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Designing an Open Innovation Framework for Digital Transformation Based on Systematic Literature Review

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Abstract

Background: Innovation is a critical success factor of digital transformation (DX). Previous research has shown that open innovation (OI) can help companies accelerate DX and improve their business performance.
Objective: This study develops a conceptual OI framework to support DX (OIDX) and provides an overview of the dimensions. OI in this study refers to Open Innovation 2.0.
Methods: We review previous research on OI dimensions, identify the activities, and map them along with the challenges that lead to failure. With this, we develop a framework to meet the needs and solve problems of OI implementation.
Results: The OIDX framework has a comprehensive dimensional scope consisting of three perspectives, eight dimensions, and 26 sub-dimensions. The perspectives are enablers, activities, and output, and the dimensions are OI governance, external environment, internal climate, digital technology, importing mechanisms, collaboration, protection mechanisms, and export mechanisms.
Conclusion: This study highlights the importance of defining dimensions to establish General System Theory. The practical application of this framework is to build an OI ecosystem that can increase the internal and external values of an organisation. The OI framework provides OI success parameters and criteria for building the OI maturity framework in future research.

Keywords*:* DX, Innovation, Open Innovation, Open Innovation Framework

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I. INTRODUCTION

Organisations today recognise the value of organisational transformation through the adoption of digital technologies into their business processes, as it can maximise efficiency and generate new revenue streams [1]. Many organisations are now gearing toward DX to improve efficiency and add value to their products and services. As a result of DX and the resulting business model innovation, consumer expectations and behaviours have fundamentally changed. This shift has disrupted markets and put pressure on traditional firms [2]. Changing customer journeys due to technological disruption have also altered business landscapes [3] as they now have access to various media channels and interact with businesses and other consumers directly, hence encountering more touchpoints in their customer journey, many of which are digital [2]. Many traditional firms suffer as they are surpassed by innovative, fast-growing digital entrants that can keep up with the changes.

Teichert [4] stated that innovation in DX includes competencies that allow for more versatility, the development of disruptive and consumer-centric innovations, business architectures, agile methodology, financing innovation, and performance standards. Innovation in business frameworks means an ecosystem that connects various parties to increase each other's value. Companies can collaborate in a mutual partnership to develop various innovations and maintain sustainability in the digital economy era. Open innovation (OI) will support this collaboration.

Since innovation in Chesbrough's publication was open [5], scholarly interest has mainly focused on knowledge sharing and co-creation advantages. OI is defined as "a distributed innovation process based on asserted competencies empowering a more adaptable way of working, advancement of disruptive innovation architectures, use of agile

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approach, involving consumers in the process of innovation, financing innovation, and performing standard on purposefully managed knowledge flows across organizational boundaries" [6]. Past research has tried and tested all aspects of OI, starting with the 'openness' [7] to the intersections of knowledge flows [8]. The studies have been undertaken from the personal and collective to the inter-organisational, industry, and national levels [8]. Some of the findings highlight the role of readiness at the organisational level [6] as it can support or hinder partnerships with external partners and move innovation from close to open [9]. The innovation environment has moved from linear to parallel or cross-sectional frameworks involving multiple disciplines [10]. In other words, the paradigm has shifted [11]. The innovation modes are illustrated in Fig. 1.

HOW INNOVATION MODES HAVE EVOLVED

Closed Innovation	Open Innovation	Open Innovation 2.0
Dependency	Independency	Interdependency
Subcontracting	Cross-licensing	Cross-fertilization
Solo	Bilateral	Ecosystem
Linear	Linear, leaking	Nonlienar mash-up
Linear subcontractors	Bilateral	Triple or quadruple helix
Planning	Validation, pilots	Experimentation
Control	Management	Orchestration
Win-lose game	Win-win game	Win more-win more
Box thinking	Out of the box	No boxes!
Single entity	Single discipline	Interdisciplinary
Value chain	Value network	Value constellation

Fig. 1 Innovation modes (adapted from Markkula [12])

The OI and OI 2.0 (OI2) frameworks are considered the most appropriate in DX, which aims to elaborate the use of digital technology and business frameworks [13], and improve a company's performance. OI help achieve this by creating a business ecosystem that connects companies, customers, suppliers, and the government. With this, DX can increase value through the inbound, outbound, and coupled innovation processes [14]. Our literature review shows that research on the development of OI frameworks in DX is scarce. Therefore, this study aims to design an OI framework for DX to identify the dimensions or critical success factors. OI in this study refers to OI 2.0, and the two research questions are:

RQ1. What dimensions of the Open Innovation for Digital Transformation (OIDX) framework?

