

# REVIEW OF MANAGEMENT INFORMATION SYSTEMS USING EXPERT SYSTEMS IN INTERNAL CONTROL FOR INDONESIA'S BUREAUCRATIC REFORM

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**Abstract**— Technological developments are driving changes in bureaucratic reform, through Presidential Regulation No. 81 of 2020 which targets that by 2025 a system of oversight and accountability will be created to create a government with high integrity. Increasing SPBE (Electronic Based Government System) by implementing MIS (Management Information System) is one of the keys to achieving this target. This study aims to examine the use of MIS for internal control (SIMWAS) using an expert system, especially for internal audits associated with bureaucratic reform in Indonesia. This research method uses a Systematic Literature Review (SLR) to find suitable articles from various sources from 2015 to 2021 and conducts a Trend Analysis of the SLR results and a total of 31 articles to find research trends. The results of this study indicate that there is still no research related to supervision and internal auditors associated with bureaucratic reform and performance. Research on internal audits to improve performance using SIMWAS using an expert system has also not been done yet. This research can be developed using artificial intelligence to evaluate, predict and improve the performance of internal auditors that impact organizational performance. This study shows that the use of MIS for internal control using an expert system for internal audit still needs to be improved to support bureaucratic reform, especially the increase in SPBE.

**Keywords:** Bureaucratic Reform (RB), Information System (IS), Management Information System (MIS), Internal Auditor, Internal Control, Expert System (ES), Artificial Intelligence (AI).

**Abstrak**— Perkembangan teknologi mendorong terjadi perubahan pada reformasi birokrasi, melalui Peraturan presiden RI no.81 tahun 2020 telah menargetkan pada tahun 2025 bisa terciptanya sistem pengawasan dan akuntabilitas untuk terwujudnya pemerintah yang berintegritas tinggi. Peningkatan SPBE (Sistem Pemerintahan Berbasis Elektronik) dengan menerapkan MIS (Management Information System) menjadi salah satu kunci pencapaian target tersebut. Penelitian ini bertujuan untuk meneliti penggunaan MIS untuk pengawasan internal (SIMWAS) menggunakan expert system terutama untuk internal audit yang dihubungkan dengan reformasi birokrasi di Indonesia. Metode penelitian ini menggunakan Systematic Literature Review (SLR) untuk menemukan artikel yang cocok dari berbagai sumber dari tahun 2015

sd 2021 dan melakukan Trend Analysis dari hasil SLR dan sebanyak 31 articles untuk menemukan trend penelitian. Hasil penelitian ini menunjukkan bahwa penelitian terkait pengawasan dan auditor internal dihubungkan dengan Reformasi Birokrasi dan kinerja masih belum ada yang meneliti. Penelitian tentang internal audit untuk meningkatkan kinerja dengan menggunakan SIMWAS menggunakan expert system juga masih belum ada yang melakukannya. Penelitian ini dapat dikembangkan menggunakan artificial intelligence untuk mengevaluasi, memprediksi dan meningkatkan kinerja internal auditor yang berdampak kinerja organisasi. Penelitian ini menunjukkan bahwa penggunaan MIS untuk Pengawasan Internal menggunakan expert system untuk internal audit masih perlu ditingkatkan untuk mendukung reformasi birokrasi terutama peningkatan SPBE.

**Kata Kunci:** Reformasi Birokrasi (RB), Sistem Informasi (IS), Sistem Informasi Management (MIS), Auditor Internal, Pengawasan Internal, Expert System (ES), Artificial Intelligence (AI).

## INTRODUCTION

### Bureaucratic Reform

Presidential Regulation of the Republic of Indonesia No. 81 of 2020 and Minister of State Apparatus Empowerment and Bureaucratic Reform of the Republic of Indonesia Regulation No. 10 of 2019 is intended to enhance the quality of development and management of work units that have established Integrity Zones, towards Corruption-Free Zones (WBK) and Clean Bureaucracy Service Areas (WBBM).

