Journal of Information Systems and Telecommunication
Vol.12, No.4, October-Deceember 2024, 291-299
http://jist.acecr.org
ISSN 2322-1437 / EISSN:2345-2773

Enhancing the Quality of ICT Regulation in Iran: A Study on the Application of the COBIT IT Governance Framework

Ehsan Baraty [1], Akbar Nabiollahi [2,3*], Naser Khani [1]

[1]. Management Department, Najafabad Branch, Islamic Azad University, Najafabad, Iran
[2]. Computer Engineering Faculty, Najafabad Branch, Islamic Azad University, Najafabad, Iran
[3]. Big Data Research Center, Najafabad Branch, Islamic Azad University, Najafabad, Iran

Received: 08 Feb 2024/ Revised: 04 Jan 2025/ Accepted: 15 Feb 2025

Abstract

This study explores the application of the COBIT (Control Objectives for Information and Related Technologies) IT governance framework to enhance the ICT Regulatory Tracker (ICTRT) scores, a tool developed by the International Telecommunication Union (ITU) to assess ICT regulatory bodies across countries. Given the absence of specific improvement strategies from the ITU, this research fills a critical gap by investigating how COBIT processes can be leveraged for ICT regulation improvement. Utilizing an Automatic Content Analysis (ACA) method, we identified significant relationships between 22 out of 37 COBIT processes and ICTRT indicators, with particular emphasis on APO09, APO11, and DSS02 processes. Focus group methodology employed to validate these findings and development of a continuous improvement plan tailored for Iran's ICT regulatory body. This plan integrates 13 COBIT processes from the identified set, providing a structured approach for implementation. The findings not only highlight effective COBIT processes but also offer actionable insights for regulatory bodies aiming to enhance their regulatory quality and advance towards a digital economy.

Keywords: ICT Regulatory Tracker; COBIT Framework; ICT Regulation Quality; Digital Transformation.

1- Introduction

The digital economy has become an essential element of the global economic landscape, with Information and Communication Technology (ICT) serving as its backbone. ICT is crucial for driving development and facilitating the digital transformation of businesses [1]. An effective regulatory framework is vital for improving business performance and promoting national growth toward sustainable development, enabling digital transformation across various sectors. Consequently, ICT regulators aim to harness digital transformation as a means to achieve the Sustainable Development Goals (SDGs) in collaboration with other sectors [2].

The ITU has analyzed data from ICT regulators in 193 countries and created the ICTRT. This tool helps countries evaluate their regulatory status and formulate policies to enhance ICT regulation, thereby supporting digital transformation and overall development. The ICTRT also enables countries to customize their regulatory reform strategies based on local and national priorities. Notably, there is a strong correlation between ICTRT scores and the development level of the digital economy; regulatory bodies with higher scores tend to be more effective in attracting investments, fostering technological innovation, and expanding market opportunities [3].

Despite its importance, the ITU has not provided specific guidance on improving ICTRT indicators, leaving individual countries to navigate this challenge independently. This gap presents a significant research opportunity for regulators seeking effective strategies to enhance ICT regulation quality. Our comprehensive review of existing frameworks and literature highlights that the COBIT framework, developed by ISACA [1], offers a robust approach for managing Information Technology (IT) processes while ensuring alignment between IT strategies and business objectives. This framework has been widely studied and implemented

1. ISACA (the Information Systems Audit and Control Association) is a professional association focused on IT governance, risk management, and cybersecurity.

✉ **Akbar Nabiollahi**
nabi.akbar@gmail.com

across various organizations, yielding successful outcomes that contribute to process improvements [4].

This paper aims to investigate the role of COBIT processes in enhancing ICTRT indicators through an ACA methodology. The main contributions of this research include:

- Identifying relationships between ICTRT indicators and COBIT processes.
- Designing a continuous improvement plan for Iran's Communication Regulatory Authority (CRA) based on selected COBIT processes.

The innovation of this research is centered on the following aspects:

- Application of the COBIT IT governance framework to enhance ICTRT scores.
- Utilization of ACA to identify significant relationships between COBIT processes and ICTRT indicators.
- Development of a tailored continuous improvement plan specifically for CRA.

The structure of this paper is as follows: The second section presents a literature review that discusses the tasks and challenges of ICT regulation, elaborates on the ICTRT, and examines the application of COBIT for business process improvement. The third section outlines the research methodology, detailing the ACA process and focus group method used in this study. Finally, sections four and five present the analysis results and summarize the study's objectives, achievements, recommendations for ICT regulators, and suggestions for future research.

2- Related Works and Literature Review

In this section, the literature and related works are explained in three parts. The first part discusses the ICT regulation tasks and challenges. The ICTRT is elaborated on in the second part, and the third part covers the use of the COBIT ITGF for business process improvement.

