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ORIGINAL PAPER

The Labyrinth of Corruption in the Construction Industry: A System Dynamics Model Based on 40 Years of Research

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Abstract
The academic literature has viewed drivers of corruption in isolation and, consequently, failed to examine their synergistic effect. Such an isolated view provides incomplete information, leads to a misleading conclusion, and causes great difficulty in curbing corruption. This paper conducts a systematic literature review to identify the drivers of corruption in the construction industry. Subsequently, it develops a system dynamics (SD) model by conceptualizing corruption as a complex system of interacting drivers. Building on stakeholder and open systems theories, the proposed SD model shows how the complex reinforcing relationship between authoritative, organizational, cultural, and financial drivers of corruption further increases corrupt practices. The new model also provides lessons that can be helpful in the development of policy frameworks to control corruption in the construction industry. To achieve success in the fight against corruption, the findings of this research suggest that (1) corruption must be understood at both the organizational and state levels, (2) anticorruption practices must be informed by ethically grounded stakeholder management strategies, and (3) anticorruption reforms must go hand-in-hand with strategies to tackle the economic downturn.

Keywords Construction industry · Corruption · Open systems theory · Stakeholder theory · Systematic literature review · System dynamics

Introduction

Unethical behavior on the part of business corporations has raised great concern among scholars and business executives (Jannat et al., 2022; Rees et al., 2022). As a result, the litany of firms engaged in unethical practices has become the thematic preoccupation of business ethics literature (Antunez et al., 2023; Zaal et al., 2019). Corruption is recognized as the most dominant unethical practice of firms, their leaders, and their employees. Corruption breeds inequality and imposes extra costs on firms and societies (Everett et al., 2006; Hauser, 2019), and, in recent years, many governments, organizations, religious groups, scholars, and civil societies in both developed and developing countries have been actively involved in studying and fighting it (Snyman, 2022). Specifically, much of the research on business ethics is concerned with corrupt behavior and the drivers of corrupt practices (Orudzheva et al., 2020).

Business ethics literature has provided useful insights regarding the drivers of corruption and impacts on business and society. Examples of common drivers include societal inequality (Hudson et al., 2022), organizational drivers (Yap et al., 2022), cultural factors (Hu et al., 2023), and political causes of corruption (Khieu et al., 2023). In addition, prior studies have explored how various internal and external factors may trigger corrupt conduct (Ren et al., 2022). Examples include psychological antecedents of corrupt behavior (Hauser, 2019), firm formality (Vu et al., 2023), and contractors' motivation for rule violation in projects (Liu et al., 2023).

Despite paying considerable attention to the drivers of corruption, the literature has not taken a holistic approach and, consequently, has failed to address the broader problem of relationships between these drivers. This reminds us of the parable of *The Blind Men and the Elephant*, where the blind men describe the elephant by touching only one part of the elephant's body and, accordingly, draw a misleading conclusion about its appearance (Tomoaia-Cotisel et al.,

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2022). In a comparable way, an isolated view of the causal drivers of corruption—without considering their role in the broader context of organizational, cultural, financial, and authoritative systems—results in a partial understanding of this concept.

Against this backdrop, this paper takes a systems thinking approach to understand the causal structure of corruption as a complex phenomenon. The construction industry, as one of the most corrupt industries worldwide (Monteiro et al., 2022), is chosen for this research. Accordingly, this paper adopts a system dynamics (SD) modeling technique to develop a conceptual model that illustrates how the interactions between corruption drivers lead to multiple vicious cycles that reinforce corrupt practices in the construction industry. The proposed SD model provides a means of elaborating two theories, open systems theory and stakeholder theory, which provide a framework to interpret patterns of interaction among corruption drivers (Whetten, 1989). Open systems theory provides a theoretical foundation to explain why organizations cannot be demarcated from their external environment in their efforts to control corruption, while stakeholder theory enables us to create a link between ethics and organizational strategies to curb corruption (Harrison & Wicks, 2013).

This research responds to the call for studies that examine the causes of corruption and the ways corrupt practices affect organizations and their stakeholders (Dacin et al., 2022). As a result, it contributes to the literature on business ethics in three ways. First, it departs from earlier studies on corruption by taking into account feedback processes. Available studies mainly adopt an open-loop view, in which the ripple effect phenomenon is ignored. This paper is among the few that illustrate how ripple effects, propagating throughout feedback loops, promote corruption. This approach diverts our attention to the causes underlying an increasing trend toward corrupt practices. Second, the proposed SD model identifies three subsystems that promote corruption in the construction industry and, accordingly, provides decisional guidance for designing policies to prevent corruption. This is achieved by developing three propositions to counter the vicious cycles that reinforce corruption in the construction industry. Third, this research is the first to undertake network analysis to locate the high-leverage points in the network of interacting drivers of corruption. This enables policy makers and managers to design high-leverage policies for curbing corruption in the construction industry.

The remainder of the paper is structured as follows. Next, it presents a structured review of the literature on corruption in the construction industry. It then provides a detailed discussion of how the proposed SD model was developed, followed by analysis of the three subsystems of the model. The paper offers an exemplary application of the proposed SD model to identify high-leverage points for policy intervention. It then illustrates how this model can be used by managers and policy makers to curb corruption, before briefly discussing how it could be improved by addressing its limitations.

Research on Corruption in the Construction Industry: Where Do We Stand?

Literature Review Methodology

To synthesize prior research in a transparent way, this paper employed an eight-step systematic literature review (SLR) approach proposed by Okoli (2015). Figure 1 depicts the steps taken to conduct this SLR. As can be seen, these can be classified into four stages: planning, selection, extraction, and execution.

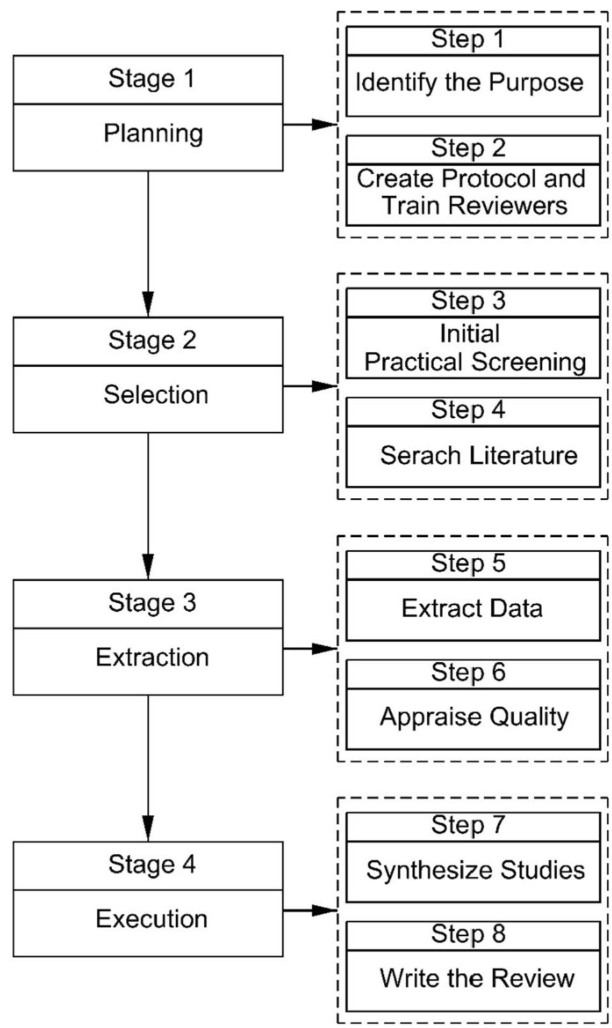

Fig. 1 Steps for conducting the systematic literature review

Planning

The first step in the planning stage defines the purpose of the SLR and justifies its suitability. The main objective of conducting an SLR here is to explore and identify the drivers of corruption in the construction industry. Contrary to other types of literature review, an SLR provides as comprehensive as possible an overview of what is already known about corruption in the construction industry. In the second step of the planning stage, a protocol, the detailed procedural steps to conduct the SLR, was developed and the reviewers were trained. The protocol also describes the electronic databases to be searched and the different screening criteria that papers have to pass for inclusion in the review.

