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Process View to Innovate the Management of the Social Housing System: A Multiple Case Study

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Abstract: All countries recognize the right to adequate housing for all human beings. Yet, in many countries, social housing is in a critical state: most buildings need to be restored and better services should be guaranteed. Such actions should be part of a larger plan aimed to overcome the organizational and technological backwardness of the agencies that manage the social housing system. With a not large, but old public asset, the Italian context may represent an interesting case to start investigating difficulties and problems in the management of the social housing system that, as it occurs in most Mediterranean countries, arise when the public housing rental model is adopted. In the paper, a multiple case study on five Italian regional public Agencies responsible for the social housing system is discussed. In particular, the theoretical lens of process theory and ambidextrous business process management are adopted to study the Agencies' "problematic situation" and identify innovative solutions to address it. The paper contributes to research and practice on process innovation and digital transformation of public administrations: three important lessons are derived and discussed also taking into consideration Industry 5.0, the vision on the future of industry recently proposed by the European Commission. Finally, the adoption of process theory combined with ambidextrous Business Process Management is an underexplored research method in the field of Architecture, Engineering, Construction, and Facility Management (AEC/FM) research. The results reported in the study reaffirm the potential deriving from its adoption also in such a field.

Keywords: social housing; asset management; process theory; ambidextrous business process management; digital transformation; Industry 5.0

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1. Introduction

The management of cities is one of the most important driving forces for the future [1] and a valuable field of experimentation and innovation. In her political agenda, Ms. Ursula von der Leyen, President of the EU Commission, listed social and environmental regeneration of urban areas, including planned maintenance of buildings and restoration of old buildings, as a priority [2]. Regeneration of urban areas is indeed relevant for achieving smart, sustainable, and inclusive growth and should be accomplished by adopting an integrated approach [3].

In this scenario, the social housing system in European cities certainly represents a relevant field of study for its structural and social characteristics. Social housing is a General Interest Objective [4] that can be used to ensure more affordable houses for specific population targets. Although all countries recognize the right to adequate housing for all human beings [5], in many countries social housing is in a critical state [6]: most buildings need to be restored and better services should be guaranteed.

Each European country adopts its own social housing system [7]. Carswell [8] identifies two macro models: one based on public financial support and the other on public housing rental. Whatever the model adopted, the central government and other local authorities are usually responsible for the macro-programming and co-financing of urban renewal programs [9]. In most Mediterranean countries, the social housing system is based on the model of public housing rental; in this case, houses are usually owned by public Agencies and rented at low prices to vulnerable citizens on a (almost) permanent basis. The management of the asset lifecycle is a responsibility of the state or local government.

Italy, which is the focus of this study, represents an interesting Mediterranean case that can be used to start investigating difficulties and problems in the management of the social housing system when the public housing rental model is adopted [10]. The need for maintenance, which is intensified by pollution and climate change, concerns all Italian public infrastructures and the built environment, as well [11]. The collapse of Morandi Bridge in Genoa is an infamous example of a strong need of maintenance from one side and neglect to address that need on the other. As to residential stock, according to the 2001 census of the Italian National Institute of Statistics, more than 60% was built before 1971, so prior to the modern requirements of anti-seismic and energy-efficient design. Such a figure provides a clear measure of the inadequacy of national buildings, including public assets which is less than 4% of the housing stock [12]. Structural and performance characteristics are often inadequate in terms of safety, accessibility, and efficiency [6]. In Italy, regional Agencies manage the social housing system. They own the social housing stock and oversee its design, construction, and management. Unfortunately, in many cases, regional Agencies are unable to deal with the system complexity. The reasons are several. First, although considered central within global development strategies [13], the social housing system is rarely a driver of local development strategies [14]. Since 1990, it has been quite neglected by local development policies [15] in favor of "the dramatic rise in market-driven housing production and prices that began late in the 1990 and continued until the bubble burst in 2007" [16]. Second, in the last twenty years, the amount of government funds available has been reduced and, at the same time, the focus of macro programming moved from the construction of new buildings to maintenance of the old crumbling assets and regeneration of the related public spaces [17]. Both aspects have undermined traditional organizational balances and made the management of social housing more difficult.

As mentioned in Chen et al. [18], maintenance cost represents more than 65% of the total cost of a building during its lifecycle. Hence, the Italian Agencies have difficulties in terms of providing economic resources in maintenance management; they usually act driven by an "emergency logic" rather than based on clear and well-defined development plans of preventive/predictive maintenance. The latter, totally absent in these public Agencies, refers to maintenance activities performed at predetermined periods or based on prescribed conditions to reduce the resort to failure maintenance. Consequently, public assets have deteriorated over time. This is not an Italian peculiarity: in several EU countries, public institutions are used to act in the case of failure rather than based on prevention.

Third, the coexistence of hard and soft interacting sub-systems [19,20] represents another problem. The hard sub-system involves infrastructure and services (e.g., building, public transport, and public spaces), while the soft one includes vulnerable people and several different organizations (e.g., Regions, Agencies, Municipalities, suppliers). The continuous interaction among such sub-systems shapes the transformations [21] that are continuously performed by public Agencies. So means that the Agencies not only have to address the need for revamping (a revamping need must be transformed into a renovated building) rent houses (a house must be transformed into a rented house) but also have to address citizens' needs (e.g., need for a house, a heating system or inclusion needs).

Starting from these premises, the study aims to (i) better understand the "problematic situation" [21] that affects the Italian regional public Agencies and (ii) provide innovative solutions to improve the management of the social housing system. In doing that, the theoretical lens of process theory [22] and ambidextrous Business Process Management [23]

are adopted and a multiple case study allows to get interesting insights into the complexity of the social housing system and how to manage it. The processes carried out by the Agencies are identified and analyzed, the attendant as-is models are developed, and the process criticalities are identified and classified. Also, in the attempt to standardize the work carried out by the Agencies, a unique high-level as-is process model is developed with the support of five discussion panels. Finally, a to-be process model for the maintenance process is developed.

The paper contributes to research and practice on process innovation and digital transformation of public administrations (and private organizations): two important lessons are derived and discussed also taking into consideration Industry 5.0, the vision on the future of industry recently proposed by the European Commission. Finally, the adoption of process theory combined with ambidextrous business process management is an underexplored research method in the field of Architectural, Engineering, Construction, and Facility Management (AEC/FM) research. The results reported in the study reaffirm the potential deriving from its adoption also in such a field.