RQ2. What main activities in OIDX?

Literature was reviewed to identify the OIDX dimensions to answer the two research questions. The results of this study are explained using General Systems Theory [15]. This study aims to provide a more holistic view of the OIDX framework to guide organisational-level implementation. Theoretically, the findings can enhance literature in General System Theory [15].

II. METHODS

To design the OIDX framework, we conducted a systematic literature review (SLR) of the existing literature. We used keyword search strategies: "open innovation", "open innovation dimension", "open innovation maturity", and "open innovation framework" on the "SCOPUS" research database between 2006 and 2022. The search process is illustrated in Fig. 2.

In the SLR, we found 30 papers from reputable journals in the top tiers (first to third quartiles), with 90% ranked in the first tier (Q1), 6.7% in the second tier (Q2), and 3.3% in the third tier (Q3). We then mapped the dimensions using taxonomy in the OI framework proposed by [16], consisting of three perspectives—enablers, activities, and outputs—and interrelated dimensions and sub-dimensions. We found three perspectives, eight dimensions, and 26 sub-dimensions relevant to OIDX. This differs from the framework in [16], which consists of three perspectives, six dimensions, and 19 sub-dimensions. The following summary of the mapping results can be found in Table 1.

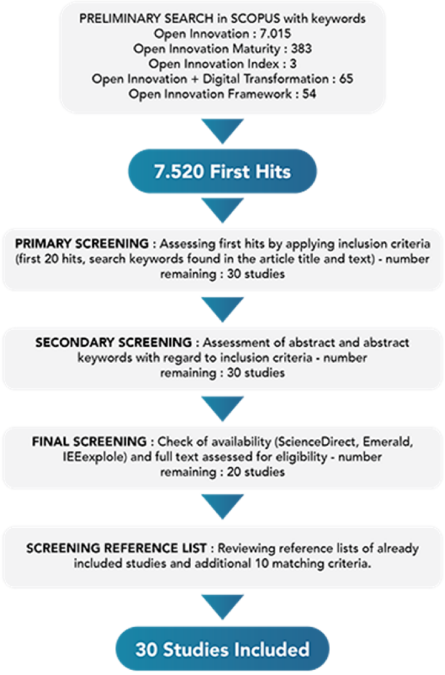

Fig. 2 The search process of SLR related to OI dimensions

TABLE 1
DIMENSION MAPPING FROM PREVIOUS RESEARCH RESULTS

Dimension	No	Sub Dimension	References
A. Enablers Perspective			
Open Innovation/Innovation Corporate Governance	1	OI/Innovation Strategy	[17]
	2	Organisational Design	[18][17]
	3	Controls	[17]
	4	Business Model Management	[18][17]
	5	OI Process	[17]
Outer Environment	6	Public Support	[7] [19] [20]
	7	Government Support	[21] [22]
	8	Idiosyncrasies of the Industry	[23] [24]
Internal Climate	9	Human Capital	[25][26] [27] [28] [29][30]
	10	Climate Culture	[31] [32] [33] [18]
	11	Entrepreneurship	[18]
Digital Technology	12	Openness	[34][18]
	13	Affordance	[34] [18]
	14	Generativity	[34] [18]
B. Outputs Perspective			
Collaboration	15	Collaboration Portfolio Varieties	[35] [27] [36][19] [37] [33] [20] [38][18]
	16	Co-Creation Value	[9]
Importing Mechanisms	17	Forms (Heterogeneous and Homogeneous alliances; Joint ventures; Networking; Co-patenting)	[35] [39] [40]
	18	Innovation ecosystem	[41][37] [42]
	19	Knowledge Management	[43] [7][33] [20]
	20	Project management capabilities	[44] [18]
	21	Finance Management	[45]
Protecting Mechanisms	22	Protection methods	[46] [47]
	23	Risk Management	[20]
C. Outputs Perspective			
Exporting Mechanisms	24	Commercialisation of Internal Knowledge	[47] [48] [45]
	25	Innovation Performance	[48] [45]
	26	Innovation Productivity	[48] [45]

III. RESULTS

We propose a conceptual OIDX framework from the OI dimension identification to answer RQ1. The conceptual framework aims to describe independent and dependent variables that affect and contribute to the success of the OIDX application. The conceptual framework we propose is in Fig. 3.