Selection

In Step 3, the criteria and keywords for the practical screening were decided. Reviewers also defined the inclusion and exclusion criteria for selecting and excluding papers. For instance, reviewers decided to restrict their review to peer-reviewed journals to ensure high quality, thereby excluding conference papers, book chapters, and doctoral theses. In addition, papers written in languages other than English were excluded due to a lack of translation resources. Moreover, the search was not restricted to specific cases of construction projects. Since the literature uses a proliferation of terms to describe "corruption" and "construction projects," reviewers agreed on keywords to search the literature as widely as possible. For example, multiple relevant synonyms for "corruption" were derived to add to the search strategy, including "bribery," "fraud," "collusion," "embezzlement," "bid-rigging," "overbilling," "price-fixing," and "kickbacks." Similarly, the term "construction industry" was presented in different ways such as "construction sector" and "construction projects." The literature search was carried out based on the developed protocol and the identified key terms. The reviewers used two well-known electronic databases: Scopus and Business Source Complete (EBSCO). To achieve more specific outcomes, the Boolean connectors "AND" and "OR" were used to combine the identified keywords.

As expected, searching Scopus and EBSCO generated duplicate citations. Thus, reviewers searched the selected papers for duplicates and deduplicated references manually, as recorded on a Microsoft Excel spreadsheet. This resulted in 354 peer-reviewed papers that address corruption in various types of construction projects including commercial, residential, industrial, and mixed-used. Two reviewers independently examined the abstracts of these deduplicated papers to eliminate clearly irrelevant papers. In performing this step, reviewers agreed to remove 226 papers, which were substantially irrelevant. As a result, 128 references were selected, of which six were not accessible. The reviewers read the 122 remaining papers in their entirety to ensure substantive relevance. These papers were further narrowed down to 56 substantively relevant papers. The backward-tracking technique was used by reviewing the references of the selected 56 papers to find potential papers that could be relevant, bringing the total journal articles under analysis to 62.

Extraction

Two reviewers independently performed data extraction (Step 5). The extracted data were compared and resolution sessions were held to resolve disagreements and reach consensus on key drivers of corruption in the construction industry. To examine the quality of the selected papers (Step 6), 18 appraisal questions, presented in Petticrew and Roberts (2006), were used. Accordingly, two reviewers evaluated the quality of the papers and decided to remove five, leaving 57 final papers as the basis for developing the proposed SD model. The final selected papers are reported in Table 1.

Execution

To present a reflective interpretation of the findings of the SLR, a synthesis of reviewed papers was performed in the execution stage (Step 7). To synthesize data, the reviewers followed the three-step coding approach proposed by Gioia et al. (2013), including (1) developing the first-order codes, (2) identifying the second-order themes, and (3) determining the aggregated dimensions. The first-order codes were developed by taking into account a full description of causal drivers contributing to corruption based on the original wording. To develop the second-order themes, the reviewers identified similarities and differences among first-order codes. Finally, the second-order themes were narrowed down into aggregated dimensions, which were not evident in the reviewed papers. Table 2 is then constructed to report the second-order themes and the aggregated dimensions. In a final move, the steps of the SLR including the outputs of each step were documented in Step 8.

A System Dynamics Model of Corruption

An Overview of System Dynamics Modeling

A complex system is defined as "a set of elements standing in interrelation among themselves and with the environment" (von Bertalanffy, 1972, p. 417). A complex system cannot be understood by examining its individual elements; rather, it "can only be understood in its entirety" (Harrison, 2020, p. 24). In the real world, quite often, a complex

Table 1 Final selected papers

Code	Paper	Code	Paper	Code	Paper
A1	Ullal (2023)	A20	Ebekozien (2020)	A39	Tabish and Jha (2011)
A2	Oluseye et al. (2023)	A21	Aduwo et al. (2020)	A40	Ameh and Odusami (2010)
A3	Soni and Smallwood (2023)	A22	Hosseini et al. (2020)	A41	de Jong et al. (2009)
A4	Devine et al. (2022)	A23	Apriyanti and Rais (2020)	A42	Kenny (2009)
A5	Z. Wang et al. (2022)	A24	Hilmi et al. (2019)	A43	Anekwe (1987)
A6	Amoah and Steyn (2022)	A25	Owusu et al. (2019)	A44	Damit (1983)
A7	Bhagat and Jha (2022)	A26	Tabish and Jha (2018)	A45	Chilakamarri (2023)
A8	Ebekozein et al. (2022)	A27	Luzgina (2017)	A46	Signor et al. (2022)
A9	Martin et al. (2023)	A28	Shan et al. (2017)	A47	Liu et al. (2023)
A10	Hu et al. (2023)	A29	Ameyaw et al. (2017)	A48	Owusu et al. (2020)
A11	Monteiro et al. (2022)	A30	Courtois and Gendron (2017)	A49	Yu et al. (2019)
A12	Yap et al. (2022)	A31	Kyriacou et al. (2015)	A50	Saim et al. (2019)
A13	Alani and Mahjoob (2021)	A32	Brown and Loosemore (2015)	A51	Chan and Owusu (2017)
A14	Cheng and Darsa (2021)	A33	Bowen et al. (2015)	A52	Zhang et al. (2017)
A15	Zhai et al. (2021)	A34	Deng et al. (2014)	A53	Doroftei (2016)
A16	Santa-Cruz et al. (2021)	A35	Gunduz and Önder (2013)	A54	Arewa and Farrell (2015)
A17	Sikombe and Phiri (2021)	A36	Mukumbwa and Muya (2013)	A55	Le et al. (2014)
A18	Yap et al. (2020)	A37	Bowen et al. (2012)	A56	Alutu and Udhawuve (2009)
A19	R. Wang et al. (2020)	A38	Abdul-Rahman et al. (2011)	A57	Bowen et al. (2007)

system of interacting elements creates a persistent problem. Addressing such a problem requires a modeling technique that takes account of the complex cause-and-effect relationships among elements that have created the problem (Zarghami, 2023). However, we cannot intuit such complex relationships because of our cognitive limitations (Haque et al., 2023). SD, developed by Jay W. Forrester, is a modeling technique that can be used to examine such cause-and-effect relationships (Zarghami & Dumrak, 2021). A causal loop diagram (CLD) is a diagramming tool used to visualize SD models by portraying the causal relationships between elements of a complex system. Causal links, with either positive or negative polarity, are used to show causality between elements. A positive polarity indicates that cause and effect move in the same direction, whereas a negative polarity implies that cause and effect change in the opposite direction. Two or more causal links create a feedback loop. Feedback loops can be classified into two primary types: reinforcing and balancing (Zarghami, 2023). In a reinforcing feedback loop, an initial increase (decrease) in any element of the loop ripples through the loop and ultimately returns to the element, resulting in an increase (decrease) in the element. Conversely, a balancing feedback loop creates stability by resisting further changes in any element of the loop.

As discussed, corruption is a complex social, economic, cultural, and political phenomenon. Such complexity dwarfs our cognitive capabilities to examine the complex cause-and-effect relationships between the drivers of corruption because of the inability of our mental models to intuit the relationships between drivers. To expand the boundaries of our mental models, an SD model of corruption is developed in the remainder of this paper. This, in turn, enables answering the second research question, "How do the drivers of corruption in the construction industry interact?".

Modeling Process

To process information obtained from the SLR and construct an SD model of interacting drivers of corruption, this paper adopts the empirical-oriented group model building (GMB) technique proposed by Vennix (1996). In this context, a group of three experts with expertise in the field of corruption was selected using purposeful sampling (Patton, 2015). Criterion sampling, a purposeful sampling strategy, was used to select experts that meet either, or both, of the following two criteria: (1) conducted research in the context of corruption over the past 5 years and (2) engaged in a range of anticorruption and integrity forums.

