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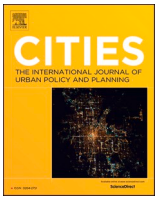

The making of cities after disasters: Strategic planning and the Central Italy temporary housing process

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ABSTRACT

The interest of scholars in the temporal dimension of post-disaster housing has grown in the past decade, but the analytic focus has primarily been around the design and delivery of more sustainable Temporary Housing solutions. However, addressing temporality and promoting Building Back Better in disaster recovery and reconstruction also requires a better understanding of the regulatory and organisational process which produces the post-disaster transitional city. Since strategic planning grows in popularity as a Disaster Risk Reduction (DRR) paradigm, an analysis of its application and outcomes helps capture lessons to inform future housing assistance practices. To this end, the paper reconstructs and analyses the Central Italy temporary housing supply and delivery process. It combines a meta-analysis of published documents and business process modelling to uncover links between policy, society, and space. The results suggest that gaps in strategic planning (related to multi-level governance, process and resource management) are significant explanatory factors for the technical and social clashes highlighted by the analysis. It is emphasised the importance to produce well-informed strategic plans to achieve DRR goals and the potential benefit of adopting the proposed approach to this end, leveraging its capacity to model and simulate the temporary housing supply and delivery process.

1. Introduction

Temporary Housing (TH) is an urban management challenge which calls for a better understanding of TH processes and connected regulatory frameworks to ensure it provides disaster-displaced communities with adequate housing and neighbourhood conditions.

Many researchers pose that TH management issues can be best addressed through pre-disaster strategic planning as shifting TH housing implementation from reactive to proactive, in principle, can help reduce costs, increase speed, improve cultural adequacy, and create public value (Abulnour, 2014; Da Silva, 2007; Edgington, 2022; Johnson, 2007; Krieger, 2019; Sukhwani et al., 2021).

Strategic planning must provide mechanisms for dealing better with change, including through forward thinking and capacity improvement. Pre-disaster TH plans should ensure that the necessary arrangements and resources are in place when their activation is needed, even when the context of the disaster is unknown. What requires establishing standard procedures for implementing TH provision protocols and addressing issues of e.g., organisational design, governance, spatial planning, logistics and stakeholders' coordination as part of disaster preparedness activities (Chang et al., 2010). Strategic plans should also cater for the analysis and assessment of TH operations to support the continuous improvement of future disaster recovery ventures (Sienkiewicz-Małyjurek, 2014).

Although the importance of strategic planning is widely recognised, and even formally codified in countries such as the USA, Japan and Italy, it is still unclear how it contributes to the delivery of quality TH assistance in disaster-stricken cities (Oggioni et al., 2019).

Existing research has mainly discussed the application of strategic planning to emergency management in conceptual terms (Choi, 2008). Although authors relate failures in post-disaster TH response (e.g., after hurricanes Katrina and Ike) to flaws in strategic planning at different governance levels (Sapat et al., 2011), more research is needed to create a solid evidence base for developing policy recommendations.

Only a few empirical studies describe the use and characteristics of strategic planning in emergency management and assess its overall impact on program quality and operational effectiveness (Manning, 2020). Research around TH public procurement is also limited (Tanaka,

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2012) despite pre-set procurement is a key element of strategic planning, which can reduce corruption and enable setting design specifications that meet local needs (Johnson, 2007).

Since "best practices […] only emerge in situations where there is an effort made to glean lessons from experiences" (Greer & Trainor, 2021; p.321) this paper presents a 'catalyst' case study analysis in which the strategic TH plan of an exemplary case in Italy is scrutinised together with its outcomes.

The presented study reconstructs and audits the process of public procurement and delivery of TH, considering how this had been originally planned and was locally implemented post-disaster. It adopts an original *post-mortem* analysis approach based on business process modelling to map the prescriptive process, identify strategic planning flaws, and critically discuss links between TH planning, societal factors, and spatial transformations. Beyond providing insights plus practical recommendations for policy and practice in the analysed case, the paper suggests the opportunity to apply a similar analysis to study other strategic planning experiences in the future to support comparative research trends, which are currently emerging in the field (Edgington, 2022). The proposed approach can facilitate benchmarking and lessons learning in different contexts, which have a longstanding history of managing housing recovery after large-scale disasters through the use of TH.

The article is structured as follows: the research background is presented in Section 2. Section 3 illustrates the analysis methodology and Section 4 the conceptualised process. The analysis results are presented in Section 5. Their implications for strategic planning and policy in a broader context are outlined in Section 6, while conclusions can be found in Section 7.

2. Research background

Following an increase in the number and severity of disasters worldwide, The New Urban Agenda demands a better consideration of contingencies in urban planning (United Nations, 2017). This includes integrating Disaster Risk Reduction principles in direct TH delivery planning, by enhancing preparedness for effective TH response and by 'Building Back Better' in disaster recovery and reconstruction (UNDRR, 2015).

As a matter of fact, TH contributes to the construction of socio-cultural relationships and to the formulation of conjectures on the future of a city, involving heterogeneous sustainability domains (Adeyeye & Albadra, 2008; Rotondo et al., 2020). Therefore, although it is critical to support a swift recovery after disasters, its poor planning can contribute to perpetuate urban vulnerabilities (Alexander, 2013; Boano, 2009; Bolin & Stanford, 1991), by widening social and spatial disparities (Contreras et al., 2017; Imperiale & Vanclay, 2019) and accelerating depopulation processes and economic impoverishment (Alexander, 1989).

The majority of TH management studies, to date, have focused on developing and testing design strategies (Félix et al., 2013; Wagemann, 2017), optimisation models (El-Anwar & Chen, 2016; Pan, 2011), decision-making methods (Hosseini et al., 2016; Kır & Yazgan, 2018) and frameworks (Eid & El-adaway, 2018; Patel & Hastak, 2013), to resolve key decision-making trade-offs associated to TH location, typology, and cost (Perrucci & Baroud, 2020).

