation course shows that they are distributed over two phases: the pre-implementation phase and the post-implementation phase. The points of focus N°44, 45 and 46 prescribe control activities to be carried out in the post-implementation phase. As for the points of focus N°47, it prescribes control activities that should be settled in two phases; the pre-implementation phase for the acquisition of an IT system (in our case, the ERP system) and the control activities for development and maintenance should be settled in the post-implementation phase.

The points of focus grouped under principle n° 11 provide a roadmap that will assist the entity during the pre-implementation and post-implementation phases. However, these points do not cover the entire ERP implementation course. There are no points of focus that cover the

implementation phase.

In practice, the auditors conduct an implementation audit and are "concerned with ensuring that the implementation procedures and standards have been properly followed" (Musaji, 2002, p. 18). Moreover, the entity should properly set within the ERP system during the implementation phase "built-in controls" that are completely missing in the structure of general control activities over technology.

It seems that the COSO internal control framework lacks technical depth. That's why the entity should combine it with other technical frameworks in order to cover ERP system IC aspects.

3.2 The apprehension of the IC in the ERP system according to current practices

Analysing the current practices of IC under the ERP system, using the ERP implementation course as a qualitative criterion, reveals some findings:

- The literature research that worked on IC under the ERP system agreed that the starting point of IC operations is the ERP go-live or the post-implementation phase, whereas this logic could:

- Omit unfavourable events that arise during earlier phases (pre-implementation and implementation phases) and may impact the entity during the ERP operational phase;
- Failure to detect and track such events as soon as they occur reduces the effectiveness of the risk management process.
- Neglect the effects of the characteristics of the different ERPLC stages. As an example, the state of the IC when the ERP reaches its maturity during the "utilisation and enhancement stage" is not the same when it reaches its decline. The performance criteria in those two periods showed an improvement, whereas they showed a significant decline in the last phase (see Fig n° (02). Thus, the state of IC in the moment of diffusion stage is not the same when the ERP system reaches the enhancement stage, where the ERP system scope starts to get more size and integrate other modules, which brings new challenges and more risks.

- The apprehension of IC under the ERP system by operational logic (current approach) shows inconsistencies in control activities along the ERP implementation course:

- The separation of risk management between the two consecutive periods of the ERP phase project and ERPLC generates temporisation in the execution of corrective actions due to the long time spent during the collection of data related to risks that happen in the ERPLC period and the

entity suspects to be generated before the ERP going-live ;
- Inconsistency in the sequence of control activities due to the separation of the two consecutive periods of "ERP phase project" and "ERPLC".

It is noticed that those inconsistencies are not risky because the project contains temporary processes with non-repetitive actions (see table N°1) that are controlled:

- As part of the project management control actions;
- As part of other permanent information flows (investment flows, flows feeding management control, etc.).

It seems that the current practices have qualitative incoherencies that could affect the IC.

4. The framework of the qualitative approach

In order to resolve the incoherencies mentioned above and bring qualitative depth to the current practices, the researchers proposed a qualitative approach based on the ERP implementation course that aims to fulfill these objectives:

- Ensure that the objectives behind the utilization of the ERP system will be reached;
- Supervise the implementation process;
- provide appropriate treatment to incoherencies that appear in the current practices;
- Ensure that the ERP system is functioning properly and that the reporting process within the ERP system provides reliable information;
- Align, within the same perspective, the risk management of the two consecutive periods of "ERP project phase" and "ERPLC".