2-1- ICT Regulation Tasks and Challenges

ICT regulation encompasses various tasks and challenges, including infrastructure management, spectrum regulation, and consumer protection. Regulatory bodies are tasked with fundamental functions such as competition oversight and internet regulation, which can differ significantly based on local conditions. For instance, Yeganeh et al. identified 25 critical measures aimed at enhancing the regulatory quality and balance within Iran's national information network [5].

Spectrum regulation is particularly crucial for national authorities. Olwal et al. examined broadband regulation initiatives in Southern Africa, proposing a framework for dynamic spectrum management to modernize outdated policies. Their findings provide valuable benchmarks for regulatory bodies [6].

The performance of ICT regulators directly impacts service quality. Danbatta and Zangina evaluated Nigeria's Communications Commission, highlighting key outcomes such as promoting telecommunications research, addressing network vandalism, and developing e-waste management policies to improve service quality. They identified power supply issues as a significant barrier to network reliability [7].

Emerging technologies present new challenges for regulators. Suryanegara recognized 5G as a disruptive innovation, introducing challenges related to security frameworks and economic considerations linked to renewable energy [8]. Similarly, Mohlameane and Ruxwana noted that South Africa's regulatory frameworks inadequately address the complexities of cloud computing, indicating a need for updates [9].

Regulatory bodies must proactively adapt to new technologies, such as smart cities. Barden outlined various challenges faced by regulators in this context, including licensing, data interoperability, and privacy concerns [10]. Additionally, Nguyen assessed the collaboration between state and non-state actors in Vietnam's cyber regulatory framework, evaluating their roles throughout different regulatory periods [11].

2-2- The ICTRT

The ICTRT employs 50 indicators categorized into four domains: regulatory authority, regulatory mandate, regulatory regime, and competition framework, each contributing to a maximum score of 100. Countries are classified into four generations based on their scores, reflecting their regulatory maturity [3].

Research utilizing ICTRT data has been categorized into three main areas:

1) **Economic Impact:** Studies such as Raifuet et al. (2023) demonstrate a strong correlation between the quality of ICT regulation and financial development across 23 African nations from 2003 to 2020. This underscores the importance of enhancing ICT regulations for economic growth [12]. Additionally, Nepal's strategic adoption of ICT development strategies illustrates efforts to improve regulatory quality [13].
2) **Social Aspects:** Research by Adams and Akobeng on 46 African countries from 1984 to 2018 examines the relationship between ICT and inequality, utilizing indicators such as governance and regulatory quality [14]. Furthermore, Shobande and Ogbeifun link ICT regulation quality with environmental sustainability, revealing how effective regulation can mitigate climate change effects through various indirect mechanisms [15].
3) **Regulatory Frameworks:** Chauhan and Mathew analyze India's telecommunications and internet access regulatory environment, highlighting successful policies that support development [16]. Similarly, Nikarya et al. find a significant correlation between

ICTRT indicators and Internet Development Index (IDI) indicators, emphasizing the critical role of regulatory quality in fostering ICT industry growth [17].

Despite these insights, most studies remain descriptive without proposing specific solutions to enhance ICTRT indicators. This gap indicates a need for targeted investigations aimed at developing operational strategies for improving regulatory frameworks.

2-3- Using COBIT ITGF for Business Process Improvement

IT has fundamentally transformed business processes, necessitating a strong alignment between IT strategies and business objectives to mitigate potential disruptions [18], [19]. IT governance plays a crucial role in this alignment, enhancing management, accountability, and compliance while fostering continuous improvement [20].

The COBIT framework is a prominent IT governance framework designed to ensure effective adoption of IT governance practices. It facilitates the mapping and alignment of business and IT goals, thereby supporting organizations in achieving their strategic objectives [1], [19], [21].

Numerous studies have demonstrated the practical application of COBIT across various sectors. For instance, Kahorongo et al. highlighted COBIT's significance in Namibia Bank's efforts to achieve holistic organizational improvement [1]. Similarly, Abu-Musa's research in Saudi Arabia emphasized how COBIT enhances service organizations' understanding and management of IT governance processes, which directly impacts their success metrics [21]. In Kenya's banking sector, Chege et al. found a positive correlation between IT governance maturity and financial performance, underscoring the framework's influence on business outcomes [20].

Organizations have also leveraged COBIT to adopt emerging technologies such as the Internet of Things (IoT). Henriques et al. explored how COBIT facilitates IoT project implementation by identifying key governance enablers, including data privacy and protection measures [22]. Almusawi's study on Iraqi private banks revealed that implementing COBIT enhances the reliability and security of accounting information systems while mitigating audit risks identified by external auditors [23].

The literature indicates that COBIT serves as a strategic model for evaluating ICT performance and can assist regulatory bodies in improving ICT regulations to foster the development of the digital economy [24]. Research suggests that the maturity level of IT governance framework implementation correlates directly with business process performance across industries [20]. Furthermore, COBIT can be utilized as a continuous improvement tool for ICT regulatory bodies to adapt to emerging technologies like IoT and cloud computing [22], [25].