Although these represent important contributions, knowledge of the critical decision-making components and processes which determine the success or failure of housing assistance programs is still limited (Fayazi & Lizarralde, 2018; Pezzica, Cutini, & Bleil de Souza, 2021) due to an insufficient understanding of post-disaster urban transition processes (Borsekova & Nijkamp, 2019). What requires further explorations on the process underpinning the making of cities after disasters and connected forms of inhabiting.

2.1. The Italy case

Technical bottlenecks, delays, governance issues and corruption, as well as the long-term permanence of past TH schemes in many areas of Italy (Pezzica & Cutini, 2020) can be associated with a non-systematic consideration of space and time in TH planning (Forino & Carnelli, 2019). Italian TH programs have, in fact, frequently lacked an organic plan linking post-disaster recovery and reconstruction through development (Emidio di Treviri, 2018). Moreover, when a long-term vision was present (e.g., the 'New Messina', the 'city-territory' in Belice, the 'New Towns' in L'Aquila etc.), the political ambitions did not match the available resources and the local socio-economic context (Parrinello, 2020). This led to informal urban growth (in Messina), urban sprawl (in L'Aquila and in Belice) and to the decentralisation of several small historic towns (Irpinia and Molise), eventually generating forms of precarious urban living and physical degradation.

Within this context, applying later corrective planning strategies has often proved hard, due to high costs, planning constraints and conflicts with the occupants. So, pre-disaster TH procurement contracts were explored within the context of a broader reformation of the Italian civil protection system, to enable a prompt activation of resourcing agreements and multi-actor colloborative procedures.

A strategic agreement for the TH supply and delivery known as "*Accordo Quadro*", with validity 72 months (6 years), was first signed by the Italian National Department of Civil Protection (NCPD) and CONSIP in 2016 (CONSIP & NDCP, 2014), just before a first devastating earthquake hit an internal area of Central Italy in August 2016. The subsequent seismic swarm (magnitude 5.5–6.5) invested 139 municipalities and dozens of towns located in an area of 8000 km^2 in the central Apennines encompassing four different regions (Fig. 1). The disaster costed hundreds of human lives, the displacement of 49,844 people (mainly in hotels on the Adriatic coast) and 23 billion and 530 million euros of estimated material damages (NDCP, 2017), making the immediate activation of the strategic agreement necessary. 7782 people applied for a temporary house - called S.A.E., an acronym for housing solution during an emergency - to remain close to their former homes. This required the construction of 228 TH sites (NDCP, 2018a), what was managed mainly by the relevant regional and municipal administrations - as the NDCP assumed an advisory and coordination role - together with the suppliers that had been previously contracted via the "*Accordo Quadro*".

While it is early to draw definitive conclusions regarding the outcomes of the Central Italy TH assistance program, some critical limitations of the "*Accordo Quadro*" have been already identified. Emidio di Treviri (2018) highlights flaws in evaluation criteria, priorities and consideration of technical elements and hence questions its suitability for supporting a timely and contextual TH assistance delivery. Oggioni et al. (2019) note delays and lock-ins in its post-disaster execution, linked to timing, technical, and managerial issues, which cast doubts on the suitability of the strategic plan for managing the response to a large-scale disaster. Moreover, Forino and Carnelli (2019) and Rotondo et al. (2020) pose that many of the temporary settlements already built in Central Italy are likely to become an unplanned permanent presence within a context of growing socio-spatial fragmentation, depopulation, and inequality.

Since no model of the TH supply and delivery workflow existed, previous research mainly provides context-bound and/or subjective insights and cannot offer a comprehensive enough explanation for the identified flaws. To advance understanding of the benefits and pitfalls of strategic planning, the paper analyses the Central Italy TH supply and delivery as a business process, where the 'who', 'what', and 'when' are explicitly mapped *ex-post*, using a standard notation system. This enables shedding some light on what worked and what did not work, by linking specific process components to known issues and by pinpointing additional gaps emerging from the analysis of the model, which deserve attention and improvement.