4. 1 the principle of the proposed approach:

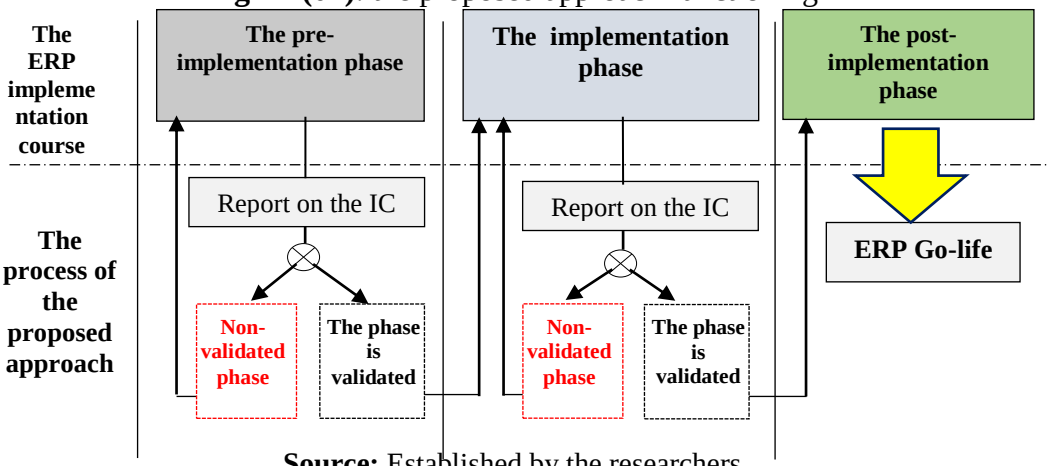
The proposed approach considers the ERP implementation course as a guideline to which the entity refers to align its IC with the ERP system. This perspective aims to fill the gaps found in the current practices and solves the incoherencies in the control activities that happened between the consecutive phases of the ERP phase project and ERPLC. Therefore, the researchers proposed the use of the "validation of phases with their appropriate deliverables" principle**.**

In other words, the phase is considered completed when the deliverables set for this phase are achieved, as shown the The Fig N° (04) below.

4. 2 the principle of the proposed approach:

The proposed approach is based on key-success factors (qualitative criteria) that seem to be adequate to validate each ERP implementation course phase.

Fig N° (04): the proposed approach functioning



Source: Established by the researchers

The researchers suggest that the first two phases should be supervised and then closed according to periodic reports (see Fig N°4), which describe the state of each phase in terms of:

- Risk assessment (controls performed, strengths and weaknesses identified);
- The effectiveness of risk management policies;
- Other financial and technical information;
- Recommendations.

At the end of each phase, two situations can be considered:

- Validated phase: the deliverables of the considered phase are valid (see appendices n°01). The validation represents the beginning of the next phase;
- Non-validated phase: represents failure, suspension, or a definitive stop of the implementation process.

During the ERPLC phase, the IC practices prescribe both general and application controls to evaluate the effectiveness of the IC. Both the current practices and the previous academic research omitted the impact of the ERPLC stages (diffusion, utilization, enhancement, and decline). According to the researchers (Huang & Yasuda, 2016), during the ERPLC phase, both organizational and system performance indicators experience significant changes, which may influence the state of IC. As a result, this study has set

controls based on qualitative criteria inspired by performance criteria used by (Huang & Yasuda, 2016) in order to:

- Compare the output of the traditional control activities (general and application controls) with its theoretical state at each phase (see Appendix 02);
- Analyze and supervise the evolution of each performance criterion during each stage of the ERPLC.

4.3 Terms of application:

The application of the approach consists of:

- Separating the ERP implementation course into 3 phases;
- Determining the deliverables for the first two phases of the ERP implementation course (see Appendix 01);
- Validating the first two phases by establishing reports about the state of IC;
- Establishing comparative controls based on performance criteria during the ERPLC;
- Aligning the risk management system with the ERP implementation course.

4.4 Risk management:

According to (Yao & Yang, 2014), "risk assessment is one of the three main factors that sensibly change after the ERP implementation, and they link these sensible changes to the new risks arising within the ERP environment:" Some of these risks may have origins prior to the ERPLC phase and can have a negative impact if the entity does not maintain a smooth transition between the risk management process in two consecutive periods that are operationally distinct (the ERP project phase and the ERPLC Phase). As a result, the researchers proposed combining the risk management in those two periods with the ERP implementation course.