The paper is organized as follows. First, the theoretical background (i.e., theoretical lens, methodological approach, and context of the study) and the research design are described. Then, the multiple case study and its main results (as-is process models, process criticalities, and to-be process model for the maintenance process) are illustrated. Finally, after a discussion on the implications and limitations of the study, future research avenues are drawn.

2. Background

In this section, the authors briefly discuss the theory adopted in the study and the context in which it is applied. The reasons why the adoption is relevant are also explained.

2.1. Process Theory and Business Process Management

Process theory describes reality as sequences of events and activities that produce some outcomes [22,24]. Such a representation embodies a detailed description of how the outcomes are achieved that is particularly useful to understand how organizations work and how to improve them [25–29].

Sequences of events and activities can be discovered and graphically represented by leveraging on Business Process Management (BPM), a discipline that deals with concepts, methods, and techniques to manage business processes. According to BPM, a process is a set of interdependent activities that takes an input, adds value to it, and provides an output to an internal or external customer. BPM programs (i.e., adoption of a process view) demand that, once identified, processes are managed based on a life cycle (Figure 1) composed of four main stages, namely discovery and analysis, redesign, implementation, and monitoring [30].

The first stage includes the in-depth study of the as-is process, e.g., discovery of activities, interdependencies, actors, resources, material and information flows, customers, and the identification of process criticalities. Based on that, processes are redesigned, configured in the organization, and executed. During execution, process performance are monitored. Deterioration in performance may prompt the process owner (i.e., the process responsible person) to start up again the cycle. In all the stages, process modelling is quite important. During the analysis, it is used to facilitate process validation. During process redesign, it is used to compare and simulate process alternatives (to-be processes) so as to select the new as-is. During execution, it can be used to create knowledge repositories on who does what and when (process documentation). Process modelling is also needed to digitalize processes, so it reveals crucial for the digital transformation of organizations. There exist several BPM modelling techniques. Among others, Business Process Model and Notation (BPMN) is considered a de-facto standard. Moreover, it is a low code technique: BPMN was developed to be used not only by process analysts and software developers, but also by process actors [30,31].

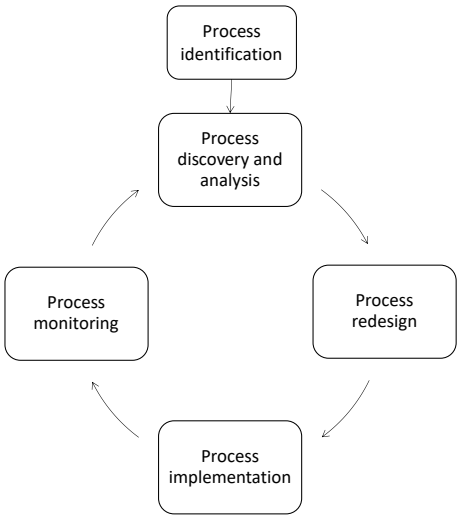

Figure 1. BPM Life-cycle (adapted from [30]).

In the last years, the so-called ambidextrous BPM approach emerged [23]. Such an approach emphasizes process innovation and requires the adoption of both problem- and opportunity-driven redesign. Adopting problem-driven BPM (process exploitation) means redesigning process to address criticalities. So the as-is process is studied, criticalities are identified and then, based on that, process is redesigned. In the case of opportunity-driven BPM (process exploration), process is redesigned to grab an opportunity (e.g., related to new technologies or a new business model) rather than to address a criticality. Hence, in addition to the traditional benefits of exploitation, standardization, or automation, ambidextrous BPM facilitates process innovation [32].

2.2. Social Housing and Process Management

A complete asset lifecycle should start from urban and economic planning and include the design phase, the realization of the assets, the maintenance phase, to end with the refurbishment of the buildings or demolition (and disassembly) [33].

The difficulty of handling the entire asset lifecycle is due to the large number of actors involved, the difficulties in getting funds, the articulated and changeable regulation framework, and the lack of a clear operative vision by all the stakeholders, especially in AEC/FM sector. The operational framework for public institutions and private stakeholders is indeed disorganized and fragmented [34].

All that becomes even more critical in the case of the social housing system. The residential assets of the Italian Regional Agencies (i.e., 107 Agencies responsible for the construction and management of social housing) amounted, in 2008, to 852,938 houses, with a catchment area of about two million people in extreme social vulnerability [35], possibly increased as a consequence of the pandemic. The Italian social housing system is regulated by national and regional legislation and the management requires the accomplishment of several interdependent activities which may involve, among others, public authorities, municipalities and regionally situated bodies, designers, construction firms, suppliers, and private actors. Activities are usually carried out by adopting a functional rather than a process view. In this context, the specific maintenance interventions should be framed in an integrated "program-process" to re-compose an overall vision [36].

The advantages of adopting a process view have been widely recognized in the last decades [37]. However, most of the studies deal with the manufacturing sector. The studies developed in the field of public administration are still very limited [38–40]. Similarly, very few studies deal with the AEC/FM sector, in both public administration and private organizations [41–43]. In the AEC/FM contexts, individuals' experience and traditional methods are mostly adopted, also because employees, whose average age is quite high, show a certain resistance to change the working methods [44]. Recent attempts to introduce

process modelling in the AEC/FM context were carried out by BuildingSMART International Organization [45], the former International Alliance for Interoperability (IAI), a non-profit industrial association established in 1996 and still active today on the founding principles of openness and interoperability in the built environment sector. BuildingSMART discusses the importance of process modelling within the Information Delivery Manual (IDM), a manual that provides the guidelines for information exchange in the digitalization of construction-related processes. Process models are defined as the "means to discover and capture the information content of a business process and how that information is to be exchanged between participants in the process" [46].

To assess the state of the art on social housing and process management, at the end of March 2021 the authors carried out a literature review on Scopus, one of the largest repositories of academic research. A research query was developed by combining process associated keywords ("process management" OR "process theory" OR "business process") with "social housing"; the final query, obtained by applying the Boolean operator AND, was searched into the Sections Title/Abstract/keyword of documents included in the Scopus database. Only six papers were retrieved [47–52]. Snowballing and citation searching techniques were also used, but no further relevant paper was retrieved. After reading the abstracts, three papers were eliminated as irrelevant for the study [48,51,52]. As to the remaining studies, Leblanc et al. [49] adopt process management for UK Housing Associations and develop a very preliminary "planned work process model". Oliva and Granja [50] investigate the issue of collaboration in the process of social housing design by the Brazilian Government. However, in the study, no process view is adopted. Diván et al. [47] discuss the application of business process modelling in public organizations located in La Pampa province (Argentina). Social housing management is one of the three proposed case studies. The strategies adopted to model, measure, and evaluate processes, are described. However, processes are not listed nor analyzed.