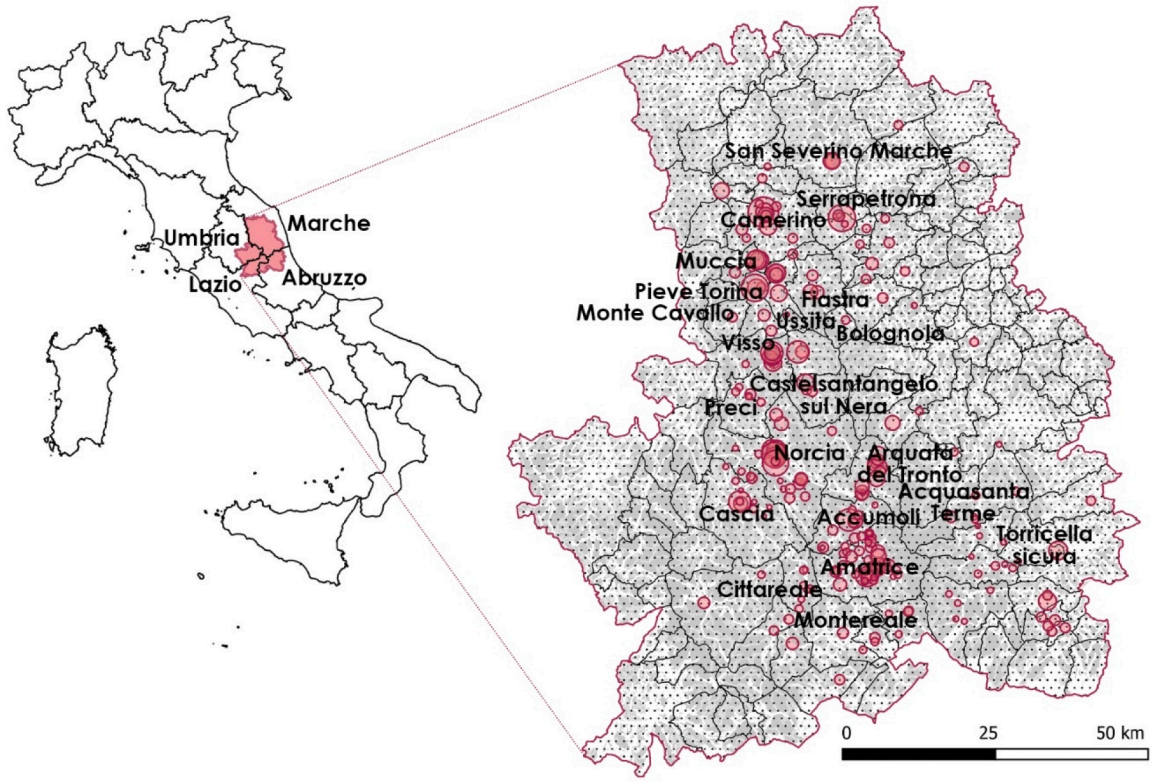

Fig. 1. Seismic crater and TH sites' locations (weighted by number of occupants).

3. Materials and methods

Since strategic planning for TH management is underexplored from an empirical perspective, a *post-mortem* case study analysis is needed to act as a catalyst for further studies. The Central Italy case was chosen for this research because this is where the first Italian strategic agreement for TH supply and delivery was enacted. This is also the latest major disaster in Italy which involved a large-scale deployment of pre-fabricated TH units (see Section 2.1).

The research design combines a formal mapping of the prescriptive 'as-planned' TH supply and delivery process with a qualitative examination of 'as-happened' deviations to analyse - without aiming to be to be exhaustive - critical activities and process components (Fig. 2). To this end, the study exploits business process modelling techniques from process management engineering (Section 3.1) and a meta-analysis of heterogeneous data sources (Section 3.2).

The practical value of transferring methods from business process management to improve disaster response has been discussed by several researchers (Hofmann et al., 2015; Nunavath & Prinz, 2015; Soini & Polancic, 2010), who have noted the common orientation of business and disaster response processes to pursue predetermined objectives. In particular, the analytic capacity of business process management can advance strategic planning through enhanced process automation, quality, and transparency (e.g., via process performance analysis, simulation and optimisation), by modelling activities and assigned responsible organisational units. Although business process models do not describe how coordination between actors is achieved (i.e., methods and tools adopted) and if human resources are overloaded, they explicitly represent data and dependencies between activities and translate multi-actor interactions into an ordered process choreography. What enables identifying issues and patterns plus improve accountability by increasing awareness of the process; allowing proposed changes to be discussed and agreed upon by stakeholders in advance.

Nonetheless, their application in TH management is still underexplored due to the challenges posed by rapid updating procedures which, differently from what happens in the industry, are not routine and consolidated and are executed by several operators unable to provide complete process information. As it happens in certain domains which traditionally operate in responsive mode, in TH management new process models are commonly generated in the field and possibly formalised only later. Strategic plans are also updated after disasters occur to respond to situational changes and environmental constraints. Therefore, some limitations affect the possibility to directly use off-the-shelf business process modelling tools for TH management. These include the difficulty of dealing with unplannable execution contexts (as understanding of the intended course of action for emergency management is often incomplete), a static representation of organisations, and process modelling tools having a fixed terminology and meta-models which could clash with those of humanitarian organisations, potentially leading to confusion and failure (Betke & Seifert, 2017; Peinel et al., 2012).

Such limitations, however, do not apply to an *ex-post* analysis of the TH process. What requires a different approach to both process modelling (exclusive use of official data sources to extract the 'as-planned' workflow) and analysis (qualitative exploration based on all available data sources instead of quantitative simulations). In this paper, the identification of TH management planning issues is the result of a reflective process which encompasses the modelling and analysis of the TH process, where critical issues are associated to:

- ad-hoc sub-processes not clearly formalised, which cannot be modelled.
- blocking activities to which an undefined waiting time is assigned.
- chains of sequential activities where the disruption of one means the process' flow is interrupted.
- loosely defined process components, which do not allow simulating the flow of activities.

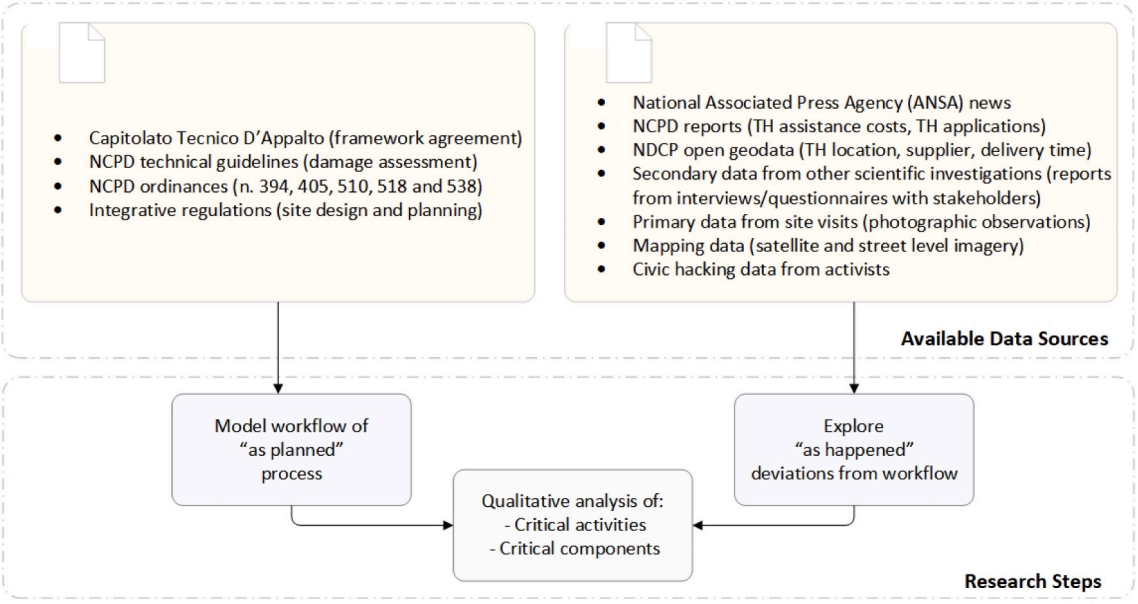

Fig. 2. Research design.

