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RESEARCH ARTICLE

FABS: A Framework for Addressing the Business Process Change Challenges for Smart City Development

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ABSTRACT Over the past decade, extensive research has focused on the conceptualization and implementation of smart cities, considering aspects such as ''City as a system of systems,'' ''city as an enterprise,'' and ''city systems integration'' as necessary for Smart City Development (SCD). However, despite these considerations, including our existing works, numerous challenges remain in the design and implementation of SCD roadmaps. One critical element for successful SCD is city systems integration, which necessitates cross-sectoral Business Process Change (BPC). However, limited attention has been given to addressing these challenges. To address this gap, our research builds upon and extends our prior works, utilising established principles and research findings to develop and validate a Framework for Addressing the BPC challenges for SCD (FABS). By undertaking a rigorous theoretical adaptation process and incorporating success factors, tools, techniques, and approaches from diverse domains, including enterprise systems, as well as conducting interviews and document analysis, our study contributes to the development of FABS. This empirically supported framework offers a systematic approach to effectively tackle BPC challenges in SCD, enabling smart city developers to assess their current SCD status and readiness for BPC, formulate their SCD roadmap, and assist solution providers in devising specialized tools and techniques tailored for SCD. Thus, our previous works have played a pivotal role in building the foundational components of this research's outcome, namely the FABS framework, which has the potential to advance the field of smart city development.

INDEX TERMS Business process change, city processes, city systems integration, smart cities, smart city roadmap, urban systems.

I. INTRODUCTION

The phenomenon of urbanisation gives rise to what is commonly referred to as the ''city disease,'' which has become a major concern for governments and local authorities. In response to this, municipal authorities categorise the challenges associated with urbanisation into six distinct areas: well-being, economy, environment, mobility, digital inclusion, and the imperative for a coordinated and integrated approach [1], [3]. Sustainable living in these fast-growing cities necessitates changing the traditional urban activities, functions, and processes, which are currently undertaken by various city sectors, operating in silos [4] to be performed in a smarter way, providing flexible, efficient and agile services in real-time.

Given that a city can be understood as a complex 'system of systems', The concept of a smart city entails the capability to deliver real-time services by integrating its sub-systems [5], [7]. The argument is reinforced by the application of a ''systems thinking'' approach, which emphasises the interconnectivity and intercommunication of all components within a system. By adopting this approach, the benefits derived from a change implemented in one part of the system can extend to other interconnected parts, leading to overall system improvement [8], [9]. Consequently, it is imperative to adhere to these principles to ensure the holistic

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development of the city, encompassing diverse sectors, agencies, and organisations functioning as service providers [10], [12]. Accordingly, SCD is about changing all components of a city to run in a smarter way and it can be achieved by establishing seamless communication amongst city sectors/systems [1], [13], facilitated by the technology as part of the integrated city system to provide joined-up and citizens-centric services that is the focal point of this research [14].

Since the 1940s, private enterprises have recognized the value of integrating their systems to access and share real-time information, make timely decisions, and enhance the efficiency and effectiveness of their business processes, as a means of thriving in a competitive business environment [6]. Similarly, in future cities, to achieve sustainable living, it is crucial to establish seamless connectivity and delivery of city functions and services, utilizing the wealth of information and knowledge generated by various sectors, aligned with citizens' demands. This can be achieved through cross-sectoral city systems integration [14]. Thus, city systems integration becomes a fundamental requirement in almost all aspects of Smart City Development (SCD) [15], [16]. Furthermore, successful systems integration in enterprises has encompassed more than just technological integration; it has also considered the integration of people, data, and business processes as essential components of Enterprise Systems Integration (ESI) [6], which plays a paramount and valuable role in organisational transformation by facilitating the acquisition and dissemination of real-time information, enabling timely decision-making, and delivering cost-effective, efficient, and superior-quality services. However, systems integration primarily involves a process-oriented integration, where Business Process Change (BPC) emerges as the central activity within ESI [17], [18]. Therefore, this research specifically focuses on addressing the challenges associated with BPC, as the key element of cross-sectoral city systems integration. In the context of smart cities, the discussion of BPC pertains to processes conducted across various city sectors, rather than individual processes within each sector [6], [19].

A. PROBLEM STATEMENT

BPC is recognised as the primary task for achieving cross-sectoral city systems integration, encompassing different types, approaches, techniques, and challenges across various dimensions. Successfully addressing these factors is essential for the effective implementation of SCD. However, the existing body of research primarily focuses on broader aspects such as the conceptualisation, initiatives, dimensions, and the development of frameworks for smart cities in general. As a result, limited attention has been given to delving into the specific intricacies and challenges associated with BPC within the context of cross-sectoral city systems integration in SCD. (e.g. [12], [20], [24]). A significant number of papers also examine the technological dimensions of SCD such as the Internet of Things (IoT), sensor technologies, etc. (e.g. [25], [28]). As a consequence, only a limited number of researchers have dedicated attention to BPC and its challenges in the context of SCD. Furthermore, there is a lack of frameworks, guidelines, structures, or standards available for effectively addressing these challenges at different stages of BPC. In contrast, previous researchers have identified challenges related to BPC within the context of ESI and have proposed several success factors, tools, techniques, best practices, and frameworks to overcome them. Although the challenges of BPC in SCD and ESI contexts may exhibit similarities, the research exploring the connection between the two is significantly lacking. This study aims to bridge the aforementioned gaps in the field of smart cities by formulating the following research questions: i) How the BPC challenges in SCD can be addressed? ii) What are the success factors, techniques, and approaches and when they should be utilised during the BPC stages in SCD?

To address the research questions, this study offers a comprehensive examination of all BPC challenges in SCD, encompassing both 'similar challenges' (i.e. the BPC challenges in SCD that have an equivalent in the ESI context) and 'unsolved challenges' (i.e. the BPC challenges in SCD, which are not similar to any BPC challenge in the ESI context). The aim of this research is to ''develop a framework for outlining the challenges, success factors, techniques, and approaches to be applied during the BPC stages for SCD.''

The following objectives are addressed to achieve the aim of this study:

- To adapt the BPC success factors from ESI to similar challenges in SCD;
- To identify success factors for BPC challenges that do not have an equivalent in the ESI context;
- To categorise the BPC challenges in SCD, using existing BPC categories in the ESI context;
- To map all identified BPC challenges in SCD and their success factors (either adapted from the ESI context or newly identified) to a Framework, the so-called FABS (Framework for Addressing the BPC challenges for SCD), according to the activities of every BPC stage;
- To validate FABS, in terms of the content, structure, usefulness, and applicability.

B. RESEARCH STRUCTURE

Following the introduction, this paper will discuss the existing studies, including our previous works, which serve as essential components of the research outcome (FABS). Section III outlines the methodology employed in this study. In Section IV, the adaption process for addressing BPC challenges, specifically those that share similarities with the ESI context, will be applied. Section V presents the analysis of findings, including the adaptation of BPC stages from the ESI context to develop the BPC life cycle in SCD. Additionally, all success factors for both similar and unsolved challenges in SCD will be categorized, enhancing the feasibility and suitability of FABS design. The mapping of BPC challenges and their corresponding success factors into the

BPC stages will also be discussed. Furthermore, this section will explore the alignment between FABS and other existing smart city frameworks, positioning FABS within the realm of smart city initiatives. Subsequently, in Section VI, the validity of the research will be examined, justified, and implemented. Finally, Section 7 concludes the study, emphasizing the research outcomes achieved through the development and analysis of FABS.

II. EXISTING STUDIES AS THE COMPONENTS OF THIS RESEARCH PAPER

This section explains the existing components of this research that have been mainly developed through the author's previous works. The components will be reviewed and connected to the requirements of this research, in order to develop FABS.

A. SMART CITY CONCEPT

We utilise our established smart city definition to underpin the implementation of this study: the smart city is defined as 'a system of systems in which cross-sectoral city systems integration has been accomplished, enabling access to real-time information and knowledge by all the city sectors, providing integrated services, and enhancing liveability, workability, and sustainability for the citizens' [6]. This definition considers the city as a system of systems, hence, based on the systems thinking approach it necessitates a seamless communication and interconnection amongst all systems/sectors of the city, as well as changing city processes and addressing the related challenges [19], [29].

B. BPC CHALLENGES IN THE ESI CONTEXT

In addition to perceiving the city as a ''system of systems,'' the concept of a city as a large-scale enterprise is also considered when addressing BPC challenges in SCD. In this regard, there are notable similarities between the constituents involved in delivering services within the city and those within an enterprise. City sectors, such as transportation, healthcare, energy, and education systems, collaborate to provide efficient services to the city's inhabitants, analogous to how different departments within an enterprise, such as marketing, sales, and finance, work collectively to meet customer demands and offer optimal services. This perspective allows for a comparison of BPC challenges in the contexts of SCD and ESI, enabling the extraction of lessons from systems integration and BPC in ESI for potential utilisation in SCD. Thus, it becomes essential to first understand the BPC challenges encountered in the ESI context and how they have been addressed. In a previous research endeavour, we developed a conceptual framework that encompasses 16 empirically validated BPC challenges in ESI. Moreover, the framework includes exemplars of success factors, suggested techniques, and approaches to effectively tackle these challenges [30]. The framework is available in appendix VI-C.

TABLE 1. BPC challenges in SCD.

No.	BPC challenge	No.	BPC challenge
1	Understanding the city processes	10	Privacy concerns
2	Monitoring BPC	11	Inter-dependencies
3	Governance and leadership	12	Politics
4	Standardization	13	Managers' hastiness
5	Agility and flexibility	14	Economic conditions and cost
6	Efficiency	15	Vertical policies
7	Inter-operability	16	Contracting
8	Complexity	17	Foundations
9	Sharing data and business processes	18	People related challenges

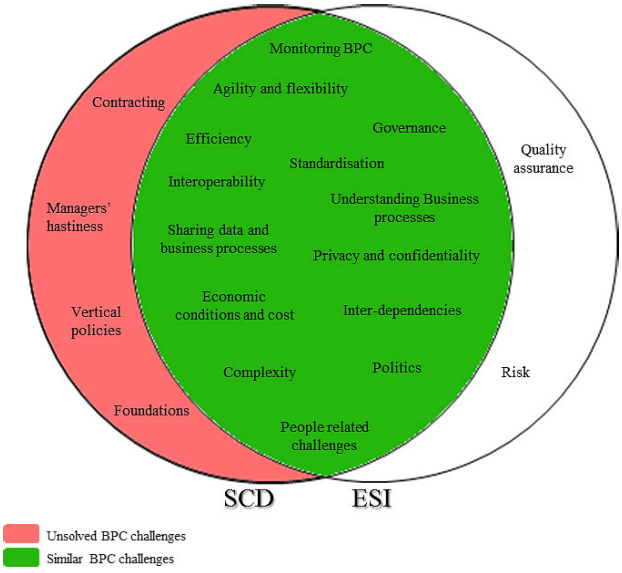

FIGURE 1. BPC challenges in ESI and SCD: a comparison framework Javidroozi et al. (2019c).

C. BPC CHALLENGES IN SCD

While there have been very few to no investigations regarding the BPC challenges in SCD, we have identified them through a qualitative survey, including semi-structured interviews and document analysis, in one of our previous research [6] (Table 1). This is a significant component of the current study.

We have also developed a comparison framework that analyses and compares these challenges with the BPC challenges in ESI and clusters them into similar and unsolved challenges (FIGURE 1).

D. ADDRESSING BPC CHALLENGES IN SCD

As shown in FIGURE 1, most of the BPC challenges in SCD correspond to a BCP challenge in the ESI context. Therefore, addressing similar BPC challenges in SCD can be aided by the equivalent BCP challenges in ESI. This is also supported by the consideration of 'a (smart) city as an (integrated) enterprise' [6]. Nevertheless, since the ESI lessons would not provide off-the-rack solutions for addressing BPC challenges in SCD, utilising the learnings should be accomplished based

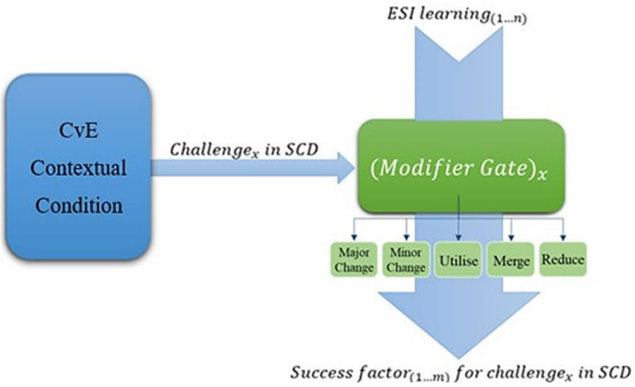

FIGURE 2. The adaption process for utilising the learnings from ESI for the SCD context (Adopted from [33]).

on an adaption process. This process has been developed by our previous work (FIGURE 2), based on critical realism philosophy and Bardack's smart practices approach. Smart practices are available when there is underlying potential to utilise the learned practices from one situation for a new situation [31], [32]. The smart practices in our research are success factors, approaches, and techniques for addressing BPC challenges in ESI. However, smart practices should be adapted for SCD contexts according to a series of conditions, which were derived from the differences between city and enterprise, so-called 'City versus Enterprise (CvE) contextual conditions' [33]. These conditions necessitate the smart practices from the ESI context to be modified according to the differences between enterprise and city. However, not all differences are relevant to every BPC challenge. Thus, for the convenience of the adaption process, the relevant differences were selected based on the characteristics of challenges to create a set of conditions per BPC challenge and they were called modifier gates (FIGURE 2).

Furthermore, the identification of the components of the adaption process was supported by critical realism philosophy, throughout all our research works. Hence, according to critical realism's fishbone diagram [34], the adaption process requires a journey from action to the outcome, necessitating the identification of some conditions (FIGURE 3). The utilisation of a fishbone diagram serves as a valuable tool to understand the causal relationships between actions, mechanisms, structures, and outcomes, facilitating problem analysis and the application of best practices to address new situations. When a problem in a new situation aligns with a problem in earlier circumstances, best practices for addressing the previous problem can be applied to the new situation. This iterative process generates actual events, which are then validated empirically. Ultimately, the completed fishbone diagram guides research toward desired outcomes [35]. As shown in FIGURE 3, all conditions have already been identified by our previous research works (see green boxes in the figure). Yet, it should be noted that the adaption process has not been universally applied to all similar BPC challenges in SCD. Consequently, the specific success factors, tools, techniques, and approaches for effectively addressing these challenges remain unknown, as indicated by the red boxes in the figure. This lack of knowledge hampers the identification of the essential components of the FABS. Furthermore, there is a significant gap in mapping the BPC challenges in SCD to the various stages of BPC within the SCD context. As a result, smart city developers lack clarity regarding when these challenges may arise and how they should be effectively addressed. Moreover, the unsolved challenges (which are outside of the fishbone diagram, outlined in IA.), have not been addressed yet (see red boxes in the figure).

III. RESEARCH METHODOLOGY

As shown in FIGURE 4, some theories, approaches, principles, and considerations underpin the execution of this research. The diagram also shows that all these research underpinnings have already been developed and utilised in our previous research so repetition has been avoided in this research. The focus of this research is on the development of FABS by identification of its remaining components (outlined in red), including success factors for similar BPC challenges (through the adaption process) and unsolved BPC challenges through primary research.

Hence, the objectives of this research (see IA.) are addressed through the following three arrangements:

1) Addressing BPC challenges in SCD:
   a. For similar challenges: through the adaption process;
   b. For unsolved challenges: identification of success factors, techniques, and approaches through a qualitative survey, comprising interviews and document analysis;
2) Consolidating all findings to design and develop FABS;
3) Validating the findings of the research, including FABS, using qualitative validation strategies as well as respondent validation through interviews.

A. ADDRESSING BPC CHALLENGES IN SCD

The adaption process was utilised to address similar BPC challenges in SCD (a) and the results are comprehensively offered in section IV. A. 1). For addressing unsolved challenges (b), further enquiries were carried out, through a qualitative survey comprising interviews, document analysis, and iteration of literature review and all data was qualitatively analysed.