Pre-workshop Preparation

The first step included deciding the model's purpose. Scholars and practitioners in the field of business ethics, as well as managers and policy makers involved in the construction industry, were considered the primary audience of the model. The basic assumptions of the proposed SD model, including its boundary, were then identified. The boundary of the model was defined based on the following question:

Table 2 An overview of drivers of corruption in the construction industry

Second-order Themes	Aggregate Dimensions	References
Weak governance	Organizational	A42
Short-term strategic goals	Organizational	A5
A lack of expertise	Organizational	A1, A12, A14, A37
Participation of non-professionals	Organizational	A36, A41, A43
A shortened investment horizon	Organizational	A1
Information asymmetry	Organizational	A4, A25, A27, A28, A47
The absence of contract/tendering monitoring systems	Organizational	A24, A39, A46
Abundance of procedural requirements in procurement	Organizational	A7
Procurement irregularities	Organizational	A25, A26, A36
Over-competition in tendering process	Organizational	A5, A6, A25, A28, A35, A36, A38, A50, A55, A57
A lack of competitive bidding process-Unfair bidding processes	Organizational	A41, A51, A53
A lack of transparency	Organizational	A12, A17, A21, A24, A25, A26, A27, A28, A29, A33, A35, A39, A50, A51
Concealment of works	Organizational	A12, A16, A21, A29, A36, A38, A40, A50, A57
Poor documentation	Organizational	A21, A25, A51
Poor leadership	Organizational	A12, A18, A32, A55
A lack of an effective financial system	Organizational	A14
Top management fraud	Organizational	A19
Project uniqueness and complexity	Organizational	A4, A6, A7, A12, A15, A16, A23, A25, A31, A35, A36, A37, A45, A47, A48, A49, A51, A54, A55, A57
Time and budget pressures	Organizational	A10, A47
Long project duration	Organizational	A36
Opportunity for time and cost overruns	Organizational	A36, A57
A large amount of money involved	Organizational	A12, A23, A36
Design problems	Organizational	A14, A50
Contradiction between design specifications and bid documents	Organizational	A14
Fragmentation of construction processes	Organizational	A12, A21, A36
The absence of standardized execution for the execution phase	Organizational	A25
A lack of rigorous supervision during project execution	Organizational	A25, A32, A55
Complexity of contractual structure	Organizational	A25, A27, A37, A54
Defective contracts	Organizational	A41
A high number of subcontractors and contractual relationships	Organizational	A6, A23
Diversity of stakeholders and relationships among them	Organizational	A12, A47
Unethical behavior such as dishonesty and greediness	Organizational	A2, A6, A12, A20, A21, A36, A50, A56, A57
Conflict of interest	Organizational	A50, A57
A lack of knowledge about the code of conduct	Organizational	A6
Work dissatisfaction	Organizational	A34
Over-close/interpersonal relationships	Organizational	A11, A25, A27, A35, A41, A45, A55
Job insecurity	Organizational	A25
The culture of secrecy	Cultural	A29, A37, A41, A54
Cultural behavior	Cultural	A10, A31, A38, A45
Culture of deviance	Cultural	A30
The influence of guanxi	Cultural	A11, A25, A47, A51, A52
Normative cognition	Cultural	A10, A13
Negative encouragement	Cultural	A12, A52
Negative role models	Cultural	A25
A weak Organizational culture	Cultural	A10, A45, A54

Table 2 (continued)

Second-order Themes	Aggregate Dimensions	References
Economic downturn	Financial	A38, A56
Organizational financial constraints	Financial	A5
Economic survival	Financial	A25
Tight margins	Financial	A35
Low income	Financial	A20, A21, A25, A34, A36, A55
Insufficient legal frameworks	Authoritative	A1,A8, A12, A13, A14, A18, A25, A27, A28, A38, A52, A55
Low-intensity punishment/inadequate sanctions	Authoritative	A5, A12, A25, A36, A37, A47, A51, A55
Officials' discretionary power	Authoritative	A9
Power to influence contract award	Authoritative	A56
Political interference	Authoritative	A20, A22, A25, A28, A31, A35, A36, A50, A53, A56
A lack of accountability	Authoritative	A14, A18, A24, A29, A39
A lack of coordination among government departments	Authoritative	A25, A32
A low level of democracy	Authoritative	A31
A lack of stakeholders' involvement	Authoritative	A13
Ambiguous ethical standards	Authoritative	A3, A25, A37, A39, B1, A51, A52, A55
Using anticorruption strategies deceptively	Authoritative	A11
Bureaucracy of permitting and approval processes-Multifarious licenses and permits	Authoritative	A4, A6, A12, A16, A18, A25, A27, A32, A36, A55, A57
Complexity of rules	Authoritative	A25, A28
Dominance of a few large players	Authoritative	A43, A49
Monopoly of suppliers/contractors	Authoritative	A25, A29, A35, A44
Forming cartels	Authoritative	A44
The absence of a system that detects collusive practices	Authoritative	A25, A33, A46
Insufficient ethics training	Authoritative	A38

"How do the drivers of corruption in the construction industry interact?" This indicates that the proposed model should provide an endogenous explanation of corruption to illustrate how corruption drivers can affect and be affected by one another. Thus, exogenous variables, which are not controlled by feedback loops in the model, were excluded (Sterman, 2000); for example, bureaucratic quality was excluded because it is not affected by other corruption drivers in the model. The list of causal factors of corruption, derived from the SLR, was e-mailed to experts. To ensure that any key causal factor was not missing, experts were asked, "Do we need to adjust or add causal drivers?" Experts confirmed that the list of causal drivers covered the main drivers of corruption in the construction industry. An online meeting was then conducted via the Zoom platform, during which the aim of the workshops was discussed. In addition, experts were introduced to the concept of systems mapping in SD, followed by a brief discussion of various modeling steps.

Exploratory Workshops

To solicit experts' perception of the relationship between causal factors of corruption, two exploratory GMB workshops were carried out. The author chaired the two-hour workshops, in which three experts participated. A deductive reasoning approach, as suggested by Cavana and Mares (2004), was employed to construct causal links between corruption drivers and to ensure the validity of expert judgment. To explain in greater detail, consider the following:

Premise X: A collusive detective system results in the deceptive use of anticorruption strategies

Premise Y: The absence of ethics training leads to the deceptive use of anticorruption strategies

If X and Y, then Z: *If* the detective system is collusive *and* ethics training is not provided, *then* the deceptive use of anticorruption strategies is likely

The following sub-argument can be constructed from these three premises:

X

Y

If X and Y, then Z

Therefore Z

The conclusion of this argument is as follows:

Premise Z: The deceptive use of anticorruption strategies results from a collusive detective system and the absence of ethics training

To check the validity of the causal relationships, a counterfactual analysis was performed. In this vein, the experts were asked whether an ineffective collusion detecting system decreases the deceptive use of anticorruption strategies and they indicated this was not the case. In a related vein, the experts were asked whether the absence of ethics training prevents the deceptive use of anticorruption strategies and they indicated that the statement was not likely. In other words, the causal relationship between *X* and *Z*, as well as between *Y* and *Z*, passed the counterfactual test. It is now possible to present premises *X*, *Y*, and *Z* in a diagrammatic form as in Fig. 2.

Following this deductive reasoning approach, the causal relationships among corruption drivers were established. The diagrammatic presentations of these relationships were linked together to construct the CLD of corruption drivers.

A Confirmatory Workshop

An online two-hour confirmatory workshop was carried out during which experts were asked to review specific feedback loops in turn. The feedback loops constructed in the exploratory workshops were consolidated using *Vensim PLE 10.0.0*. Vensim is a simulation software, developed by Ventana Systems, which provides a platform for qualitative modeling, as well as quantitative analysis, of SD models (Zarghami & Gunawan, 2023). This software provides a flexible approach to construct a consolidated SD model of corruption drivers and thus facilitates discussion. In the confirmatory workshop, the experts discussed whether they agreed with the consolidated SD model. With some suggested minor modifications, they confirmed the CLD of corruption drivers shown in Fig. 3.