Despite this approach may appear to constraint the analysis to technical and procedural aspects, the way the model is conceived and analysed aims to overcome this limit. For instance, although several elements of the TH supply and delivery process could be evaluated individually and further deconstructed, the complexity of the process representation is kept at a manageable level so that its overall analysis can inform changes in future TH strategic agreements. This choice enables performing an assessment of the process, which - if not exhaustive - is at least more explanatory, as it manages to keep the study in focus. Additionally, it helps overcome difficulties in crystallising processes which are temporally constrained and hard to verify in full with stakeholders in order to enable criticism and ideas for improvement. The meta-analysis supports the modelling effort and enables a nuanced discussion of results via theory-informed interpretation, contextualisation, and triangulation.

3.1. *Business process modelling and notation*

In practice, mapping the TH supply and delivery process as a business process means representing the former as a set of coordinated activities (i.e., units of work that require resources to be performed) executed by organisational units in interaction with partners, which jointly realise a certain goal by passing and creating physical and/or information objects.

Building an explicit representation of this process requires the use of a precise and flexible notation system such as the graphical modelling language known as Business Process Model and Notation 2.0 (BPMN 2.0): a leading standard (ISO 19510), used by most modelling tools for specifying business processes in a flowchart (O.M.G., 2014).

Besides activities, BPMN models events (start, end, boundary, intermediate catching and throwing), connectors and gateways controlling their flow (e.g., approval processes are modelled as event-based gateways). BPMN includes horizontal graphical components called "pools", which represent organisational units, each one undertaking a business process. The assignment of activities to resources is done by placing them in a pool and when a sequence flow crosses a pool (always via message flows) this indicates that a work is handed over to another actor.

A cloud-based service called ®Signavio, was used to create a digital model of the TH supply and delivery process. Among other things, this can perform automatic syntax checks and enable generating multiple process instances from one baseline process model.

3.2. *Meta-analysis*

A meta-analysis was used for providing theoretical grounding and geo-temporal contextualisation to the BPMN workflow reconstruction and subsequent qualitative assessment.

Initially, this required searching for official data sources to generate a sufficiently accurate unbiased description of the TH supply and delivery process 'as-planned' (Section 4), by combing through local regulations, rules, directives, besides conventions and adaptations. What was facilitated by the unprecedented availability of information about public administrations' activities, enforced by the legislative decree n.33 (*Decreto Legislativo 14 Marzo*, 2013) to favour control over the pursuit of institutional functions and the use of public resources. The core technical document used for modelling this prescriptive process is the Capitolato Tecnico D'Appalto (CONSIP & NDCP, 2014). In addition to this, the model was built considering all the relevant ad-hoc NDCP ordinances, i.e. Ocdpc n. 394, 405, 510, 518 and 538 (NDCP, 2016a, 2016b, 2018b, 2018c, 2018d), guidelines (NDCP, 2009) and integrative regulations (Presidenza del Consiglio dei Ministri, 2017), which were promulgated in due course to fill regulatory gaps[1] as a response to emerging issues in the execution phase. These comprise all official documents available at the national level.

Then the 'as-happened' workflow deviations were qualitatively audited using information from the National Associated Press Agency (ANSA, 2017a, 2017b) and the NDPC (2019), open geodata about all TH sites (NDCP, 2018a, 2020), plus secondary information (Goodwin, 2012) such as reports from 17 in-depth interviews and 98 questionnaires with stakeholders (Emidio di Treviri, 2018; Oggioni et al., 2019), among others (Chioni et al., 2021; Rotondo et al., 2020), to represent the widest case history and variety of problems. This, together with civic hacking data (TCI, 2016) and public life photographic observations (Gehl & Svarre, 2013) made by the authors during two field visits in 2019 and 2020 (Figs. 6 and 8), were reviewed to assist results' interpretation and triangulation in discussing gaps between the process 'as-planned' and 'as-happened' following a theoretical saturation protocol that applies to case-study research (Bryman, 2016).

[1] For instance, the strategic agreement capped only the cost of the TH units, but the circular subsequently introduced reference prices for urbanisation works too, together with additional design constraints for TH layouts.

4. Central Italy TH supply and delivery process

The TH process is initiated when the technicians of the local administration receive the request for a TH unit from a resident and is terminated when this is accepted by the requesting person. The modelled activities are grouped according to the following ten steps:

1. TH request logging.
2. TH site proposal elaboration.
3. TH site proposal assessment.
4. Land acquisition and TH supply order submission.
5. TH production and layout proposal.
6. TH site layout proposal assessment.
7. Executive TH site project submission, approval, and TH production.
8. Urbanisation works and foundation construction.
9. TH supply.
10. TH handover to the mayor.

Step 1: TH request logging. Once a TH request is received from a candidate, the local administration (with the support of the NDCP) approves or rejects it based on eligibility requirements for TH assistance and damage survey data. If the request is invalid, it is rejected, and the candidate informed. If the request is valid (i.e., the former house of the displaced person is in the red zone or declared inhabitable in an AeDES assessment[2] with an outcome of E, or F if not quick to resolve,[3] NDCP, 2016a), the applicant is informed, and the request is added to a waiting list.

Step 2: TH site proposal elaboration. After all the needs are assessed, the local administration's technicians elaborate the proposal for the candidate TH site(s), send it to the Regional Administration (RA), and wait for its approval or rejection from the regional offices. If the proposal is rejected, they elaborate a new proposal, otherwise they define the procedure for the TH site land acquisition in agreement with the RA.