5. CONCLUSION

The alignment of the IC with ERP systems represents a great challenge for entities that have become more dependent on their IT environment. Therefore, these entities are always seeking to achieve high levels of efficiency and vigilance to face the risks associated with ERP systems. For that purpose, the researchers proposed aligning the IC with the ERP system using a qualitative approach based on the ERP implementation course.

The research came to the following results:

- The redeployment of the control activities provided by the COSO internal control framework on a chronological axis (ERP implementation course)

covers only two phases (pre-implementation and post-implementation) in the absence of the control activity elements supervising the implementation period;

- The analysis of the current practices by using a chronological axis (ERP implementation course) shows deficiencies and inconsistencies in the succession of control activities during the periods of ERP in its project phase and ERPLC.
- The characteristics of the various ERPLC phases may affect the state of the IC during the ERP implementation course;
- The resolution of the control activities succession problems along the ERP implementation course lies in the validation of phases by deliverables (key success factors).
- The appropriate treatment of risks whose origins come from deficiencies and inconsistencies in the succession of control activities during the periods of "ERP in its project phase" and "ERPLC" lies with the alignment of risk management with the ERP implementation course.

The results above match the previous research in the necessity to improve the concepts of IC in an ERP system environment but diverge in the scope and the method. The proposed approach is qualitative by nature, and it covers not only the ERPLC but also the pre-implementation and implementation phases.

The researchers suggested the following points as recommendations:

- The necessity to align IC in the ERP system environment, with the ERP implementation course, in order to avoid inconsistencies in control activities,
- Monitoring each phase with its own appropriate deliverables to ensure the validity of each phase.

This research opens new research perspectives, among others:

- Assessing the feasibility of this approach through case studies.
- The development of the approach by adding other qualitative criteria (criteria related to the entity, criteria related to the ERP).

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7. Appendices

Appendices N° (01): deliverables of the pre-implementation and implementation phases

pre-implementation phase			**implementation phase**		
N°	**Stage**	**deliverables**	**N°**	**Stage**	**deliverables**
1	ERP feasibility study	Feasibility study of the ERP project	**1**	GAP analysis	Roadmap
2	Obtaining the agreement of the management after the validation of the feasibility study	The approval of the project	**2**	modeling the possible processes	mapping of possible processes
3	The establishment of the project business plan	Business Plan	**3**	redefinition of the company's processes	mapping of the selected processes
4	Business plan approval	Investment program	**4**	setting the final project schedule	update the project management documents
5	The establishment of project management	Documents and programs organizing the project (project chart, task allocation, Gantt chart, communication plan...)	**5**	The choice of the implementation methodology	implementation commitment
6	Preliminary works that precede the elaboration of the specifications (requirements list)	List of the requirements and the target processes, mapping of existing processes, mapping of target processes	**6**	ERP deployment and data migration	installation of the ERP in the computers and servers
7	Elaboration of specifications (requirements list)	Specifications (requirements list)	**7**	ERP testing and parameterization of its functions	synthesis of the tests
8	the call for suppliers	all necessary documents that serve in organizing his phase	**8**	personal training	training plan, documentation
9	the study of suppliers offers	selection of ERP solution	**9**	validation of the ERP choice	ERP manual, the mapping of the final flow processes, password policies, saving data policies and updating of the “information system security policy (ISSP)”.
10	ERP selection	project contract	**10**		

Appendices N° (02): Monitoring of the post-implementation phase "ERPLC" through performance criteria

	Critical points		post-implementation							
			Diffusion		Utilization		enhancement		decline	
			policies/ controls	findings	policies/ controls	findings	policies/ controls	findings	policies/ controls	findings
Organizational dimension	governance	Continuous Improvement								
		Budget control								
		adaptability								
	Personnel participation	willingness								
		efficiency								
		frequency								
	Personnel skills	Business-IS understanding								
		Efficiency of training								
		Knowledge sharing								
System dimension	Cost efficiency	operations								
		support								
		maintenance								
	Scope and arhitecture	Coverage scope								
		flexibility								
		Architectural integration								