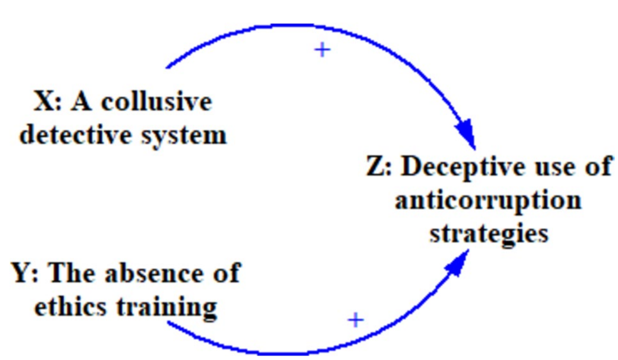

Fig. 2 The diagrammatic form of premises X, Y, and Z

Anatomy of Corruption in the Construction Industry: Propositions Development

In the proposed SD model (shown in Fig. 3), three subsystems connect authoritative, organizational, cultural, and financial drivers of corruption. These subsystems include 25 reinforcing feedback loops that create vicious cycles leading to further increases in the level of corruption.

Subsystem 1: The Interface Between Authoritative and Organizational Drivers

The CLDs for this subsystem are provided in Fig. 4. This subsystem focuses on the state in which corruption occurs and, accordingly, describes the interface between authoritative and organizational drivers of corruption. Table 3 presents the causal drivers of corruption in this subsystem.

Feedback loops R1–R4 examine the interactions among authoritative drivers and describe how corruption can be entrenched in undemocratic states. Feedback loop R1 explains that government officials resist accountability in undemocratic states, leading to a high degree of discretion in exercising power (Pertiwi & Ainsworth, 2021). This, in turn, leads to improper political interference, thereby imposing pressure to influence contracts. The consequent outcome of such interference is the dominance of large players in the construction industry and the subsequent formation of construction cartels. This results in the monopoly power of a few contractors, which further increases corrupt public practices. Feedback loops R2, R3, and R4 take into account the lack of involvement of the public and officials in decision making in undemocratic states. These feedback loops emphasize that government departments/agencies face coordination problems arising from the low level of stakeholder involvement, in turn resulting in the establishment of ineffective legal frameworks to eradicate corruption (Adelopo & Rufai, 2020). Feedback loop R2 shows that an ineffective legal framework is a major impediment to the provision of an effective sanctioning system, which increases the probability of corruption.

Moreover, feedback loops R3 and R4 examine the relationships that exist among the complexity of rules, resulting from ineffective legal frameworks, and the deceptive use of anticorruption strategies. More explicitly, feedback loop R3 depicts that an increase in the complexity of rules hinders the development of effective collusion detection systems. The absence of a system that can effectively detect corrupt practices in the construction industry promotes the deceptive use of anticorruption strategies, thereby failing in the fight against corruption. Feedback

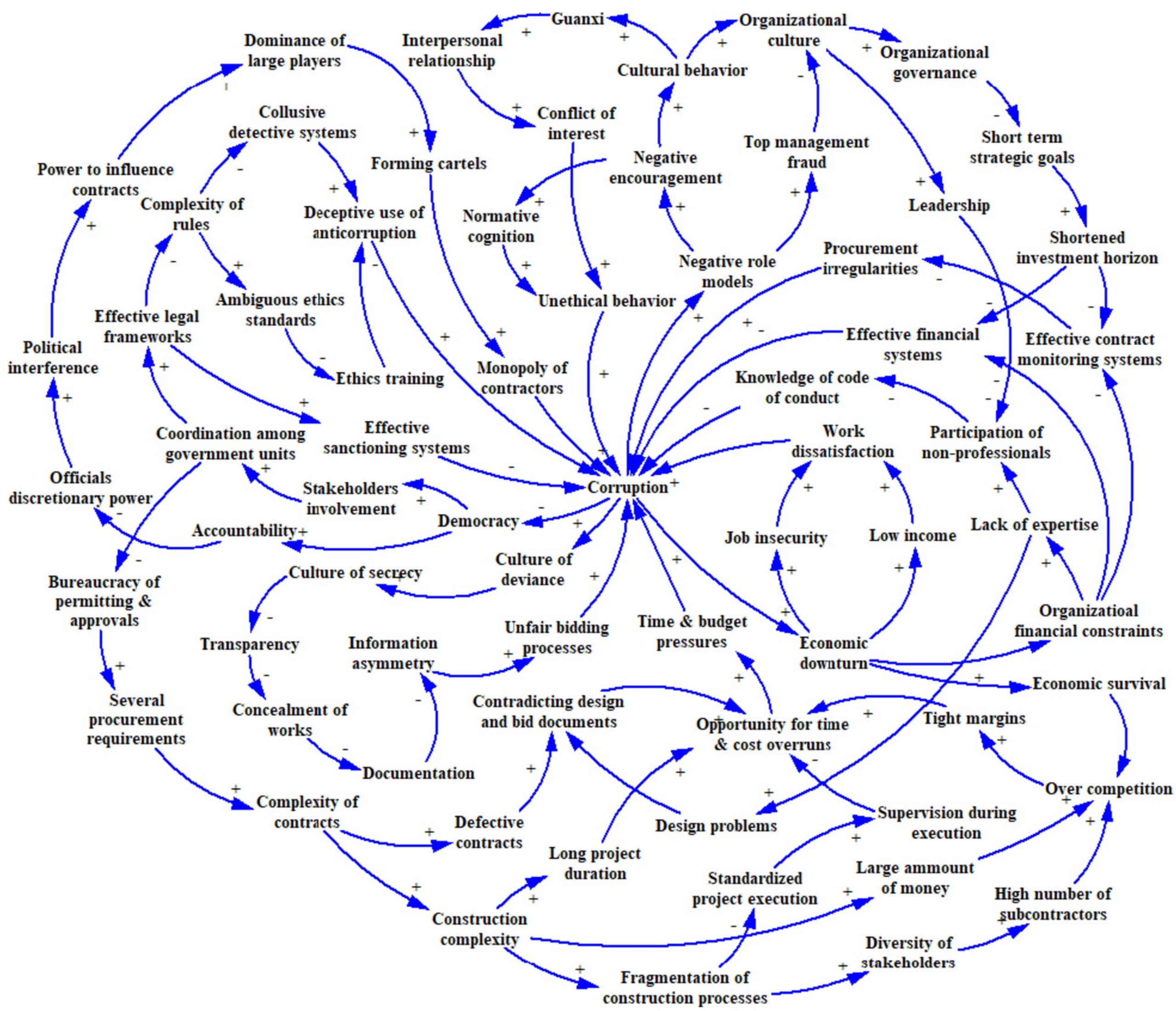

Fig. 3 Causal loop diagrams of corruption drivers in the construction industry

loop R4 captures the direct correlation between the complexity of rules and the ambiguity of ethical standards. Such ambiguity decreases the effectiveness of ethics training, reinforcing the deceptive use of anticorruption strategies.

Feedback loops R5, R6, R7, R8, and R9 illustrate five cycles in which an increase in the complexity of contracts propagates through the cycle and returns to increase corrupt practices in the construction industry. These feedback loops commonly act to reinforce the complexity of construction contracts in line with the interactions among authoritative drivers, including stakeholder involvement, coordination among government units, permits and approvals bureaucracy, and procurement requirements. In feedback loop R5, contractual complexity increases mistakes in contract documents. Discrepancies between design and contracts may occur as a result of defective contracts. This, in turn, provides the opportunity for time and cost overruns in projects, leading to time and budgetary pressures. Under such pressures, construction managers must make fast decisions based on limited information, which creates difficulty in curbing corruption. In a similar vein, the key determinant of feedback loops R6, R7, R8, and R9 is the contractual complexity of construction projects. Construction projects consist of interwoven networks of multiple subcontractors and suppliers whose behavior is motivated and regulated by contracts (W. Wang et al., 2018). Contractual complexity adds complexity to the coordination task within such networks, which in turn increases project complexity. In feedback loops R6, R7, R8, and R9, construction complexity cascades across other organizational drivers and ultimately amplifies the level of corruption in the construction industry.