The literature review thus confirms that the theoretical lens of process theory has never been adopted and process management is an underexplored topic not only in the AEC/FM sector, but also in the field of social housing research.

3. Research Design

The goal of the paper is twofold: (i) better understand the "problematic situation" [21] that affects the Italian regional public Agencies and (ii) provide innovative solutions to improve the management of the social housing system. To do that, process theory supported by ambidextrous BPM was adopted. To get results more robust, a multiple case study [53] on the five regional Agencies (ARCA) responsible for the entire social housing system in the Apulia Region was carried out. In particular, the study encompassed the following stages (Figure 2):

Stage 1. Data collection (analysis of existing documentation, field observation, and interviews with process actors);

Stage 2. Process analysis (as-is process analysis and modelling, identification of process criticalities) and redesign of the maintenance process to address process criticalities and seize opportunities in accordance with ambidextrous BPM;

Stage 3. Validation (panel discussion and focus groups to get feedback and insights on the study).

Therefore, the processes carried out by the Agencies are identified and analyzed, the attendant as-is models are developed, and process criticalities as well as opportunities are identified and classified. Also, in the attempt to standardize the work carried out by the Agencies, a unique high-level as-is process model (called as Social Housing Process Reference Model) is developed with the support of five discussion panels. Finally, a to-be process model for the maintenance process is developed. Both processes are validated through focus groups and continuous panel discussions.

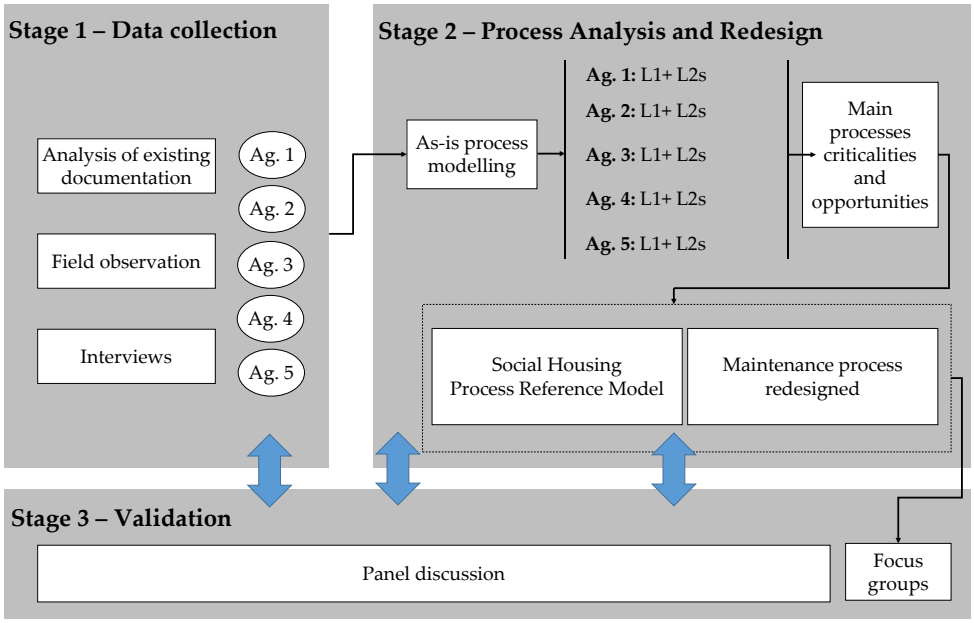

Figure 2. Research Stages.

3.1. Data Collection

Such a stage was aimed to collect data useful to identify the *modus operandi* of the Agencies, the processes carried out and how they are accomplished (i.e., actors and activities, technologies, data and information flows), recurrent problems as well as actors' opinions on innovation opportunities [54,55]. As already explained, such data are needed to analyze a process (Stage 2). Three data collection methods were adopted, namely the analysis of existing documentation, field observation, and interviews with ARCA process actors, i.e., managers and employees working in the technical and administrative sectors of the regional Agencies as well as those who directly interact with them.

As to documentation, the organizational charts and internal regulations were studied. Also, for each Agency the following documents were retrieved and analyzed:

- Regional and National Legislation (common to all the five Agencies).
- "Carte dei Servizi" (Services Charter) and "Statuto" (Statute).
- "Bilancio Sociale" (Sustainability Report) and "Annual Report", which describe the work carried out, human resources, strategic vision, collaboration, and active network.
- Documentation and descriptions reported on the official website.
- Asset information.

As to interviews, a semi-structured protocol composed of 32 open-ended questions was developed to have standard, but flexible guidelines during the interviews. The protocol encompassed four sections (Figure 3), namely General Information, Process, Technology and Knowledge Management, Strategy, and Innovation. Questions reported in the "Section 1" were aimed at better understanding the mission, and the organizational structure (e.g., age, role, and sector of employees). The "Section 2" asked questions useful to understand processes carried out and workflows, information and document flows, and interactions with other actors operating in the same or different organizations (e.g., description of the activities in which the officers are involved, duration of each activity, and interconnection among sectors). The questions, repeated for each process, were formulated based on the Input-Guides-Outputs-Enablers method [56]. The "Section 3" investigated the role of technologies and the modes adopted to manage explicit and tacit knowledge [57] (e.g., external stakeholders involved in processes and interaction modes, technologies and information systems used, and knowledge exchange, mode). The "Section 4" explored the actors' point of view on strategies and innovation opportunities for the Agencies (e.g., willingness to

adopt new technological solutions, priorities and barriers to innovation). Such data were extremely useful for exploring innovation opportunities according to the ambidextrous BPM approach [23].