The assessment of performance improvement in bureaucratic reform through self-measurement, as outlined in Regulation No. 26 of 2020 of the Minister of State Apparatus Empowerment and Bureaucratic Reform of the Republic of Indonesia on Guidelines for Evaluating the Implementation of Bureaucratic Reform, is described in Figure 1.1. This figure represents a model of the Self-Assessment of Bureaucratic Reform Implementation (PMPRB) developed based on the Bureaucratic Reform Road Map 2020–2024. PMPRB guidelines are issued by

each ministry in its implementation (Kardono & others, 2018; Andry & Setiawan, 2019). Implemented bureaucratic reform requires Human Resource Development as well (Hartati, 2020) to become a good government (Wandari, 2022)

Through the PMPRB model, it can be elaborated that the Change Management program, Arrangement of Administration, Human Resource Management, Performance Accountability Strengthening, Supervision Strengthening, and Public Service Quality Improvement are leverage

components expected to achieve the goals of a clean and corruption-free government, as well as improving the quality of public services. Within this model, there is a leverage component, namely supervision. The maturity of the government's internal control system (SPIP) and the capacity of the internal control apparatus (IACM) are key factors in supervision (Thahir H, 2018). The SPBE Index is one of the outcomes of the administration, including within the leverage components.

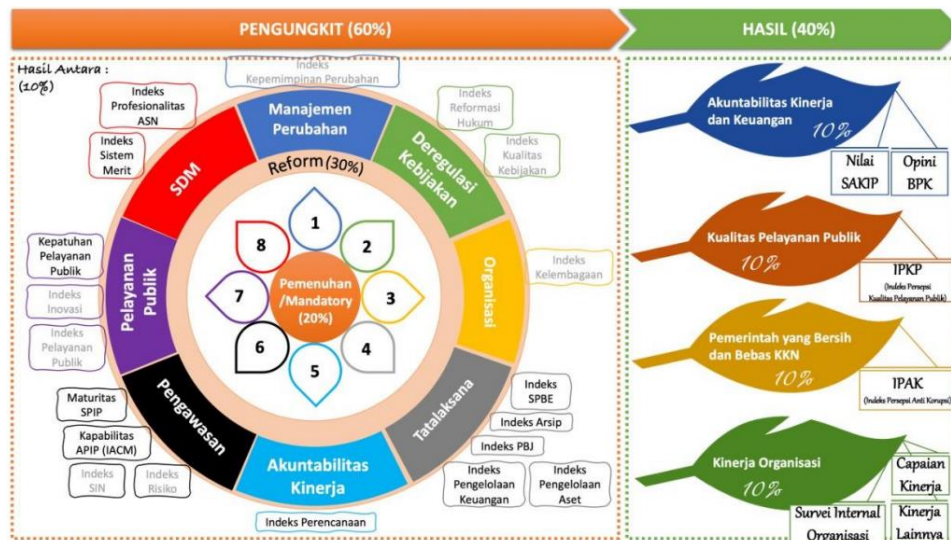


Figure 1. Model of Self-Assessment of the Implementation of Bureaucratic Reform

### MIS in Internal Control to Improve SPBE

Government Internal Supervisory Apparatus (APIP) is an auditor assigned by the inspector to carry out the internal supervision of performance and finances through audit, review, evaluation, monitoring, and other supervisory activities (Kurnia, 2020). Auditors are personnel who have qualifications according to their fields or other parties who are given the full task, authority, responsibility, and rights by the authorized official to carry out supervision and examination on behalf of APIP (Nainggolan & Prabowo, 2019).

If the implementation of the internal control system is solely focused on fraud prevention and regulatory compliance, then an important opportunity is missed. The same internal controls can also be leveraged to systematically enhance business operations, particularly in terms of effectiveness and efficiency (Mishra & Pradhan, 2019). Technological advancements and data analysis have resulted in the development of diverse tools capable of automatically assessing the effectiveness of internal controls.

The application of MIS in internal supervision and control will increase the SPBE index, while the system will also help the APIP (internal auditor) access, manage, and use large volumes of information quickly and accurately. IT systems are

also able to reduce audit risk through electronic data processing and electronic audits. Improving the efficiency, effectiveness, transparency, and accountability of governance. MIS, used in conjunction with continuous auditing and continuous control monitoring, assures the information flowing through business processes (Mishra & Pradhan, 2019).