1) INTERVIEWS

Semi-structured interviews were conducted to elicit in-depth insights and facilitate comprehensive discussions on the unsolved challenges. Both face-to-face and web-based methods were employed, ensuring flexibility and accommodating participant preferences. Permission was obtained, and interviews were recorded digitally while the interviewer also took detailed notes. The interviews had an average duration

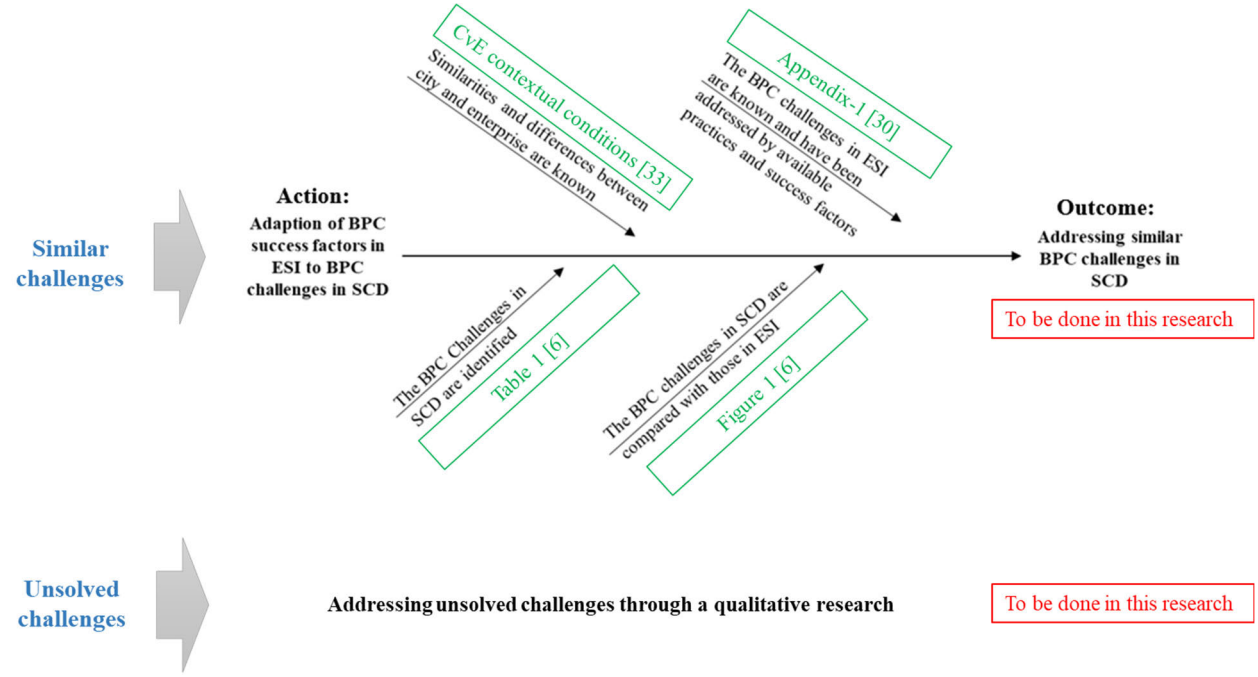

FIGURE 3. A summary of the components required to address BP challenges in SCD.

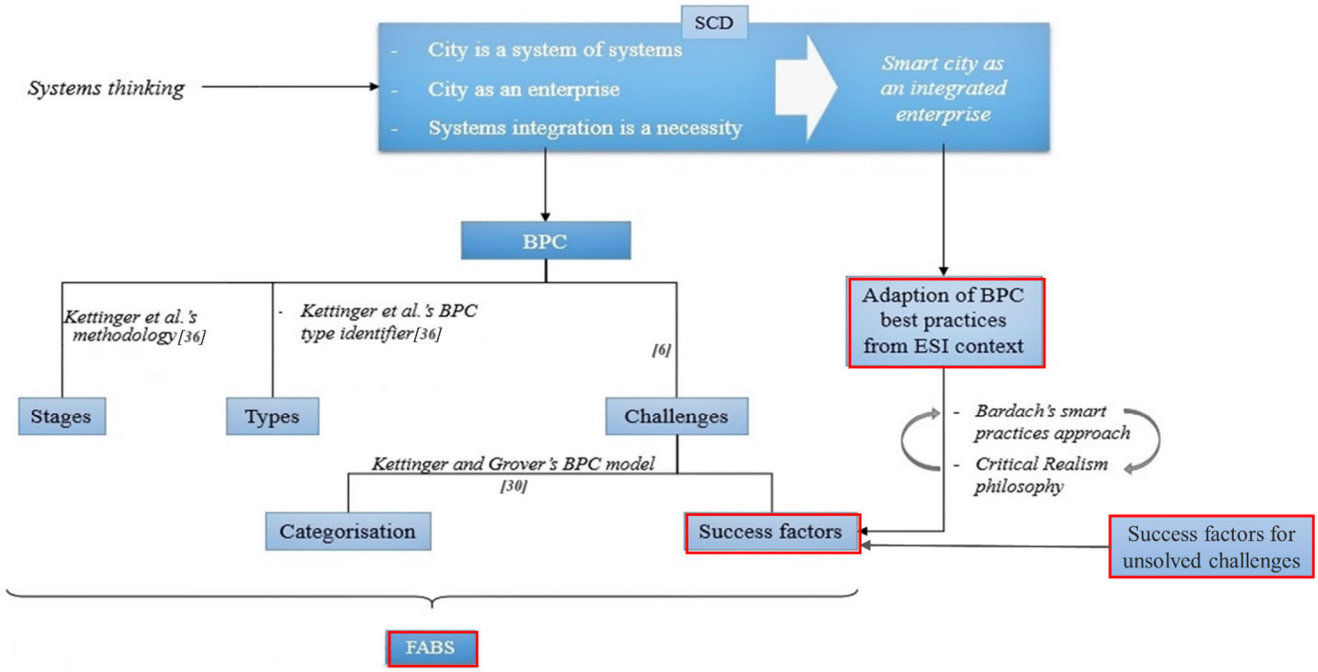

FIGURE 4. The underpinning principles of this study.

of 45-60 minutes. The selection of interviewees followed a purposive and critical case sampling approach, considering factors such as job affiliation, role, expected ability to contribute relevant information to the qualitative survey, and their involvement in SCD projects. This sampling strategy aimed to gather diverse perspectives from stakeholders who could provide valuable insights on the subject matter. The participants were also selected from the following population groups: i. smart city developers (e.g. city authorities, government advisors/consultants for SCD); ii. solution providers for SCD (e.g. CISCO, SAP, IBM, and Schneider Electric). In addition, people who have directly been involved with

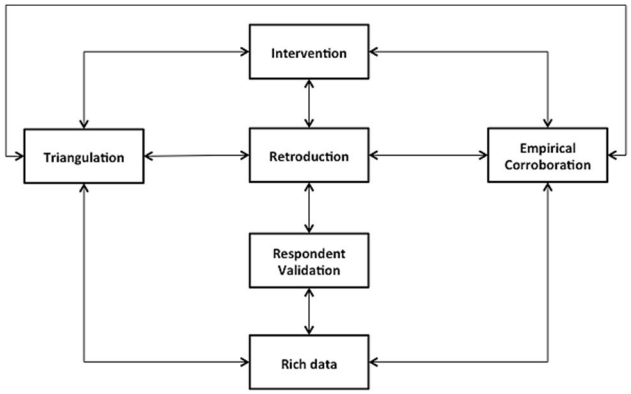

FIGURE 5. Validation strategies in this research.

SCD projects were targeted to achieve effective results in this study.

2) DOCUMENT ANALYSIS

Document analysis was mainly performed to achieve a within-method triangulation. In this phase documents including progress reports, mission statements, and policy documents were analysed to enrich and verify data from the interviews [36]. In this phase, the document, which was mainly related to BPC challenges in SCD, especially the ones published by the cities where SCD has significantly progressed were studied. Moreover, the BPC-related documents published by the solution providers were fully analysed.

3) LITERATURE ANALYSIS

This phase was mainly conducted to selectively review the literature with different keywords (based on the unsolved challenges titles), to explore supporting theoretical explanations and success factors for unsolved challenges to complement the findings of the previous data generation techniques. Peer-reviewed journal articles, conference papers, and most cited books were selected for this purpose. Online databases (e.g. IEEE, Scopus, and Emerald) were used to find useful literature.

4) DATA ANALYSIS

All data were analysed qualitatively. The interview records were transcribed by an external researcher and verified by the authors. Notes were also organised and added to the transcripts. After skimming and assessing the relevancy of all documents, data were thematically coded and analysed to capture significant concepts associated with addressing unsolved challenges. Many episodes of categorisation were undertaken, mainly within the following two types [37]:

- Organisational categorisation: The title of every unsolved challenge was utilised as an initial code for every dataset in this categorisation so that the data (including the success factors for that particular challenge) was categorised accordingly;
- Substantive categorisation: the datasets were picked, and the researcher tried to extract the themes based on the meaning, similarities, and relations of material, without considering the themes generated by the previous episode of categorisation. This episode was executed several times for all datasets to see if a new success factor is identified and to check if a new unsolved challenge emerges. This categorisation provided more insights to understand how unsolved challenges in SCD can be addressed so that it updated the result of the previous categorisation.

Next, selected literature, containing data related to unsolved challenges was qualitatively surveyed and a summary of the data was prepared, thematically analysed, and organisationally categorised to explore any supporting theoretical explanations and success factors for the unsolved challenges [38]. Then, a connecting strategy was employed to interrelate the identified themes/descriptions of success factors to relevant unsolved challenges.

B. DEVELOPING FABS

When the abovementioned components of FABS were identified, the BPC challenges and their success factors, tools, techniques, and approaches were mapped against the stages of BPC. However, since the stages of city process change had not yet been suggested by researchers and developers, this research developed a new set of steps for BPC in SCD, through the adoption of the 'BPC Steps Model' developed for the ESI context in our earlier research [39]. At this point, all components became available, so FABS was developed.

C. VALIDITY OF THE RESEARCH

The validation of FABS was qualitatively addressed to ensure the structure and contents can be properly implemented in the cities. Long-term involvement, respondent validation, rich data, intervention, searching for contradictory evidence and negative cases, numbers, triangulation, and comparison are the criteria that [40] has provided as a checklist for the validation of qualitative research. From the philosophical viewpoint, the critical realism aspects of validation should also be considered in this research, meaning that the empirical aspect of the conditions to lead the action to the outcome (explained in II.D.) should be postulated to justify that the conditions are capable of leading action to the outcome. Reference [41] have proposed five methodological principles for evaluating this capability, as follows: explication of events (application of adaption process for every BPC challenge in this research), explication of structure and context (the conditions, and the two contexts: ESI and SCD in this study), retroduction (described in II.D.), empirical corroboration, and triangulation. Therefore, we extended Maxwell's checklist to incorporate 'empirical corroboration' and 'retroduction', as 'triangulation' already exists. Nonetheless, it is acknowledged that the full checklist may not be applied in a single research and it was necessary to determine which are

TABLE 2. Detail of participants' roles.

Interviewee No.	Consultant	Director	Advisor	Project manager	Planner	Ex-mayor
1	-	-	-	-	✓	-
2	-	-	-	✓	-	-
3	✓	-	-	-	-	-
4	-	-	-	✓	✓	-
5	✓	-	-	-	-	-
6	✓	-	-	-	-	-
7	-	✓	-	✓	-	-
8	-	-	-	-	✓	-
9	-	-	-	-	✓	-
10	✓	-	-	-	-	-
11	-	✓	-	-	✓	-
12	-	-	✓	-	-	-
13	-	✓	-	-	-	-
14	-	-	-	-	-	✓
15	✓	-	-	-	-	-
16	✓	✓	-	-	-	-

feasible and the most probable ones for our study, depending on purpose and circumstances, as well as the gravest and plausible validity threats [42]. Therefore, the most applicable and feasible criteria, which were relevant to the purpose, circumstances, and philosophy of the study, were implemented. It was also deemed that these principles are closely related to each other and by addressing one aspect the other aspects are also facilitated (0).

The richness of data was ensured by collecting detailed and varied data from interviews, document analysis, literature analysis, various sampling methods, the diversity of interviewees' roles and experience, providing an in-depth discussion about SCD challenges, audio recording as well as taking notes for all interviews, listening to audios by the researcher several times and transcribed by professional transcribers.

As stated by [40], the presence of a researcher is always an intervention to interpret, test, and develop ideas and research topics. In this research, to adapt the success factors from the ESI context to the SCD situation, firstly the BPC challenges in the SCD were interpreted and compared with those challenges in ESI, then the decision was made by the researcher through his interpretation, consciousness, and volition along with obtaining some help from the application of modifier gates.

In this study, document analysis was mainly conducted to provide within-approach triangulation, providing reliability, credibility, and validity of the data [43]. It sought another source of evidence to provide convergence and corroboration of data. Thus, cross-checking of the data between interviews and document analysis was achieved by conducting this validation strategy.

Since this research has utilised a critical realism fishbone diagram to identify the components of FABS, based on the availability and accuracy of the conditions, the empirical corroboration attempts to verify that first, the conditions are clearly and accurately identified to generate outcomes; second, the identified conditions provide more explanatory power than other potential conditions [41]. Hence, this strategy was mainly substantiated during the development of these conditions in our previous research works and they were re-verified in this study. For example, by checking whether the BPC challenges in SCD have equivalents in ESI and reducing the BPC challenges in SCD to similar ones, the second part of empirical corroboration was verified.

In this study, 'respondent validation' was conducted, firstly to rule out the possibility of misinterpreting the meaning of interviewees' responses, and to overcome personal bias, and secondly, to ensure the interpretations are analytically sound [43], [45]. At the end of each interview, a summary of findings was reviewed and verified by the interviewees to validate the accuracy of the key points and interpretations of the meanings, so that, if necessary, the amendments could be made immediately. The second aspect of this strategy was also verified by assessing the FABS by participants familiar with the setting studied in terms of contents/structure, usefulness, applicability / implementability, and improvement. During the implementation of this strategy, several returns to the data providers occurred, more data were collected, and the quality of existing data was enhanced.

IV. THE RESEARCH FINDINGS FOR ADDRESSING UNSOLVED CHALLENGES

Before conducting the adaption process, this section offers the findings regarding addressing the unsolved challenges (outlined in FIGURE 1). This will fulfil arrangement 1.b (described in section III).

TABLE 3. The interviewees' experience.

No. of years	No. of interviewees
Two to four years	4
Five to nine years	7
Ten to fifteen years	5

TABLE 4. The breakdown of interviewee experience by city/organisation.

Interviewee No.	Smart city experiences (cities/organisations)	The total number of cities / orgs.
1	Trondheim (Norway), Copenhagen, Smart City Catalyst	3
2	IBM	1
3	Barcelona	1
4	Singapore, Barcelona, Tokyo, Paris, San Francisco	5
5	Belfast, Birmingham (England)	2
6	Sao Paolo, Rio De Janeiro, Madrid	3
7	London, Birmingham, Siemens	3
8	Birmingham	1
9	Amsterdam, Atos	2
10	Madrid, Barcelona, Berlin, Napoli (Italy)	4
11	Buenos Aires, Santiago (Chile), Sao Paolo (Brazil)	3
12	SAP	1
13	Service Birmingham	1
14	Tehran	1
15	Vienna	1
16	Berlin, SAP	1

A. DATA PROFILE

1) INTERVIEWS

A total of 16 interviews were successfully conducted during this phase of the study. The saturation point, where no new Business Process Change (BPC) challenges emerged, was reached after conducting 12 interviews. However, to ensure confidence in reaching the saturation point, four additional interviews were conducted. It is worth mentioning that some participants had multiple roles, as indicated in Table 2 and Table 3, which provided diverse perspectives and rich information based on their varied experiences. This comprehensive coverage of participants contributes to the overall depth and breadth of the study.

In addition, since the interviewees worked in multiple cities and organisations, they provided multiple answers to every interview question based on their smart city experience. Thus, it can be concluded that the 16 interviews offered extensive knowledge regarding addressing the unsolved challenges, gained from 20 cities worldwide and six smart city organisations.

2) DOCUMENT ANALYSIS

Out of 40 smart city-related documents, 19 documents, which included data regarding unsolved challenges were identified and analysed. These documents were published by eight smart city developers and/or city authorities, eight solution providers, and three standards/guidance providers. The breakdown is shown in Table 5.

TABLE 5. Breakdown of documents by authors/organisations.