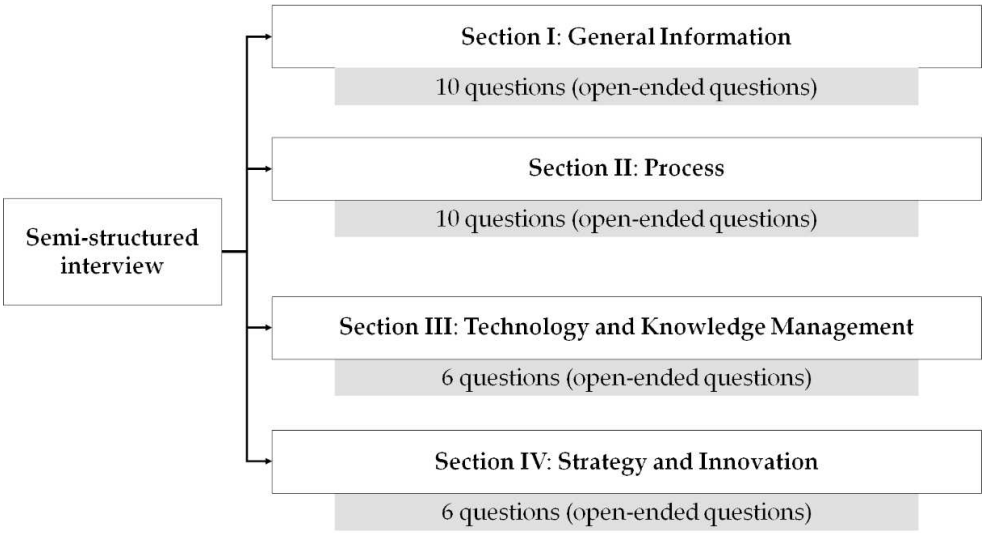

Figure 3. Structure of the interview protocol.

A total of 31 face-to-face interviews were administered in the period March–April 2018. The Sole Administrator, the General Director, and the technical and administrative managers of each Agency were the first persons to be interviewed. They recommended other employees to be interviewed. So, by adopting a snowball sampling technique, new actors were selected and interviewed [58]. The interview process stopped when data collected were considered complete and clear (information saturation). At that point, in each Agency 20% of the employees had been interviewed.

The total interview time was 1526 min (more than 25 h). The average length of interviews was 50 min (minimum: 10 min, maximum 126 min). All interviews were recorded and then digitally transcribed to retain the conversation details. During the interviews, drafts of the process models were drawn and discussed with the actors to obtain prompt feedbacks.

Data collected by document analysis and interviews were integrated with those collected by direct observations of the work carried out within the Agencies. Direct observation was particularly useful to characterize the information flows and the technologies used as well as to better understand the relationships among actors and recurrent problems.

3.2. Process Analysis, Redesign and Standardization

Based on the collected data, processes were analyzed and modelled in BPMN [30] by using the software ®Signavio, a web-based professional BPM app (https://www.signavio.com/).

For each Agency, a draft model of processes was drawn immediately after each interview and then revised and enriched based on a critical analysis of all collected data. These models were discussed with the interviewees. The revisions involved a cyclical procedure: doubts and gaps were addressed/filled by new interviews with the same actors.

Each process model was decomposed into sub-processes. In detail, for each process, two levels of decomposition were considered. Interestingly, similar processes carried out in different Agencies had different names. Moreover, no actors in any of the Agencies had a clear vision of all the processes and activities carried out. For that reason, during this research stage, the authors also developed a unique high-level as-is process model resulting from the generalization of processes carried out of the five Agencies. The authors also studied the processes to identify criticalities and opportunities as required by ambidex-

trous BPM. Based on that, the maintenance process was selected as the first process to be redesigned. Finally, a new model for the maintenance process was developed.

3.3. Validation

As discussed, interactions with process actors were essential to understand the context, develop the as-is process models, identify the actors' perspectives on innovation opportunities [23]. Nonetheless, once the final as-is models and the to-be model for the maintenance process were developed, further validation methodologies were adopted. In particular, panel discussion and focus group methods were the validation methods selected [59].

The panel discussion is a "discussion in which a few people carry on a conversation in front of the audience" [60]. Such a method is inherited from the marketing research where permanent groups are asked to answer questions by direct (e.g., interviews) or indirect communication (e.g., email, video calls). In this study, five panels were built, one for each ARCA, made up of about 10 people belonging to the technical and administrative staff. Interaction with them started during data collection, continued during the development of the first process model drafts, up to the validation of the final as-is process models. Also, the panels were involved in the development of the unique high-level as-is process model which was created based on the process models developed for each Agency, and in the redesign of the maintenance process.

Focus groups are used to collect data through interactive and direct discussions [61]. The collected comments are analyzed to assess the solution quality and determine the expected impacts [58]. Two focus groups were used to validate the high-level process model and the to-be model for the maintenance process. To support the validation and avoid any bias, different alternatives were proposed for the to-be model. Each change in the as-is models was carefully discussed, tasks and activities to be impacted were discussed, possible alternatives and motivations of preferences analyzed. Participants were invited to express their opinion in terms of implementation feasibility and desirability [21] of the proposed models. The first focus group was organized as a unique session with 10 participants from each Agency (profile and experience were evaluated in the data collection stage) and a moderator (one of the paper's authors). All participants had a strategic role in the Agencies and were already familiar with the research topics because they had been previously interviewed. The second focus group involved the Housing Policies Director of the Apulia Region and her staff. In this case, the goal was to assess the possibility to standardize the processes carried out by the Agencies starting from the high-level process model also to make simpler the relationships between the Agencies and the Apulia Region. Two days before each focus group, models to be discussed were emailed to the participants to let them examine the documents to be discussed. During each focus group, the models were first presented by a moderator (one of the authors of this study). Each presentation took approximately 20 min. Then, participants were invited to ask questions and discuss the validity of the models. Specific questions were asked to investigate the consistency among the process models and real processes (semantic validation of the models). The focus group sessions were recorded and analyzed.

4. Multiple Case Study

The multiple case study encompassed the five Regional Agency for Housing and Services (ARCA—*Agenzie per la Casa e per l'Abitare*) located in the Apulia Region, namely: ARCA Puglia Centrale for Bari Metropolitan city, ARCA Sud Salento for the province of Lecce, ARCA Capitanata for the province of Foggia, ARCA Nord Salento for the province of Brindisi, and ARCA Jonica for the province of Taranto (Figure 4).

