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MASTER'S THESIS SUMMARY
Expert System for Automation in the Implementation of COBIT 5 Case study: Teacher evaluation at UPPachuca

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Abstract.
Information technology (IT) governance and management are critical to organizational success in the digital age. The COBIT (Control Objectives for Information and Related Technologies) framework has been widely recognized as an effective tool for aligning IT with strategic objectives, managing risks and ensuring regulatory compliance. However, COBIT implementation and monitoring can be complex and resource-demanding, which has generated growing interest in its automation. This article explores how COBIT model automation, through the integration of technology, can optimize IT management processes, improve the accuracy of controls, and provide real-time information. Additionally, the challenges inherent to this automation are addressed, such as adaptation to specific contexts and integration with pre-existing systems. Based on a theoretical analysis and a case study, a reference framework is offered for the successful implementation of COBIT automation, highligh its potential to transform IT governance in organizations in various sectors
Keywords: COBIT, IT governance, IT management, automation, regulatory compliance, framework.

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1 Introduction

In the digital era, effective governance and management of information technology (IT) have become critical factors for organizational success. The increasing reliance on IT systems requires a structured approach to ensure their alignment with strategic objectives and proper risk management. COBIT, developed by ISACA (Information Systems Audit and Control Association), is a widely used framework for IT governance and management. This model provides a comprehensive structure

that helps organizations strengthen control over their information systems, optimize the value of their IT investments, and ensure regulatory compliance (ISACA, 2012).

From a business perspective, a company is an organized economic entity that integrates human, financial, and material resources to produce goods or services that meet market demands. Robbins and Coulter (2016) define a company as "a social organization whose purpose is to generate profits through the production and distribution of goods and services" (p. 45). In this context, corporate governance plays a crucial role in aligning IT systems with the organization's strategic objectives. According to Cadbury (1992), corporate governance is "the system by which companies are directed and controlled" (p. 15), highlighting the importance of frameworks like COBIT for efficient management.

Globally, COBIT has been adopted by various organizations to standardize processes, improve operational efficiency, and ensure regulatory compliance. A notable example is a financial services company that, after implementing COBIT, achieved significant improvements in operational efficiency and risk management. This enabled the standardization of IT processes, reduced security incidents, and enhanced compliance with financial sector regulations (De Haes & Van Grembergen, 2009). Similarly, Hardy (2006) highlights that "organizations implementing COBIT not only improved control over their IT processes but also experienced greater agility in strategic decision-making due to the transparency and accuracy of information provided by IT systems" (p. 45). These enhancements have been essential for businesses to remain competitive in an ever-evolving corporate environment.

In this context, COBIT automation emerges as an innovative solution to address the challenges associated with its implementation and maintenance. Automation, defined as a system's ability to perform tasks without human intervention (Agudelo, Tano & Vargas, 2020), enables organizations to significantly enhance the efficiency and effectiveness of their IT controls. By automating COBIT, companies can implement continuous monitoring, proactively detect irregularities, and respond swiftly to incidents, reducing human error and allowing IT professionals to focus on higher-value strategic tasks.

In an environment where information is a critical asset, organizations must automate processes, implement information systems, and maintain constant monitoring to ensure strategic compliance and adapt to new market demands (Loor & Bernal, 2018). This need aligns with the evolution of IT auditing, which, according to Piattini and del Peso (2003), has become a well-established field in response to the rapid advancement of information technology. IT auditing focuses on evaluating and ensuring the quality, security, and efficiency of information management and its associated resources.

In conclusion, COBIT automation not only optimizes IT management but also provides organizations with a powerful tool to maintain competitiveness in an ever-changing business landscape. This article explores how COBIT automation can be effectively implemented, overcoming the inherent challenges of its application and offering a reference framework for successful integration into various organizational contexts.

2 Methodology

This study aims to enhance IT process management by automating COBIT model controls and processes. The methodology follows a structured approach to map COBIT control objectives with organizational goals, ensuring alignment and efficiency.

1. Assess the Current State:

- Objective: Analyze the current state of IT processes within the organization.
- Activity: Conduct a comprehensive assessment to identify areas for improvement and alignment with COBIT.

2. Define the Implementation Plan:

- Objective: Map the relationship between COBIT control objectives and organizational goals in detail.
- Activity: Develop a strategic plan that encompasses all areas of the organization, ensuring IT objectives align with corporate goals.