Category	Document No.	Document provider (city/organisation)
Smart city developers	Doc. 1	Toronto
	Doc. 2	London
	Doc. 3	Tokyo
	Doc. 4	Berlin
	Doc. 5	Copenhagen
	Doc. 6	Barcelona
	Doc. 7	Birmingham
	Doc. 8	Cape town
Solution providers	Doc. 9	SAP
	Doc. 10	IBM
	Doc. 11	CISCO
	Doc. 12	Schneider Electric
	Doc. 13	Atos
	Doc. 14	ESRI
	Doc. 15	Ovum
	Doc. 16	Blue Cities
Standards and Guidance providers	Doc. 17	British Standards Institute (BSI)
	Doc. 18	Smart City Council (SCC)
	Doc. 19	The European Commission

Table 6 also represents the breakdown by the analysed documents type.

3) LITERATURE ANALYSIS

Apart from the analysis of the literature for the previous phases of this research, 55 additional publications were identified and selected, particularly for unsolved challenges. Then, 16 of them, including 15 journal articles and one magazine article were fully analysed to support the identification of additional success factors to address the unsolved challenges.

B. SUCCESS FACTORS FOR UNSOLVED CHALLENGES IN SCD

The findings regarding the success factors for unsolved challenges, identified through interviews, document analysis, and literature analysis is presented in this section.

1) MANAGERS' HASTINESS

One important challenge identified by several interviewees in relation to city process change is the issue of ''managers' hastiness.'' This challenge is closely linked to people-related challenges, indicating that some success factors from that category could also be applicable in addressing the managers' hastiness challenge. Furthermore, interviewees highlighted the importance of establishing clear targets and strategies for achieving these success factors, including the necessary transitions and stages. It was suggested that these targets and strategies should be incorporated into the main national outlook plans, with the stages allocated to specific city management periods. Additionally, an interviewee emphasised the need for comprehensive clarity and explanation of the full SCD and BPC projects, as well as the significance of each

TABLE 6. The document types.

Document types	Smart city developers category	Solution providers category	Standards / Guidance providers	Total
Progress reports	2	1	-	3
Vision/mission statements	4	1	-	5
Government reports	1	-	-	1
General reports	-	5	1	6
Guides	1	1	1	3
Standards	-	-	1	1

stage and component, to the managers and authorities. It is essential to ensure that managers and authorities understand the objectives and benefits of the projects and that their contributions and efforts will be recognised and appreciated. This recognition serves as an encouragement for their active involvement and commitment to achieving the targets within their management period.

Some similar success factors have also been suggested in the literature to address managers' hastiness challenges in other projects. These success factors can be useful for BPC in SCD. For instance, [46] argued that understanding the benefits of changing business processes to achieve the main goal is crucial to address the managers' hastiness challenge. It means, after spending a long time for BPC, a city would have a new asset, which is smartness and integration of its business processes. These assets have been developed during a period that particular managers have supported. Moreover, as discussed by [47], short-term (12 to 24 months) results should be seen by people to prevent possible give-ups/resistance, and they can use those results to show their achievements during their tenure. Thus, creating some short-term wins is a success factor to overcome this challenge in BPC.

2) VERTICAL POLICIES

All cities are different, so their business processes, challenges, and priorities are different. Therefore, dictating policies from the national level (vertically) is not useful for implementing the changes in all cities and may hinder BPC (commented by several interviewees). However, due to this challenge city authorities do not have the freedom and power to change and align smart city processes with their city's characteristics, environment, citizen needs, geographical location, and so forth.

To overcome this obstacle, suggestions from interviewees and documents propose the reduction of centralisation and the delegation of greater power to local authorities. This does not imply complete autonomy for each city, but rather adapting the national strategy to accommodate the unique circumstances of each city. Some interviewees further recommend that the national government should establish overarching targets and a long-term vision, while city authorities take responsibility for planning and implementing decisions to attain those targets.

A few success factors can also be inferred from the literature. For example, horizontal policy integration (alignment of policies between city authorities and municipalities in metropolitan areas) is key to enhancing collaboration and coordination among the sectors, to meet governmental priorities [48], [49]. However, as argued by [50], in addition to horizontal policy integrations, sectoral policy integrations (coordination of policies between city sectors) and vertical policy integration (alignment of policies in various government layers) should also be undertaken. In addition, national, provincial, and local policies should be coordinated. This way, vertical policies would not hinder changes at the city level, because changes such as BPC for SCD are aligned with the national or perhaps international strategies and policies so that the national policies facilitate the required change in the cities. [51] also believe that more demand-driven policies should be developed instead of supply-driven policies because supply-driven (government-driven) policies are not service/citizen-centric, which is a requirement of smart city innovations including cross-sectoral BPC. Demand-driven policies reduce governmental push and align city policies with smart city initiatives and cross-sectoral innovations. Therefore, the policies in all three dimensions should also be integrated and aligned with each other, and it can be achieved by combining various visions in the urban region and creating a comprehensive vision for SCD. In addition, demand-driven policies should be developed more than supply-driven and pushing policies by the government.

3) CONTRACTING

A few interview participants and some documents mentioned ''contracts'' as barriers to BPC. For example, an interviewee said:

> *'Long-term contracts should be avoided. In addition, the contracts should be somehow written that support SCD and future city's objectives, not create issues' (sic).*

The documents reviewed did not recommend any success factors for this challenge.

Literature also confirms that any change in public organisations including city agencies/sectors is complex, and contracting issues make it even more complicated [52]. This enhances the capacity of managing the contracts by city authorities [53], as well as the efficiency of the contracts by observing some principles, including 'standardisation of contracting rules', 'competition between contractors, and 'training and professionalism of involved staff', reduces the impact of contracting issues in changing public business processes [52].

4) FOUNDATIONS

Infrastructures, intra-sectoral alignments, priorities, efficient and integrated city systems/sectors, and so forth are the

TABLE 7. Coding for BPC challenges in SCD.

BPC challenges in SCD	Codes
Understanding city processes	U
Standardization	S
Monitoring business process change	M
Agility and Flexibility	AF
Governance and Leadership	GL
Efficiency	E
Sharing data and business processes	Sh
Interoperability	IO
Privacy Concerns	PC
Inter-dependencies	ID
Politics	P
People Related Challenges	PR
Economic conditions and Cost	EC
Complexity	CPX

foundations that should be established before BPC. For instance, an interviewee commented:

> *'Business processes within sectors should be automated and integrated before inter-sectoral integration, which is required by SCD'.*

Another interviewee suggested BPM tools/techniques such as Six Sigma and Lean for intra-sectoral preparation, ensuring the business processes are running efficiently, effectively, and smoothly.

There were some suggestions for designing a platform to integrate all requirements and having a holistic view of business processes for change, as well as their relationships with other factors such as people, technology, and data, instead of just some mobile applications and sensors to collect data.

Similarly, another interviewee said:

> *'We need to define projects that relate all aspects of smart city development including business process change, infrastructure, architecture, people management, and so on and integrate all sectors of the city.'*

Some documents and interviewees suggested that cities should set the strategy, vision, objectives, and long-term plans, including integration and BPC, to get a better understanding of the necessity for BPC. Thus, there is a need for having a core strategy in cities before BPC. This could also support addressing other challenges, such as resistance to change.

As mentioned in a document, a shared vision, strategy, and roadmap for the smart city should be in place with multiple partners across multiple domains. In addition, establishing the business case and shared investments are also necessary, in order to secure scalable improvements to agreed outcomes.

One of the most important success factors that can address this challenge is to understand the priorities. The priorities for developing smart cities should be appropriately realised and be considered for executing BPC for SCD. However, smart city developers should approach SCD in a systemic manner, instead of implementing high-priority projects in isolation. Regarding this principle, an interviewee from the smart city developers group commented:

> *'It is common to see projects in which only infrastructure importance is given. But there are very few that integrate all aspects, from the planning to the management of waste; from energy production to the social aspects; and I think only the complete projects are really in the way to transform our cities.'*

Thus, the priorities of every city should be analysed and understood for the whole SCD project. Most interviewees and some documents suggested technology should be given a low priority. For example, an interviewee said:

> *'Solution providers should listen more instead of pushing to use their technologies. We do not have to let the companies define smart business processes for us. Every city should change their city processes based on its priorities.'*

Another interviewee commented:

> *'We should create an environment, in which more collaboration between the private sector, local government, and citizens occurs. Then, the priorities will be (sic) realised easier and they will co-create and determine what solution works for them and where should they start.'*

Citizens' involvement was also pointed out by some documents and interviewees as a crucial success factor for understanding the needs of future cities and their priorities. Therefore, as stated by an interviewee:

> *'The solution providers should create/customise their solutions based on the priorities in every city by open innovative contents instead of traditional pre-defined solutions.'*

Moreover, a few interviewees indicated that the target and transition phase for BPC should be set first. Then, the priorities should be identified as steps, and then a balance between priorities should be sought.

Furthermore, setting the target and transition phase for BPC is regarded as a success factor for this challenge by some of the interviewees.

In addition, policies and regulations should be prepared for smart city-related matters such as implementing the Internet of Things (IoT) and cloud computing [54], [55]. Moreover, foundations for SCD should start from 'developing a readiness to implement smart policies' to 'improvement of infrastructure (street, transport, utility networks, and ICT)', and 'visioning for transformation' [56], [57]. Moreover, the following success factors would also be useful to overcome the foundations' challenges [4], [58]: evaluating existing infrastructure, defining objectives of SCD for every city, identifying funding options and appropriate business models, designing overall architecture, exploring

possible partnerships with private sectors, and preventing any push from solution providers and technology vendors.

Furthermore, [20] propose three main prerequisites, which are needed for any transformation including BPC towards SCD, These are:

- Political readiness: reconciling internal (e.g. city council, mayor, directions) and external (e.g. ministries, strategies, projects, international pressures) political elements of cities;
- Institutional readiness: such as removing regulatory and legal barriers;
- Transitional readiness: e.g. having a vision for change, leadership, and organisational transition in the structure.

V. DEVELOPING A FRAMEWORK FOR ADDRESSING BPC CHALLENGES IN SCD (FABS)

Having the research findings described, the three arrangements (explained in section III) are executed in this section.

A. ARRANGEMENT 1: ADDRESSING BPC CHALLENGES IN SCD

1) ARRANGEMENT 1.A: ADAPTION OF THE ESI LEARNINGS FOR SIMILAR CHALLENGES IN SCD

According to our adaption process explained in IID., the learnings from the ESI context propose a number of Hypothetical Preliminary Success Factors (HPSFs) for addressing similar challenges. Next, the application of modifier gates generated for every challenge converts the HPSFs to Actual Success Factors (ASFs) for the SCD context. Hence, for every similar challenge in SCD, there would be some ASFs, which are coded for the convenient development of FABS. The first part of the code represents a similar challenge for which the ASF is adapted (Table 7), and the second part contains the characters, representing the ASF.

The initials of the important actions of every ASF are utilised for this coding. For example, for the challenge of 'Understanding city processes (**U**)', the actual is '**A** nalysing and **A** ssessing the existing city processes', which is coded as **AA**. Therefore, a complete code for the proposed success factor is '**U-AA'**. Nevertheless, addressing some similar challenges requires overcoming other challenges. For instance, one of the success factors for 'efficiency' is 'monitoring BPC', so all success factors of monitoring BPC would also be useful for addressing 'efficiency'. However, repeating those success factors for efficiency is avoided, instead 'addressing the challenge of monitoring BPC' would be an ASF for 'efficiency' and a code (E-ALLM), which represents 'all' success factors for 'monitoring BPC', is assigned to it. Moreover, if a success factor is useful for more than one challenge, all those challenges' codes will be placed in this part using a forward slash (/). For example, U/PR-T represents that 'Training (T)' is useful for both challenges of 'Understanding city processes (U)' and 'People Related challenges (PR)' (All the success factors codes and a summary of their descriptions are provided in Appendix B).

The following 14 sections describe the adaption of smart practices for every similar BPC challenge to create the 'ASFs' and code them according to the above rules.

a: UNDERSTANDING CITY PROCESSES (U)

The adaption process for this challenge has been demonstrated in our previous work [33]. The equivalent of this similar challenge in the ESI context is 'clarification and understanding'. Thus, the seven HPSFs are generated based on the corresponding success factors from the ESI context (explained in II.B.). The adaption process converts the HPSFs to five ASFs for this challenge. As explained in II.D., this requires a modifier gate, generated based on the relevant CvE contextual condition factors to this challenge. The modifier gate for this challenge has been made available here (Table 3). The same process has been followed for the other 13 challenges and a modifier gate for each challenge has been provided in Appendix C.

Considering the modifier gate for this challenge generates the following ASFs:

- ASF-1: the analysis and assessment of the existing processes in the city and understanding of the relationships between city functions (function networking) (U-AA). The barriers, such as excessive bureaucracy and red tape, multiple stakeholders, political managers and process design based on legal regulations demand more effort in cities than enterprises to achieve this ASF. In addition, as the city processes are more complex, more time-consuming, and more bureaucratic, analysis and assessment of existing processes should be accurately planned, all stakeholders should be involved, and their advice and opinions should be applied. Also, sufficient time must be allocated for it. It should also be agreed upon by all stakeholders, especially politicians. Moreover, city processes and their specifications should be defined and documented. Also, every process must have a standard description, which is recognised by the stakeholders to avoid naming the same processes differently in a city;
- ASF-2: realisation and clarification of the need for BPC; informing the stakeholders and political entities about it and defining BPC for them (U-RN);
- ASF-3: explaining the BPC to all stakeholders, especially politicians, also assuring them about aligning the new processes with legal regulations and policies (U-C);
- ASF-4: effective training programmes to be scheduled for all involved people to better understand cross-sectoral city processes and the BPC, as well as educating citizens to use transformed services (U/PR-T); and
- ASF-5: visualisation of city processes (U/E/CPX-V), through segmentation of the city processes. Then, the smaller models will be designed and prototyped and the

TABLE 8. Modifier gate for understanding city processes (U).