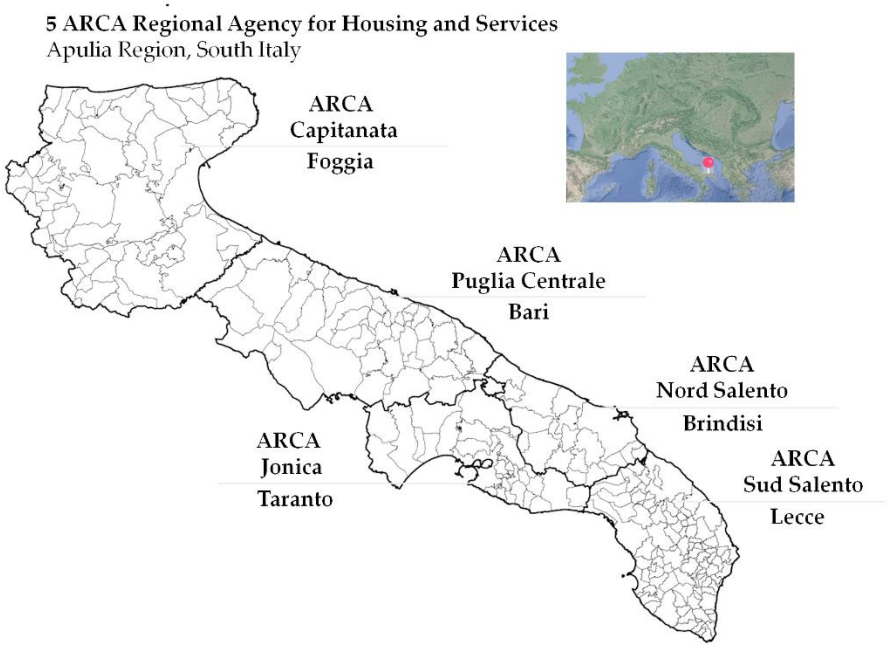

Figure 4. ARCAs: geographic locations.

The Agencies have overseen the regional social housing system for more than a hundred years and, in total, manage about 54,600 public houses, many of which are old (about 40% of the houses are over 40 years old) and characterized by structure, energy consumption, and quality-related problems. The Agencies own the assets and are responsible for their entire lifecycle, including the management of the technical and administrative aspects and the rental to vulnerable citizens. The Agencies depend on the Apulia Region for the political vision, strategic choices, and economic funds, but are autonomous from the technical and organizational point of view. All Agencies adopt a functional structure; existing roles are the same for each Agency. The number of employees, municipalities where the assets are located, and the number of houses managed by each Agency are shown in Figure 5.

Apulia Region public body

ARCAs	Puglia Centrale	Sud Salento	Capitanata	Nord Salento	Jonica
employees	123	50	54	29	38
municipalities	41	89	61	20	28
houses	20,861	9 624	11,287	5 789	7 049

about 54,600 houses

Figure 5. ARCAs: structural and asset data.

ARCAs work together with the whole AEC/FM supply chain. They interact with numerous and different actors during the asset lifecycle (e.g., municipalities, external technicians, construction companies, banks).

Each Agency has a Sole Administrator who supervises the work of the Agency, and a General Director who coordinates the managers' activities, thus ensuring unity of action with the political and institutional bodies, and monitors performance (Figure 6). The General Director is also responsible for the objectives, institutional programs, and their achievement. Technical and administrative managers oversee the attendant sectors. Based on the General Director's indications, they organize and manage the employees' work, and take care of all proposals and technical acts. They also coordinate the activities carried out within their sector, have responsibilities for costs, manage human resources and equipment,

and supervise the office managers when specific issues arise. Although similar, the name and number of sections and offices vary from Agency to Agency. Some technical and administrative employees are experienced professionals (D category), others are professionals (C category). Most employees are simple executors (B category). The number of employees per category varies from Agency to Agency and is usually proportionate to the number of assets owned by the Agency.

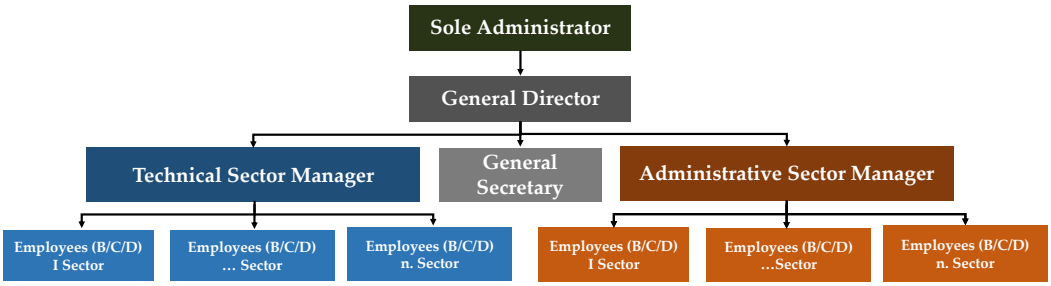

Figure 6. Model of organizational chart of each Agency.

The way to accomplish the work is mostly left to the knowledge and experience of single employees [62]. Rather than processes, employees carry out a set of practices [63]. Apart from those related to legal obligations, there are no established procedures or processes that describe the activities to be carried out and the attendant workflows, document and information flows, and technologies to be used. Moreover, from Agency to Agency same (or similar) practices are differently referred to and managed.

5. Results

As discussed, to investigate the "problematic situation" that affects the ARCAs and provide innovative solutions, the lens of process theory supported by ambidextrous Business Process Management was adopted. In doing so, the as-is process models, main criticalities and opportunities as well as the to-be process model for the maintenance process were developed. Such results are presented below.

5.1. As-Is Process Models

The processes that the Agencies carry out have been classified based on two categories, namely technical and administrative ones. Such a classification resembles the main sectors of the Agencies. The technical sector deals with processes related to the asset lifecycle (i.e., from design to maintenance), while the administrative one deals with bureaucratic issues (e.g., tenant relations, rent management). For each process, the authors have identified actors, activities, procedures, workflows, information and document flows as well as relations with external organizations. Although the goals and procedures are the same, each Agency uses its terminology, approaches, and technologies.

For each Agency, the processes were identified and described, classified, and modelled in BPMN. The use of BPMN facilitated the representation of process workflows and made it possible to clearly show decision-making activities (by inclusive and exclusive gateways), sectors/units and involved organizations (by lanes and pools), exchanged documents (by data flows and data objects), and information storage points (by database symbol). Interdependencies among processes were also identified. Based on them, a high-level as-is process (i.e., as-is model that comprises all the processes carried out and their relationships) was created for each Agency.