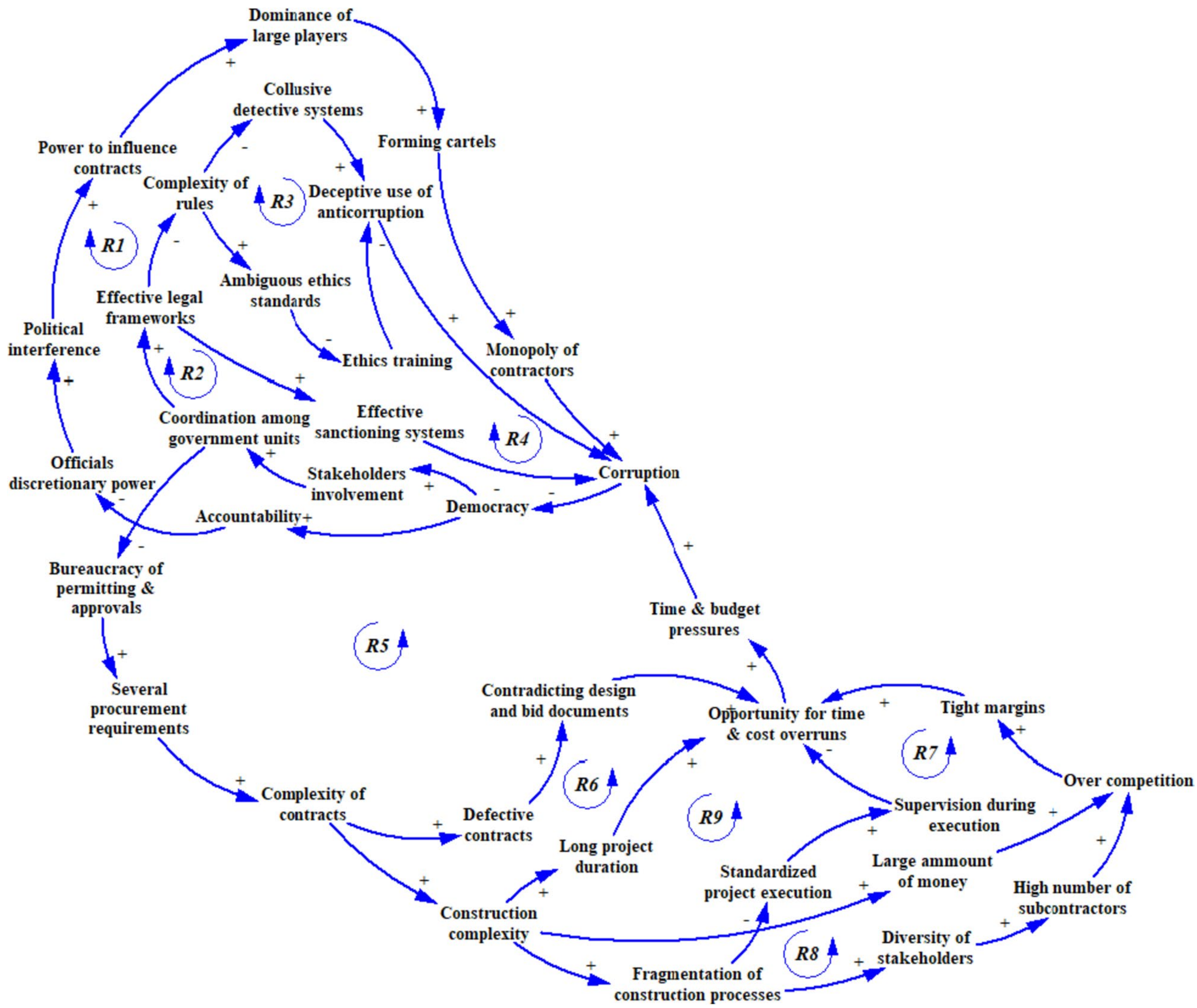

Fig. 4 Causal loop diagrams of Subsystem 1

Subsystem 1 stresses the importance of an open systems view of corruption, which suggests that the boundaries of an organization are permeable (Harrison, 2019). This indicates that organizations are dependent on their external environment in their efforts to control corruption. More explicitly, corruption as a complex phenomenon can be best described as based on not only organizational drivers but the interaction between authoritative drivers that emerge from the external environment such as government entities and officials. In this context, governments can be viewed from two perspectives. The first perspective views governments as part of a broader stakeholder group (Esper et al., 2023). Viewed from this perspective, governments interact with other stakeholders in various ways—cooperatively, such as by outlining procurement requirements (feedback loops R5–R9), and at times, engaging in corrupt practices, such as favoring contractor monopolies (feedback loop R1). The second perspective regards governments as part of the external environment for organizations, overseeing corruption through the utilization of stakeholder management practices. From this perspective, particularly in democratic states (feedback loops R1–R4), governments employ a participatory and people-centric approach to actively involve social actors in the planning and implementation stages of policies aimed at combating corruption.

Proposition 1 *Corruption in the construction industry must be understood at both state and organizational levels, and the fight against corruption cannot be successful without reform of both states and organizations.*

Table 3 Corruption drivers of feedback loops in Subsystem 1

Loop	Corruption factors
R1	Democracy–Accountability–Officials' discretionary power–Political interference–Power to influence contracts–Dominance of large players–Forming cartels–Monopoly of contractors
R2	Democracy–Stakeholder involvement–Coordination among government units–Effective legal frameworks–Effective sanctioning systems
R3	Democracy–Stakeholder involvement–Coordination among government units–Effective legal frameworks–Complexity of rules–Collusion detection systems–Deceptive use of anticorruption strategies
R4	Democracy–Stakeholder involvement–Coordination among government units–Effective legal frameworks–Complexity of rules–Ambiguous ethical standards–Ethics training
R5	Democracy–Stakeholder involvement–Coordination among government units–Permits & approvals bureaucracy–Several procurement requirements–Complexity of contracts–Defective contracts–Contradicting design & bid documents–Opportunity for time & cost overruns–Time & budget pressures
R6	Democracy–Stakeholder involvement–Coordination among government units–Permits & approvals bureaucracy–Several procurement requirements–Complexity of contracts–Construction complexity–Long project duration–Opportunity for time & cost overruns–Time & budget pressures
R7	Democracy–Stakeholder involvement–Coordination among government units–Permits & approvals bureaucracy–Several procurement requirements–Complexity of contracts–Construction complexity–Large amount of money involved–Over-competition–Tight margins–Opportunity for time & cost overruns–Time & budget pressures
R8	Democracy–Stakeholder involvement–Coordination among government units–Permits & approvals bureaucracy–Several procurement requirements-Complexity of contracts—Construction complexity–Fragmentation of construction processes–Diversity of stakeholders–High number of subcontractors–Over-competition–Tight margins–Opportunity for time & cost overruns–Time & budget pressures
R9	Democracy–Stakeholder involvement–Coordination among government units—Permits & approvals bureaucracy–Several procurement requirements–Complexity of contracts–Construction complexity–Fragmentation of construction processes–Standardized project execution–Supervision during execution–Opportunity for time & cost overruns–Time & budget pressures

Subsystem 2: The Interface Between Individual, Cultural, and Organizational Drivers

Subsystem 2 describes the interactions between individual, cultural, and organizational drivers of corruption. This subsystem provides causal evidence of how conformity to the prevailing culture of corruption promotes corruption in the construction industry. It consists of nine reinforcing feedback loops, as illustrated in Fig. 5. Additionally, Table 4 presents the causal drivers of corruption in each feedback loop. "Negative role models" and "a culture of deviance" are two drivers that trigger feedback loops in this subsystem. Feedback loop R10 explains how the presence of corruption as a norm leads to a culture of deviance in which corruption is practiced by being in the presence of deviant individuals. The culture of deviance creates a culture of secrecy wherein a lack of transparency encourages the fraudulent concealment of works, and thereby failure to document practices and procedures. Information asymmetry can arise as a consequence of inadequate documentation, which erodes the fairness of bidding processes.

Feedback loop R11 describes how motivational features of corruption can affect acts of corruption, individually and organizationally. This feedback loop highlights that if corruption becomes the expected behavior, an unethical culture develops; in turn, reinforcing unethical behavior (Persson et al., 2013, p. 457). Feedback loop R12 offers a potential explanation as to how conformity to the norm tempts individuals to choose corrupt alternatives.