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
People	Nearly all managers are political people	Managers are rarely political
	Limited motivation for change	Broader motivation for change
	Multiple stakeholders	A limited number of stakeholders
Process	Low flexibility of processes	Processes are more flexible
	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	High level of complexity of city processes	Business processes are less complex
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency
System	System of systems	Comprising departments
	Subsystems are big, and complex, and are called sectors, comprising organizations and departments	Sub-systems are the enterprise's departments
	High level of complexity	Low level of complexity
	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal

relationships among them will be addressed [59], [60]. As a result, for visualisation/modelling of cross-sectoral city processes, innovative BPMo tools and techniques must be developed, meaning that merely adding a few elements to the existing BPMo techniques would not address this challenge. Thus, the transformation of current BPMo techniques must occur to provide clarity, intuitiveness, conciseness, uniformity, intelligibility, and adaptability [61], [62].

b: MONITORING BPC (M)

According to the adaption process, like what was carried out in the previous section, the HPSFs are created and converted to ASFs based on the modifier gate (available in Appendix III-A). The ASFs for this challenge are described and coded as follows:

- ASF-1: top management and all stakeholders' support and their strategic commitment (M/S/P/PR-MSS) is one of the important success factors for this challenge. In addition, because of the instability of the city managers, it has to be supported by the government and region/country's development strategies to be consistent;
- ASF-2: motivating people to integrate human activities with BPM, adapted for the public sector and SCD (M-MI). This success factor has also been explained by solution providers such as [63], for smart cities;
- ASF-3: appropriate BPMo for complex and bureaucratic city processes (M/S/AF/E-BPMo). This technique has to be developed based on legal regulations and city policies as a framework for controlling and measuring business processes. Thus, understanding city processes are necessary for this adaption; and
- ASF-4: step-by-step testing/troubleshooting of BPC by a team of professional staff (M-T).

c: GOVERNANCE AND LEADERSHIP (GL)

This challenge is mostly related to the city sectors (subsystems of the whole city system). Success factors to address this challenge from the ESI context make five HPSFs, which are modified by a modifier gate shown in Appendix C.2. The ASFs for this challenge are as follows:

- ASF-1: development and clarification of an integrated strategy, goal(s), and the expectation(s) for every business process and all required changes in any particular city (GL/MH/F-SGE): allocating appropriate project management, allocating adequate budget to ensure efficient and transparent delivery of system-wide change, setting priorities for governance, specifying the way to achieve the goals
- ASF-2: coordination and balance of governance mode for each business process across sectors, in order to share accountability for the delivery of system-wide outcomes and establishment of governance profile for them (GL-GMP)
- ASF-3: recognition of all stakeholders' needs from all sectors and agencies (GL-SN)
- ASF-4: prevent and avoid risk (GL-R); 'Risk' has not been pointed out by interviewees and documents as a BPC challenge in SCD. However, addressing this challenge in ESI is a success factor for 'governance'. Thus, the success factors for 'risk' are also adapted for addressing the challenge of 'governance and leadership in the SCD context as follows:
    - Understanding and following every stage of BPC precisely
    - Commitment and support from top management and all stakeholders
    - Inter-communication between all the sectors and involved people including managers, leaders, and staff
    - Work on staff culture, convincing them to generate new ideas and solutions and share their knowledge

- Structure the city as a whole enterprise to be supported and guided to the change
- Teaching all the involved people regarding the success factors and the necessity of avoiding risk to address the 'governance and leadership challenge
- Trust, which encourages the implementers to focus on the change; especially political managers should trust all involved people and implementers

d: STANDARDISATION (S)

Nine HPSFs are created for this challenge based on the success factors in the ESI context. The modifier gate (Appendix C.3) for this challenge demonstrates that the adaption of success factors for this challenge is mostly affected by people and process-related differences between city and enterprise. Hence, the ASFs for this challenge are as follows:

- ASF-1: BPC should act as a standardiser for existing business processes by defining common understanding and language of the business processes, their components, terms, synonyms, and so on [64], [65]. For instance, a citizen (in city authorities) is equal to the patient (in healthcare), which matches to 'customer' (in retail). This should also be carried out according to all stakeholders' agreement and their control, as well as legal regulations and policies (S-L);
- ASF-2: clarifying the features, focus, purpose, detail, complexity, scope, and level of effort for standardisation (S-CF); this success factor is crucial in SCD. For example, the focus is on cross-sectoral business processes for the purpose of BPC to integrate city systems across various sectors. In addition, business processes are more complex, so the level of effort for the standardisation of city processes would be higher;
- ASF-3: maturity of business processes (S/E-M);
- ASF-4: management of standardisation to be carried out completely and implemented by all sectors and involved people, and utilised by all users (S-MNG);
- ASF-5: top management support and strategic commitment should be available (M/S/P/PR-MSS);
- ASF-6: selection of appropriate BPMo techniques, as discussed for 'monitoring BPC' in V. A. b. (M/S/AF/E-BPMo);
- ASF-7: experience of team members in standardisation projects; training of all involved people is significant as their level of experience is mostly low (S-ET); and
- ASF-8: avoid over-standardisation to provide more flexibility in city processes (S/AF-NOS).

e: AGILITY AND FLEXIBILITY (AF)

The rigidity, sluggishness, and complexity of city processes pose a considerable challenge for BPC in SCD. Therefore, it is crucial to prioritize the introduction of agility and flexibility into city processes, enabling them to effectively accommodate agile and flexible BPC approaches. Furthermore, the newly designed business processes themselves should embody agility and flexibility, allowing them to efficiently adapt to the evolving needs of city services and the dynamic nature of the urban environment. Based on the modifier gate available in Appendix C.4, the HPSFs created by success factors for agility and flexibility in ESI would be transformed to ASFs for addressing this challenge in SCD, as follows:

- ASF-1: balance between standardisation and flexibility of city processes and avoiding over-standardisation by understanding key city processes and level of flexibility and standardisation for them (S/AF-NOS); hence, success factors for understanding city processes are also counted as success factors for this challenge. In addition, as city processes are complex, sluggish, and bureaucratic, flexibility and agility for BPC and city processes should be provided by simplification of the processes and seeking support from all stakeholders, especially political managers and should be aligned with legal regulations and policies;
- ASF-2: technical and behavioural integration (AF-TBI); utilising technology as an enabler to address the technical aspect of this challenge, enhance the accessibility of data, reduce the complexity of city systems, and combine it with the behavioural aspect of it. This is achieved by utilising professional staff, enhancing their motivations and expertise (through training programmes, improving the efficiency of city administration), and getting support from all stakeholders, especially politicians;
- ASF-3: computerising and integrating the city policies and standards with BPM (AF-BPM), so that the process of BPC is aligned with those policies and standards. In addition, aligning the city policies and standards with the red tape zones' processes, which may not be computerised. Moreover, combining technological and modelling techniques, as well as innovative architectures for BPM to enhance flexibility and agility of business processes (e.g. [66]'s architecture for BPMS); and
- ASF-4: selection of appropriate BPMo techniques (M/S/AF/E-BPMo).

f: EFFICIENCY (E)

This challenge is more significant in inter-organisational business processes [19]. Hence, this is one of the important challenges of cross-sectoral BPC in SCD. It can be addressed if redundancies in new processes and time lags are minimum, processes are running smoothly, and the information is available for all city sectors, appropriately and in real-time. These conditions also challenge BPC, so these should be addressed to achieve efficiency in BPC. Appendix C.5 shows a modifier gate for efficiency. Accordingly, the ASFs for this challenge are listed as follows:

- ASF-1: enhancing the availability of information (E-IA); the attempts to enhance and improve availability, accessibility and quality of information for SCD (e.g. sensor technologies, IoT, Big Data, social media, mobile

apps, and so forth) have abounded by solution providers for smart cities. They also support the execution of BPC for SCD. Earlier researchers have tried to achieve this success factor through developments, explanations, and frameworks (e.g. information framework by [67], and sensing as a service by [68]. These attempts should be utilised for the implementation of this success factor for BPC in SCD. Nevertheless, all people, involved with BPC in the cities including stakeholders, should also support this enhancement by facilitating the creation, sharing, and application of information, based on legal rules and policies [69], improving communication between sectors and reducing bureaucracies and barriers;

- ASF-2: automatic task assignment to process users in current active city sectors (E-ATA); this success factor can be applied if similar to BPM and BPMo, a WfM system is developed specifically for SCD and it utilises cloud-based architectures and scheduling algorithm [65], [70], [71];
- ASF-3: choosing the most appropriate BPC approach according to legal regulations and policies (E-BPC):
  - Analysis of city processes by professional and trained staff
  - Regular meetings to discuss the results of analysis and select the best approach on-time
  - Selected approach to be agreed upon by all stakeholders and involved sectors
  - Minimising radical changes, because city processes are complex
- ASF-4: reducing wasteful activities by all processes across city sectors (E-RW);
- ASF-5: standardisation of city processes (discussed in the standardisation section), so that all actuals for addressing the BPC challenges of 'standardisation' are also applied for this challenge (E-ALLS);
- ASF-6: monitoring, as discussed in section V-A.1) Ab., so that all actuals for addressing 'monitoring' are also applied here (E-ALLM);
- ASF-7: visualisation of city processes (U/E/CPX-V);
- ASF-8: appropriate integration of suitable BPMo approach, BPM and IT (M/S/AF/E-BPMo);
- ASF-9: maturity of city processes for change (S/E-M)

g: SHARING DATA AND BUSINESS PROCESSES (SH)

One of the main benefits of systems integration is sharing data and processes, which allows the city processes to be performed cross-sectorally. To adapt success factors from ESI to the SCD context, a modifier gate was developed (see Appendix C.6) and the following ASFs were generated:

- ASF-1: assignment of business process owners to city sectors and agencies in a way that provides accessibility for other parties, based on their share, benefits, roles, responsibilities, and level of engagement (Sh-BPO); this should be carried out after standardisation of city processes, as well as addressing the challenges of 'agility and flexibility, 'complexity', and 'inter-dependencies';
- ASF-2: developing trust between city sectors, stakeholders, and agencies (Sh/PC-T), which facilitates ownership assignment, by:
  - Providing confidence for people about the purpose of sharing data, its usage and storage
  - Underpinning activities that encourage people to provide data that are needed for changing the processes
- ASF-3: motivation of business process partners for BPC and data sharing (Sh-MB), by explaining the benefits and final outcomes of BPC, offering analytics, and providing examples based on their goals and interests (e.g. bringing agencies, who can provide services for vulnerable people such as hospitals, police, children's services, and youth offending, together, explaining the benefits, providing examples, and motivating them);
- ASF-4: providing authority (political and non-political) to business process owners to get all involved agencies and organisations to change and share their data and processes (Sh-A); and simultaneously, enhancing motivation and changing the working culture of these agencies and organisations, as the commanding heights in the cities would not work as expected, so that the agencies may not accept the process owners' commands;
- ASF-5: understanding and respecting the business goal(s) of each agency (Sh/PC-AG);
- ASF-6: city sectors/agencies relationship management (Sh/PR-RM) (e.g. choosing appropriate BPC type with the capability to manage cross-sectoral relationships); peer-to-peer communication between agencies, transform the relationships towards a strategic and integrated manner for the whole city and the future of the country, regardless of various political dependencies;
- ASF-7: securing a competitive advantage for city process partners by monitoring and controlling city processes (Sh-CA); and
- ASF-8: specifying the goals, procedure for resolving disputes, and performance measurements in an open environment with the participation of all stakeholders and sectors (Sh-SOE); be certain about their involvement with the support of top management and set its priority at the national level.

h: INTEROPERABILITY (IO)

Interoperability is the main goal of BPC, and it is required for collaboration, communication, and integration among systems in both ESI and SCD contexts [72], [73]. Nevertheless, systems integration in the ESI context is mostly intra-organisational. However, when ESI extends to Supply Chain Integration (SCI), inter-organisational integration is carried out, in order to integrate all supply chain's organisational systems. However, in the SCD context, inter-organisational and intra-organisational integration can be considered equal,

because when a city is considered an enterprise, all systems and organisations within the city are considered enterprise units. By this consideration, all units of a city are integrated. It means intra-organisational integration has been carried out. However, those units are also various organisations. Therefore, by implementing an intra-organisational integration, an inter-organisational integration is also performed. This argument is considered for adaption of success factors for addressing this challenge in SCD. As represented by the modifier gate (available in Appendix C.7), most of the CvE contextual condition factors are relevant to this BPC challenge. Considering these modification factors creates ASFs for addressing this challenge:

- ASF-1: appropriate types of City Systems Architecture (CSA), such as SOA or a combination of other architectures, such as FEA and SAGA, should be selected and implemented (IO/CPX/F-CSA). While private sector enterprises implement systems architectures in a straightforward fashion, city authorities may not enjoy such luxury [74]. Thus, it must be firstly understood by all stakeholders and city authorities that having an architecture for the whole city is a necessity for city systems integration and BPC so that they are motivated to implement CSA. In addition, every system of various sectors within a city may have different architectures, which should be treated as components of the main CSA to improve understanding and communication with each other, via technological interfaces. Thus, a seamless flow of information amongst city systems is enabled [75];
- ASF-2: peer-to-peer communication among business processes across city sectors and agencies (interagency collaboration) creates a dialogue between national and local levels [76], [77] (IO-P2P). This can be achieved by the motivation of all involved people, reducing bureaucracy, facilitating cooperation, and creating value from collaboration by all stakeholders, especially politicians and bureaucratic players;
- ASF-3: addressing the challenges of 'sharing data and processes' (IO-ALLSh); and
- ASF-4: administration procedures should be aligned with technical systems and IT governance (IO-AAT). This has also been pointed out by [74].

i: PRIVACY CONCERNS (PC)

The success factors for this challenge create six HPSFs, which are transformed into ASFs by applying the modifier gate, available in Appendix C.8:

- ASF-1: guarantee privacy and security of business processes (PC-G); this success factor can be achieved by developing and transforming confidentiality and security rules, as well as SCD-related data protection policies at national and local levels that also enhance the availability and accessibility of data. Thus, governments and policymakers should think about changing some of the regulatory barriers, which have been set before the emergence of big data and systems integration for the cities. In addition, the research findings indicated that legislation would not be an obstacle if data sharing and BPC in smart cities are appropriately aligned with the legislation, and the data protection requirements are set beforehand;
- ASF-2: providing business process visibility (PC-V), (required by all stakeholders and agencies involved), by setting up various views for external partners towards the same integrated process, as well as considering their responsibilities, red tape, and political factors;
- ASF-3: explaining and ensuring that stakeholders and the involved city agencies benefit most from their own business objectives (discussed in Sharing data and business processes) (Sh/PC-AG); and
- Actual-4: providing trust and confidence for people, especially stakeholders and service agencies regarding the purpose of sharing data, its usage, and storage (Sh/PC-T).

j: INTER-DEPENDENCIES (ID)

There is a mutual influence between this challenge and the BPC itself because the aim of BPC in SCD is to enhance relationships amongst city processes, which would increase interdependencies between the processes. Accordingly, any deficiency in any sector would cause a shortage in the whole process of service delivery. Therefore, all city sectors that create services for citizens should work with each other in an inter-connected environment, in which the level of inter-dependency would be high. Consideration of the modifier gate for this challenge (see Appendix C.9) creates ASFs as follows:

- ASF-1: quality assurance (ID-QA); as shown in Table 1, 'Quality assurance' was not identified as a BPC challenge in SCD. However, addressing this challenge in ESI is a success factor for 'inter-dependencies'. Thus, the success factors for 'quality assurance' are also adapted for the 'interdependencies' challenge in the SCD context, as follows: visioning and planning for change, improving timeliness, quality, and provision of data, strong support from all stakeholders, local and national government, understanding integrated business processes as an activity network, people involvement, training, monitoring, testing and troubleshooting continuously
- ASF-2: addressing the challenge of 'understanding city processes' (ID-ALLU)
- ASF-3: addressing the challenge of 'efficiency' (ID-ALLE)
- ASF-4: addressing the challenge of 'interoperability' (ID-ALLIO)

k: POLITICS (P)

This challenge is much more significant in SCD than in ESI [78], [79]. Accordingly, it has also been specified

as a different factor between city and enterprise in many aspects. This is shown by the modifier gate available in Appendix C.10. Hence, addressing political challenges would be more difficult in the cities than in enterprises.

By using the modifier gate, six HPSFs for this challenge are transformed into ASFs as follows:

- ASF-1: understanding the politics in the cities at local and national levels (P-UP) by:
  - Appreciation and strategic management of stakeholders and agencies' power and watch over all factors, which makes them interested in BPC and SCD ('Buy-in')
  - Recognition and management of legislations, rules, policies, bureaucracies, red tape
  - Identification of the communications between stakeholders, agencies, and people;
- ASF-2: recognition of reservations borne by stakeholders and decision-makers (P-RR);
- ASF-3: conducting disruptive political factors to productive ones (P-D2P); for example, involving political managers in BPC projects by assigning them as leaders or advisors;
- ASF-4: avoiding underestimation of political factors (P-NUE);
- ASF-5: obtaining guarantee regarding support and compliance of stakeholders, decision-makers, and managers (M/S/P/PR-MSS); and
- ASF-6: a mixed approach for initiation of BPC in SCD (P-MAI); while [79] suggested a top-down approach (to guarantee the feasibility of the change, as well as economic and political support), [80], [81] believed that bottom-up approach should be carried out (to involve all stakeholders). The findings of this research suggest a mixed approach to provide the benefits of both approaches.

l: ECONOMIC CONDITIONS AND COST (EC)

The cost of SCD and consequently BPC has always been mentioned as a significant challenge. However, although BPC is expensive, it reduces the cost of city processes [82], [83], and this is what the decision-makers and authorities should realise. Therefore, most of the success factors for addressing this challenge in ESI are about this realisation. In addition, addressing other challenges of BPC would decrease the cost. Therefore, all factors of the CvE contextual condition are relevant to this challenge. Consequently, the ASFs for this challenge are adapted through a modifier gate, which is equivalent to CvE contextual condition:

- ASF-1: appropriate control over the resources utilised for BPC (EC-CR); hence, high priority should have been assigned for SCD and BPC, otherwise competing and complicated priorities in the cities would not allow the implementation. In addition, professional and well-educated human resources should be assigned to BPC projects;
- ASF-2: understanding costs and ROI, providing cost structure, representing the value of spending money over integration and BPC to the stakeholders and agencies, and using KPIs and real measures (EC-UC);
- ASF-3: establishing linkage between costs in all stages of BPC (EC-L); and
- ASF-4: addressing other challenges of BPC, especially understanding city processes, monitoring, and standardisation of business processes (EC-ALL).

m: COMPLEXITY (CPX)

BPC is a complicated process. This complexity would be increased when business processes are inter-organisational, interdependent, and multi-faceted. Moreover, it would be more complex if it occurred in the public sector. Hence, this challenge is closely related to the difficulty of inter-sectoral BPC for SCD, so all factors of the CvE contextual condition are relevant to this challenge, hence, the modifier gate for this challenge is equal to CvE contextual condition.