The high level as-is models so obtained were analyzed and compared. Despite the differences in the terminology/name of activities/vocabulary, with the panel discussions discussed in Section 3.3, the authors were able to identify the similarities among the five high-level as-is process models. Relationships with external actors were also clearly identified and resulted to be the same for all Agencies. Based on that, a unique high-level as-is process model was developed (social housing process reference model). As mentioned,

such a model resulted from the attempt carried out in the study to generalize processes, standardize the work and create a common vocabulary for the Agencies. The list and a brief description of the processes such a model comprises are reported in Table 1. The BPMN version is reported in Appendix A.

Table 1. ARCAs main processes.

Technical Processes	**Description**
Work Planning	New building planning and/or works on existing buildings as well as the estimation of the time and cost of each intervention
Work Design (further decomposed into: New Construction, Definitive Design, and Executive Design)	Feasibility study, definitive and executive planning
Work Execution (further decomposed into: Tender, Work Supervision, Accounting, and Mandate Payment)	All the operations needed to carry out the planned works
Maintenance with ordinary funds (Self-Maintenance, Self-Management, and Emergency Maintenance)	Planned and unplanned maintenance
Periodic assessment of the assets' conservation state	Survey activities to assess the state of conservation of the assets
Sale	Definition of sale agreements
Maintenance with extraordinary funds	Corrective maintenance with external funds
Demolition	Decision-making and planning for demolition of old and critical buildings
Reconstruction	Evaluation and planning for building reconstruction after demolition.
Administrative Processes	**Description**
Economic and Administrative Management	Administrative and economic management of the Agency regarding both fixed and asset-related costs
Assignment and Accommodation Delivery	Assignment procedures and delivery of housing to tenants
Asset Management	Rental management activities and related administrative procedures
Reassignment	Assignment procedures and delivery of housing to tenants after demolition works

5.2. "Problematic" Situation

The analysis and modelling of the as-is processes of the ARCAs facilitated the identification of the "problematic situation" that affects the Agencies. The critical issues the authors identified are reported in Table 2 and discussed below.

Each Agency organizes and manages the work in its own way. Terminology, methods for document management, work practices and processes, workflows, and technologies are different. That represents a problem for the Apulia Region, which is obliged to interact differently with each Agency and is not able to start and manage any integrated projects. Different forms, deadlines, and information exchange protocols are a problem also for other stakeholders (e.g., builders, suppliers) who operate in the Region and need to interact with different Agencies.

Agencies do not have an overall vision of the entire building lifecycle. The fragmentation of knowledge and data related to buildings among different employees and on different supports is another serious problem that affects the way they work. Employees are used to report relevant data of the buildings on spreadsheets and documents stored on personal computers. Although the reported information can be relevant for other actors,

such files are not shared. That practice makes the management of any interventions on an asset quite problematic.

Table 2. ARCAs critical issues.

Critical Issues
Lack of standardization of the work carried out by the Agencies - Workflows, tools and technologies, even vocabulary, are different from one Agency to another
Lack of an overall vision of the entire building lifecycle - Knowledge and information related to buildings is fragmented - Use of single employees' personal spreadsheets to store pieces of information related to a building - Use of several non-integrated information systems and lack of a centralized database
Lack of coordination - Data and knowledge are not shared - Relevant communication is transferred only informally - Technical and administrative sectors work separately
Use of obsolete technology - Important documents are paper-based or stored in CD-ROMs so the retrieval of results is hard - Absence of any process automation
Inadequate procedures - Maintenance activities are carried out based on "emergency logic"

Another serious problem, strictly related to the previous one, is represented by the lack of coordination (between sectors, within each sector, and among actors). Most communication is informally transferred, during meetings or personal calls. Data sharing between the technical and the administrative sector is an uncommon practice. Information related to a building is extremely fragmented. Again, such problems are caused by the lack of an overall view of what is carried out within each Agency.

Furthermore, obsolete technologies are used. In all Agencies paper documents and CD-ROMs are still largely used to store information. That, in turn, causes loss of information and difficulties in data retrieval.

Finally, some procedures, in particular, those related to maintenance, are inadequate. Maintenance is quite relevant in the lifecycle of the ARCAs' buildings. It is the longest phase in the building lifecycle and has to be cyclically repeated. Unfortunately, it is not managed as a process but, rather, as a project: each time it is managed differently, thus causing a delay in addressing problems, as reported by tenants. Most of the maintenance interventions are managed according to an "emergency logic". The absence of any structured intervention plan creates work overload and inefficiency. Furthermore, information related to each intervention often gets lost because paper documents are stored without adopting any shared logic. As mentioned, over time it becomes quite difficult to find out which works were done, when, and where.

Due to its criticalities as well as to its strategic relevance in the asset lifecycle, in this study, maintenance was selected as the first process to be redesigned. The redesigned model for the maintenance process is discussed in Section 5.3.

5.3. To-Be Process Model for the Maintenance Process

Maintenance process (with ordinary and extraordinary funds) for ARCAs is particularly significant because it:

- involves several players of the AEC/FM supply chain, e.g., construction companies, suppliers, designers, Region, Municipalities, citizens;
- has the longest duration, compared to the entire building lifecycle;
- is characterized by multiple instances that repeat over time for a specific building;
- is deficient in information support (as all the other processes);

- requires huge economic resources, more than those required by other processes.

Because of its relevance in the building lifecycle, the authors decided to redesign such a process as first. According to the ambidextrous BPM [23,64], to innovate the process both the analysis of critical issues and the identification of opportunities were considered.

As discussed in Section 5.2, all processes carried out by the five Agencies—maintenance included—are affected by the criticalities reported in Table 1.

The adoption of a process view and the standardization of processes would help addressing all problems associated with the lack of an overall vision, the interaction with the stakeholders, and the coordination difficulties within the process and among interdependent processes.

Moreover, maintenance activities should foresee both preventive maintenance, not carried out in the as-is process, and corrective maintenance that in turns includes the activities of incidental or emergency maintenance and self-maintenance, already existing in the as-is model, but carried out in a fragmented and disorganized manner. As said in the Introduction, preventive maintenance provides added value to the process because it prevents or reduces failure in the organization of activities in predetermined periods or based on prescribed conditions which is useful in the case of very large assets.

As mentioned, in accordance with ambidextrous BPM, innovation opportunities were also identified and used to support redesign. To do that, technology scouting was first carried out. Based on it, two main opportunities were identified.