Step 3: TH site proposal assessment. The RA receives the TH site proposal from the local administration and coordinates its evaluation. This involves assessing the hydro-geological situation of the proposed site(s) and verifying the need of an evaluation of environmental impact called "*Valutazione di Impatto Ambientale*" (VIA). If the VIA is necessary, they request it, and the required mitigation measures are proposed when appropriate. If the VIA is not needed, only the hydro-geological assessment is considered. If this is negative, a request is sent to the municipality for a new proposal. Before approving a proposal, the RA must evaluate possible associated direct and indirect costs (e.g., due to poor services' availability), including the absence of alternative options. When the proposal is approved, the decision is communicated to the municipality. After confirmation of receipt, the RA defines the land acquisition procedure, together with local authorities and with the support of the NDCP.

Step 4: Land acquisition and TH supply order submission. If the land is already public this step is omitted. If the land is private the expropriation procedure is initiated, and the land is acquired. If the owner opposes the decision of the public administration, he/she can appeal to the regional administrative court, "*Tribunale Amministrativo Regionale*" (TAR), with consequent potential delays. Once the land is acquired, the RA prepares the TH supply order, including the TH site's delivery report, and sends it to the supplier who had signed the binding strategic agreement.

Step 5: TH production and layout proposal. Once the order is received by the supplier, it can be accepted or not; in which case the RA issues the order to a different supplier and applies a penalty to the former.[4] When accepting, the supplier signs the delivery report (which formally hands over the TH site to the supplier) and must submit the design of at least two masterplans with different TH arrangements within 5 natural days together with a weekly construction schedule for approval by the administration.[5] In case of delays or errors the supplier pays a fine.[6]

Step 6: TH site layout proposal assessment. Once the proposed masterplans are received, the municipality, in agreement with the RA, either chooses one and sends the approval to the supplier, or requests amendments/integrations by fixing a new suitable term for the resubmission of the reviewed version. Special requirements and their relative costs need to be computed separately to facilitate the assessment by the administration. Once the layout is approved the communication is sent to the supplier.

Step 7: Executive TH site project submission, approval, and TH production. After receiving the layout approval, the supplier must submit to the RA the executive project of the urbanisation works and TH foundation systems - complete of the necessary environmental and geological surveys and of structures and plants for the TH units - within 20 natural days and wait for approval. After receiving the project, the RA approves it or requests amendments. When the project is approved, the RA prepares the tender for the urbanisation and foundation construction works, specifying delivery modes and time schedule. If the executive project evidences the need for ground consolidation and safety works, these are included in the primary urbanisation bid. The approval of the executive project enables the supplier to start producing the TH units.

Step 8: Urbanisation works and foundation construction. After winning the bid and accepting the job, a third-party constructor starts the execution of urbanisation works. The TH supplier must monitor them and check their compliance to the executive project. If mismatches are found, these need to be reported to the works' direction office (employed by the RA), otherwise the supplier is considered responsible for errors and connected delays. If no-cost amendments to the executive project are needed due to unforeseen circumstances related to the urbanisation works, the public administration requests these to the supplier, who must promptly provide the amendments.

Step 9: TH supply. After receiving communication on the handover of the TH site with the finalised preparation works from the public administration, the supplier has 30 consecutive days to deliver at least 50 % of the TH units ordered and 60 days to deliver all the rest.[7] This involves bringing the units to the site, mounting and anchoring them to the foundations, linking them to the services (for up to 30 m from the perimeter of each unit), supplying the furnishings, communicating the end of the works, providing a certificate of plan conformity, and cleaning up.

Step 10: TH handover to the mayor. Once the TH units are handed over to the public administration, the RA employs a technician to perform a static structural audit and, if the outcome is positive, the administration sends the supplier a certificate attesting the installation has been completed and emits the invoice. Otherwise, the supplier needs to make up for the mistakes. After the invoice emission, the supply process ends, and the TH units' assignment procedure to end users

[2] The damage assessment is the one based on the filling of AeDES forms (NDCP, 2009).

[3] This criterion is established by the NDCP ordinance n.394 which, however, does not give a clear indication of what "quick to resolve" means.

[4] Penalty defined in Article 16 of the technical document (the *Capitolato*).

[5] A general indication for both design and assessment is to assign 200 m^2 of urbanised surface to each TH unit, allowing the supplier the use of more surface but with a price cap.

[6] Penalty defined in Article 13 of the technical document (the *Capitolato*).

[7] Even if less than 4 months pass between the executive project approval and the TH site handover, the supplier must deliver a number of TH units bigger or equal to the 50 % of the total amount requested, within 5 months from the handover, and 100 % of the units within six months from the formal approval date of the executive project. If unjustified delays happen, fines apply.

begins.

The assignment procedure can be only guessed in its general lines as the documents used to build the model do not discuss this part of the process, which is usually managed by the local administration. The BPMN includes a reference to it, to highlight that potential issues and delays may arise whenever the public refuses to occupy the assigned TH units. From this point onwards, the local administration and the occupants need to collaborate to ensure that issues are promptly reported and resolved. However, this part falls out of the scope of this analysis, which ends with the hand-over of TH units to the mayor.