By way of organization, six feedback loops (R13–R18 in Fig. 5) show that a weak organizational culture is a significant causal factor of corruption in the construction industry. These feedback loops regard negative role modeling as key to shifting organizational culture. Feedback loops R13 and R14 demonstrate that organizations whose members only poorly understand the code of conduct, because of poor leadership and participating non-professionals in projects, are likely to experience corruption. Feedback loops R15 and R16 describe how a weak organizational culture cascades across other organizational factors including poor organizational governance and short-term strategic goals and consequent shortened investment horizon. This cascading effect can lead to the absence of effective financial systems, and ultimately causes a high level of corruption. Similarly, feedback loops R17 and R18 emphasize that such a cascading effect results in ineffective contract monitoring systems, which is detrimental to the ability of organizations to prevent corruption.

Subsystem 2 indicates the fundamental importance of organizational ethics. This subsystem highlights the role organizations play in influencing individual conduct (Phillips, 2003). Stakeholder theory is well suited to describe how the development of organizational ethics creates a culture in which individuals "do their best" to deliver organizational values (Freeman, 1984; Freeman et al., 2004). As long acknowledged in the literature, stakeholder theory provides an exciting opportunity to create a link between ethics and organizational strategies (Harrison &

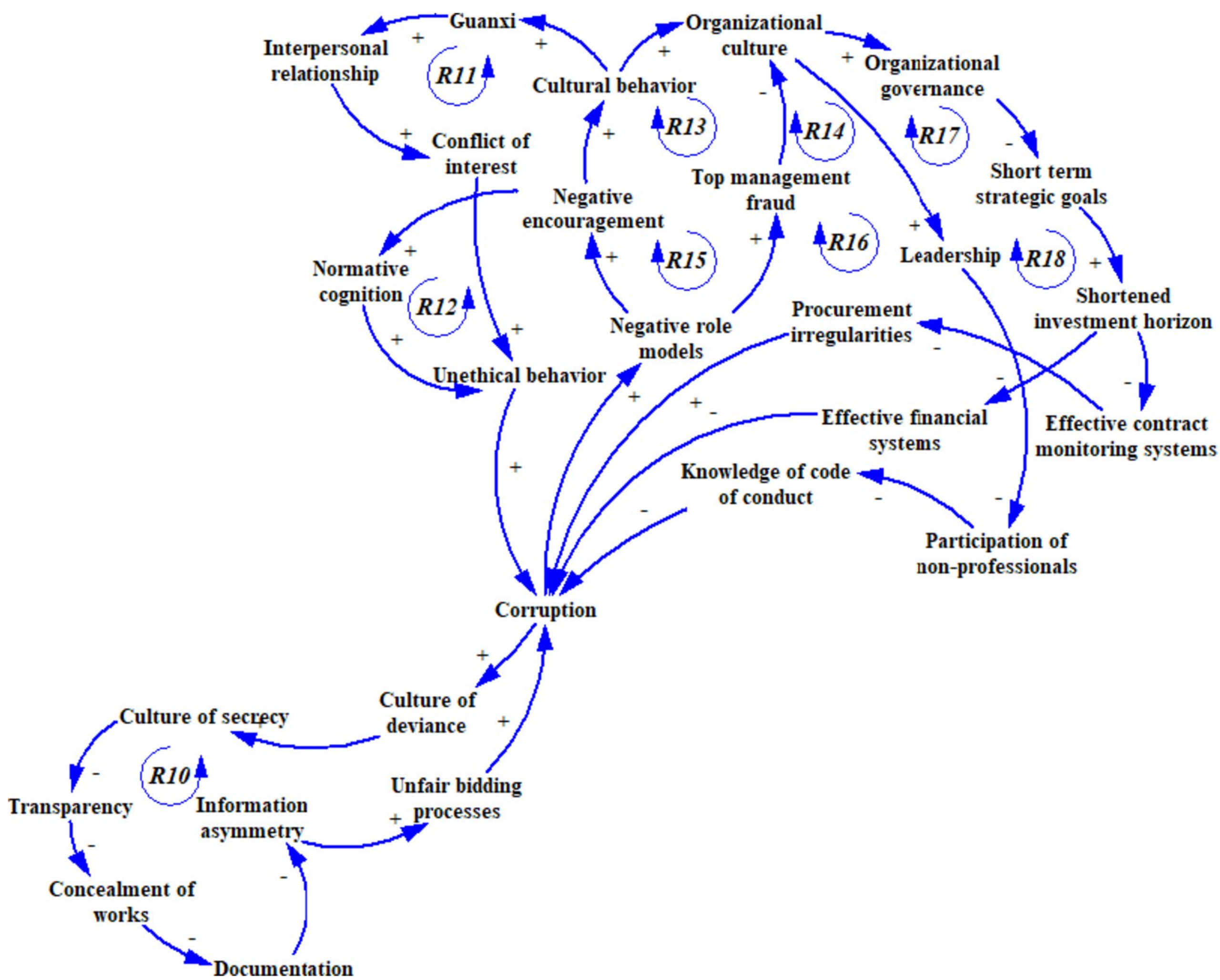

Fig. 5 Causal loop diagrams of Subsystem 2

Table 4 Corruption drivers of feedback loops in Subsystem 2

Loop	Corruption factors
R10	Culture of deviance–Culture of secrecy–Transparency–Concealment of works–Documentation–Information asymmetry–Unfair bidding process
R11	Negative role models–Negative encouragement–Cultural behavior–Influence of guanxi–Interpersonal relationship–Conflict of interest–Unethical behavior
R12	Negative role models–Negative encouragement–Normative cognition–Unethical behavior
R13	Negative role models–Negative encouragement–Cultural behavior–Organizational culture–Leadership–Participation of non-professionals–Knowledge of code of conduct
R14	Negative role models–Top management fraud–Organizational culture–Leadership–Participation of non-professionals–Knowledge of code of conduct
R15	Negative role models–Negative encouragement–Cultural behavior–Organizational culture–Organizational governance–Short-term strategic goals–Shortened investment horizon–Effective financial systems
R16	Negative role models–Top management fraud–Organizational culture–Organizational governance–Short-term strategic goals–Shortened investment horizon–Effective financial systems
R17	Negative role models–Negative encouragement–Cultural behavior–Organizational culture–Organizational governance–Short-term strategic goals–Shortened investment horizon–Effective contract monitoring systems–Procurement irregularities
R18	Negative role models–Top management fraud–Organizational culture–Organizational governance–Short-term strategic goals–Shortened investment horizon–Effective contract monitoring systems–Procurement irregularities

Wicks, 2013). In light of the influence of top managers on moral norms, this theory suggests that "those highest in the governance hierarchy" can significantly contribute to building an ethical culture in organizations "through the role modeling of appropriate stakeholder treatment" (Jones et al., 2018, p. 374).

Proposition 2 *Anticorruption practices in the construction industry must be informed by ethically grounded stakeholder management strategies. As such, these practices must take account of a continuum of ethical orientations toward stakeholders.*

Subsystem 3: The Interface Between Organizational and Financial Drivers

Subsystem 3 illustrates the relationship between organizational drivers of corruption and financial constraints; Table 5 shows the causal drivers of corruption in this subsystem. This subsystem is governed by seven reinforcing feedback loops, R19–R25 (as shown in Fig. 6). These feedback loops portray that corruption in the construction industry is maintained by multiple self-reinforcing vicious cycles, which in turn provide greater scope for corrupt practices. Subsystem 3 emphasizes that corruption leads to economic downturn, which in turn increases the probability of corruption.