Obviously, addressing all the challenges of BPC in SCD makes the BPC less complex. Additionally, some specific success factors adapted from the ESI context can be tailored to this challenge. The ASFs for this challenge are as follows:

- ASF-1: decomposition of business processes to interrelated activities (CPX-D)
- ASF-2: innovative architectures for BPMS similar to [66] architecture (discussed in Interoperability sectionh) (IO/CPX/F-CSA)
- ASF-3: visualisation (U/E/CPX-V)
- ASF-4: addressing other challenges of BPC in SCD, especially 'interdependency' (CPX-ALL)

n: PEOPLE-RELATED CHALLENGES (PR)

This challenge belongs to the 'human issues' category and includes many challenges such as resistance to change, the ability to give up power, and willingness. The findings highlighted that when more focus is given to addressing human issues, it significantly reduces the effort required to address the BPC challenges in SCD. As shown in the modifier gate for human issues (see Appendix C.11) and all previous modifier gates, 'people' is also a difference aspect, which influences all success factors for BPC challenges in SCD. This statement also represents the significance of this category. The main success factor for 'people-related challenges' is to minimise human issues by:

- ASF-1: identifying all stakeholders' power and involvement and watching any changes in stakeholder members (PR-S)
- ASF-2: assessing and defining all stakeholders, authorities, and agencies' people characteristics, cultures, and elements, which influence their decisions, commitment, motivations, and willingness to change (PR-PCh)
- ASF-3: clarifying the need for city systems integration, BPC and defining it (PR-CN)

- ASF-4: explaining the situation, benefits, and impacts of SCD and BPC, and preparing people for BPC by the number of meetings, training, and workshops (PR-EP)
- ASF-5: reducing insularities by improving the relationships between all involved people including the stakeholders, agencies, city managers, authorities, and staff (Sh/PR-RM)
- ASF-6: engaging all involved people with the change and allowing them to make decisions and measure the changing process (PR-PE)
- ASF-7: evaluation, measurement, and advertising of BPC projects' progress and showing the short-term results/benefits to other sectors, in which integration has not yet occurred (PR/MH-P)
- ASF-8: effective training programmes to be scheduled for all involved people to better understand cross-sectoral city processes and the BPC, as well as educating citizens to use transformed services (U/PR-T)
- ASF-9: support from all stakeholders, managers, and authorities at both local and national levels (M/S/P/PR-MSS)
- ASF-10: integration of all fields of the human system, human-centricity (PR-HC)
- ASF-11: teamwork to review BPC in the cities, sharing knowledge, and other BPC activities (PR-TW)
- ASF-12: managing collaboration between sectors, city businesses, organisations, and citizens (PR-SC) (e.g. using communication technologies like social networking)
- ASF-13: effective selection of human resources from professional and educated staff and consultants (PR-HR) (e.g. try to choose city authorities with business and entrepreneurial backgrounds rather than political); as well as hiring expert trainers
- ASF-14: clarification of the change process to reduce the pressure of the change (PR-CC)
- ASF-15: addressing all other BPC challenges in SCD (PR-ALL)

2) ARRANGEMENT 1.B: ADDRESSING UNSOLVED CHALLENGES

The findings of this research regarding the success factors, tools, techniques, and approaches to address unsolved challenges were discussed in BIVB. Table 9 represents a combined list of those success factors, along with their coding for the purpose of FABS development. If any of the success factors were similar to those that were coded in V. A. 1), the previous codes are updated.

B. FABS DESIGN (ARRANGEMENT 2)

Having addressed the identified BPC challenges in SCD, including similar and unsolved challenges, FABS is developed as the amalgamation of all the discussions, explorations, and adaptions undertaken as part of this research. It comprises four components, i. BPC challenges in SCD; ii. BPC challenges levels/categories; iii. the success factors to address BPC challenges in SCD, and iv. the BPC stages. The first three components of FABS have been already discussed in the earlier sections. This research adopts the BPC steps model, developed in our earlier research [39] (available in appendix D) to map the other components in appropriate places, based on their relevance to the activities of every BPC step. A similar approach has also been utilised by previous researchers (e.g. [84], [85]).

FABS uses the codes to map ASFs for the BPC challenges (including similar and unsolved challenges), according to the activities of every step. For example, as illustrated in FIGURE 6, 'EC-UC' as a success factor for 'Economic conditions and Cost (EC)', is mapped to present 'understanding costs, ROI, and providing cost structure; representing the value of spending money over integration and BPC to stakeholders and agencies, using KPIs and real measures'. Thus, based on this meaning, it should be mapped in three BPC stages, as follows:

- 'Comprehension', because the cost of each business process is analysed at the business process level of this stage (see appendix D);
- 'Preparation', because as argued by [39], all the information regarding the change should be given to stakeholders at this stage;
- 'Design', because another cost analysis is carried out during feasibility analysis in this stage.

Similarly, the ASFs for all BPC challenges in SCD are mapped across the BPC stages, to create FABS. Nevertheless, some of the success factors cannot be mapped in the BPC stages, because their tasks for changing city processes cannot be performed during any of the BPC activities. Thus, it is important to accomplish these activities before the first BPC stage. For instance, 'readiness of smart policies and regulations (F-PRR)' is a success factor that must be addressed before the comprehension stage, to address the 'foundations' challenge. Moreover, reconsideration of some already mapped success factors should be performed before the comprehension stage. For example, 'prevent and avoid risk (GL-R)' is applicable in the comprehension, design, and implementation stages, because of the following reasons:

- The necessity for precisely understanding and following every stage of BPC
- Top management support and commitment of all stakeholders
- Inter-communication among all the sectors and people involved in BPC, such as managers, leaders, and staff
- Work on staff culture, convincing them to generate new ideas and solutions and share their knowledge
- Teaching all the involved people regarding the success factors and the necessity of avoiding risk to address the 'governance and leadership challenge

However, GL-R includes another success factor, which is 'structure the city as a whole enterprise to guide, support, and conduct the whole to the change'. Thus, this should be accomplished before the comprehension stage. Hence, a new BPC

TABLE 9. Unsolved BPC Challenges in SCD and their success factors.

Unsolved Challenges	Success factors
Managers' hastiness	- Determining and understanding the targets and the way to achieve them, including the transitions, stages and distributing the stages to particular timeframes, including the BPC plan in the main national strategy and plans (GL/MH/F-SGE) - Clarifying and explaining the whole SCD and BPC projects, and the importance of every stage and component for the managers/authorities (MH-C) - Assuring current managers and authorities that their efforts and contributions will be acknowledged (MH-Ack) - Short-term results/wins should be seen by people (PR/MH-P) - Addressing people-related challenges (MH-ALLPR)
Vertical policies	- Emphasising the fact that every city is different; thus, the vertical policies should not be dictated to every city by the government. In other words, having an adaptable national strategy that can be made to fit the strategy for each city (VP-NOD) - Giving more power to local authorities (VP-PLA) - Eliminating centralisation (VP-EC) - Unification between municipal authorities and high-level leaders (VP-UAL) - Policy integration (VP-PI): horizontal, sectoral, vertical, and whole integration - Developing demand-driven, citizen-centric, service-oriented policies (VP-DP) - Comprehensive vision for SCD (VP-V)
Contracting	- Avoiding long-term contracts (CNT-NOL) - Appropriate writing of the contracts to support SCD and future city's objectives (CNT-WTS) - Enhancing the capacity of managing the contracts (CNT-C) - Enhancing the efficiency of the contracts (CNT-E) by standardisation of contracting rules, competition between contractors, and training and professionalism of the involved staff
Foundations	- Preparing technological infrastructures within and across the sectors (F-TI) - Intra-sectoral capability alignment (F-CAW) - Intra-sectoral automation and integration of business processes (F-IW) - Using BPM tools and techniques such as lean and 6-sigma (F-BPM) - Having a platform to integrate all requirements of the change, having a holistic view of business processes and the relationships amongst processes and other factors such as people, technology, and data; Correspondingly, defining some projects based on these requirements (F-IP) - Having a core strategy in the cities before BPC (F-CS) - Setting the target, roadmap, shared vision, and transition phase (GL/MH/F-SGE) - Establishing business cases and shared investments to secure scalable improvements to agreed outcomes (F-BC) - Understanding priorities (F-P): • Analysing, understanding, and setting the priorities for every city, based on a whole SCD project • Understanding that technology has a low priority • More collaboration between the private sector, local government, and citizens • Citizens' involvement • Developing open, innovative content instead of traditional pre-defined solutions • Setting the target and transition phase for BPC, and then, identifying the priorities as stages • Developing a balance between priorities - Smart policy and regulation readiness (F-PRR) - Infrastructure improvements (F-II) - Identification of funding opportunities and appropriate business model (F-FBM) - Design appropriate architecture (IO/CPX/F-CSA) - Explore appropriate partnerships with private companies (F-PPP) - Impede push from solution providers and technology vendors (F-NOP) - Reconciling internal and external political elements of cities (F-RIE) - Readiness of leadership and organisational transition in structure (F-R)

stage, 'Readiness', is introduced prior to the comprehension. Thus, this study presents seven stages for achieving BPC for SCD (FIGURE 7).

FIGURE 8 illustrates the complete mapping of the success factors for the BPC in SCD, generating the outcome of this research (FABS).

The 'readiness' stage ensures all prerequisites to prepare a city for cross-sectoral BPC are performed. Based on this study's findings, and explanation from earlier researchers (such as [20], [56], [57], [69], [86]), the activities of this stage are listed as follows:

- Understanding infrastructure, technology, and regulatory requirements of cross-sectoral BPC
- Analysing and understanding city regulations and legal policies
- Enhancing intra-sectoral performance in all aspects of BPC, such as systems integration, automated business processes, interoperability, data and process sharing
- Enhancing a city's ICT infrastructure
- Improving relationships between city and national authorities to maximum collaboration level
- Improving relationships between city sectors to the maximum level of collaboration

These activities indicate that there should be no barrier regarding infrastructure, policy, legal, or relationships before commencing the comprehension stage. Thus, this stage is

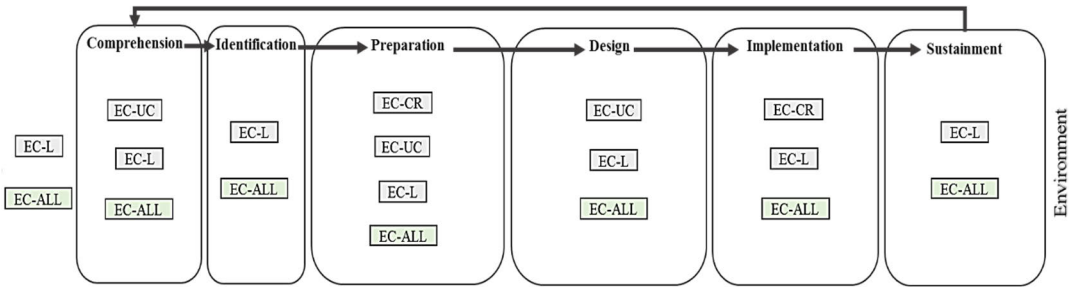

FIGURE 6. Mapping success factors' codes in a preliminary framework for addressing the 'Economic conditions and cost' challenge in SCD.

FIGURE 7. Figure-1: BPC stages for SCD.

necessary to overcome all these issues and make a city ready for cross-sectoral BPC. These activities should be accomplished and complimented by applying the success factors listed for this stage in FABS.

The BPC stages in FABS are represented as a BPC lifecycle for SCD in Figure-1. It means, after accomplishment of the sustainment stage, any additional change/improvement in business processes should be undertaken by a return to the 'comprehension' stage. Moreover, any change required in policies, regulations, infrastructure, or other features of the readiness phase should be performed first.

FABS also shows that the challenges are more significant in some BPC stages. For example, 'vertical policies,' 'contracting,' and 'foundations' are mainly addressed in the 'readiness' stage. Thus, 'readiness' is the most important BPC stage for the challenges in the level of 'provisions'. Moreover, many success factors for addressing 'people-related challenges' should be considered in all stages of BPC. Hence, smart city developers are involved with human issues in the whole BPC lifecycle. Similarly, some other BPC challenges including 'foundations', 'managers' hastiness', 'economic conditions and cost', 'efficiency', 'complexity', and 'interdependencies' have success factors in all BPC stages. In addition, FABS represents relationships amongst the success factors, as well as the BPC challenges. For example, addressing some of the challenges requires some others to be fulfilled first (e.g. addressing 'efficiency' in 'comprehension,' 'preparation,' and 'design' stages, needs all success factors of 'standardisation' to be initially tackled). This is shown by 'E-ALLS' code in the FABS. Therefore, 'standardisation' should be met before 'efficiency'. Furthermore, 'complexity' can be addressed if all other challenges of BPC have been tackled (CPX-ALL). The codes, which represent these kinds of relationships, are shown by green boxes in the framework.

Moreover, as discussed earlier, some success factors are common for addressing some BPC challenges. For example, 'design appropriate CSA' should be considered as a success factor for three BPC challenges of 'interoperability,' 'complexity,' and 'foundations' (IO/CPX/F-CSA). Thus, there is a relationship between these challenges, so addressing any of them supports the others. Whenever these common success factors are repeated within one BPC stage, they are shown in blue boxes in the FABS. For example, IO/CPX/F-CSA is repeated three times in the 'readiness' stage.

Nevertheless, these are some success factors exemplars, which have been explored in this study. Continuous adaption of emerging best practices in the ESI context, as well as utilising the framework in some real SCD projects would identify more success factors that should be mapped to the framework.

The FABS also reveals that the success factors for addressing 'interdependencies' are all about fulfilling four BPC challenges of 'efficiency', 'quality assurance', 'interoperability', and 'understanding city processes'. Hence, this challenge can be eliminated from the framework because it can be automatically addressed by overcoming those four challenges. However, because of the importance of interdependencies in SCD, it is not removed from the FABS.