Recent studies have also examined COBIT's application in Enterprise Architecture scenarios, demonstrating its effectiveness in analyzing various organizational contexts, including Iran's telecommunication research center [18]. Overall, the COBIT framework is instrumental for ICT regulatory bodies in making informed investment decisions regarding IT resources and enhancing regulatory quality.

3- Research Method

This study is designed to address two questions:

1) How can we measure the relationship between ICTRT indicators and COBIT processes?
2) How can we design a continuous improvement plan for the CRA based on selected COBIT processes?

To answer these questions, we used a two-step strategy. First, we employed the ACA methodology to discover the relationships between ICTRT indicators and COBIT processes. Then, we conducted a focus group method to validate the ACA results and design a continuous improvement plan for the CRA based on selected COBIT processes. Each of the two steps is explained below.

3-1- Step 1: The ACA Process

Given that COBIT comprises 37 processes and ICTRT includes 50 indicators, this results in 1,850 potential relationships for analysis. To efficiently analyze these relationships, we employed the ACA method.

To implement the ACA method various key steps have been described in the research literature. First, define the research objectives and questions to guide the analysis. Next, data collection is performed from relevant sources, followed by preprocessing to clean and prepare the data for analysis. Finally, algorithms are applied to analyze the data and identify patterns or themes, leading to the interpretation and reporting of the findings [26], [27] and [28].

According to the literature, the ACA method designed with three steps: data collection, data analysis, and output preparation. Fig. 1 shows these steps that are explained below.

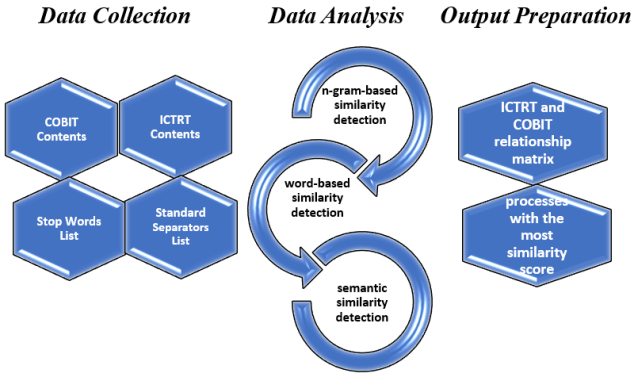

Fig. 1 The ACA method steps

Data Collection:
In this step, the following tasks conducted:

- Text contents regarding ICTRT indicators and COBIT processes were collected from ISACA publications for COBIT [1] and ITU publications for ICTRT [2], with the selection of content carried out through purposive sampling.
- Stop words list and standard separators for English texts were stored in a database;
- To prepare the texts for the analysis, a set of preprocessing tasks like tokenizing the text contents into words and n-grams, creating text vectors of words and n-grams, stop-words removal, keywords extraction, and semantic expansion of the keywords were performed.

Data Analysis:
In this step, 37 COBIT processes and 50 ICTRT indicators were considered as the ACA categories. Each category was assigned a set of keywords, semantic expanded items, and n-grams, and the relationship between categories was calculated using text similarity detection techniques.
Different methods have been proposed for similarity detection between two contents in ACA research. ACA researchers in similar studies used NLP and Text similarity detection techniques such as terms frequency, Latent Semantic Analysis (LSA), and Hyperspace Analog to Language (HAL) to find major themes in the ACA process; each of them tries to find the most critical concepts in content and aid in rapid understanding of unfamiliar domains and content exploration [29], [30], [31], [32].
In this study, we measured the similarity between categories using three similarity detection methods: n-gram-based similarity detection, word-based similarity detection, and semantic similarity detection. Each relationship was assigned a score between 0 and 1, where 1 indicates the strongest relationship and 0 indicates the weakest relationship. Eq. (1), Eq. (2) and Eq. (3) respectively shows the equations used to measure n-gram-based similarity, word-based similarity, and semantic similarity between categories and the final score for each relationship was calculated by averaging these three similarity scores.

$$ngramsCosineSimilarity(I_x, P_y) = \frac{I_x . P_y}{||I_x|| \times ||P_y||} = \frac{\sum_{i=1}^{n} I_i \times P_i}{\sqrt{\sum_{i=1}^{n} {I_i}^2} \times \sqrt{\sum_{i=1}^{n} {P_i}^2}} \quad (1)$$

$$WordsCosineSimilarity(I_x, P_y) = \frac{I_x . P_y}{||I_x|| \times ||P_y||} = \frac{\sum_{i=1}^{n} I_i \times P_i}{\sqrt{\sum_{i=1}^{n} {I_i}^2} \times \sqrt{\sum_{i=1}^{n} {P_i}^2}} \quad (2)$$

$$SemanticSimilarity(I, P) = Sim(IW, PW_1) + Sim(IW, PW_2) + Sim(PW, IW_1) + Sim(PW, IW_2) \quad (3)$$

Output Preparation:
In this step, the relationship matrix was prepared. **Error! Reference source not found.** shows the relationship matrix schema. In this matrix, rows are ICTRT indicators (named I1, I2, …, I50) and columns are COBIT processes (named P1, P2, …, P37), while each cell shows the relationship score between related indicators and related processes.