The first opportunity regards the centralization of the assets' information according to the Building Information Modelling (BIM), an approach increasingly used to innovate and digitize the entire asset lifecycle. Succar [65] defines BIM as "the process of creating and using digital models for design, construction and/or operations of projects". To do so, three-dimensional informative and parametric models are used to allow all team members (owners, architects, engineers, contractors, and suppliers) to collaborate more accurately and efficiently than using traditional approaches [66,67]. BIM was recently made mandatory for public procurement in many states, Italy included, to innovatively manage the entire asset lifecycle, but only over certain economic thresholds. In detail, all the information related to a specific building is associated with a univocal building ID and is stored in a shared BIM database, which is a three-dimensional informative model containing building information. In the database, all knowledge on the asset (i.e., dimensional, technological, and performance data as well as data related to maintenance works) is organized and stored. All information concerning each building, from design to all maintenance works (i.e., realized in the past, in progress, and planned for future) decommissioning included, is stored in the BIM database. The adoption of the BIM approach requires the centralization of all the information related to each asset, thus overcoming the current fragmentation and the coordination problems within and among sectors. BIM enables the traceability of operations and involved actors, facilitates the digitalization of processes and building data, and simplifies the procedures for information exchange and coordination between actors. In the to-be process model, each Agency is equipped with a comprehensive information system that captures and stores data in an effective (with respect to their retrieval) and efficient way and also pushes data (e.g., by a Business Process Management System) towards those units that need them.

The second innovation deals with the adoption of the Case-Based-Reasoning (CBR) approach to solve new problems based on the solutions found for similar problems already addressed [68]. In detail, a CBR may enhance the Agencies' ability to manage knowledge and facilitate the retrieval of data and documents on successful (or ruinous) past maintenance works, thus facilitating decision-making on new works. The CBR Library database would be linked to the Agencies' database to help retrieve the knowledge about past cases by using BIM protocols and specific attributes. The CBR would indeed enable the retrieval of similar cases (e.g., the solution adopted for a maintenance problem and eventual solutions not adopted) to address new critical cases. New cases would make the

library richer and richer over time. Such an approach is quite diffuse in the manufacturing and aerospace industries.

BIM and CBR are innovative solutions to improve the Agencies' workflows from a technological and technical point of view, enhance performance, and also overcome some of described critical issues.

Table 3 reports the critical issues, solutions, and opportunities of the as-is model as well as improvements implemented in the to-be model.

Table 3. Maintenance processes: as-is criticalities and to-be solutions.

As-Is Processes—Critical Issue	As-Is Process Opportunities/Solutions	To-Be Proces
Lack of standardization of the work carried out by the Agencies - Workflows, tools and technologies, even vocabulary is different from one Agency to another	- Process view - Preventive maintenance (Predictive Maintenance, Condition based maintenance, and Cyclical maintenance) - BIM approach - CBR approach	A standard to-be maintenance process for the five Agencies
Lack of an overall vision of the entire building lifecycle - Knowledge and information related to buildings is fragmented - Use of single employees' personal spreadsheets to store pieces of information related to a building - Use of several non-integrated information systems and lack of a centralized database		Use of a shared Database BIM-based
Use of obsolete technology - Important documents are paper-based or stored in CD-ROMs so the retrieval of results is hard - Absence of any process automation		Use of a shared Database BIM-based Process redesigned exploiting BIM and Case- Based-Reasoning (CBR)
Lack of coordination - Data and knowledge are not shared - Relevant communication is transferred only informally - The technical and administrative sectors work separately		Use of a shared Database BIM-based Creation of a high level process model Process redesigned based on BIM and CBR Adoption of a process view
Inadequate procedures - Maintenance activities carried out based on "emergency logic"		Introduction of Preventive Maintenance also by means of CBR module

The to-be process model for maintenance includes sub-processes that deal with preventive maintenance (with workflows to manage predictive, condition-based, and cyclic maintenance) and corrective maintenance (with workflows to deal with emergency maintenance and self-maintenance). Self-maintenance is a responsibility of the assignees. All other sub-processes should rely on CBR before starting maintenance works so as to streamline resources, and time. The entire maintenance process relies on the BIM database. The to-be process model of the maintenance process is reported in Appendix B.

The BIM technology was indeed implemented, and the process redesigned accordingly. A training program on BIM targeted to employees of the Agencies also started. Due to financial constraints, CBR technology has not been implemented yet.

5.4. Validation Outcome

During the panels' discussions, the moderator perceived a clear change in the attitudes of ARCA employees towards the study itself and its goals. During the first interviews, resistance to providing information and doubts about the usefulness of the research initiative

were showed and expressed by several actors. At the end of the study, the interest in the idea of standardization, possible improvements, and the proposed solutions (including BIM and CBR) was undeniable.

During two focus groups, the response was positive: all participants agreed that the high-level as-is model was valid and useful for all five Agencies. The need to standardize processes among five Agencies and to use the same terminologies, processes, and procedures, as suggested in this study, emerged as common to all Agencies. The first focus group validated the high-level as-is process model. Also, the to-be model for the maintenance process was defined as interesting and inspiring. The addition of preventive maintenance and the introduction of BIM and CBR were considered necessary to improve the process in terms of effectiveness and efficiency.

Similarly, in the second focus group, the Housing Policies Director of the Apulia Region and her team appreciated the results and expressed extremely positive opinions on the utility and the importance of the process view adoption, the recourse to standardization, and redesign of maintenance based on the introduction of BIM and CBR approaches. Two main explanations were provided: the interactions between the Region and the Agencies would be made much easier. In addition, the changes were considered strategic to start a digital transformation program within the ARCAs.

6. Discussion

The research is relevant with respect to both the topic and the approach used.

As to the topic, the urgency of finding new, more effective, and efficient ways to manage the social housing system is confirmed by the increasing number of problems that the Italian regional public Agencies seem unable to address. The study investigates such problems only in five regional Agencies but, considered the state of Italian public assets, similar results may apply to other Italian Regional Agencies. The study has the potential to be replicated both in Italy and in other Mediterranean countries. As some problems—as mentioned in [69]—seems to be common to different countries, the solutions identified in the Italian case could be useful also in other Mediterranean countries.