Table 5 Corruption drivers of feedback loops in Subsystem 3

Loop	Corruption factors
R19	Economic downturn–Job insecurity–Work dissatisfaction
R20	Economic downturn–Low income–Work dissatisfaction
R21	Economic downturn–Organizational financial constraints–Lack of expertise–Participation of non-professionals–Knowledge of code of conduct
R22	Economic downturn–Organizational financial constraints–Lack of expertise–Design problems–Contradicting design & bid documents–Opportunity for time & cost overruns–Time & budget pressures
R23	Economic downturn–Organizational financial constraints–Effective financial systems
R24	Economic downturn–Organizational financial constraints–Effective contract monitoring systems–Procurement irregularities
R25	Economic downturn–Economic survival–Over-competition–Tight margins–Opportunity for time & cost overruns–Time & budget pressures

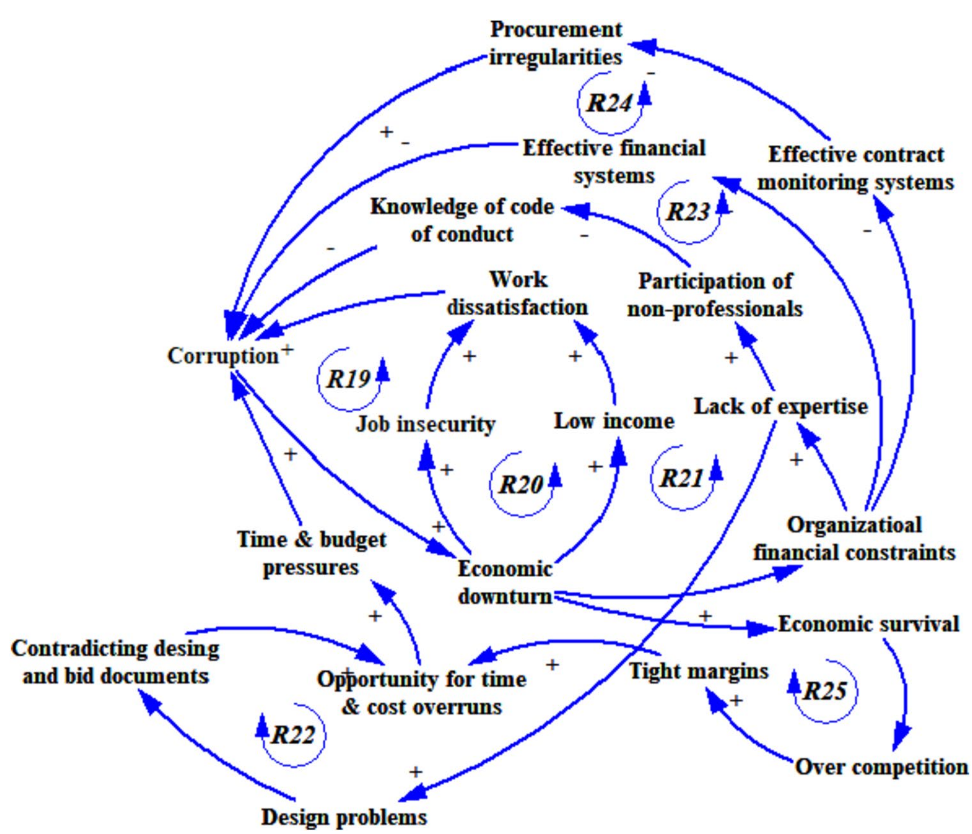

Fig. 6 Causal loop diagrams of Subsystem 3

Feedback loops R19 and R20 are based on the notion of "rational self-interest," which refers to the tendency of employees in organizations to act based on their self-interest (Watson & Sheikh, 2008). These two feedback loops demonstrate the ways that an economic downturn can be a source of work dissatisfaction among employees since it causes job insecurity (R19 in Fig. 6) and low income (R20 in Fig. 6), thereby seeding the ground for corruption.

Feedback loops R21 and R22 depict how corruption is reinforced in organizations that are prone to financial constraints. These feedback loops posit that financial constraints pose challenges for developing organizational expertise—defined as "the skills and knowledge accumulated through prior investments in learning within a domain" (Greenwood et al., 2019, p. 191). A lack of organizational expertise promotes corruption associated with design problems in construction projects (feedback loop R22), but also increases the probability of corrupt behavior in organizations because of participating non-professionals and the subsequent reinforcement of lack of knowledge of the code of conduct.

Feedback loops R23 and R24 focus on the implications of ineffective financial (R23, in Fig. 6) and contract monitoring systems (R24, in Fig. 6) for corruption in the construction industry. More explicitly, these two feedback loops explain how financial constraints, resulting from an economic downturn, impair the capability of organizations to invest in developing effective financial and contract monitoring systems. Clearly, the absence of effective financial and contract monitoring systems results in higher levels of corruption in organizations.

Feedback loop R25 illustrates that, when economic output falls, organizations undertaking projects have lower liquidity to survive, which renders the construction industry extremely competitive. Over-competition encourages organizations to set lower profit margins, which increases the likelihood of time and cost overruns. In this situation, construction managers must make fast decisions based on limited information, which adversely affects corruption in projects.

Proposition 3 *Corruption in the construction industry is affected by, and affects, economic downturn. Consequently, anticorruption reforms must go hand-in-hand with strategies to tackle any economic downturn.*

An Exemplar Application of the Proposed SD Model: Identifying High-Leverage Points for Policy Intervention

As discussed above, the literature has extensively examined the causes underlying corrupt practices in the construction industry (Shan et al., 2017) including organizational drivers (R. Wang et al., 2020; Yap et al., 2022), cultural behavior (Hu et al., 2023), financial factors (Abdul-Rahman et al., 2011; Ebekozien, 2020), and authoritative drivers (Cheng & Darsa, 2021; Hosseini et al., 2020). However, in neither case has there been an attempt to identify the high-leverage points where anticorruption strategies can have significant effects on controlling corruption.

The proposed SD model is the first that analytically determines the best intervention points for anticorruption strategies. To locate the high-leverage points, the network of interacting drivers of corruption (shown in Fig. 3) is first mapped into a graph of nodes and links, where nodes denote corruption drivers and links represent the causal relationships between these drivers. A graph theory tool called PageRank centrality is then used to measure the relative importance of corruption drivers. The PageRank centrality measures the extent to which causal drivers of corruption can affect and be affected by one another (Zarghami & Zwikael, 2023). The larger the value of the PageRank centrality of a causal driver, the more potently this driver can affect and be affected by other drivers, and therefore, diverting attention to this driver can provide leverage to improve outcomes. To explain this in greater detail, the real-life example of how the government of Ghana enacted anticorruption practices to control corruption in construction projects is now presented.

Corruption is a major challenge faced by the construction industry in Ghana (Ameyaw et al., 2017). The Corruption Perception Index, developed by Transparency International (https://www.transparency.org/en/cpi/2022), is a widely discussed and quoted indicator that shows the perceived level of corruption in 180 countries. Ghana achieved a score of 43 out of 100 and thus ranks 72 of 180 countries in 2022. Over the last 20 years, the Public Procurement Act 2003 (ACT 663) has been used as a means of controlling corruption in construction projects in Ghana. However, despite the enactment of ACT 663, corruption persists (Ameyaw et al., 2017).

To identify the best intervention points for anticorruption strategies, the values of PageRank centrality for corruption drivers are calculated. An open-source network analysis tool *R Package igraph version 1.3* is used to measure the relative importance of causal drivers of corruption in the proposed model. Figure 7 provides a graphical illustration. As can be seen, the PageRank centrality assigns the highest score to two drivers: "opportunity for time and cost overruns" and "time and budget pressures." This implies that these two causal drivers serve as key leverage points. As such, anticorruption strategies to tackle these drivers can lead to enduring improvements in eradicating corruption. This explains why ACT 663, which focuses only on public procurement, has caused only transitory