The conceptual framework proposes OI as one of the variables determining the success of OIDX, which means there are other independent variables affecting the success of DX. Zooming in, the framework consists of four perspectives, eight dimensions, and 26 sub-dimensions as independent variables. 'Enablers' is the dependent variable of the relationship between OI governance, external environment, internal climate, and digital technology. Meanwhile, 'activities' modulate the interaction between importing mechanisms, collaboration, and protection mechanisms. Investigation mechanisms, commercialisation of internal know-how, and innovation performance and productivity are linked to output as a dependent variable.

Organisations must undertake main activities in each dimension to implement OIDX effectively (and answer RQ2). These main activities can be used as guidance for companies to delegate tasks to each related work unit. In other words, the application of OIDX is not only a function of the research and development (R&D) division but an orchestrated effort of all work units. The main activities of each dimension become an integral part of every work unit to the point where they cannot carry out business processes without them. The main activities in each dimension are in Table 2.

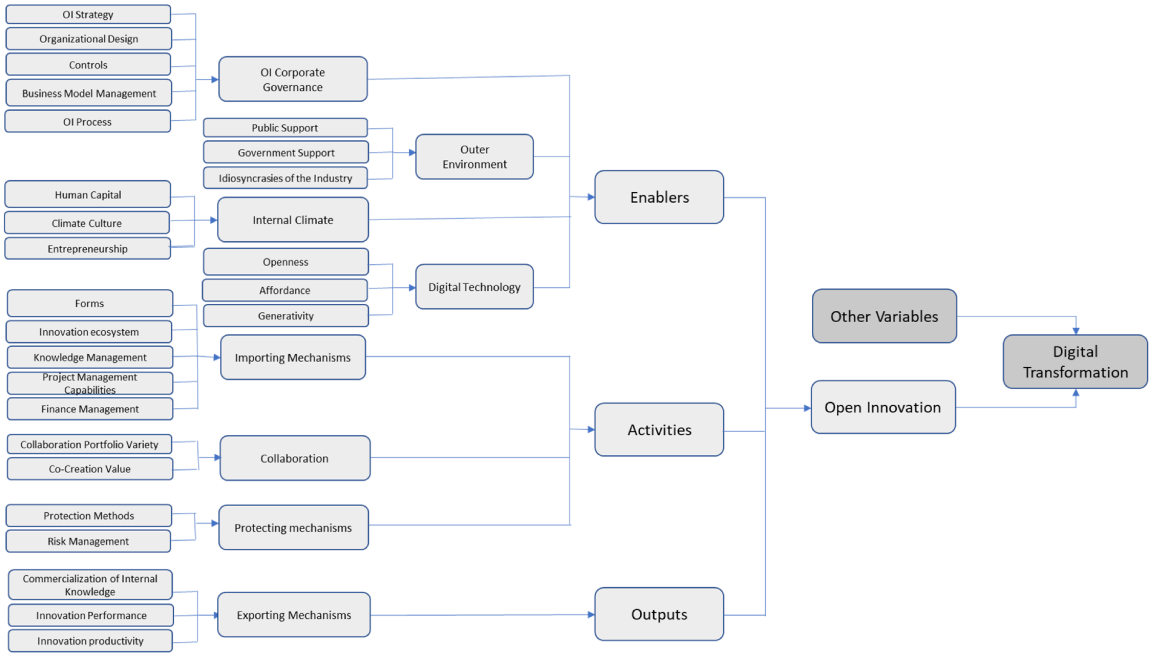

Fig. 3 Conceptual framework of OIDX

IV. DISCUSSION

Following the General System Theory [15], the OIDX framework in this study consists of three perspectives, nine dimensions, and 26 sub-dimensions overlapped in an interrelated system. We propose the main activity dimension as a starting point for detailing business activities and processes to increase the framework's effectiveness. As such, OIDX dimensions play a key role in improving the quality of OI as a system.

This framework can help companies implement OI as it encourages involving internal and external parties and enhances the value of products and services. In relation to RQ1, this framework can guide in managing the perspectives of enablers, activities, and outputs, consisting of eight dimensions and 26 sub-dimensions. This framework adopted the core characteristics of the OI 2.0 paradigm. The quadruple helix model prevents working in silos and unites the government, businesses, academic institutions, and social parties to work collaboratively, driving systemic changes beyond what companies or individuals could do on their own [12]. In the case of dramatic transformation such as DX, collaboration gives advantages because companies can move more quickly, share risk, and pool resources [12].