As to the approach, while largely adopted in other business context, process theory supported by ambidextrous BPM, to the best of the authors' knowledge, has never been used to study the social housing system and is an underexplored approach in the context of AEC/FM. The adopted approach revealed extremely useful to understand the work performed within the Agencies, their "problematic situation", and the innovation opportunities, so reaffirming the potential deriving from its adoption also in such a field. The same approach could be used by any public administration as well as private organization involved in AEC/FM sector. Also, the multiple case study shows how the process view can be used as a vehicle to innovate the social housing system that could prove crucial to facilitate the digital transformation of public administrations. Its adoption may result in a better management of the resources and organizational knowledge, as suggested by Hitt et al. [70] and Ho and O'Sullivan [71]. The use of process modelling techniques can be used to create knowledge repositories on who does what and how, which may prove extremely useful to improve coordination and properly manage the complexity of the asset lifecycle. Processes modelled in BPMN could be easily configured and digitally executed on a Business Process Management System. Adopting a process view would also facilitate the adoption of BIM-based methodologies and technologies. In the last years, the adoption of process modelling in BIM research and practice has indeed grown [72–74], and, in this context, the current study represents an opportunity in the digital transition of the AEC/FM sector. Moreover, the study allowed to exemplify the adoption of the ambidextrous BPM approach [23] in a context wherein resistance to change is quite diffuse and propensity to innovate is low. As described in this study, investigating the criticalities of the as-is processes (i.e., problem-driven innovation) and possible process opportunities (i.e., opportunity-driven innovation) together with the process actors can be particularly productive. In the specific case, it resulted in the proposal to adopt BIM and CBR ap-

proaches, and to implement preventive maintenance policies, in addition to more classic BPM benefits (e.g., standardization, development of an overall vision of the work carried out). More importantly, the multiple case study showed that the adoption of any innovative technologies (e.g., BIM) in an organization should come after an in-depth analysis of the processes wherein the technology is to be implemented. Such an analysis should be carried out together with the process actors and main stakeholders. The involvement of process actors is indeed essential to address the resistance to change and to develop "feasible and desirable" solutions [21]. This is also clearly expressed in "Industry 5.0", the vision on the future of industry proposed by the European Commission [75] to complement and extend the Industry 4.0 paradigm. As mentioned in Bellantuono et al. [76], according to such a vision, any technological transformation should be designed and managed according to human needs rather than being based on purely technical and economic perspectives.

Three important lessons are derived and discussed also taking into consideration Industry 5.0 and can be thus summarized as follows:

(1) the adoption of process theory combined with ambidextrous business process management is an underexplored research method in the field of AEC/FM research. The results reported in the study reaffirm the potential deriving from its adoption also in such a field;
(2) the process view can be used as a vehicle to innovate the social housing system that could prove crucial to facilitate innovation and the digital transformation of public administrations. All innovation interventions need, indeed, to be framed into an integrated "program-process" able to provide an overall vision on what is carried out in the organization;
(3) the analysis and redesign of processes should be carried out together with the process actors and main stakeholders. The involvement of process actors is essential to develop "feasible and desirable" solutions and successfully implement technological innovations.

7. Conclusions

In the paper, a multiple case study on five Italian regional public Agencies responsible for the social housing system is reported. In particular, the theoretical lens of process theory and the approach of ambidextrous business process management are adopted to study the Agencies' "problematic situation" and identify innovative solutions to improve it. The case study allows to get some insights into the complexity of the social housing system as implemented and managed in some Italian regional Agencies. Based on the analysis of the as-is processes carried out by the Agencies, the main process criticalities were identified and classified according to five main categories, namely lack of standardization of the work carried out, lack of an overall vision of the entire building lifecycle, lack of coordination, use of obsolete technologies, and inadequate procedures. Also, the as-is models of all processes were developed and mapped in BPMN. With the support of discussion panels involving process actors, a unique high-level as-is process model was developed (named as Social Housing Process Reference Model). Such a model resulted from the attempt to generalize processes, standardize the work and create a common vocabulary—at least related to the name of processes and sub processes—for the Agencies. Then, because of the relevance for the Agency work, the attention was focused on the maintenance process.

By adopting ambidextrous BPM, a to-be model for the process was developed and, some innovative solutions—i.e., the adoption of BIM and CBR approaches and predictive maintenance policies, were identified and partially implemented.

The adoption of process theory combined with ambidextrous Business Process Management is an underexplored research method in the field of AEC/FM research. The application reported in the study contributes to reaffirming the relevance of the combined approach and stimulates further research in that direction. The paper also presents a multiple case study that contributes to research on process innovation and digital transformation of public administrations. In this respect, the paper presents three main lessons that should

be considered by public administrations as well as private organizations interested to innovate their processes. First, the adoption of process theory combined with ambidextrous business process management in such a field. Second, it is important to frame each innovation intervention into an integrated "program-process" to maintain an overall vision of what is carried out in the organization. Regarding such an aspect, the adoption of a process view may result particularly useful. Third, the involvement of process actors and main stakeholders is essential to identify "feasible and desirable" innovation solutions. Such a lesson resembles the participatory and human-centric approach that, together with the concepts of sustainability and resilience, are at the core of Industry 5.0, the European Commission's vision for the future of the industry.

The study presents some limitations. First, the five analyzed Agencies are located in the same geographical area (Apulia Region). By adopting the multiple case study methodology (so collecting multiple information on each element of the study) we tried—to some extent—to limit the problem. Second (and strictly connected to the first), results, in particular the developed process models, are not generalizable. Yet, considering the state of Italian public assets, similar results could apply to other Italian Regional Agencies and Mediterranean countries with similar public housing systems. Furthermore, the Italian problem seems to be common in several countries [69] and thanks to the detailed description of the research method and steps, the study has the potential to be replicated in other contexts. Third, the study proposes a to-be model only for the maintenance process. Such a decision was made based on the criticality of the process. Future research will deal with the redesign of other processes.

Finally, as to future research avenues, similarly to what is proposed in other contexts [77], the authors intend to extend the research by carrying out more case studies at the national and international levels. The final aim is to identify best practices and, based on that, develop a more general version of the Social Housing Process Reference Model, i.e., a collection of processes models, described at different levels of decomposition, that can be used to support the management of processes carried out in the context of the social housing system.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Social Housing Process Reference Model

https://cpdm.unisalento.it/cem/AppendixA_Social_Housing_Process_Reference_Model_modelled_in_BPMN.

Appendix B. Maintenance Process Redesigned

https://cpdm.unisalento.it/cem/AppendixB_Maintenance_Process_redesign_modelled_in_BPMN.

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