3. Filter the Mapping:

- Objective: Establish a framework linking COBIT control objectives to organizational goals.
- Activity: Assign unique identifiers to each objective to facilitate matching and ensure a consistent and effective relationship.

4. Develop the Rule-Based System:

- Objective: Define and apply the necessary rules for organizational control and management.
- Activity: Implement an automated rule-based system to manage and control organizational processes according to the mapped objectives.

The following fig. 1 illustrates the sequence of described activities:

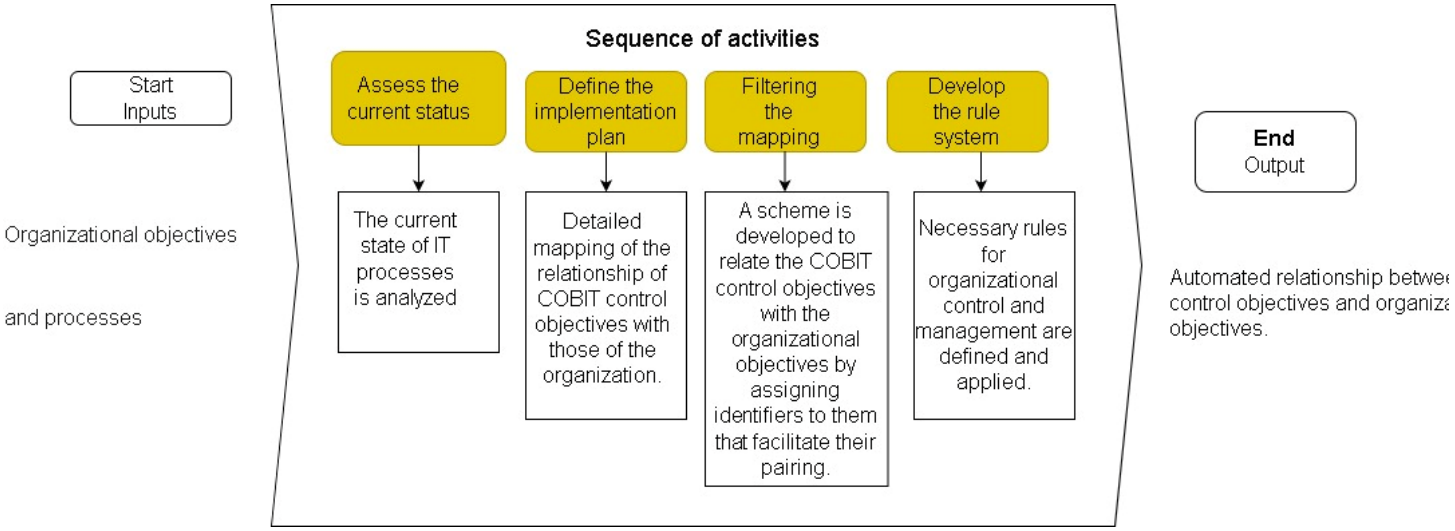

Fig. 1. Sequence of activities for automating the relationship between COBIT control objectives and organizational objectives.

This methodology enables a structured and systematic integration, ensuring that IT objectives are not only aligned with organizational goals but also managed efficiently and automatically. Using COBIT as a control framework provides a solid foundation for IT governance and management, fostering continuous improvement.

2.1 Case Study

This case study focuses on teacher feedback in the educational field, specifically in peer evaluation. The process combines both qualitative and quantitative approaches. Two subject-matter experts evaluate a faculty member using a peer evaluation instrument, which includes a Likert scale (1 to 5) for quantitative data collection. Additionally, the evaluators provide detailed qualitative feedback on the instructor's teaching performance.

The methodology follows a mixed-methods approach, where expert evaluators assess the assigned instructor through both qualitative observations and quantitative scoring. The evaluation process is structured using a Likert scale to quantify specific teaching aspects, complemented by in-depth qualitative comments regarding class delivery.

Qualitative Aspects

- **Observation and Judgment:** Peer evaluation relies on expert observation and judgment.
- **Descriptive Feedback:** Evaluators provide detailed qualitative feedback and suggestions.
- **Interviews:** A qualitative technique was used by interviewing the Head of the Academic Secretariat to identify issues in the data consolidation process.

Quantitative Aspects

- **Likert Scale:** The use of a 1-to-5 Likert scale provides measurable data on various teaching aspects.