Table 1: The relationship matrix schema

	P1	P2	P3	…	P37
I1	0.08	0.62	0.17	…	0.91
I2	0.10	0.14	0.09	…	0.14
I3	0.07	0.21	0.06	…	0.16
I4	0.30	0.13	0.08	…	0.30
I5	0.10	0.14	0.14	…	0.30
I6	0.32	0.03	0.19	…	0.87
I7	0.08	0.71	0.10	…	0.13
I8	0.23	0.49	0.13	…	0.13
…	…	…	…	…	…
I50	0.11	0.17	0.14	…	0.28

In this step, also, the list of processes with the most similarity score was prepared. Table 2 shows these processes.

Table 2: Top 10 discovered relationship scores

Rank	ICTRT Indicator ID	COBIT Process Name	Relationship Score
1	11	APO09	0.909
2	16	APO09	0.872
3	26	APO11	0.844
4	47	APO09	0.689
5	50	DSS02	0.68
6	48	APO09	0.679
7	49	APO09	0.679
8	37	DSS05	0.677
9	38	DSS05	0.653
10	20	APO01	0.634

3-2- Step 2: The Focus Group Process

The focus group method involves several key stages in the literature. First, researchers define clear objectives and questions to guide the discussions. Next, participants are

1. Selected parts of the COBIT supplemental tools and materials and the COBIT 5 toolkit documents were used.
2. Selected parts of the ITU GSR (Global Symposium for Regulators) and Global ICT Regulatory Outlook (GIRO) Reports were used.

selected based on specific criteria relevant to the research topic, ensuring a diverse range of insights. A structured discussion guide is then created to facilitate the session, which is conducted by a trained moderator in a comfortable environment, typically lasting 60 to 120 minutes. After recording and transcribing the sessions for analysis, thematic analysis is performed to identify patterns and insights [33], [34], [35].

In this study, the focus group method employed with the following objectives:

- To assess the accuracy and validity of the relationship matrix.
- To develop a continuous improvement plan for the CRA using COBIT processes.

After defining the research objectives, six participants were selected from experts within the CRA. In the selection process, emphasis was placed on expertise relevant to ICT regulation, encompassing areas such as IT, mobile communications, fixed communications, postal services, finance, administration, legal affairs, and management. This diverse selection aimed to ensure a comprehensive understanding of the various aspects of ICT regulation during the focus group discussions.

Finally, we conducted a two-hour focus group meeting to discuss our objectives and systematically review each topic with the participation of experts in the field. During these discussions, we randomly assessed and confirmed the validity and reliability of the identified relationships between ICTRT indicators and COBIT processes.

Additionally, we examined several reports derived from the relationship matrix, including those highlighting the highest-scoring relationships and the domains and processes that significantly impact ICTRT indicators.

We also reviewed the CRA's latest status in the ITU annual assessments and prepared a prioritized COBIT processes list for the CRA enhancement and based on this list, a plan for continuous improvement of regulation quality in four steps with a cyclic strategy was developed that is shown in Fig. 2.

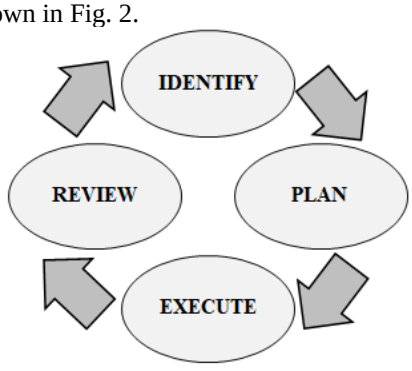

Fig. 2 The CRA continuous improvement plan

Step 1- Identify: In this step, in addition to the prioritized processes list, new organizational and environmental status and the feedback from the last cycle are identified.

Step 2- Plan: In this step, first the prioritized processes list is updated using the identified data and the focus group method; then, the top one/multiple process in the processes list is/are selected to be executed.

Step 3- Execute: In this step, the selected process/processes is/are implemented.

Step 4- Review: In this step, the performance and improvements in ICTRT indicators and regulation quality are evaluated and the feedback is applied to the next cycle.

The presented continuous improvement plan enables the CRA to make key decisions to improve ICT regulation quality, achieve higher scores in ICTRT, and facilitate digital transformation and sustainable development in different sections of the economy in a step-by-step program.

4- Discussion

In the previous section, the methodology of the study was outlined in two parts: the ACA process and the focus group process. This section will discuss the results of the conducted study in four parts:

- Analyzing the highest relationship scores.
- Analyzing the most effective COBIT processes.
- Analyzing the most effective process domains of the COBIT.
- Analyzing the CRA continuous improvement plan.