TABLE 2
PROPOSED MAIN ACTIVITIES OF OIDX DIMENSIONS

Dimension	Sub Dimension	Proposed Main Activities
A. Enablers Perspective		
OI/Innovation Corporate Governance	OI/Innovation Strategy	The company formulates an OI strategy for DX to achieve corporate sustainability
	Organisational Design	The company has an organisational structure that can support the development of sustainable innovation
	Controls	The company controls the implementation of sustainable innovation by using a metric
	Business Model Management	The company develops a business model that can support the formation of a sustainable OI
	OI Process	The company formulates an effective OI process that can be applied internally and collaborates with external parties
Outer Environment	Public Support	The company builds partnerships with the community to contribute to the innovation in the company
	Government Support	The company builds partnerships with the government (central/local government/regulators) to contribute to the innovation in the company
	Idiosyncrasies of the Industry	The company builds partnerships with related industries to contribute to the innovation in the company
Internal Climate	Human Capital	The company has a strategy to manage HR competencies in creating sustainable innovation
	Climate Culture	The company has a strategy of building a culture of innovation to realise business continuity
	Entrepreneurship	The company builds HR entrepreneurial values, such as pushing boundaries and taking on new challenges
Digital Technology	Openness	The company manages technology that can be accessed by external parties (community, industry, partners, etc.) to collaborate on an innovation
	Affordance	The company manages the right and safe technology that can be accessed by external parties (community, industry, partners, etc.) to collaborate on an innovation
	Generativity	The company manages technology by following best practice
B. Activities Perspective		
Collaboration	Collaboration Portfolio Varieties	The company has a strategy for developing collaboration portfolios with various parties
	Co-Creation Value	The company develops a co-creation value strategy with various parties to support business continuity
Importing Mechanisms	Forms (heterogeneous and homogeneous alliances, joint ventures, networking, co-patenting	The company develops cooperative alliances with various parties in developing innovation
	innovation ecosystem)	The company has a strategy to build a sustainable innovation ecosystem to improve performance
	Knowledge Management	The company has effective knowledge management to absorb information/knowledge from inside and outside of the company
	Project Management Capabilities	The company develops project management capabilities to maintain product and service development innovation initiatives
	Finance Management	The company manages finances to support the implementation of sustainable innovation
Protecting Mechanisms	Protection Methods	Companies formulate innovation protection strategies so as not to harm the company
	Risk Management	The company manages a risk management process to control losses from factors that cause innovation failure
C. Outputs Perspective		
Exporting Mechanisms	The Commercialisation of Internal Knowledge	The company has a strategy and governance in commercialising innovation to increase the business added value
	Innovation Performance	The company manages innovation performance to support the realisation of company performance
	Innovation Productivity	The company continues to develop innovation productivity to build sustainable innovation

Regarding RQ2, organisations with greater innovative capabilities could immediately seize potential markets and rapidly respond to dynamic environments and customer demands [49], establish and sustain competitive advantages, and contribute to the economy [50].

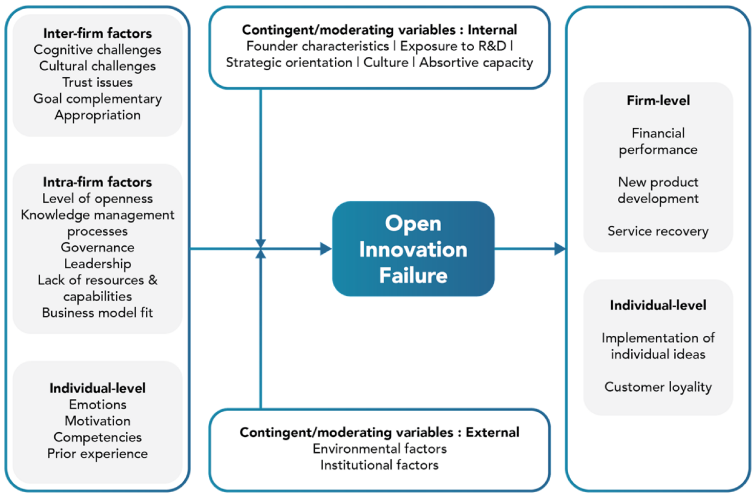

Fig. 4 Conceptual framework of open innovation failure (adapted from Chaudhary et al.[51])

The OIDX framework also identifies the challenges that can cause OI implementation failure. Several researchers have identified the challenges [51] [48]. Chaudhary et al. [51] stated that the challenges include internal, intra-company, and individual factors. Moderating variables that influence internal factors include founder attributes, exposure to R&D, strategic alignment, culture, and knowledge transfer. Meanwhile, environmental and institutional factors as moderating variables impact the external forces. The challenges that can cause the failure of the implementation of OI can be described in Fig. 4.