Feedback has been widely recognized as a crucial element in learning at all levels. Hattie et al. (Wisniewski et al., 2020) argue that feedback is the most significant contributor identified in meta-analyses of different intervention effects on learning. Furthermore, Hattie and Timperley (2007) state that "feedback is one of the most powerful influences on student performance" (p. 81). As new technologies develop, university faculty must expand their understanding and practice of feedback, often referred to as teacher feedback literacy (Carless & Winstone, 2020).

Mapping organizational objectives to COBIT processes ensures strategic alignment, enabling IT activities to directly support educational goals. Implementing an automated feedback system based on COBIT, using conditional control structures (if-else), has proven effective in determining the need for feedback based on Likert scale scores. A score below 4 indicates areas requiring improvement, as identified by expert consensus.

However, despite advancements in automation, significant challenges remain in consolidating feedback data. Specifically, the Academic Secretariat at the Universidad Politécnica de Pachuca has reported delays of up to two semesters in data consolidation, affecting the timely delivery of feedback to faculty members. These delays highlight the need for further improvement in automated systems to ensure that feedback is delivered efficiently and in real-time.

The combination of qualitative and quantitative approaches in faculty evaluation, alongside the adoption of automated systems such as COBIT, enables more objective and standardized feedback. This process not only enhances teaching performance but also fosters a positive and collaborative educational environment, essential for students' comprehensive development.

Research Approach

This study is primarily descriptive, as it aims to detail the current faculty evaluation process, the associated challenges, and how automation could enhance it. Additionally, it includes correlational and explanatory elements, as it examines the relationship between automation and feedback efficiency while explaining why adopting COBIT may be beneficial.

The study population includes all faculty members and administrative staff involved in the peer evaluation process, as well as all faculty evaluations conducted over two semesters at the Universidad Politécnica de Pachuca.

Key Informants

Key informants are individuals with in-depth knowledge of the faculty evaluation process and its challenges. These include:

- **Evaluated Faculty Members:** To gather insights on the feedback received and its usefulness.
- **Peer Evaluators:** To understand the evaluation process and its challenges.
- **Academic Secretariat:** To provide information on the data consolidation process and encountered delays.
- **Head of the Academic Secretariat Department:** To assess administrative issues and potential solutions (previously interviewed).

Sample Selection

The study will use a **convenience sampling** approach, selecting available faculty evaluations. The sample includes:

- **Previous Faculty Evaluations:** A representative set of evaluations from the last two semesters.
- **Evaluated Faculty Members:** Those assessed in these evaluations.
- **Manual Feedback Data:** Feedback generated manually from these evaluations.

- **Automated Evaluation Simulations:** Results from applying the COBIT-based automated model to these evaluations.

Process Mapping and Automation

The diagram in Figure 2 illustrates how each faculty evaluation process aligns with one or more COBIT control objectives. Each process flow is mapped to these objectives to ensure objective and standardized feedback. The Likert scale scores (1-5) are linked to corresponding COBIT corporate goals through an ID system, ensuring alignment between evaluation outcomes and organizational objectives.