4-1- Analyzing the Highest Relationship Scores

Table 2 shows the top 10 relationships with the highest scores within the relationship matrix. There are noteworthy comments about this list that are explained below:

- Five relationships out of 10, related to the APO09 process, that could help ICT regulators to improve indicators 11, 16, 47, 48, and 49. The implementation of the APO09 process named "Manage Service Agreements" could play a crucial role in enabling regulatory bodies to maintain oversight and ensure that service providers meet the required standards in the rapidly evolving technologies. It also could help ICT regulators to establish service standards, manage service level agreements, performance monitoring, risk identification and management, and continuous improvement.
- Two relationships out of 10, related to the DSS05 process, that could help ICT regulators to improve indicators 37 and 38. This process named "Manage Service Requests and Incidents" enables ICT regulators to manage incidents efficiently, handle service requests from operators, end users, and other stakeholders, and manage documentation and reporting tasks. It also

supports ICT regulatory bodies in maintaining effective governance and ensuring that IT services meet both operational needs and regulatory requirements.

- Three remaining processes in the list are APO11, DSS02, and APO01 which have strong effects on ICTRT indicators 26, 50, and 20 respectively.

4-2- Analyzing the Most Effective COBIT Processes

In the relationship matrix, the average of 50 scores associated with each COBIT process effectively represents the overall impact of that process on enhancing ICTRT indicators. This indicates that the implementation of that process will play a more significant role in improving the overall ICTRT indicators compared to other processes. Table 3 shows the top 5 processes with the highest correlation with all indicators.

Table 3: Top 5 processes with the highest correlation with all indicators

Rank	Process Name	Process Title
1	DSS02	Manage Service Requests and Incidents
2	APO09	Manage Service Agreements
3	DSS01	Manage Operations
4	DSS05	Manage Security Services
5	EDM01	Ensure Governance Framework Setting and Maintenance

4-3- Analyzing the Most Effective Process Domains of the COBIT

In this section, we will present a comprehensive and holistic overview of the effect of COBIT processes on improving ICTRT indicators, which is summarized in Table 4. As we see, in the first row of the table there are five processes in the EDM domain within the governance key area. Out of these five processes, two (40%) have a significant impact on four ICTRT indicators, which represents 8% of the total 50 indicators, and the other rows of the table can be interpreted in the same way, too.

Table 4: COBIT key areas and process domains

Key area	Domain name	Num. of processes	Num. of effective processes (%)	Num. of affected indicators (%)
Governance	EDM	5	2 (%40)	4 (%8)
Management	APO	13	9 (%69)	24 (%48)
	BAI	10	5 (%50)	8 (%16)
	DSS	6	4 (%67)	11 (%22)
	MEA	3	2 (%67)	3 (%6)
Total:		37	22 (%59)	50

This table provides an overview of the relationship between the COBIT framework and the ICTRT, offering insights that can be valuable for regulators in the ICT sector when designing a continuous improvement plan. For example, as indicated in the table, a total of 22 unique processes out of the 37 COBIT processes contribute to the improvement of the 50 ICTRT indicators. This suggests that regulators should prioritize implementing processes from this set of 22 to achieve maximum improvement in ICTRT indicators. Additionally, the table highlights that the processes within the APO, DSS, and BAI domains play the most significant roles in improving ICTRT indicators, which should be a focal point for ICT regulators.

4-4- Analyzing the Continuous Improvement Plan of the CRA

This section analyzes the continuous improvement plan prepared for the CRA.

Analyzing the process list for the CRA improvement: According to the latest ICTRT report, the CRA achieved a score of 86 out of 100 and was classified among G4 group countries. Table 5 presents the details of CRA's most recent scores. As indicated in this table, the CRA received scores of 20 (100%) in the Regulatory Authority dimension, 19 (86%) in the Regulatory Mandate dimension, 28 (93%) in the Regulatory Regime dimension, and 19 (68%) in the Competition Framework dimension. Conversely, the CRA lost scores of 0 (0%), 3 (14%), 2 (7%), and 9 (32%) in the same dimensions respectively. This indicates that the CRA should focus more on improving indicators within the Competition Framework domain.

Table 5: The CRA's latest status in the ICTRT

ICTRT Dimension	Number of indicators (%)	The CRA achieved scores (%)	The CRA lost scores (%)
Regulatory Authority	10 (%20)	20/20(%100)	0/20 (%0)
Regulatory Mandate	11 (%22)	19/22(%86)	3/22 (%14)
Regulatory Regime	15 (%30)	28/30(%93)	2/30 (%7)
Competition Framework	14 (%28)	19/28(%68)	9/28 (%32)
Total:	50	86/100 (%86)	14/100(%14)

According to the ITU report, the CRA needs to enhance 12 indicators. Table 6 presents a list of these 12 indicators along with the top three COBIT processes that could contribute to their improvement. For instance, in the first row, the processes BAI07, DSS04, and APO04, with correlation scores of 0.204, 0.187, and 0.185 respectively, can be utilized to improve the indicator "New Mandate: Entity in Charge of Broadcasting (Radio and TV Transmission)."