4.1. Modelling assumptions and choices

Building a comprehensive and explanatory model of this process (Annex A), required making the following assumptions and modelling choices:

- The analysis focuses on candidate TH occupants, who send the request for a TH unit[8] to be approved by the public administration,[9] although a technician may do this on their behalf (Fig. 3).
- The model does not consider re-assessments in case of aftershocks, as these are new instances of the same process. It represents one of the many parallel and subsequent cycles which occur after a disaster, and considers the data collected during the corresponding time window.
- The model does not take into consideration cases where less than five TH units are built, which differ from the modelled scenario only in that required urbanisation works are reduced to the essential minimum (i.e., foundations, connection to services and road access).
- The possibility to rent a plot of land from a private owner and return it in pristine conditions is excluded, because this option was ruled out by the 2017 ministerial circular (Presidenza del Consiglio dei Ministri, 2017), which stated that the construction of important urbanisation works would have made this an economically unviable option.
- To improve clarity, the bidding process of urbanisation works appears exclusively managed by the RA, despite evidence that, in certain cases, this task was delegated to the local municipalities (Oggioni et al., 2019).
- The TH site proposal assessment (Fig. 4) is modelled as a collapsed sub-process. Here, a choice was made to evaluate the need of a VIA only after receiving the results of the hydrogeological assessment, because passing the former is compulsory for the approval of a TH site proposal.
- A collaborative pool called “Regional and local administration (with the support of the NDCP)” is created to separate the activities with a higher conflict potential and to avoid the duplication of tasks in the model, which would have made it less readable.

5. The process ‘as-planned’ and ‘as-happened’

Fig. 5 shows the 10 steps in which the process described in Section 4 was subdivided and highlights in different colours where technical clashes have been identified.

Steps ‘external’ to the TH units’ supply process, for which no reference timeframe was established in the strategic plan (Section 5.1), are flagged in red as they exert a high influence on TH delivery time.

Additional issues raising from uncontrolled ad-hoc procedures (e.g., deal with complaints from people and appeals from landowners to TAR), which are flagged in yellow, are linked to an ill consideration of critical process components (Section 5.2), i.e., the role of disaster-affected people and data requirements for process monitoring.

5.1. Critical process activities

This section examines the identified critical process activities: damage and TH need assessment; TH site selection, and land acquisition; TH site layout approval; management and execution of primary urbanisation works.

5.1.1. Damage and TH need assessment

Damage assessment is a crucial element of strategic planning for TH management as it establishes who is entitled to apply for direct TH assistance. However, it presents challenges linked to: (i) area coverage (if the disaster hits a large territory, especially if the area is hard to reach from the outside and there are issues travelling around it); (ii) aftershocks; and (iii) availability of professional volunteers for the entire length of the emergency. In the Central Italy case this step presented difficulties linked to bureaucratic problems, the lack of technicians with the skills required to complete the AeDES[10] forms (Italian acronym for usability and damage in the seismic emergency, NDCP, 2009), and slowdowns due to the effects of the second seismic wave (Emidio di Treviri, 2018). Matters of urgency and the delays provoked by the inefficiency of the AeDES filing system as implemented at the beginning of the emergency, motivated the NDCP (2016b) to change the existing policy and adopt new forms, called FAST, which are quicker to fill out and require only little prior training to use.

5.1.2. TH site selection

The selection of TH sites also has a significant impact on TH delivery time. In Central Italy, around 6 months after the first quakes, the viability of the proposed TH areas – as well as the possibility to minimise their number - was still under evaluation in 16 of the 24 affected municipalities in Abruzzo, in 23 (out of 57) municipalities in Lazio, while comparable delays were reported in the Marche and Umbria regions (Oggioni et al., 2019). In the municipality of Fiastra, the elaboration of the TH site proposal took around 2 months while the approval from the Marche region took another 3 months (Emidio di Treviri, 2018). An important barrier for prompt TH site selection, reportedly, was the lack of suitable (public) areas respondent to TH dimensional and soil safety requirements, such as in the case of Visso and Camerino, which in some cases made further technical assessments or land arrangement projects necessary, with consequent delays (Emidio di Treviri, 2018).

Arguably, connected issues could have been avoided or greatly reduced if preventive measures, such as pre-reserving candidate TH sites (Félix et al., 2015), had been put in place as part of local-level strategic planning. This should have also helped striking a better balance between priorities of landscape ecological preservation and the necessity to support a prompt and equitable disaster recovery.

[8] This is not always the case as people are given the option to request other forms of housing assistance such as cash grants for house renting. This exclusive decision is modelled using a XOR Gateway, known in technical jargon as the exclusive data-based gateway, (diamond with an “X” in it). This component evaluates in order all outgoing sequence flows and enables only that which evaluates to ‘true’ to continue the process.

[9] Checks on the formal correctness of the request are done by the public administration by looking at the submitted documentation and the damage assessment data. Following the check requests can either be approved or rejected. This checkpoint is modelled as an event-based Gateway (diamond with a pentagon), which enables deciding based on events. In the model, each outgoing sequence flow, which exits the gateway needs to be connected to an intermediate catching event (e.g., rejection/approval message received).

[10] AeDES forms have been used in Italy since the 1997 earthquake in Umbria. They were conceived to support a rapid detection of damage, the definition of emergency measures, and to assess the safety of surviving houses or facility buildings with ordinary structural typologies, i.e., masonry, reinforced concrete, steel, wood.