### Expert system

By Turban's assertion (1995), the Expert system (ES) aims to replicate the knowledge of an expert. This system is usually used when an organization encounters a complex problem that necessitates decision-making. Specifically, an ES refers to a computer package designed to address or make decisions regarding a specific or delimited problem, with its problem-solving capabilities able to match or surpass those of an expert.

The basic idea behind ES, which is an applied artificial intelligence technology, is to transfer the expertise of one or several experts to a computer (Auditor, 2017). This expert knowledge is then stored on the computer. The user only needs to call the computer for the Supervision Management Information System and ask for the advice needed to make inferences in order to arrive at a specific conclusion. Therefore, like a consultant, the system

can provide advice to someone who is not an expert and, if necessary, explain the logic behind the suggestion (Panuntun, 2020).

The expert system is one of the building blocks of AI (artificial intelligence), used to develop algorithms in the ML (machine learning) model in 1990 and the DL (deep learning) model in 2014, as shown in Figure 2.

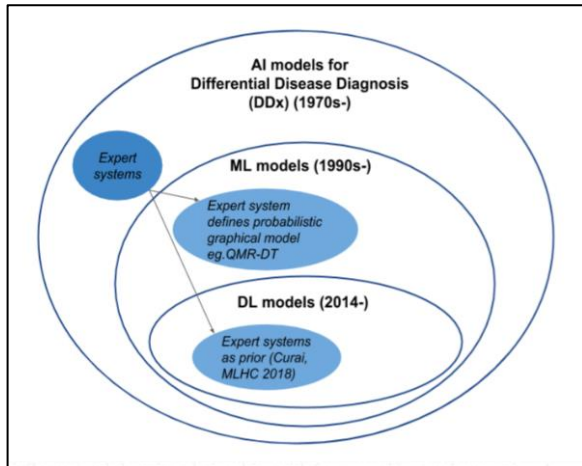


Figure 2. Expert System and Artificial Intelligence

## MATERIALS AND METHODS

### Materials

The materials were obtained from various sources, including conferences, theses and dissertations, journals, and regulations. These materials were collected using the Perish and Mendeley applications, utilizing keywords such as bureaucratic reform (RB), information system (IS), management information system (MIS), internal auditor, internal control, expert system (ES), and artificial intelligence (AI). The combination of these keywords yielded approximately 1345 articles.

### Systematic Literature Review

The Systematic Literature Review (SLR) stages carried out are 1) searching according to keywords and their combinations with a publishing duration between 2015 and 2021; 2) selecting articles according to inclusion and exclusion criteria, including grouping the types of articles such as conferences, journals, book chapters; 3) determine the quality of the article by checking the keywords contained in the article. The final result of the SLR is 31 articles, which will then be processed for trend analysis.

Table 1. Articles Obtained are based on the Stages of SLR

|              | Step 1      | Step 2     | Step 3    |
|--------------|-------------|------------|-----------|
| Conference   |             | 38         | 4         |
| Journal      |             | 189        | 20        |
| Thesis       | 1345        | 47         | 5         |
| Book Chapter |             | 5          | 0         |
| Rules        |             | 18         | 2         |
| <b>Total</b> | <b>1345</b> | <b>297</b> | <b>31</b> |

### Trend Analysis

Trend analysis is a technique used to examine and predict the movement of an item based on current and historical data. In the field of statistics, trend analysis commonly refers to methods used to extract fundamental patterns of behavior from either partial or complete time series data. If the trend can be assumed to be linear, then trend analysis can be performed in a formal regression analysis, as described in Trend estimation. If the trend has a shape other than linear, trend testing can be performed using non-parametric methods.

In this study, trend analysis is used to see the trend of the research study using a combination of keywords within a certain period. If it has been widely researched, then what kind of research is it? If there are not many or do not exist yet, then a new research form can be proposed.