Table 6: Process list to improve 12 indicators for the CRA

Indicator needed to be improved	Top 3 effective processes	score
New mandate: entity in charge of broadcasting (radio and TV transmission)	BAI07	0.204
	DSS04	0.187
	APO04	0.185
New mandate: entity in charge of broadcasting content	BAI04	0.298
	DSS04	0.218
	APO11	0.179
New mandate: entity in charge of Internet content	BAI04	0.298
	DSS04	0.207
	MEA02	0.188
Number portability available to consumers and required from fixed-line operators	DSS06	0.493
	DSS01	0.393
	DSS04	0.360
Level of competition in IMT (3G, 4G, etc.) services	DSS05	0.653
	EDM01	0.231
	APO01	0.210
Level of competition in International Gateways	EDM01	0.271
	APO01	0.210
	MEA02	0.164
Status of the main fixed line operator	APO01	0.294
	EDM01	0.274
	DSS06	0.253
Foreign participation/ownership in facilities-based operators	APO01	0.217
	EDM01	0.205
	DSS01	0.197
Foreign participation/ownership in spectrum-based operators	APO01	0.217
	EDM01	0.208
	DSS01	0.197
Foreign participation/ownership in local service operators/long-distance service operators	APO09	0.689
	DSS02	0.677
	DSS01	0.398
Foreign participation/ownership in international service operators	APO09	0.679
	DSS02	0.668
	DSS01	0.398
Foreign participation/ownership in Internet Service Providers (ISPs)	APO09	0.679
	DSS02	0.677
	DSS01	0.325

In Table 6, 36 processes are listed to improve 12 indicators. Some processes appear multiple times, indicating that they play more significant role in enhancing various indicators. Since the CRA requires a concise and prioritized list of processes, an aggregation of data in Table 6 resulted in a shortlist of 13 processes, which is displayed in Table 7. This table includes the number of indicators that each process can improve, along with the average correlation scores for all indicators.

Table 7: Process list for the CRA improvement

Process name	number of indicators can be improved	Average of correlation scores
DSS01	6	0.318
EDM01	5	0.238
APO01	5	0.230
DSS04	4	0.243
APO09	3	0.682
DSS02	3	0.674
MEA02	2	0.176
DSS06	2	0.373
BAI04	2	0.298
APO04	1	0.185
BAI07	1	0.204
APO11	1	0.179
DSS05	1	0.653

In Table 7, the process that can improve the largest number of indicators is DSS01 which is capable of improving six indicators; and the process with the maximum score of correlation is APO09 which is noted for its potential to improve three indicators.

Analyzing the prioritization list and the continuous improvement plan: Since the implementation of each COBIT process involves specific complexities and requires significant time and resources, it is essential to prioritize the compiled list. This prioritization should focus on identifying the processes that play the most critical role in improving ICTRT indicators and enhancing regulation quality, taking into account various dimensions. The focus group employed for process list prioritization, presented the final priority list, shown in Table 8.

Table 8: Process prioritized list

Priority	Process name	Process key area
1	DSS01: Manage Operations	Management
2	EDM01: Ensure Governance Framework Setting and Maintenance	Governance
3	APO01: Manage the IT Management Framework	Management

Priority	Process name	Process key area
4	DSS04: Manage Continuity	Management
5	APO09: Manage Service Agreements	Management
6	DSS02: Manage Service Requests and Incidents	Management
7	DSS06: Manage Business Process Controls	Management
8	BAI04: Manage Availability and Capacity	Management
9	MEA02: Monitor, Evaluate, and Assess the System of Internal Control	Management
10	DSS05: Manage Security Services	Management
11	BAI07: Manage Change Acceptance and Transitioning	Management
12	APO04: Manage Innovation	Management
13	APO11: Manage Quality	Management

Processes listed in this table can be incorporated into the CRA continuous improvement plan, as outlined in the cycles depicted in Fig. 2, to continuously enhance regulatory quality and facilitate digital transformation. It is considerable that IT governance is a continuous process, and the mere implementation of its processes is not sufficient to gain the maximum value, and needs to be monitored and evaluated continuously, so, the CRA should provide continuous monitoring and evaluation mechanisms. Furthermore, full adoption of the COBIT takes years and is a too large and complex process and step-by-step implementation of processes needs to be considered [37] and [38].

5- Conclusion

This study was designed to address two questions:

1) **How can the relationship between ICTRT indicators and COBIT processes be measured?**
   To answer this question, a two-step approach was employed. Initially, the ACA methodology was applied to investigate the relationships between ICTRT indicators and COBIT processes. The results of ACA process validated using focus group methodology.
2) **How can a continuous improvement plan for the CRA be designed based on selected COBIT processes?**
   In response to this question, a focus group was convened to develop a continuous improvement plan for the CRA, utilizing the identified COBIT processes.

The findings from this study provide a foundational roadmap for enhancing the quality of ICT regulation, supporting both development and digital transformation. The adaptable nature of our case study allows other ICT regulatory bodies to tailor our research outcomes to formulate their own improvement strategies, considering their unique local and national contexts.