The proposed framework allows smart city developers to assess their readiness and SCD status by examining their progress in addressing BPC challenges at each stage of the BPC lifecycle. By utilising FABS and addressing the BPC challenges in a cohesive and integrated manner, developers can gain insights into the overall status of BPC for SCD. This understanding enables them to design an effective SCD roadmap. Solution providers can also play a role in supporting the addressing of BPC challenges at each stage by offering tools and techniques that align with the requirements identified by the success factors. Therefore, by utilising the framework for addressing BPC challenges in SCD, the aim of

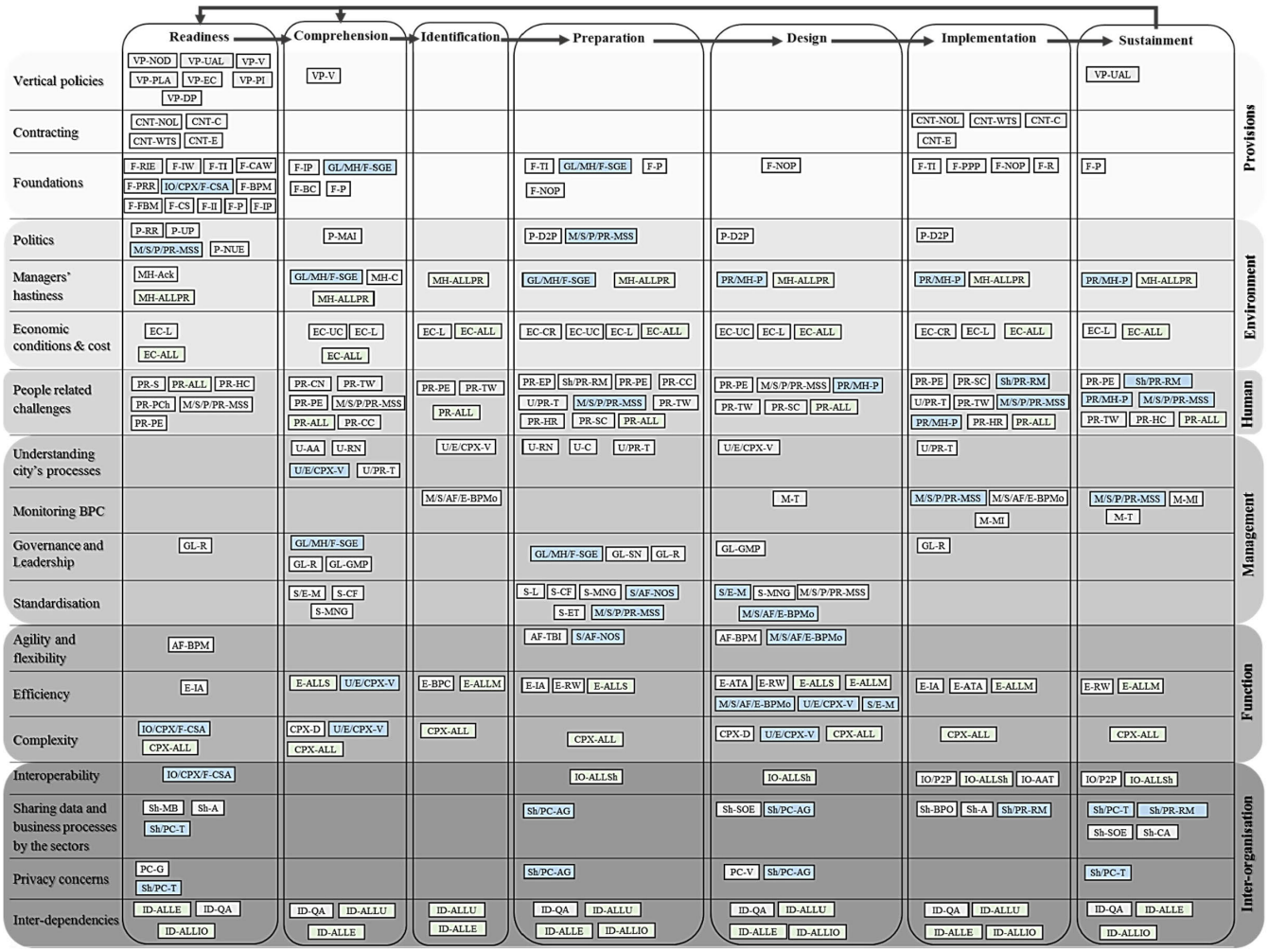

FIGURE 8. Framework for Addressing BPC Challenges in SCD (FABS).

the research has been achieved. Consequently, the validation of this study's findings and FABS is assessed in the next section.

C. VALIDATION (ARRANGEMENT 3)

During the research, the validation strategies explained in III and the first aspect of respondent validation have already been carried out to achieve an empirical layer of the findings. This section is particularly focused on the second aspect of respondent validation, in which FABS is assessed and validated through interviews.

Similar to the data generation phase, for the validation phase, participants were selected from two categories: smart city developers (such as smart city consultants and city authorities/advisors) and solution providers for SCD. To enhance the generalisability of the research, different individuals from those involved in the data generation phase were interviewed. Face-to-face interviews were conducted using a semi-structured approach. A total of 15 interviewees were engaged in discussions regarding the FABS. Based on the research targets and saturation point, this sample size was deemed sufficient.

Table 10 represents the interviewee's experiences by city/organisation. Fifteen interviewees have devoted their smart city experiences to 16 cities and 5 organisations/companies. Although some of them worked in merely one city, a number of them offered their smart city experiences, gained in various cities. In addition, a few of them worked in both population categories.

Table 11 illustrates the participants' roles related to SCD in the cities or organisations.

This validation aims at gathering the participants' opinions based on their SCD experience to assess FABS content, structure, usefulness, applicability, and improvability. The validation began by explaining the FABS development research journey. Then, FABS was presented and discussed with them based on the guiding questions.

As strongly expressed by all participants, the framework properly covers all aspects of BPC for SCD. They also described FABS as a comprehensive, clear, and deep framework. Additionally, it was suggested that FABS is a valuable

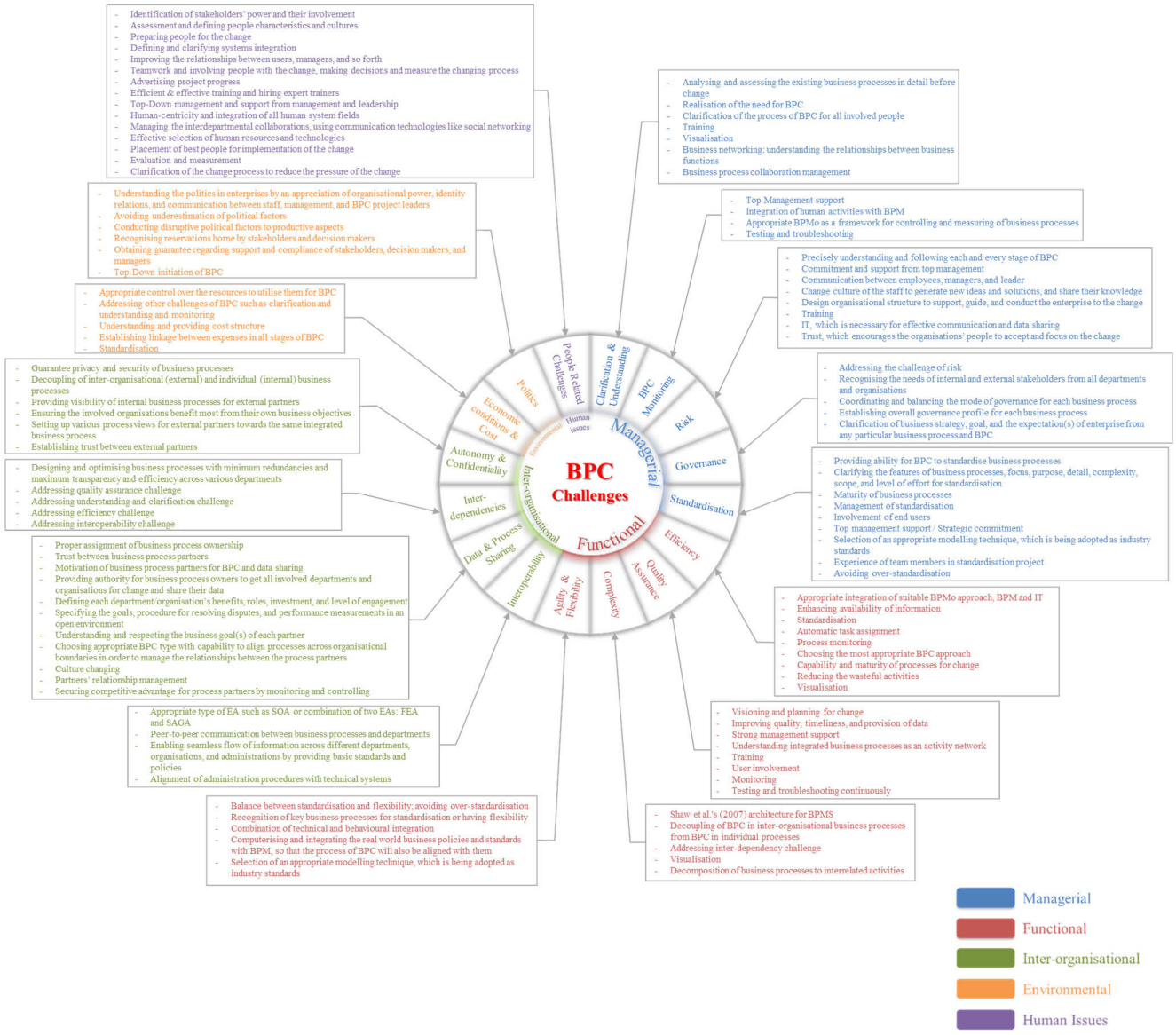

FIGURE 9. A conceptual model for BPC challenges in ESI and their success factors.

guide for smart city developers since it offers a collection of smart city-related opinions from numerous cities around the world. For example, a respondent said:

> *'Such a framework with this kind of structure should be available for all the city managers to see everything together and not miss out on any challenge'.*

Another respondent commented:

> *'It is a very extensive, comprehensive, and well-organised analysis of different indicators for what helps the cities to implement their smart city and structure it'.*

A participant highlighted that the value of this framework lies not in its specific content or success factors for individual cities, but rather in its overall structure and the considerations it encompasses. They emphasized that while the contents and success factors may evolve and become standardized over time, the framework's structure, which includes BPC challenges, stages, and categories, assists decision-makers in identifying and addressing their specific SCD issues and requirements. However, another respondent expressed a different viewpoint, stating that the framework may not directly support decision-making in cities, as decision-makers are often politicians. Nevertheless, they acknowledged that FABS is highly beneficial for comprehending the challenges faced by cities, addressing their existing issues, and conducting analysis, research, and understanding of the current state of cities involved in SCD.

Moreover, another respondent commented:

TABLE 10. Interviewee experiences by city/organisation.

Interviewee No.	Experience in cities/organisations
1	Berlin, Karlsruhe (Germany), Copenhagen (Denmark), Barcelona (Spain)
2	Jiangsu (China)
3	Responscity; Hyderabad Area (India)
4 - 7	Seoul, Korea
8	Kyoto (Japan)
9	Stockholm (Sweden)
10	Madrid, Spain
11, 12	Microsoft; Madrid (Spain)
13	Madrid (Spain)
14	Siemens
15	Boston and Pennsylvania (US), Melbourne (Australia), Kuala Lumpur (Malaysia), Beijing, China, São Paulo area (Brazil); Baumann Consultancy Network, Smart Cities Wheel (SCW).

TABLE 11. Detail of interviewee roles.

Interviewee No.	Smart city consultant	Smart city advisor	Executive board member	Smart city Planner	Founder and Director
1	✓	✓	-	-	-
2	-	✓	-	✓	-
3	✓	-	-	-	-
4	-	✓	-	-	-
5	✓	-	-	-	-
6	✓	✓	-	-	-
7	-	✓	-	-	-
8	-	✓	-	✓	-
9	✓	-	-	✓	-
10	-	✓	-	✓	-
11	✓	✓	-	-	-
12	✓	-	-	-	-
13	✓	-	-	-	-
14	✓	-	-	-	-
15	✓	✓	✓	✓	✓

'The FABS is so useful because it has been created by qualitative research. This is what had to be done for this kind of subject. In addition, the interconnectivity of the contents including challenges, stages, success factors, and levels is very interesting and useful'.

All respondents suggested that FABS is implementable and applicable to SCD. However, most of them said that the framework must be studied and analysed precisely to determine its application in various cities. In addition, it was pointed out that not all parts of the framework would be applicable to all cities, and the smart city developers should recognise the most applicable segments. This opinion confirmed the fact that the framework should be adapted by smart city developers for various cities based on their BPC challenges and SCD progress status. Moreover, regarding the implementation of FABS for the first time, many respondents suggested that it must be implemented in a few small cities, while some other respondents recommended starting from the implementation of some parts of the framework in any city. Both approaches provide an opportunity to have FABS implemented, tested, and practically evaluated. Then, the implementation would be more feasible, because the value would be more visible for smart city developers to 'buy-in' to the use and implementation of FABS. This was advised as the most crucial issue for the implementation of the FABS by many respondents. Moreover, another respondent suggested the following criteria to enhance people 'buy-in' to FABS:

- Having a measurable plan for the FABS implementation
- Constructive thinking and transference of ideas developed the smart city developers and decision-makers, to interpret and resolve the issues faced during the implementation of FABS
- Providing the framework to smart city developers at their SCD planning stage
- Finding people at the right level of leadership to discuss the implementation of FABS

Regarding improvement, one of the key suggestions was to convert FABS into understandable, applicable, and user-friendly application software. Another recommendation was to add some more visualised indicators, such as technological tools, videos, and so forth to the framework. Accordingly, one respondent advised that:

'A user-friendly and easy interface for the FABS should be developed, in order to convert it to an app., to diagnose the current position of the city for SCD, guide smart city developers to continue with their development, monitor, and measure their progress'.

Adding a case study to the framework was suggested by a respondent to improve FABS. This would improve the understandability of the framework. However, as discussed before, it requires at least a pilot city to implement the framework, as pointed out by another respondent:

'Improvement is not about improving the contents academically; it is about making cities to use it'.

Another interviewee said:

'Regarding improvement, I don't see any need of any changes but it can be improved by prioritising the challenges and success factors, to show where are the greater needs for change in the cities (sic)'.

Regarding the latter comment, it should be clarified that FABS can be prioritised for every city, based on their requirements, challenges, plan, and priorities; because every city is different, and not all challenges and success factors for a city would be applicable to another city.

Overall, the opinions in respect of FABS' usefulness, contents, structure, applicability, and implementability support the outcome of this research. Moreover, the transformation of FABS to application software, to make it more tangible

TABLE 12. The BPC success factor codes and a summary of their descriptions.

A	AF-BPM	Computerising and integrating the city policies and standards with BPM, hence, the BPC process will also be aligned with policies and standards. In addition, to align them with the processes in red tape areas, which may not be computerised. In addition, combining technological and modelling techniques, as well as innovative architectures for BPM to enhance flexibility and agility for business processes after the change
	AF-TBI	Technical and behavioural integration; utilising technology as an enabler to provide the technical aspect of this challenge, enhance the accessibility of data, and reduce the complexity of city systems, and combine it with the behavioural aspect of it by utilising professional staff, enhancing their motivations and expertise by training programmes, improving the efficiency of the city administration, and getting support from all stakeholders, especially politicians
C	CNT-C	Enhancing the capacity of managing the contracts
	CNT-E	Enhancing the efficiency of the contracts by - Standardisation of contracting rules - Competition between contractors - Training and professionalism of the involved staff
	CNT-NOL	Avoiding long-term contracts
	CNT-WTS	Appropriate writing of the contracts, to support SCD and future city's objectives, not create issues
	CPX-ALL	Addressing other challenges of BPC in SCD, especially 'interdependency'
	CPX-D	Decomposition of business processes to interrelated activities
E	E-ALLS	Standardisation of city processes, so that all actuals for addressing 'standardisation' are also applied here
	E-ATA	Automatic task assignment to process users in current active city sectors: This success factor can be applied, if similar a WfM system is developed specifically for SCD and utilises cloud-based architectures and scheduling algorithm
	E-BPC	Choosing the most appropriate BPC approach according to legal regulations and policies - Analysis of city processes by professional and trained staff - As city processes are complex and the level of radicalness would be more radical, do not change radically, when it is not required - Regular meetings to discuss the results of analysis and select the best approach on-time - Selected approach to be agreed upon by all stakeholders and involved sectors
	E-IA	Enhancing availability of information: The attempts to enhance and improve availability, accessibility and quality of information for SCD (from sensor technologies, IoT, Big Data, social media, mobile apps, and so on) have abounded by solution providers for smart cities. These also support the execution of BPC for SCD. Previous researchers have also tried to achieve this success factor through their developments, explanations, and frameworks (e.g. Information Framework by Jin et al. (2014), Sensing as a Service by Perera et al. (2014)). They should be utilised for the implementation of this success factor for BPC in SCD. Nevertheless, all BPC-involved people in the cities including stakeholders should also support this enhancement by facilitating the creation, sharing, and application of information based on legal rules and policies, improving communication between sectors, and reducing bureaucracies and barriers
	E-RW	Reducing the wasteful activities by all processes across city sectors
	EC-ALL	Addressing other challenges of BPC, especially understanding city processes, monitoring, and standardisation of business processes
	EC-CR	Appropriate control over the resources to utilise them for BPC; Hence, high priority should have been assigned for SCD and BPC, otherwise competing and complicated priorities in the cities would not allow the implementation. In addition, professional and well-educated human resources should be assigned to BPC projects
	EC-L	Establishing a linkage between costs in all stages of BPC
	EC-UC	understanding costs, ROI, and providing cost structure; representing the value of spending money over integration and BPC to stakeholders and agencies, using KPIs and real measures
F	F-BC	Establishing business cases and shared investments, to secure scalable improvements to agreed outcomes
	F-BPM	Using BPM tools and techniques such as lean and 6-sigma
	F-CAW	Intra-sectoral capability alignment
	F-CS	Having a core strategy in the cities before BPC
	F-FBM	Identification of funding opportunities and appropriate business model
	F-II	Infrastructure improvements
	F-IP	Having a platform to integrate all requirements of the change, having a holistic view of business processes and the relationships amongst processes and other factors such as people, technology, and data. Correspondingly, defining some projects based on these requirements
	F-IW	Intra-sectoral automation and integration of business processes
	F-NOP	Impede push from solution providers and technology vendors
	F-P	Understanding priorities: - Analysing, understanding, and setting the priorities for every city, based on a whole SCD project - Understanding that technology has a low priority - More collaboration between the private sector, local government, and citizens - Citizens' involvement - Developing open innovative content instead of traditional pre-defined solutions - Setting the target and transition phase for BPC. Then, identifying the priorities as stages - Developing a balance between priorities
	F-PPP	Explore appropriate partnerships with private companies
	F-R	Readiness of leadership and organisational transition in the structure