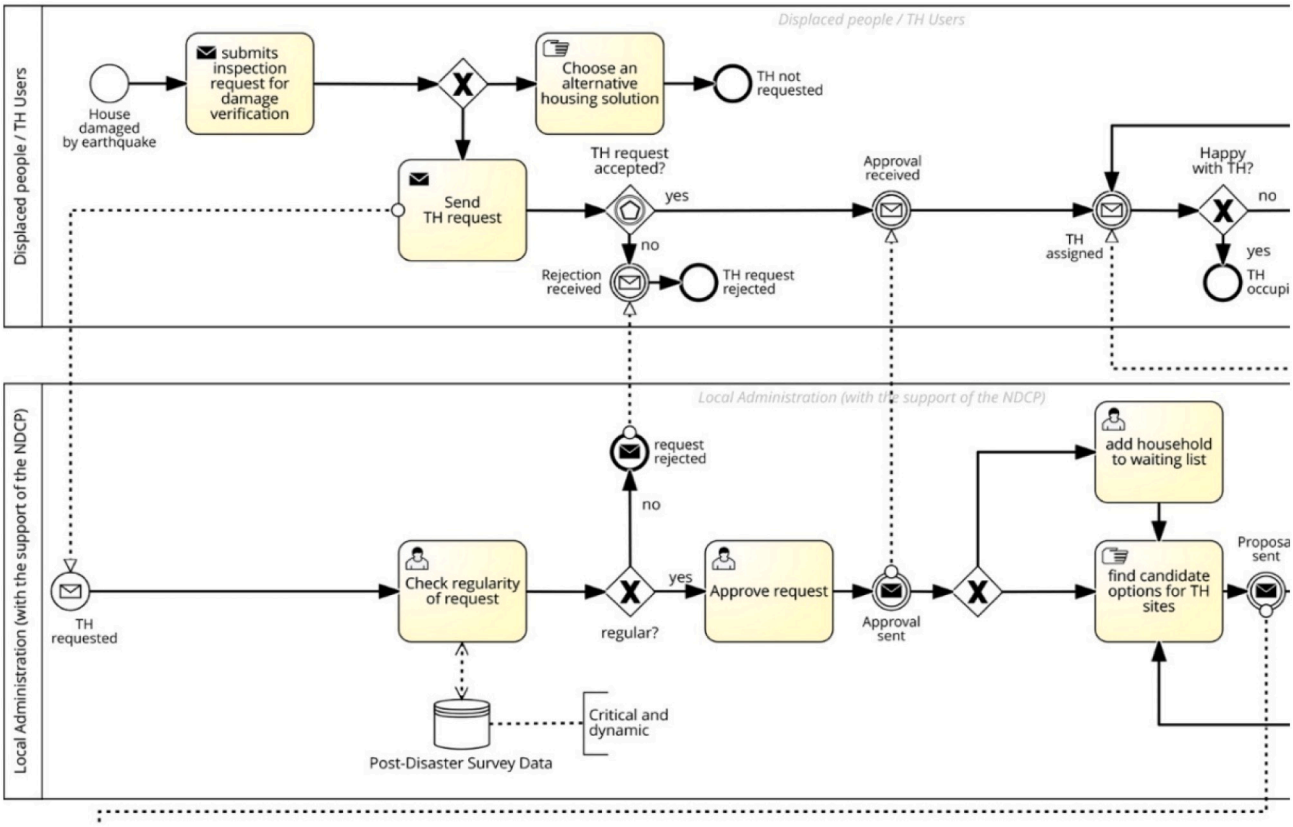

Fig. 3. BPMN 2.0, extract of TH request process.

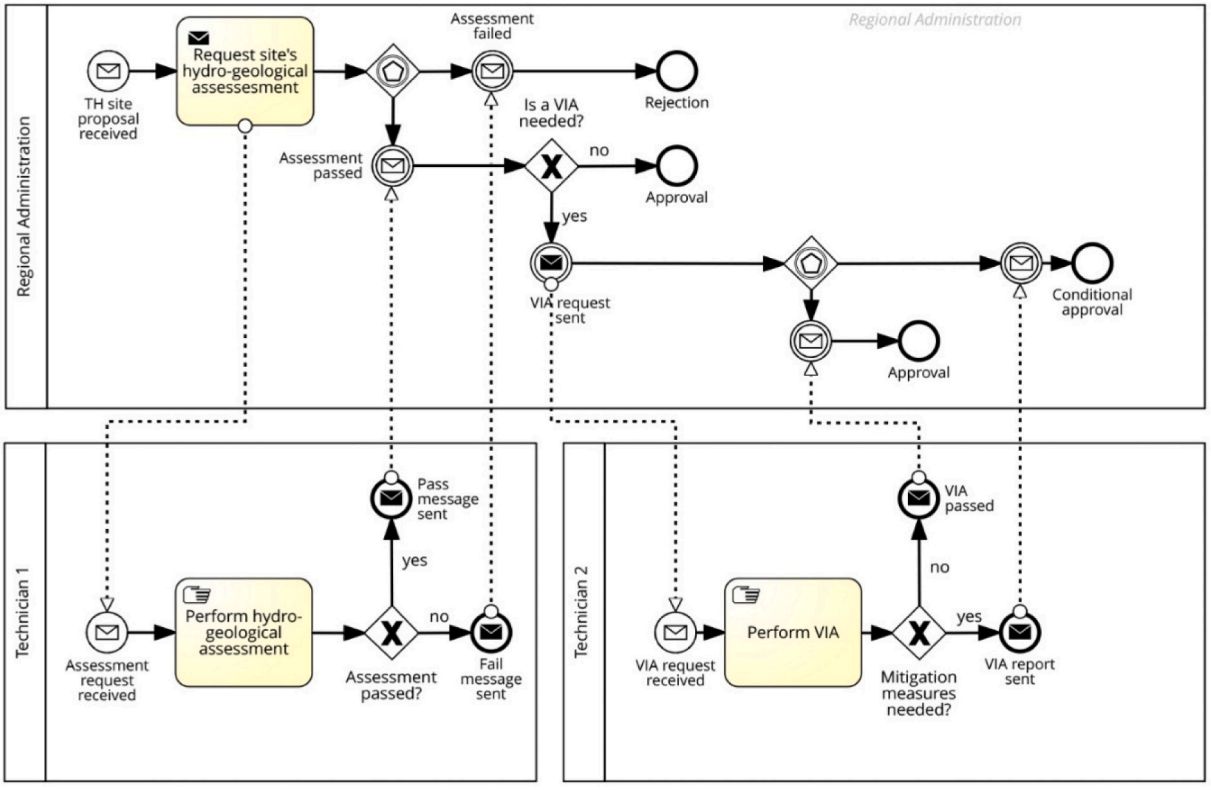

Fig. 4. TH site proposal assessment, collapsed sub-process.