The ICTRT functions as a comprehensive framework that assists countries in enhancing their ICT regulatory quality in the face of the challenges posed by an ever-evolving digital landscape. This research highlights the multifaceted role of the ICTRT, emphasizing its significance beyond mere ranking purposes. The findings derived from this study provide valuable insights that can guide regulatory bodies in their efforts to achieve improved compliance and better alignment with the ICTRT as well as other frameworks established by the ITU. By leveraging these insights, countries can strategically navigate the complexities of ICT regulation and foster an environment conducive to digital transformation and growth.

Future Works:

In this study, we used the ACA and focus group methodologies. Future studies are encouraged to apply alternative methodologies for discovering relationships between ICTRT and other frameworks.

Acknowledgment:

This study was conducted in collaboration with the Enterprise Architecture Laboratory of IAUN and the Communications Regulatory Authority of the Islamic Republic of Iran. We express our gratitude for their support and contributions to this research.

References

[1] T. C. T. Kahorongo, N. Reddy, and A. M. Karodia, “The Adoption of Information Technology in the Governance System of the Bank of Namibia,” Business and Management Studies, vol. 1, no. 2, 2015, doi: 10.11114/bms.v1i2.876.
[2] ITU Publications, The impact of policies, regulation, and institutions on ICT sector performance. Geneve: ITU, 2021.
[3] GIRO, Global ICT Regulatory Outlook 2020 (GIRO 2020). Geneva: ITU, 2020.
[4] ISACA, “COBIT 2019 Framework: Introduction and Methodology, https://www.isaca.org/resources/cobit,” ISACA.
[5] H. Yeganeh, A. S. Mortazavi Kahangi, and A. Hadizadeh, “Identifying and analyzing macro actions in order to achieve regulatory goals in the country’s national information network,” Iranian Journal of Information Processing and Management, 2023.
[6] T. Olwal, M. Masonta, L. Mfupe, and M. Mzyece, “Broadband ICT policies in Southern Africa: Initiatives and dynamic spectrum regulation,” in 2013 IST-Africa Conference and Exhibition, IST-Africa 2013, IEEE Computer Society, 2013.
[7] K. B. Danbatta and T. Zangina, “Performance analysis of telecommunications regulations in Nigeria: A quality of service approach,” Dutse Journal of Pure and Applied Sciences, vol. 8, no. 1a, 2022, doi: 10.4314/dujopas.v8i1a.17.
[8] M. Suryanegara, “5G as disruptive innovation: Standard and regulatory challenges at a country level,” International Journal of Technology, vol. 7, no. 4, 2016, doi: 10.14716/ijtech.v7i4.3232.
[9] M. Mohlameane and N. Ruxwana, “Exploring the impact of cloud computing on existing South African regulatory