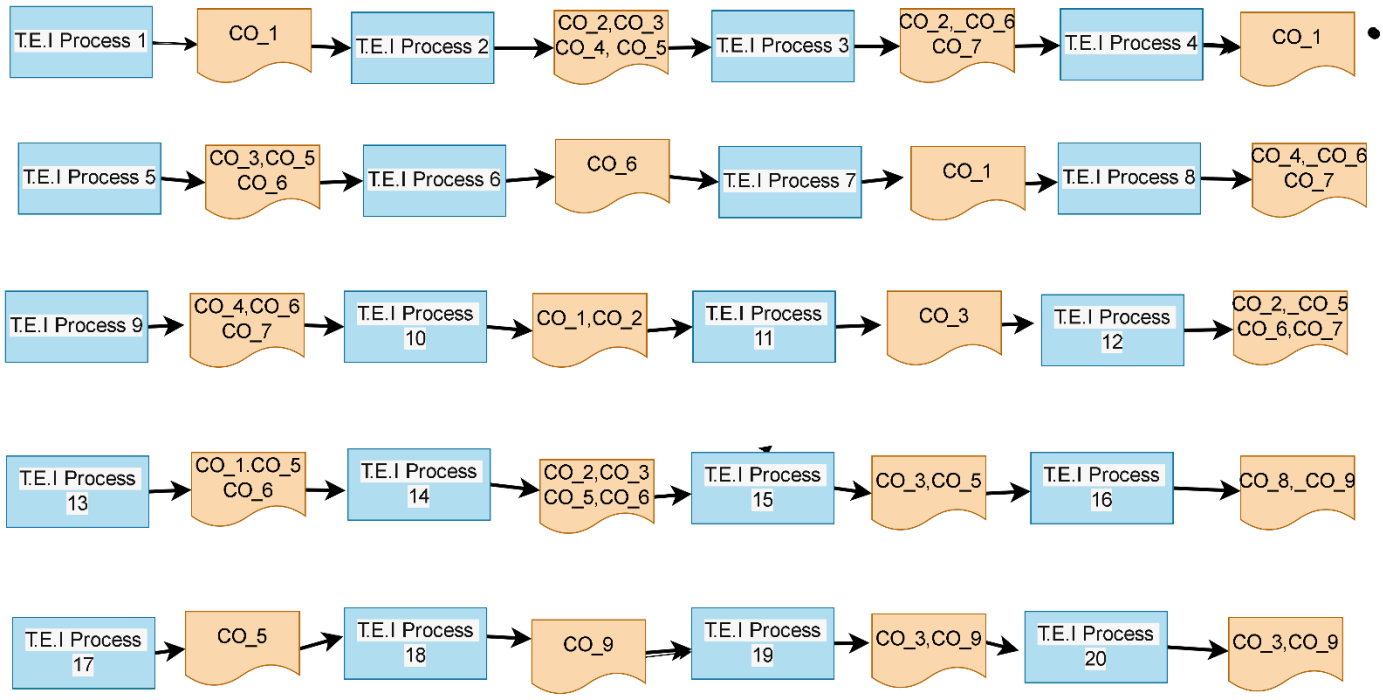

Fig. 2. Process Flow of the Teacher Evaluation Instrument (T.I.E) and its Alignment with the COBIT Control Objectives.

Co refers to the COBIT control objectives that were best suited to be used in this case study.

3 Code. - Automated Feedback Generation Based on Performance

The rule-based system implementation focused on automating faculty evaluation by programming a set of specific rules aligned with the COBIT model. PHP was chosen as the primary programming language due to its cross-platform compatibility, seamless database integration, scalability, and cost-effectiveness. The system design included an initial configuration based on corporate goals and organizational processes. As part of this study, we developed an automated feedback system based on the COBIT control model, utilizing a Likert scale (1 to 5) to assess various teaching aspects. The system's logic relies on a structured set of rules implemented through nested control structures (if-else) within the code, ensuring objective and standardized evaluations.
The code implements a function called retro, designed to generate personalized feedback recommendations based on a series of evaluation criteria (ca1 to ca20). These criteria are assessed using a Likert scale from 1 to 5, where scores below 4 indicate areas that require attention and improvement.

The function starts by defining a fixed-size array of 20 elements, initializing responses with a default value. It then analyzes each criterion individually:

- If the score falls within the valid range (1-5) and is less than 4, a specific improvement message is assigned based on predefined constants containing recommendations related to teaching and learning.
- If the score is 4 or higher, a positive recognition message is generated, highlighting the evaluated individual's strong performance.

This approach ensures a structured and targeted evaluation, making it easier to analyze strengths and areas for improvement in the teacher's performance.
Below is a table 1 detailing the key steps and components of the code.

Table 1. Description of code statements

Code section	Description
function retro(...)	Definition of the retro function, which takes 20 **i**nput variables **(**ca_1 to ca_20**)** representing evaluation criteria**.**
$tamano = 20;	Define the size of the $respuestas array with 20 positions to store the responses corresponding to each evaluation criterion.
global $respuestas;	Declares that $respuestas will be a global variable**,** allowing its use outside the function.
array_fill(...)	Initializes the $respuestas array with 20 positions**,** each filled with the value "default1"**,** which will later be replaced based on the evaluations.
define("co_1", "...");	Defines constants such as co_1, co_2, etc., which contain predefined messages for feedback based on evaluation criteria.
Conditions if	Evaluates the criteria (ca_1 to ca_20) and assigns a specific response to each criterion depending on whether its value is less than 4**.**
$respuestas[...] = "..."	Assigns personalized feedback to each evaluated criterion based on its value (whether it is less than or greater than 4).
Example if ($ca_1 < 4)	If ca_1 is less than 4, the suggested feedback is assigned at position 0 of the $respuestas array.
Repetition of logic	The if-else structure is repeated for each criterion (ca_2 to ca_20), adjusting the answers according to the constantsdefined and values.
return $respuestas;	In the end, the function returns the $respuestas arrangement, which is has the feedbacks generated for each criterion Evaluated.