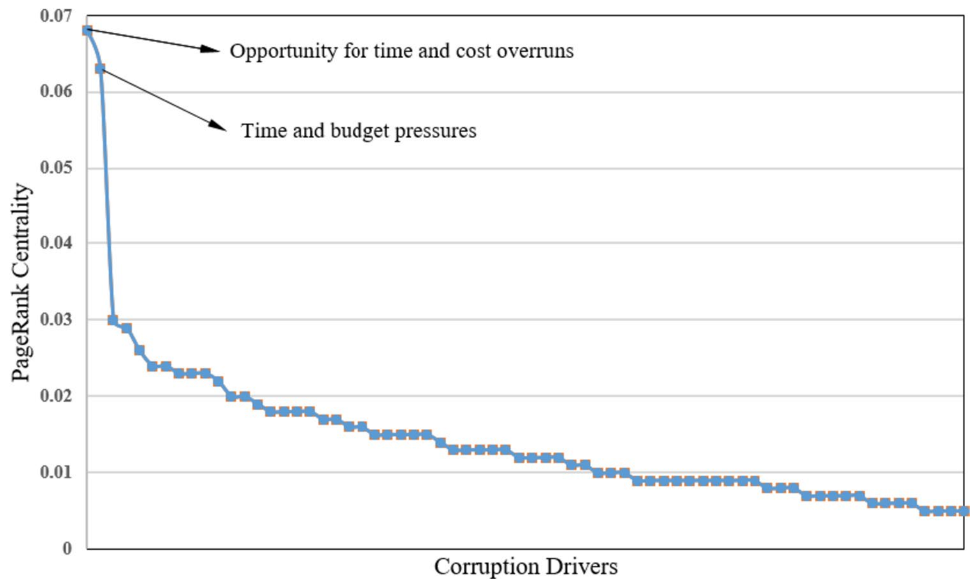

Fig. 7 Values of the PageRank centrality for corruption drivers

improvements; in other words, ACT 663 does not provide any leverage to effectively address time and budget-related drivers that might manifest during the execution phase of projects.

Implications for Policy and Practice

This section presents information cues that governments and policymakers can use in their efforts to control corruption. Specifically, it discusses four implications to emerge from the proposed SD model.

First, a central insight of Proposition 1 is that governments are on the front line of the fight against corruption. In particular, Subsystem 1 emphasizes that promoting democracy, governed with accountability, is crucial in controlling corruption. Despite this, most governments, especially in developing countries with rampant corruption, confine their efforts to enhancing their steering capabilities. This highlights the need for strategies that foster accountability to citizens, the media, and interest associations. Such strategies should improve the capabilities of independent supervisory bodies to monitor and oversee government (Schiller et al., 2022). This can lead to a balancing process that seeks to balance reinforcing feedback loops R1–R9 in Subsystem 1 (see Fig. 4). This balancing process, in turn, underpins the government's strength in the fight against corruption.

Second, as noted above, Proposition 1 illuminates that curbing corruption in the construction industry demands governmental attention. Specifically, Subsystem 1 illustrates the importance of stakeholder participation in the implementation and evaluation of anticorruption policies, encouraging governments to incorporate stakeholder management principles into their decision making. From the stakeholder theory perspective, incorporating stakeholder management principles into governmental decisions "mitigates the need for industrial policy and an increasing role of government intervention and regulation" (Freeman, 1998, p. 132). Indeed, the implementation of stakeholder management principles in the long run provides an intrinsically oriented means of controlling corruption, where corrupt practices are proactively addressed (Lange, 2008). Stated differently, the implementation of stakeholder management practices ensures that individuals' behavior complies with ethical rules, thereby reducing the incentives to engage in corrupt practices that might necessitate government intervention or regulatory measures. The stakeholder perspective on decision making (1) reduces political interference and, thus, counteracts feedback loop R1, and (2) decreases the permits and approvals bureaucracy that reinforces feedback loops R5–R9, thereby countering these vicious cycles.

Third, Proposition 2 accentuates that incorporating stakeholder theory into anticorruption strategies is a necessary adjunct to the fight against corruption. Subsystem 2 shows that public acceptance of corruption in the construction industry increases the level of corruption. Individuals involved in the construction industry continue to engage in corrupt practices if they perceive corruption as a norm, rather than a morally wrong concept. In an environment where individuals behave based on their shared expectations of others' behavior, this will undermine efforts to eradicate corruption (Persson et al., 2013). It is therefore essential for top managers of organizations to reinforce relational ethics with stakeholders by "relying on mutual trust and trustworthiness to maintain reciprocal loyalty" (Jones et al., 2018, p. 357). This, in turn, counteracts feedback loops R11–R18 (see Fig. 5), thereby providing a framework for individuals to act fairly.

Finally, Proposition 3 describes that the financial constraints of organizations, particularly in an economic downturn, are likely to increase the level of corruption. This indicates that governments, especially in developing countries with widespread corruption, should act to support construction firms by implementing various financial instruments; for example, by easing access to external borrowing. Therefore, policymakers should facilitate the process of obtaining external financing in policy design, particularly for private firms in developing countries, which face greater difficulty in accessing external finance than public organizations. In addition, ethical regulations in developing countries are not sufficiently robust, leading to potential gaps in ensuring compliance with ethical standards and principles, especially in the context of external borrowing and project finance (Wörsdörfer, 2015). In this vein, adopting the Equator Principles (EPs)—a standardized foundation and risk management framework for financial institutions to evaluate and handle environmental, social, and ethical issues—strengthens the ethical commitments of borrowing firms (Martens et al., 2019). This is because the EPs impose ethical obligations on both financial institutions and borrowing firms. Such a balanced approach can mitigate the self-reinforcing consequences of an economic downturn, which are caused by feedback loops R19–R25 in Subsystem 3 (see Fig. 6).

Conclusion

The literature has tended to study corruption in the construction industry by separately analyzing its drivers. This research addressed this problem, arguing that corruption as a complex phenomenon cannot be understood by dividing it into its drivers; rather, it must be understood by taking into account the overall pattern. Building on the results of a SLR, this paper developed an SD model to examine the synergistic effect of corruption drivers in the construction industry. The proposed SD model illustrated how the interactions between corruption drivers created 25 reinforcing feedback loops that could increase corrupt activities. To counteract these feedback loops, this paper drew on stakeholder and open systems theories to formulate three propositions that could be used by policymakers in policy design.

The proposed SD model presents a powerful and concise way of modeling the interactions between corruption drivers. Building on four decades of research, the proposed model also provides lessons that can be helpful in the development of policy frameworks to control corruption in the construction industry. However, as long acknowledged in literature and practice, "all models are wrong, but some are useful" (Box & Draper, 1987). Despite adopting an empirical-oriented GMB technique to ensure the completeness of causal links, as a new SD model of corruption, there might be a need to add any missing link between corruption drivers; specifically, the connections between the three subsystems of the proposed model. Therefore, the suggested links should be supplemented by eliciting opinions from additional experts, whose knowledge can increase confidence in the proposed model.

Much remains to be done in future research to address the limitations of the proposed model. For instance, this paper employed the PageRank centrality to identify the high-leverage points to assist policymakers in designing interventions. However, it did not validate such leverage points nor did it test the proposed recommendations. This may be achieved by constructing a stock and flow diagram (SFD) as a promising avenue for identifying and modeling leverage points and policy recommendations. An SFD can evaluate the sensitivity of policy recommendations by linking feedback loops and system behavior (Sterman, 2000). More explicitly, an SFD would be a great help to policy makers in evaluating the effectiveness of anticorruption strategies, by running the model for various policy recommendations. Furthermore, this paper demonstrated how interactions between corruption drivers resulted in multiple reinforcing loops leading to further increases in the level of corruption. Such reinforcing loops can be examined in a complementary way by focusing on industry-responsive ethical principles and a code of conduct. Specifically, future studies might seek to explore the effectiveness of various ethical standards in counteracting the vicious cycles that reinforce corruption in the construction industry.

The author believes that this research will resonate with the interests of business ethics scholars. The findings of this research emphasize that corruption, like many other ethical issues, should be understood as a complex phenomenon involving social, economic, cultural, and political dimensions. In this context, the author anticipates that business ethics scholars, who are concerned about the limitations of an isolated view of ethical issues, will employ the proposed SD modeling approach to examine prevalent ethical matters such as environmental ethics, social justice an inequality, artificial intelligence and privacy, and so forth. More broadly, the author hopes that this research contributes to responding to the recent call for "stepping out our scientific comfort zone" (Nilsen, 2024, p. 4) by expanding the engagement of systems thinking with business ethics research.

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Declarations

Conflict of interest The author declares that there is no conflict of interest.

Informed Consent Not applicable.

Research Involving Human Participants and/or Animals Not applicable.

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