## RESULTS AND DISCUSSION

Trend analysis was used in this research to examine the research trends that have been conducted over the past 10 years. There are two comparative models utilized: the number of studies related to the use of management information systems (MIS) and the number of studies related to the use of both MIS and expert systems. The mechanism involves evaluating whether each article contains the selected keywords and examining the combinations of keywords to identify the topic of discussion in each article.

### Trend Analysis for Research in Bureaucratic Reform Using MIS

Trend analysis was conducted using 18 articles (books, regulations, and journals) as shown in Table 1, focusing on internal auditors and supervision using information systems connected to bureaucratic reform. The findings reveal that:

- The research on internal auditors resulted in the following outcomes: three articles aim to assess performance, three articles focused on bureaucratic reform, and one article explored the utilization of information systems.
- The research on supervision resulted in the following outcomes: eleven articles were related to internal auditors, eleven articles were linked to bureaucratic reform, and three articles were associated with performance.

Based on the two analysis results, research related to internal audit and performance in the context of bureaucratic reform has been extensively conducted. However, when it comes to integration with information systems, the number of studies is very limited. This suggests that the utilization of information systems is not yet widespread. Consequently, there is a need to enhance its implementation to promote SPBE (clean and

efficient government administration), as targeted by bureaucratic reform efforts.

Based on Table 2, there is a discussion of bureaucratic reform utilizing the Clean and Efficient Government Administration (SPBE) in Article 3, but the concrete implementation proposals have not been explicitly described. Articles 14, 15, 16, and 18 primarily focus on government management for

accountability systems and the performance of public servants, as well as human resources, but the article still does not mention information systems. Only one article, Article 7, presents a suggestion regarding the use of information systems. The introduction of internal government auditors in this digital era necessitates the electronic input and display of all data using an information system.

Table 2. Keyword comparison between articles (2015–2020) (keyword P1: Supervision, P2: Internal Auditor, P3: bureaucratic reform, P3: Performance, P4: Government Management, P5: General Management, P6: Information System)