3 Results

In this section, the results of the mapping between organizational objectives and COBIT control objectives are presented. This mapping is essential for aligning IT management with the organization's strategic goals and ensuring effective governance.
The process of identifying organizational objectives allows us to observe how the implementation of COBIT and peer evaluation feedback contribute to achieving these objectives.

List of UPP Objectives
• Increase the coverage and quality of the educational offering by improving comprehensive training.
By continuously improving the way professors teach, positive progress in education is achieved, which in turn enhances the quality of the educational offering.
• Promote research, innovation, development, technology transfer, and internationalization as measures to reduce inequality in the country and among individuals.
By providing feedback to faculty, it is possible to identify whether they need additional courses or training to more effectively promote scientific research.
• Strengthen Educational Management in an environment that fosters healthy coexistence and equity.
Part of teacher feedback includes being an individual with integrity, principles, and values, who can promote these aspects by leading by example. This helps create a healthy and respectful environment where everyone feels comfortable.

COBIT provides us with general options for corporate goals, divided into four sections: financial, customer, internal, and learning and growth. From these sections, the goals that best aligned with the processes observed in peer faculty evaluation were selected to provide effective feedback. The goals selected after the corresponding relationship analysis were as follows:

- Agile responses to a changing business environment.
- Business service continuity and availability.
- Strategic decision-making based on information.
- Employee operational productivity.
- Culture of product and business innovation.
- Well-prepared and motivated individuals.
- Compliance with laws and external regulations.
- Compliance with internal policies.

3.1 Mapping COBIT Corporate Goals with Faculty Evaluation Processes for Feedback

Table 2. Relationship of COBIT Corporate Goals with Evaluated Processes (1-5) in Peer Feedback from Teachers.

Qualitative Variables of the Peer Teacher Evaluation Instrument	COBIT corporate goals that match	Id
1.- When the teacher has not concluded the topic, he/she begins the session by summarizing the main aspects (concepts, definitions, methods) addressed in the previous session, or begins by reviewing tasks (homework exercises, complementary research, etc.) or, when the teacher begins a new topic, he/she indicates the topic to be addressed, and clearly and precisely establishes the learning result to be achieved or the purpose to be achieved.	Agile responses to a changing environment that may have the topic addressed	co_1
2.- The teacher stimulates the students' interest in the topic by starting with the statement of a QUESTION OR CHALLENGE PROBLEM that he/she will try to answer or solve during the session; or, he/she establishes the importance of the topic in the professional field or in the personal development of the students.	Continuity and availability of the service of the quality of teaching to the student	co_2
	Create strategies for student operational productivity	co_3
	Learning innovation culture	co_4
	Students must be prepared and motivated	co_5
3.-When starting a new topic, the teacher investigates the students' prior knowledge through a brainstorming session and uses it in the process of learning new knowledge; or, when continuing a topic, he investigates whether the knowledge	Continuity and availability of the service of the quality of teaching to the student	co_2
	Student-oriented service culture to improve student learning	co_6

previously addressed on the topic has been understood by the students.	Strategic decision making based on information	co_7
4.-The teacher modulates his voice to emphasize the most important concepts and, when possible, moves around the classroom between the rows of chairs in order to keep the students' attention.	Agile responses to a changing environment that may have the topic addressed	co_1
5.-The teacher shows enthusiasm when leading the development of learning and transmits confidence to the students.	Students must be prepared and motivated	co_5
	Student-oriented service culture to improve student learning	co_6
	Create strategies for student operational productivity	co_3

Table 3. Relationship of COBIT Corporate Goals with Evaluated Processes (6-10) in Peer Feedback from Teachers.

Qualitative Variables of the Peer Teacher Evaluation Instrument	COBIT corporate goals that match	**Id**
6.-The teacher uses various teaching resources (blackboard and markers, video projector, textbook, simulators, graphics, acting, music or songs, teaching prototypes, etc.) in accordance with the topic and the subject, to support his explanations and facilitate learning.	Student-oriented service culture to enhance learning.	co_6
7.-The teacher uses realistic or close-to-reality examples to facilitate the understanding of concepts, principles or procedures (SIGNIFICANT LEARNING).	Agile responses to a changing environment that may have the issue addressed.	co_1
8.-The teacher encourages active participation of students by posing questions of an inquisitive nature; or through discussions or activities.	Continuity and availability of the quality of teaching service to the student.	co_6
	Create strategies for student operational productivity.	co_7
	Students must be prepared and motivated.	co_4
9.-The teacher applies various teaching techniques and strategies (brainstorming, conceptual map, synoptic table, comparative tree, analogies, role-playing, case studies, ABPro, ABProy) in accordance with the topic, to facilitate student learning.	Culture of product and business innovation.	co_6
	Student-oriented service culture to improve their learning.	co_7
	Strategic decision making based on information.	co_4
10.-The teacher uses a constructivist approach, based on the contrast between concepts and facts, inducing students to discover concepts and facts; or the teacher guides students to extract the general objective implicit in them from certain observations or experiences.	Agile responses to a changing environment that may have the issue addressed.	co_1
	Continuity and availability of quality teaching services to students.	co_2