The OIDX framework can help organisations to respond to challenges that may lead to the failure of OI implementation [51]. The mapping of the dimensions of this framework with various aspects that cause the failure of OI implementation is detailed in the Table 3.

TABLE 3
MAPPING OF OI IMPLEMENTATION CHALLENGES BY OIDX DIMENSIONS

Challenges in Open Innovation	Dimension and Sub-dimension of OIDX
A. Inter-firm factors	
Cognitive challenges	Entrepreneurship
Culture challenges	Climate Culture
Trust issues	Controls, Climate Culture
Goal complementary	Innovation Productivity
B. Intra-firm factors	
Level of openness	Openness, Affordance, Generativity
Knowledge management process	Knowledge Management
Governance	OI Corporate Governance
Leadership	Organizational Design
Lack of resources and capabilities	Human Capital, Entrepreneurship
Business model fit	Business Model Management
C. Individual level	
Emotions	Control
Motivations	OI Strategy
Competencies	Human Capital, Organizational Design, Project Management Competency
Prior experience	Innovation Productivity, Innovation Performance, Organisational Design
D. Moderating variables: internal	
Founder characteristic	OI Strategy
Exposure to R&D	Organizational Design, Risk Management, Control
Strategic orientation	OI Strategy
Culture	Climate Culture
Absorptive capacity	Knowledge Management
E. Moderating variables: external	
Environmental	OI Process, Collaboration Portfolio Variety, Innovation Ecosystem
Institutional	OI Process, Innovation Ecosystem

The OIDX framework was adopted from research by [16], i.e., the perspectives, dimensions, and sub-dimensions. We develop this by reviewing the literature. We found 11 sub-dimensions similar to the dimensions used by [16] and 15 different sub-dimensions. The OIDX framework dimension and sub-dimension mapping in [16] are presented in Table 4.

TABLE 4
THE COMPARISON BETWEEN OIDX WITH [16]

Dimension	No	Sub Dimension in This Research	[16]
A. Enablers Perspective			
	1	OI/Innovation Strategy	No
Open	2	Organisational Design	No
Innovation/Innovation	3	Controls	No
Corporate Governance	4	Business Model Management	No
	5	OI Process	No
	6	Public Support	Yes
Outer Environment	7	Government Support	Yes
	8	Idiosyncrasies of the Industry	Yes
	9	Human Capital	Yes
Internal Climate	10	Climate Culture	Yes
	11	Entrepreneurship	
	12	Openness	Yes
Digital Technology	13	Affordance	No
	14	Generativity	No
B. Outputs Perspective			
Collaboration	15	Collaboration Portfolio Varieties	Yes
	16	Co-Creation Value	No
Importing Mechanisms	17	Forms (Heterogeneous and Homogeneous alliances; Joint ventures; Networking; Co-patenting)	Yes
	18	Innovation ecosystem	No
	19	Knowledge Management	Yes
	20	Project management capabilities	No
	21	Finance Management	No
Protecting Mechanisms	22	Protection methods	Yes
	23	Risk Management	No
C. Outputs Perspective			
	24	Commercialization of Internal Knowledge	Yes
Exporting Mechanisms	25	Innovation Performance	No
	26	Innovation Productivity	No

V. CONCLUSIONS

The purpose of this research is to design a conceptual framework for OIDX. The results produce a conceptual framework of three perspectives, eight dimensions, and 26 sub-dimensions. We argue that this framework has a broader scope for building an OI ecosystem to support DX. In developing the theoretical framework, this study highlights the importance of defining main activity dimensions as components in General System Theory. In managerial applications, organisations can apply this framework to develop sustainable innovations to make DX successful. This framework can also help provide solutions to challenges that can lead to failure. Further research needs to measure the effectiveness of each perspective and dimension in supporting the success of OI. Another research direction is building an Open Innovation Capability Maturity Model (OI-CMM) to measure the OI maturity level as a basis for designing OI strategies and implementing roadmaps to support DX.

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