frameworks," SA Journal of Information Management, vol. 22, no. 1, 2020, doi: 10.4102/sajim.v22i1.1132.
[10] G. Maccani, N. Connolly, S. McLoughlin, A. Puvvala, H. Karimikia, and B. Donnellan, "An emerging typology of IT governance structural mechanisms in smart cities," Gov Inf Q, vol. 37, no. 4, 2020, doi: 10.1016/j.giq.2020.101499.
[11] H. N. Nguyen, "Regulating Cyberspace in Vietnam: Entry, Struggle, and Gain," Columbia Journal of Asian Law, vol. 35, no. 2, 2022, doi: 10.52214/cjal.v35i2.10028.
[12] I. A. Raifu, I. A. Okunoye, and A. Aminu, "The effect of ICT on financial sector development in Africa: does regulatory quality matter?," Inf Technol Dev, 2023, doi: 10.1080/02681102.2023.2233458.
[13] S. Shrestha and D. Ram Adhikari, "Telecommunications Infrastructures and Services Development and Challenges in Nepal," International Journal of Internet, Broadcasting and Communication, vol. 9, no. 2, pp. 27–36, 2017, [Online]. Available: https://doi.org/10.7236/IJIBC.2017.9.2.27
[14] S. Adams and E. Akobeng, "ICT, governance and inequality in Africa," Telecomm Policy, vol. 45, no. 10, 2021, doi: 10.1016/j.telpol.2021.102198.
[15] O. A. Shobande and L. Ogbeifun, "Has information and communication technology improved environmental quality in the OECD? —a dynamic panel analysis," International Journal of Sustainable Development and World Ecology, vol. 29, no. 1, 2022, doi: 10.1080/13504509.2021.1909172.
[16] P. Chauhan and J. Mathew, "Evolution and Regulation of Telecommunication and Internet in India: A Study of the Policy governing the development of telecommunication and Internet in India," Revista de Direito, Estado e Telecomunicacoes, vol. 15, no. 1, pp. 225–255, May 2023, doi: 10.26512/lstr.v15i1.45322.
[17] M. Nikarya, M. Mazoochi, A. M. Montazeri, and F. Ayazi, "Investigating the Relationship between Regulatory Promotion Indicators and ICT Development," Iranian Journal of Information Management, vol. 6, no. 2, pp. 47–66, 2021, doi: 10.22034/aimj.2021.132967.
[18] M. Fasanghari, M. S. Amalnick, R. T. Anvari, and J. Razmi, "A robust data envelopment analysis method for business and IT alignment of enterprise architecture scenarios," Journal of Information Systems and Telecommunication, vol. 1, no. 2, 2013, doi: 10.7508/jist.2013.02.004.
[19] K. Bamary, M. R. Behboudi, and T. Abbasnejad, "An ICT Performance Evaluation Model based on Meta-Synthesis Approach," Journal of Information Systems and Telecommunication, vol. 10, no. 39, 2022, doi: 10.52547/jist.16445.10.39.229.
[20] S. Chege, G. Wanyembi, and C. Nyamboga, "The Relationship Between the Business-IT Alignment Maturity and the Business Performance for the Banking Industry in Kenya," International Journal of Scientific and Technical Research in Engineering, vol. 3, no. 7, 2018.
[21] A. Abu-Musa, "Exploring the importance and implementation of COBIT processes in Saudi organizations: An empirical study," Information Management & Computer Security, vol. 17, no. 2, 2009, doi: 10.1108/09685220910963974.
[22] D. Henriques, R. Almeida, R. Pereira, M. M. da Silva, and I. S. Bianchi, "How IT governance can assist iot project implementation," International Journal of Information Systems and Project Management, vol. 8, no. 3, 2020, doi: 10.12821/ijispm080302.
[23] I. G. Almusawi, "USING COBIT FRAMEWORK FOR REDUCING THE AUDIT RISKS OF ACCOUNTING INFORMATION SYSTEMS," Akkad Journal Of Contemporary Accounting Studies, vol. 1, no. 1, 2022, doi: 10.55202/ajcas.v1i1.18.
[24] A. Ilmudeen and B. H. Malik, "A Review of Information Technology Governance, Business Strategy and Information Technology Strategy," 2016.
[25] A. Badran, "Developing Smart Cities: Regulatory and Policy Implications for the State of Qatar," International Journal of Public Administration, vol. 46, no. 7, 2023, doi: 10.1080/01900692.2021.2003811.
[26] H. F. Hsieh and S. E. Shannon, "Three approaches to qualitative content analysis," Qual Health Res, vol. 15, no. 9, 2005, doi: 10.1177/1049732305276687.
[27] S. E. Baker and R. Edwards, "How many qualitative interviews is enough ?," National Centre for Research Methods Review Paper, 2012, doi: 10.1177/1525822X05279903.
[28] K. A. Neuendorf, The Content Analysis Guidebook. 2020. doi: 10.4135/9781071802878.
[29] P. Stockwell, R. M. Colomb, A. E. Smith, and J. Wiles, "Use of an automatic content analysis tool: A technique for seeing both local and global scope," International Journal of Human-Computer Studies, vol. 67, no. 5, 2009, doi: 10.1016/j.ijhcs.2008.12.001.
[30] M. Scharkow, "Content Analysis, Automatic," in The International Encyclopedia of Communication Research Methods, Wiley, 2017, pp. 1–14. doi: 10.1002/9781118901731.iecrm0043.
[31] Janusz Kacprzyk, Standardisierte Inhaltsanalyse in der Kommunikationswissenschaft – Standardized Content Analysis in Communication Research. Warsaw, Poland: Springer Publications, 2023. doi: 10.1007/978-3-658-36179-2.
[32] H. Ahangarbahan and G. A. Montazer, "A fuzzy approach for ambiguity reduction in text similarity estimation (Case study: Persian web contents)," Journal of Information Systems and Telecommunication, vol. 3, no. 4, 2015, doi: 10.7508/jist.2015.04.002.
[33] E. F. McQuarrie and R. A. Krueger, "Focus Groups: A Practical Guide for Applied Research," Journal of Marketing Research, vol. 26, no. 3, 1989, doi: 10.2307/3172912.
[34] M. Bloor, J. Frankland, M. Thomas, and K. Robson, Focus Groups in Social Research. 2012. doi: 10.4135/9781849209175.
[35] V. Braun and V. Clarke, "Using thematic analysis in psychology, Qualitative Research in Psychology," J Chem Inf Model, vol. 3, no. 2, 2008.
[36] J. Grimmer and B. M. Stewart, "Text as data: The promise and pitfalls of automatic content analysis methods for political texts," Political Analysis, vol. 21, no. 3, 2013, doi: 10.1093/pan/mps028.
[37] S. Harguem, "A conceptual framework on IT governance impact on organizational performance: A dynamic capability perspective," 2021. doi: 10.36941/ajis-2021-0012.
[38] A. C. Amorim, M. Mira da Silva, R. Pereira, and M. Gonçalves, "Using agile methodologies for adopting COBIT," Inf Syst, vol. 101, 2021, doi: 10.1016/j.is.2020.101496.