| No | Author   | Title  | Year | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
|----|--|--|------|----|----|----|----|----|----|----|
| 1  | Tim BPK RI                                     | Pedoman Teknis Penilaian Mandiri Kapabilitas Aparat Pengawasan Internal Pemerintah (APIP)  | 2015 | v  | v  |    |    |    |    |    |
| 2  | Mohammad Thahir Haning                         | Reformasi Birokrasi Di Indonesia: Tinjauan Dari Perspektif Administrasi Publik (Thahir H, 2018)  | 2018 |    |    | v  |    |    |    |    |
| 3  | Yusa Djuyandia and Muhammad Gufran Ghazian     | Kementerian Pertahanan: Birokrasi Sipil Dan Hierarki Militer (Djuyandi & Ghazian, 2019)  | 2019 |    |    |    |    | v  | v  |    |
| 4  | Hari Bucur-Marcu, Philipp Fluri, Todor Tagarev | Defence Management, An Introduction (206 Halaman) (Bucur-Marcu, Fluri, & Tagarev, 2010; Lima, Silva, & Rudzit, 2021)                                     | 2009 |    |    |    |    | v  | v  |    |
| 5  | Lovely Dhillon and Sara Vaca                   | Refining Theories of Change (Dhillon & Vaca, 2018)   | 2018 |    |    |    |    |    | v  |    |
| 6  | Nasir Uddina, Fariha Hossain                   | Evolution Of Modern Management Through Taylorism: An Adjustment of Scientific Management Comprising Behavioral Science (Uddin & Hossain, 2015)           | 2015 |    |    |    |    |    | v  |    |
| 7  | Dayu Jati Sri Panuntun                         | Auditor Internal Pemerintah di Era Digital (Panuntun, 2020)  | 2020 | v  | v  |    |    |    |    | v  |
| 8  | Agustinus Widanarto                            | Pengawasan Internal, Pengawasan Eksternal dan Kinerja Pemerintah (Widanarto, 2012)   | 2020 | v  | v  |    |    |    |    |    |
| 9  | Suryo Setiyo Kardono                           | Pengendalian Internal Pengelolaan Informasi dengan Framework Cobit 4.1 Domain Me 2 (Studi Kasus Dinas Kominfo Kabupaten Madiun) (Kardono, 2018)          | 2018 | v  | v  |    |    |    |    |    |
| 10 | Karli Soedijatno                               | Pengaruh Pelaksanaan Audit Internal Terhadap Penerapan Good Corporate Governance (Studi Pada Bumn Yang Berkantor Pusat Di Bandung) (N. D. Wahyuni, 2018) | 2019 | v  | v  | v  |    |    |    |    |
| 11 | Mirra Sri Wahyuni, Irwansyah, Baihaqi          | Profesionalisme Auditor, Pengalaman Auditor, Pemahaman Good Governance, Dan Kualitas Audit (M. S. Wahyuni et al., 2021)                                  | 2016 | v  | v  | v  |    |    |    |    |
| 12 | Susi Ardiyani                                  | Peranan Audit Internal Terhadap Penerapan Good Government Governance Di Provinsi Sumatera Selatan (Wandari, 2022)  | 2017 | v  | v  | v  |    |    |    |    |
| 13 | Oki Wahyu Budijanto                            | Mekanisme Pengawasan Intern Kementerian Hukum Dan Hak Asasi Manusia (Internal Control Mechanism Ministry of Law And Human Rights) (Budijanto, 2020)      | 2020 | v  | v  |    |    |    |    |    |
| 14 | Eri Kurniawan                                  | Analisis Kualitas Audit Aparat Pengawasan Internal Pemerintah ditinjau dari Kompetensi, Independensi, dan Motivasi (Kurniawan, 2020)                     | 2019 | v  | v  |    | v  |    |    |    |
| 15 | Rusdi Akbar                                    | Pengukuran Kinerja Dan Akuntabilitas Publik di Indonesia Studi Awal Di Pemerintah Daerah (Akbar, 2018)   | 2019 | v  | v  |    | v  |    |    |    |
| 16 | Agustiawan                                     | Dimensi-Dimensi Akuntabilitas dan Kinerja Organisasi Sektor Publik (Agustiawan & Halim, 2018)  | 2018 | v  | v  |    | v  |    |    |    |
| 17 | Zulfatun Ruscitasari                           | Implementasi Sistem Akuntabilitas Kinerja Satuan Kerja Perangkat Daerah (Ruscitasari, 2019)  | 2019 | v  | v  |    |    |    |    |    |
| 18 | Erina Sudaryati, Dhikawidya Nugraha            | Pengaruh Karakteristik Manajemen Kinerja Terhadap Kinerja Aparatur Pemerintah (Sudaryati & Nugraha, 2020).   | 2019 |    |    | v  | v  |    |    |    |

**Trend Analysis for Research in Bureaucratic Reform Using MIS**

The trend analysis conducted in Table 3 went deeper into the utilization of management information systems (MIS) integrated with artificial intelligence or expert systems. This trend analysis is based on 13 articles from conferences and journals. It focuses on the trend of internal audits using MIS, specifically the Supervisory Management Information System (SIMWAS), augmented with artificial intelligence or expert system algorithms. The results of the trend analysis revealed that:

- a. The research on internal audit resulted in the following outcomes: two articles focused on the utilization of MIS, four articles explored the implementation, and two articles investigated the use of expert systems.
- b. The research on performance improvement resulted in the following outcomes: four articles focused on the utilization of MIS, three articles explored the implementation of AI, and two articles investigated the use of expert systems.

- c. The research on SIMWAS resulted in the following outcomes: two articles focused on the utilization of MIS, no articles were found that specifically explored the use of AI, and no articles were found that specifically investigated the use of expert systems.
- d. The research on internal audit and performance improvement, as well as SIMAWAS, did not result in any specific findings.

Based on Table 3, there is an indication of a strong correlation between management information systems (MIS) and decision-making in articles 4, 5, 6, and 8. The use of MIS has been documented since 2005, but its application in supervision began in 2007. The utilization of expert systems (ES) has been present since 2005 (as mentioned in articles 12 and 13), while the use of artificial intelligence (AI) has been more prevalent between 2018 and 2021 (as noted in articles 7, 9, 10, and 11).