Table 4. Relationship of COBIT Corporate Goals with Evaluated Processes (11-15) in Peer Feedback from Teachers.

Qualitative Variables of the Peer Teacher Evaluation Instrument	COBIT corporate goals that match	Id
11.-The teacher encourages students to work collaboratively through participation in analysis groups, guided discussions of the topic, solving exercises or completing tasks or projects.	Create strategies for operational productivity of students.	co_3
12.-The teacher verifies that the students, especially those who do not participate much or have attention difficulties, are understanding the	Continuity and availability of the service of quality of teaching to the student	co_2
	Students must be prepared and motivated	co_5

aspects of interest addressed (Concepts, definitions, principles or methods) and provides feedback on the matter.	Cultura de servicio orientada al alumno para mejorar su aprendizaje	co_6
	Strategic decision making based on information	co_7
13.-The teacher expresses himself clearly and answers the students' doubts and questions in the same way.	Agile responses to a changing environment that may have the topic addressed	co_6
	Students must be prepared and motivated	co_1
	Student-oriented service culture to improve their learning	co_5
14.-The teacher states guiding questions for students to test themselves on what they should have learned (Purposes of the session). The guiding questions should test the ability to understand, explain, illustrate and apply the concepts and principles learned in the session.	Continuity and availability of the service of quality of teaching to the student	co_6
	Create strategies for student operational productivity	co_2
	Students must be prepared and motivated	co_5
	Student-oriented service culture to improve their learning	co_3
15.-The teacher asks a student to summarize the important points covered in the session or proposes activities or extra work (task) related to the topic covered or the topic to be covered.	Create strategies for student operational productivity	co_3
	Students must be prepared and motivated	co_5

Table 5. Relationship of COBIT Corporate Goals with Evaluated Processes (16-20) in Peer Feedback from Teachers.

Qualitative Variables of the Peer Teacher Evaluation Instrument	COBIT corporate goals that match	Id
16.-The teacher shows the ability to conduct the learning session in a climate of order and respect.	Compliance with external laws and regulations	co_8
	Compliance with internal policies	co_9
17.-The teacher shows mastery of the subject addressed, demonstrating his aptitude in the subject he teaches.	Students must be prepared and motivated	co_5
18.-The teacher starts the learning session on time.	Compliance with internal policies	co_9
19.-The professor demonstrates the planning of the subject, presenting the evaluators with the schedule of the program and evaluations of the subject.	Create strategies for operational productivity of students	co_9
	Compliance with internal policies	co_3
20.-The teacher teaches the topic established in his calendar, corresponding to the current week.	Compliance with internal policies	co_9
	Create strategies for operational productivity of students	co_3

4 Conclusions

In conclusion, the integration of the COBIT control framework with an automated faculty feedback system has proven to be an effective solution for improving the management and governance of information technology in an educational environment. Mapping organizational objectives with COBIT processes enabled strategic alignment, ensuring that IT activities directly support educational and continuous improvement goals.

The implementation of the code, based on a rule-based logic that evaluates the characteristics of the faculty evaluation instrument using a Likert scale, provides a systematic approach for identifying areas that require feedback. This system not only facilitates the standardization and objectivity of faculty evaluations but also ensures that the recommendations are accurate and aligned with the best IT practices defined by COBIT.

The automation of the feedback process, through the evaluation of scores and the generation of specific recommendations, has allowed for the optimization of time and resources dedicated to improving faculty quality. By using a score threshold based on expert experience, the system ensures that interventions are both relevant and effective.

In summary, this study has shown that the application of the COBIT framework in faculty evaluation can significantly contribute to continuous improvement and alignment of educational activities with IT strategic goals. The automation of the feedback process, based on a clearly defined rule system, not only improves operational efficiency but also raises the quality standards in education.

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