TABLE 12. *(Continued.)* **The BPC success factor codes and a summary of their descriptions.**

	F-RIE	Reconciling internal and external political elements of cities
	F-PRR	Smart Policy and regulation readiness
	F-TI	Preparing technological infrastructures within and between the sectors
G	GL-GMP	Coordination and balance of governance mode for each business process across sectors, to share accountability for the delivery of system-wide outcomes and establishment of governance profile for them
	GL/MH/F-SGE	Development and clarification of an integrated strategy, goal(s), and expectation(s) for every business process and all required changes in any particular city - Allocating appropriate project management - Allocating appropriate budget to ensure effective and transparent delivery of system-wide change - Set the priorities for governance - Specifying the way to achieve the goals
	GL-R	Prevent and avoid risk: - Precisely understanding and following each and every stage of BPC - Top management support and commitment from all stakeholders - Inter-communication between all the sectors and involved people including managers, leaders, and staff - Work on staff culture, convincing them to generate new ideas and solutions and share their knowledge - Structure the city as a whole enterprise with a view to guide, support, and lead the whole to the change - Teaching all the involved people regarding the success factors and necessity of avoiding risk to address the 'governance and leadership' challenge - Trust, which encourages the implementers to focus on the change; especially political managers should trust all involved people and implementers
	GL-SN	Recognition of all stakeholders' needs from all sectors and agencies
I	IO-AAT	Alignment of administration procedures with technical systems and IT governance
	ID-ALLE	Addressing the challenge of 'efficiency'
	ID-ALLIO	Addressing the challenge of 'interoperability'
	IO-ALLSh	Addressing the challenges of 'sharing data and processes'
	ID-ALLU	Addressing the challenge of 'understanding city processes'
	ID-QA	Quality assurance: - Visioning and planning for change - improving timeliness, quality, and provision of data - Strong support from all stakeholders, local and national government - Understanding integrated business processes as an activity network - Training - People involvement - Monitoring - Testing and troubleshooting continuously
	IO/CPX/F-CSA	Design appropriate architecture
	IO-P2P	Peer-to-peer business process communication across city sectors and agencies (interagency collaboration), which can be achieved by the motivation of all involved people, reducing bureaucracies and facilitating collaboration and creating value from collaboration by all stakeholders, especially political authorities and bureaucratic players so that a dialogue between national and local levels is created
M	MH-Ack	Assuring current managers and authorities that their efforts and contributions will be acknowledged
	MH-ALLPR	Addressing people-related challenges
	MH-C	Clarifying and explaining the whole SCD and BPC projects, as well as the importance of each and every stage for the managers and authorities
	M-MI	Motivating people to integrate human activities with BPM, which is adapted for the public sector and SCD
	M/S/AF/E-BPMo	- Appropriate BPMo for complex and bureaucratic city processes; has to be developed based on legal regulations and city policies as a framework for controlling/measuring business processes. In addition, addressing the challenge of 'understanding city processes' is necessary for this adaption - Obtaining support and compliance guarantee from stakeholders, decision-makers, and managers
	M/S/P/PR-MSS	Top management and all stakeholders' support and their strategic commitment, which is one of the significant smart practices for this challenge; In addition, because of the instability of a city's managers, it has to be supported by the government and region/country's development strategies to be consistent
	M-T	Step-by-step testing and troubleshooting of BPC by a team selected from professional staff
P	PC-G	Guarantee privacy and security of business processes: This success factor can be achieved by developing and transforming confidentiality and security rules, as well as SCD-specific data protection policies at national and local levels that also enhance the availability and accessibility of data. Thus, governments and policymakers should think about changing some of the regulatory barriers because they have been written before the emergence of big data and systems integration for cities. In addition, as clarified by some participants and documents in this research, the legislation would not obstacle BPC for smart cities, if data sharing and BPC are aligned with them properly, and the data protection requirements are set beforehand
	PC-V	Providing required visibility of business processes for all stakeholders and involved agencies by setting up various process views for external partners towards the same integrated business process and considering their responsibilities, red tape, and political factors
	P-D2P	Conducting disruptive political factors to productive aspects of them, for example, involving political managers in BPC projects e.g. Assigning them as leaders or advisors
	P-NUE	Avoiding underestimation of political factors

TABLE 12. *(Continued.)* **The BPC success factor codes and a summary of their descriptions.**

	P-MAI	A mixed approach for initiation of BPC in SCD: Jurisch et al. (2012) suggested a top-down approach (to guarantee the feasibility of the change, as well as economic and political support), and Weerakkody et al (2011) and McAdam and Donaghy (1999) believed that bottom-up approach should be carried out (to involve all stakeholders), this research suggests a mixed approach, in order to provide all the benefits
	P-RR	Recognition of reservations borne by stakeholders and decision-makers
	P-UP	Understanding the politics in the cities at local and national levels by - Appreciation and strategic management of stakeholders and agencies' power and looking after whatever makes them interested ('Buy-in') - Recognition and management of legislations, rules, policies, bureaucracies, and red tape - Identification of the relations and communication between stakeholders, agencies, and people
	PR-ALL	Addressing all other BPC challenges in SCD
	PR-CC	Clarifying the process of change to reduce its possible pressure
	PR-CN	Clarification of the need for city systems integration and BPC and defining them
	PR-EP	Explaining the situation, benefits and impacts of SCD and BPC, and preparing people for BPC by the number of meetings, training, and workshops
	PR-HC	Integration of all fields of the human system, human-centricity
	PR-HR	Effective selection of human resources from professional and educated staff and consultants (e.g. try to choose city authorities with business and entrepreneurial backgrounds rather than political); hiring expert trainers
	PR/MH-P	Evaluation, measurement, and advertising of BPC projects' progress and showing the short-term results and benefits to other sectors, in which integration has not yet occurred
	PR-PCh	Assessing and defining all stakeholders, authorities, and agencies' people characteristics, cultures, and elements, which influence their decision, commitment, motivations, and willingness to change
	PR-PE	Engaging all relevant people with the process of change and allowing them to make decisions and evaluate the change process and measure the impact
	PR-S	Identifying all stakeholders' power and their involvement; keeping an eye on any change in them
	PR-SC	Managing collaboration between sectors, businesses, organisations, and citizens (e.g. using communication technologies like social networking)
	PR-TW	Teamwork to review BPC in the cities, sharing knowledge, and other activities of BPC
S	S/AF-NOS	The balance between standardisation and flexibility of city processes and avoiding over-standardisation by understanding and recognising key city processes and level of flexibility and standardisation for them; hence smart practices for understanding city processes are also counted as success factors for this challenge. In addition, as city processes are complex, time-consuming, and bureaucratic, flexibility and agility for BPC and city processes should be provided by simplification of the processes and seeking support from all stakeholders, especially political managers. Moreover, the flexibility of the processes should be aligned with legal regulations and policies
	S-CF	Clarifying the features of business processes, focus, purpose, detail, complexity, scope, and level of effort for standardisation; is crucial in SCD. For example, the focus is on cross-sectoral business processes for the purpose of BPC to integrate city systems across various sectors. In addition, business processes are more complex, so the level of effort for standardisation of city processes would be higher than which in enterprises is
	S/E-M	Maturity of city processes for change
	S-ET	Experience of team members in standardisation projects; training of all involved people is significant as their level of experience is mostly low
	Sh-A	Providing authority (political and non-political) for business process owners to get all involved agencies and organisations for change and share their data and processes. Additionally, enhancing motivation and changing people's culture at the same time, as the commanding heights in the cities would not work as expected
	Sh-BPO	Proper assignment of business process ownership to city sectors and agencies in a way that provides accessibility for other parties, based on their share, benefits, roles, responsibilities, and level of engagement; this should be carried out after the standardisation of city processes, as well as addressing the challenges of 'agility and flexibility', 'complexity', and 'inter-dependencies'
	Sh-CA	Securing competitive advantage for city process partners by monitoring and controlling city processes
	Sh-MB	The motivation of business process partners for BPC and data sharing by explaining the benefits and final outcome of BPC for all stakeholders and agencies, offering analytics for them, and providing examples based on their goals and interests (e.g. bringing agencies who provide services for vulnerable people such as hospitals, police, children's services, Youth Offending together and explaining the benefits and providing examples and motivating them)
	Sh/PC-AG	Explaining and ensuring that stakeholders and the involved city agencies benefit most from their own business objectives
	Sh/PC-T	Providing trust and confidence for people, especially stakeholders and service agencies about the purpose of sharing data, its usage, and storage - Providing confidence for people about the purpose of sharing data, usage, and storage - Underpinning activities that encourage people to provide data, which is needed for changing the processes
	Sh/PR-RM	Improving the relationship between all involved people including the stakeholders, agencies, city managers, authorities, and staff and reducing insularities
	S-L	BPC should act as a standardiser for existing business processes by defining common understanding and language of business processes, their components, terms, synonyms, and so on. E.g. citizen (in city authorities) = patient (in healthcare) = Customer (in retail). This should also be carried out according to all stakeholders' agreement and their control, as well as legal regulations and policies
	S-MNG	Management of standardisation to be carried out completely and implemented by all sectors and involved people, and utilised by all users

TABLE 12. *(Continued.)* **The BPC success factor codes and a summary of their descriptions.**

	Sh-SOE	Specifying the goals, procedure for resolving disputes, and performance measurements in an open environment with the participation of all stakeholders and city sectors; be certain about their involvement with the support of top management and set its priority at the national level
U	U-AA	The analysis and assessment of the existing processes in the city and understanding of the relationships between city functions (function networking): The barriers, such as excessive bureaucracy and red tape, multiple stakeholders, political managers and process design based on legal regulations demand more effort in cities than enterprises to achieve this. In addition, as the city processes are more complex, more time-consuming, and more bureaucratic, analysis and assessment of existing processes should be accurately planned, all stakeholders should be involved, and their advice and opinions should be applied. Also, sufficient time must be allocated for it. It should also be agreed upon by all stakeholders, especially politicians. Moreover, city processes and their specifications should be defined and documented. Also, every process must have a standard description, which is recognised by the stakeholders to avoid naming the same processes differently in a city.
	U-C	Explaining the BPC to all stakeholders, especially politicians, also assuring them about aligning the new processes with legal regulations and policies; this would also increase their motivation.
	U/E/CPX-V	Visualisation of city processes
	U/PR-T	Effective training programmes to be scheduled for all involved people to better understand cross-sectoral city processes and the BPC, as well as educating citizens to use transformed services
	U-RN	Realisation and clarification of the need for BPC; informing the stakeholders and political entities about it and defining BPC for them
V	VP-DP	Developing demand-driven, citizen-centric, service-oriented policies
	VP-EC	Eliminating centralisation
	VP-NOD	Understating the fact that every city is different; thus, the vertical policies should not be dictated by the government to all cities. In other words, having an adaptable national strategy that can be made to fit the strategy for each city
	VP-PI	Policy integration: - Horizontal - Sectoral - Vertical - Whole integration
	VP-PLA	Giving more power to local authorities
	VP-UAL	Unification between city authorities and high-level leaders
	VP-V	Comprehensive vision for SCD

TABLE 13. **Modifier gate for 'Monitoring BPC' (M).**

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
People	The lower level of proficiency of staff	Staff are more proficient in their role
	The lower level of commitment	Higher level of commitment
	Limited motivation for change	Broader motivation for change
	Frequent changes occur in management positions	Managers are usually in their position for a long time
	Multiple stakeholders	A limited number of stakeholders
Process	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	High level of radicalness for 'radical' changes	The level of radicalness for 'radical' changes is low
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency

and understandable by smart city developers and solution providers for SCD is recommended.

VI. CONCLUSION

The research intended to expedite city systems integration through changing cross-sectoral city processes (BPC) for SCD, by developing a framework that can be used as a frame of reference and a guiding tool for decision-makers, implementers, and solution providers for SCD.

The need to address the challenges associated with BPC in SCD required us to first identify the challenges, categorise them, and explore approaches, techniques, success factors, and tools. This research implemented the adaption process to address 14 BPC challenges with an equivalent in the ESI context (so-called similar challenges in this study). The research also explored solutions for addressing BPC challenges, which are specific to the SCD context (so-called unsolved challenges in this study), through analysing the literature, conducting interviews and document analysis. Then, the paper integrated these results, as well as the findings from our previous research to develop a framework for addressing BPC challenges in SCD (FABS). Next, the FABS was

TABLE 14. Modifier gate for 'Governance and Leadership' (GL).

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
	Commanding heights do not work as expected	Commanding heights are relevant and do work
	Limited freedom of funds allocation	Managers are relatively free to allocate funds for various projects
	Competing and complicated priorities	Limited priorities that can always be changed
	Lack of integrated strategies	Strategies are mostly integrated into successful enterprises
People	Lengthier decision making	Quicker decision making
	Nearly all managers are political people	Managers are rarely political
	Frequent changes occur in management positions	Managers are usually in their position for a long time
	Multiple stakeholders	A limited number of stakeholders
System	System of systems	Comprising departments
	Subsystems are big and complex, and they are called sectors, comprising organisations and departments	Sub-systems are the enterprise's departments
	High level of complexity	Low level of complexity
	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

TABLE 15. Modifier gate for standardisation (S).

Difference aspects	City	Enterprise
People	Education (Training) is difficult for all people	Training is easier, and for specific groups of staff
	Frequent changes occur in management positions	Managers are usually in their position for a long time
	Multiple stakeholders	A limited number of stakeholders
Process	Low flexibility of processes	Processes are more flexible
	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency

validated through a qualitative validation process, including interviews.

Addressing one of the significant aspects of systems integration for SCD, the current findings of this research add to a growing body of literature on SCD, ESI, and BPC. In addition, on the subject of smart cities, this research is one of the few studies to develop a framework for supporting changes in city processes for systems integration.

A. CONTRIBUTIONS OF THE RESEARCH

The contributions of this research are described in three categories: theoretical, substantive, and methodological.

1) THEORETICAL CONTRIBUTIONS TO THE BODY OF KNOWLEDGE

While the technological aspects of SCD have been mainly discussed in the existing literature, the findings of this research stressed the significance of BPC and proposed a systematic approach for addressing this aspect of SCD by:

- Proposing a BPC lifecycle for SCD and indicating the activities of every stage by adapting BPC stages in the ESI context and introducing a new stage called 'readiness';
- Identifying and presenting the BPC challenges in SCD and their occurrence, according to the activities of every BPC stage and characteristics of the BPC challenges;
- Postulating success factors for BPC challenges in SCD by adapting the best practices from the ESI context for similar challenges, and identifying several success factors for unsolved challenges;
- Developing a comprehensive and novel framework as a guide for BPC in SCD, namely FABS;

2) SUBSTANTIVE CONTRIBUTIONS

The framework guides smart city developers to realise the BPC challenges that could be confronted during their SCD projects and offers success factors for them. These allow the city authorities and decision-makers to design their SCD

TABLE 16. Modifier gate for agility and flexibility (AF).

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
People	The lower level of proficiency of staff	Staff are more proficient in their role
	High level of political influence on decisions	Limited political influence on decisions
	Limited motivation for change	Broader motivation for change
	Multiple stakeholders	A limited number of stakeholders
Process	Low flexibility of processes	Processes are more flexible
	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	High level of radicalness for 'radical' changes	The level of radicalness for 'radical' changes is low
	Process design is based on legal regulations and policies	Process design is based on company targets and strategies
	Very high level of interdependency	Low level of interdependency
Data	Accessibility of data is limited and time-consuming	Data is accessible
System	System of systems	Comprising departments
	Subsystems are big, complex, and they are called sectors, comprising organisations and departments	Sub-systems are the enterprise's departments
	High level of complexity	Low level of complexity
	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

TABLE 17. Modifier gate for efficiency (E).