Table 3. Keyword comparison between articles (2005 – 2021) (keyword P1: MIS, P2: DSS, P3: SIMWAS, P3: Performance, P4: Internal Audit, P5: Artificial Intelligence, P6: Expert System)

| No | Author   | Title   | Year | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
|----|--|---|------|----|----|----|----|----|----|----|
| 1  | Aferdita Berisha - Shaqiri                     | Management Information System and Decision-Making (Berisha - Shaqiri, 2014)   | 2014 | v  |    |    |    |    |    |    |
| 2  | Lahar Mishra, Ratna Kendhe, Janhavi Bhalerao   | Review On Management Information Systems (Mis) And Its Role in Decision Making (Mishra & Pradhan, 2019)                           | 2015 | v  |    |    | v  |    |    |    |
| 3  | Tanti Susanti                                  | Analisis Implementasi Sistem Informasi Manajemen Pengawasan (SIMWAS) Studi Kasus di Batan (Susanti, 2015)                         | 2011 | v  |    | v  | v  | v  |    |    |
| 4  | Triatmaja                                      | Dampak artificial intelligence (AI) pada profesi akuntan  | 2019 | v  | v  | v  |    | v  |    |    |
| 5  | Azwir Nasir dan Ranti Oktari                   | Pengaruh Pemanfaatan Teknologi Informasi Dan Pengendalian Intern Terhadap Kinerja Instansi Pemerintah (Nasir & Oktari, 2011)      | 2017 | v  | v  |    | v  | v  |    |    |
| 6  | David Gichoya                                  | Factors Affecting the Successful Implementation of ICT Projects In Government (Gichoya, 2005)                                     | 2005 | v  | v  |    | v  |    |    |    |
| 7  | Raden Roro Widya Ningtyas Soeprajitno          | Potensi Artificial Intelligence (Ai) Menerbitkan Opini Auditor? (Soeprajitno, 2019)   | 2018 |    |    |    | v  | v  | v  |    |
| 8  | Ita Hartati                                    | Strategi Pembangunan SDM Kementerian Keuangan Republik Indonesia dalam Menghadapi Tantangan Era Disrupsi 4.0                      | 2020 | v  | v  |    |    |    |    |    |
| 9  | Muhammad Fithrayudi Triatmaja                  | Dampak Artificial Intelligence (Ai) Pada Profesi Akuntan (Triatmaja et al., 2019)   | 2017 |    |    |    | v  | v  | v  |    |
| 10 | Fandhy Haristha                                | IIA's Artificial Intelligence Auditing Framework (IIA, 2021)  | 2021 |    |    |    | v  | v  | v  |    |
| 11 | Peter Brady                                    | Artificial Intelligence and Big Data: A Double-Edged Sword for Risk Management and Internal Audit (Korkmaz et al., 2022)          | 2021 |    |    |    |    | v  | v  |    |
| 12 | Emine Kizmaz, Esmadeveci, Huseyin Selcuk Kilic | An Expert System Approach for The Internal Audit of Iso 9001: 2015 (Kizmaz, Deveci, & Kilic, n.d.; Korkmaz et al., 2023)          | 2005 |    |    |    | v  | v  |    | v  |
| 13 | Chuleeporn Changchita and Clyde W. Holsapple   | The Development of An Expert System for Managerial Evaluation f Internal Controls (Changchit & Holsapple, 2004); Zemankova, 2019) | 2005 |    |    |    | v  | v  |    | v  |

## CONCLUSION

The use of MIS for internal audit as a driving force for increasing SPBE is needed to achieve the target of bureaucratic reform as outlined in RI Presidential Decree No. 81 of 2020. The use of SIM specifically is still not translated into regulations. This is an opportunity for technology experts to help formulate technology policies to enhance bureaucratic reform.

MIS in internal control (SIMWAS) is needed to assist internal auditors to improve their performance and also the performance of their organization. The application of SIMWAS needs attention and its use can be standardized.

SIMWAS using an expert system still needs to be developed, moreover, the use of artificial intelligence is increasing. This development needs to be continued to make predictions to be able to optimize resources for efficiency and effectiveness.

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