Difference aspects	City	Enterprise
People	Lengthier decision making	Quicker decision making
	The lower level of proficiency of staff	Staff are more proficient in their role
	Education (Training) is difficult and it would be for all people	Training is easier, and for specific groups of staff
	The lower level of commitment	Higher level of commitment
	Multiple stakeholders	A limited number of stakeholders
Process	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	High level of radicalness for 'radical' changes	The level of radicalness for 'radical' changes is low
	Process design is based on legal regulations and policies	Process design is based on company targets and strategies
	Very high level of interdependency	Low level of interdependency
Data	Data management is difficult	Data management is easier
	Limited availability of data	Enough data is usually available
	Accessibility of data is limited and time-consuming	Data is accessible
	Data sharing is strongly influenced by government policies and legislation	Data sharing is influenced by the internal policies of the organisation
	The scale of data and information is large	The scale of data and information is small
System	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

roadmap and plan for their city's future. In addition, FABS is a customisable framework for every city based on their challenges and SCD status. In addition, new success factors/best practices for the BPC challenges in the cities can be added. FABS reveals the BPC challenges and their success factors in every stage of city process change. Thus, the decision-makers

TABLE 18. Modifier gate for the BPC challenge of 'Sharing Data and Processes' in SCD.

Difference aspects	City	Enterprise
General	Commanding heights do not work as expected	Commanding heights are relevant and do work
	Lack of integrated strategies	Strategies are mostly integrated into successful enterprises
People	The lower level of commitment	Higher level of commitment
	Nearly all managers are political people	Managers are rarely political
	High level of political influence on decisions	Limited political influence on decisions
	Limited motivation for change	Broader motivation for change
	Multiple stakeholders	A limited number of stakeholders
Process	Low flexibility of processes	Processes are more flexible
	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency
Data	Data management is difficult	Data management is easier
	Limited availability of data	Enough data is usually available
	Accessibility of data is limited and time-consuming	Data is accessible
	Data sharing is strongly influenced by government policies and legislation	Data sharing is influenced by the internal policies of the organisation
	The scale of data and information is large	The scale of data and information is small
System	High level of complexity	Low level of complexity
	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

and authorities for SCD should consider this framework as a guide to determine and understand their SCD status, as well as their city's readiness to implement SCD projects, especially in changing their cross-sectoral processes. FABS can accommodate the priorities of every city, which is becoming smart. This is achieved by recognition of relevant BPC challenges to each city and according to the status of SCD. Thus, the required actions in every BPC stage are determined by the identification of the important challenges in those stages. The status of the city shows when actions should be taken. Then, smart city developers can realise if they have implemented the BPC success factors in every stage or not. Next, they can set their priorities based on the requirements of each stage. FABS provides valuable information for solution providers to redirect their solution developments towards integrating a city system, changing processes and developing tools, techniques, and technological approaches for BPC in SCD, based on the FABS suggestions.

3) METHODOLOGICAL CONTRIBUTIONS

This study utilised a qualitative survey supported by theoretical foundations, such as Bardach's smart practices theory and critical realism philosophy to develop FABS. In addition, it proposed a novel strategy for the validation of qualitative research by combining 'Maxwell's qualitative validity criteria' with 'Wynn & Williams's methodological principles of evaluating the capabilities of actual events to lead action to the outcome in critical realist research'. This was carried out during the data generation and analysis phases, as well as after achieving the research outcome. Based on this approach the empirical layers of the results and FABS were qualitatively achieved.

B. LIMITATIONS

Alike any qualitative research, the small number of participants and generalisability could be considered limitations when compared with quantitative studies. Nevertheless, during all interview phases of this research, the knowledge generated from most of the cities, which are becoming smart (especially the top 10 smart cities) from various geographical locations. In addition, the saturation point was met during the interviews. Thus, the researchers ensured that a sufficient number of interviews were carried out and an appropriate amount of data was collected in this study. Furthermore, document analysis was conducted to complement the interview data. Also, it must be noted that as the cities are in competition for their SCD projects, it is possible that not all the challenges and success factors were shared during the interviews

TABLE 19. Modifier gate for 'Interoperability' (IO).

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
	Lack of integrated strategies	Strategies are mostly integrated into successful enterprises
	Limited motivation for change	Broader motivation for change
	Multiple stakeholders	A limited number of stakeholders
Process	Low flexibility of processes	Processes are more flexible
	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency
Data	Data management is difficult	Data management is easier
	Limited availability of data	Enough data is usually available
	Accessibility of data is limited and time-consuming	Data is accessible
	Data sharing is strongly influenced by government policies and legislation	Data sharing is influenced by the internal policies of the organisation
	The scale of data and information is large	The scale of data and information is small
System	System of systems	Comprising departments
	Subsystems are big, complex, and they are called sectors, comprising organisations and departments	Sub-systems are the enterprise's departments
	High level of complexity	Low level of complexity
	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

TABLE 20. Modifier gate for privacy concerns (PC).

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
	Very large with thousands/millions of residents	The smaller scale with no residents
	Lack of integrated strategies	Strategies are mostly integrated into successful enterprises
People	The lower level of commitment	Higher level of commitment
	Nearly all managers are political people	Managers are rarely political
	High level of political influence on decisions	Limited political influence on decisions
	Limited motivation for change	Broader motivation for change
	Multiple stakeholders	A limited number of stakeholders
Process	Low flexibility of processes	Processes are more flexible
	High level of complexity of city processes	Business processes are less complex
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency
Data	Limited availability of data	Enough data is usually available
	Accessibility of data is limited and time-consuming	Data is accessible
	Data sharing is strongly influenced by government policies and legislation	Data sharing is influenced by the internal policies of the organisation
	The scale of data and information is large	The scale of data and information is small
System	Insularity is highly noticeable	Insularity is less noticeable

or published in the documents. To minimise this limitation, in some of the cities, especially the top 10 smart cities, more than one person was interviewed, and many documents were reviewed.

TABLE 21. Modifier gate for Inter-Dependencies (ID).

Difference aspects	City	Enterprise
People	The lower level of proficiency of staff	Staff are more proficient in their role
	Education (Training) is difficult for all people	Training is easier, and for specific groups of staff
	The lower level of commitment	Higher level of commitment
	Nearly all managers are political people	Managers are rarely political
Process	Low flexibility of processes	Processes are more flexible
	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
	Business processes in the cities are less agile and with lots of redundancies	Business processes are mostly agile and with fewer redundancies
	High level of radicalness for 'radical' changes	The level of radicalness for 'radical' changes is low
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
	Very high level of interdependency	Low level of interdependency
Data	Data management is difficult	Data management is easier
	Limited availability of data	Enough data is usually available
	Accessibility of data is limited and time-consuming	Data is accessible
	Data sharing is strongly influenced by government policies and legislation	Data sharing is influenced by the internal policies of the organisation
	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

TABLE 22. Modifier gate for politics (P).

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
	Lack of integrated strategies	Strategies are mostly integrated into successful enterprises
People	Nearly all managers are political people	Managers are rarely political
	High level of political influence on decisions	Limited political influence on decisions
	Frequent changes occur in management positions	Managers are usually in their position for a long time
	Multiple stakeholders	A limited number of stakeholders
Process	Bureaucracy in the cities is a critical issue	The level of bureaucracy in enterprises is not significant
	High level of complexity of city processes	Business processes are less complex
	Process design is based on legal regulations and policies	Process design relies on companies' targets and strategies
Data	Limited availability of data	Enough data is usually available
	Accessibility of data is limited and time-consuming	Data is accessible
	Data sharing is strongly influenced by government policies and legislation	Data sharing is influenced by the internal policies of the organisation
System	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal

C. RECOMMENDATIONS AND FURTHER RESEARCH

This study concentrated on the systems aspects of developing smart cities and explained the systems integration, as one of the significant elements of this aspect. In addition, the research mainly focused on the 'process' element of systems integration. Therefore, future directions of research must elucidate the technological and social aspects of systems integration for SCD. Feasibly, a similar framework for each of these aspects of SCD is required to put implementers and solution providers in the right direction for their SCD projects. Next, all the frameworks can be combined and integrated as a smart city reference model to provide a holistic view of SCD. This will help smart city developers and solution providers to understand the challenging areas in their SCD roadmap and position the related projects in appropriate domains. Secondly, the study offered a basis for elucidation of the success factors for BPC in SCD that can be transformed into new techniques, tools, and approaches by further research and development. In addition, it is recommended that the research on enhancing these success factors

TABLE 23. Modifier gate for human issues.

Difference aspects	City	Enterprise
General	Excessive bureaucracy and red tape	Less bureaucracy and no red tape
	Commanding heights do not work as expected	Commanding heights are relevant and do work
	Very high customers' power in decision making	Customers have no power in decision making
People	Lengthier decision making	Quicker decision making
	The lower level of proficiency of staff	Staff are more proficient in their role
	Education (Training) is difficult and it would be for all people	Training is easier, and for specific groups of staff
	The lower level of commitment	Higher level of commitment
	Nearly all managers are political people	Managers are rarely political
	High level of political influence on decisions	Limited political influence on decisions
	Limited motivation for change	Broader motivation for change
	Frequent changes occur in management positions	Managers are usually in their position for a long time
	Limited competition in the delivery of services	There is competition in the delivery of services
	Multiple stakeholders	A limited number of stakeholders
Process	High level of complexity of city processes	Business processes are less complex
	Different language for similar business processes	A common language for nearly all business processes within an enterprise
System	Communication between systems is difficult, time-consuming, vertical, and bureaucratic	Communication between systems is easier, quicker, and mostly horizontal
	Insularity is highly noticeable	Insularity is less noticeable

for addressing BPC challenges in SCD is continuously conducted. This enhancement can be achieved by continuous adaption of emerging best practices in the ESI context, as well as by utilising the framework in some real SCD projects. Consequently, FABS would also be enriched. Thirdly, further studies are recommended to design and develop application software, using the developed tools, techniques, and approaches, based on the FABS components. In other words, the FABS should be converted to application software, which allows smart city developers to gain a better understanding of their SCD status and city process change lifecycle and easier designing of their SCD roadmap. Accordingly, further studies should also be undertaken on the characteristics and design of system architecture and web-based platform, for the software application, based on the FABS features and structure. Lastly, FABS should be implemented and tested in some pilot cities. This could enhance the empiricism of the findings and the framework. Then, further research and developments can be carried out based on the experiments' outcomes.

APPENDIX A
A CONCEPTUAL MODEL FOR BPC CHALLENGES IN ESI AND THEIR SUCCESS FACTORS

See Fig. 9.

APPENDIX B
THE BPC SUCCESS FACTOR CODES AND A SUMMARY OF THEIR DESCRIPTIONS

See Table 12.

APPENDIX C
MODIFIER GATES FOR ADDRESSING BPC CHALLENGES IN SCD THROUGH THE ADAPTION PROCESS

APPENDIX C-1
MODIFIER GATE FOR 'MONITORING BPC' (M)

See Table 13.

APPENDIX C-2
MODIFIER GATE FOR 'GOVERNANCE AND LEADERSHIP' (GL)

See Table 14.

APPENDIX C-3
MODIFIER GATE FOR STANDARDISATION (S)

See Table 15.

APPENDIX C-4
MODIFIER GATE FOR AGILITY AND FLEXIBILITY (AF)

See Table 16.

APPENDIX C-5
MODIFIER GATE FOR EFFICIENCY (E)

See Table 17.

APPENDIX C-6
MODIFIER GATE FOR THE BPC CHALLENGE OF 'SHARING DATA AND PROCESSES' IN SCD

See Table 18.

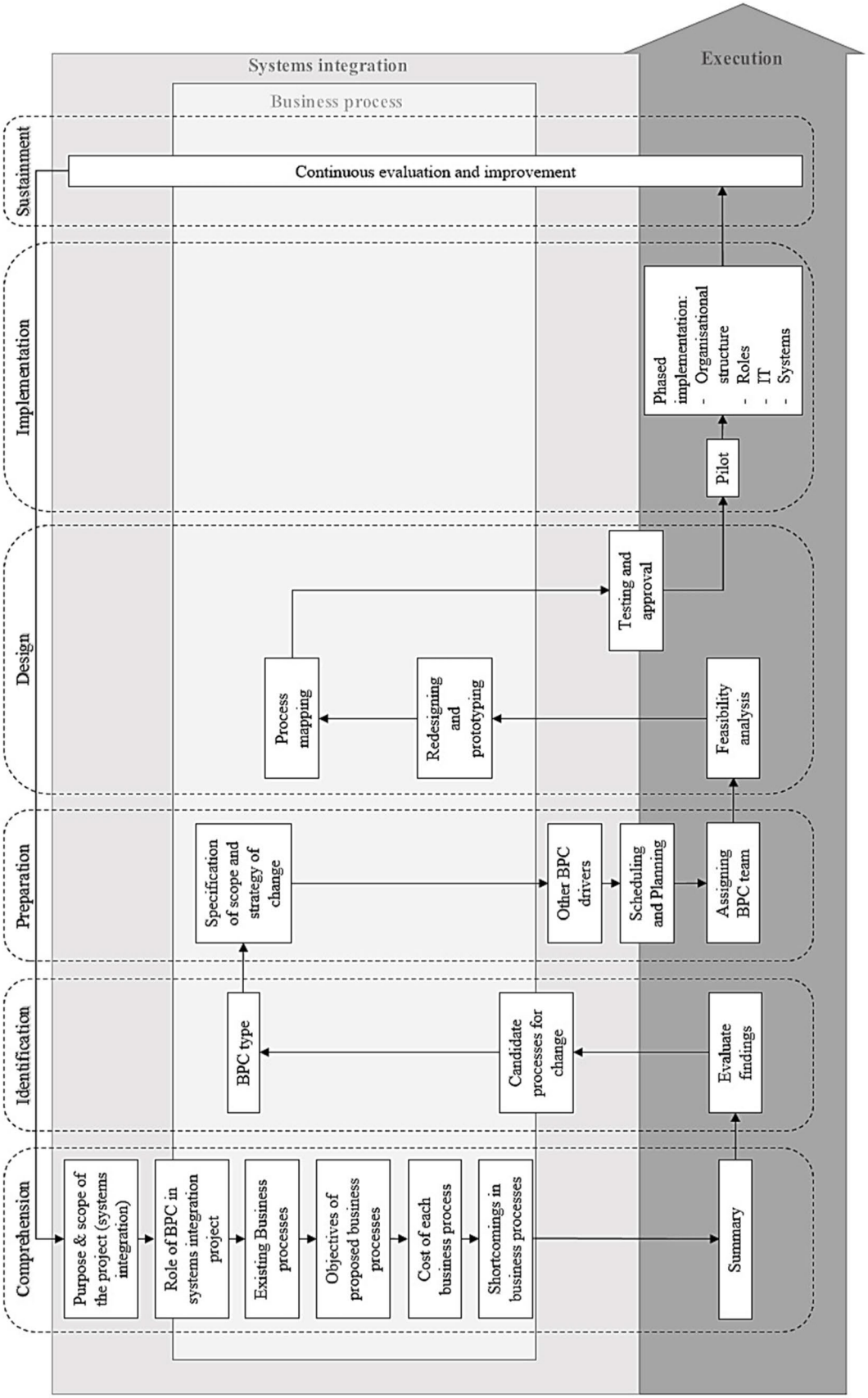

FIGURE 10. BPC steps model (Javidroozi et al., 2016).

APPENDIX C-7
MODIFIER GATE FOR 'INTEROPERABILITY' (IO)
See Table 19.

APPENDIX C-8
MODIFIER GATE FOR PRIVACY CONCERNS (PC)
See Table 20.

APPENDIX C-9
MODIFIER GATE FOR INTER-DEPENDENCIES (ID)
See Table 21.

APPENDIX C-10
MODIFIER GATE FOR POLITICS (P)
See Table 22.

APPENDIX C-11
MODIFIER GATE FOR HUMAN ISSUES
See Table 23.

APPENDIX D
BPC STEPS MODEL [39]
See Fig.10.

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