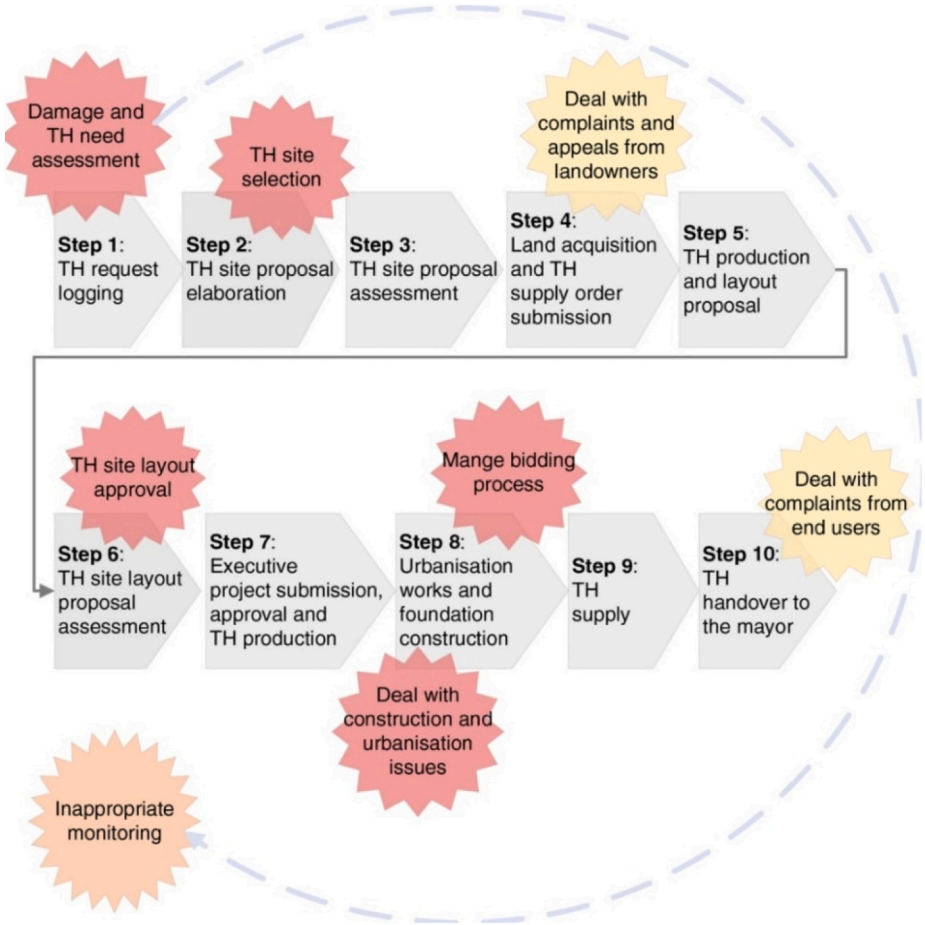

Fig. 5. Critical process activities and components.

5.1.3. TH site layout approval

Further slowdowns can happen during TH site layout approval following conflicts between local stakeholders and national civil protection authorities, caused by roles' overlaps and competing perspectives.

In Central Italy, there was occasional dissent among the NDCP, the LA and the RA over TH layouts choices, which in the case of Torricella Sicura required the intervention of the head of the NDCP to solve the dispute (Oggioni et al., 2019). This is again a strategic planning issue as the "*Accordo Quadro*" indirectly limited the power of local administrations over TH layout decisions; going against the principle of "centralised planning and decentralised execution" (Choi, 2008; p.12). A better organisational design should have guided strategic planning in establishing the balance between short-term goals and long-term outcomes (Davidson et al., 2007).

The BPMN shows that the strategic plan also did not consider critical sustainability factors such as activities related to the long-term maintenance and future use of the TH units and sites. A better definition of typological specifications (Bologna, 2007; Pezzica & Cutini, 2021) and an early consideration of end-of-life scenarios for candidate TH sites (Pezzica et al., 2020), could have reduced conflicts while limiting the influence of a few individuals on key planning decisions.

Disputes over TH layout choices and connected delays are likely to have been further exacerbated by the installation of irreversible foundation systems, whose technical requirements were not stated in the strategic framework agreement. The lack of broader sustainability constraints in TH layouts (Hosseini et al., 2021) implied that TH suppliers opted for the most economically and technically convenient solutions, being one storey layouts (Fig. 6), with consequent high consumption of land, materials, and energy resources. Additionally, the criteria used to fix a new suitable term for the reviewed project resubmission in step 6 (TH layout proposal assessment) should have been clearly defined to prevent delays as, on average, the elapsed time in this phase more than doubled the NDPC target of 30 days.

Fig. 6. TH site in Norcia.

5.1.4. Management and execution of primary urbanisation works

TH management problems related to primary urbanisation bids to be considered in strategic planning include bureaucratic slowdowns, poor management of construction works, and defective TH design and

planning. In the Central Italy case, the "*Accordo Quadro*" set deadlines on design but not on tendering. Indeed, no clear audit system was identified for urbanisation works.

The bids managed by the municipality of Accumoli, and that for the construction of the *Zona industriale A* TH site in Norcia, took more than one month (Oggioni et al., 2019), i.e., around four times longer than anticipated (NDCP, 2018a). In *Borgo1* TH site in Arquata del Tronto, delays occurred in the execution phase due to mistakes in the plano-volumetric plans. In other cases, ad-hoc agreements had to be signed last-minute with external agencies prior to commencing the construction works. The Autonomous Italian Road Company (ANAS) had to be consulted for building *Pescara del Tronto* TH site close to a motorway, while the Ministry of Cultural Heritage had to be involved for building in the *Zona industriale A*, where archaeological remains were found. Whereas the latter is an unforeseen circumstance, the former issue could have been anticipated and settled as part of strategic planning at the local level, which should cater for the formalisation of aid agreements with other jurisdictions (Manning, 2020).

The lack of coordination between external construction companies represented a barrier to the timely preparation of *Zona industriale A* TH site in Norcia, which was further slowed down by trial-and-error attempts to correct the design of a few TH units to enable access for disabled people (Oggioni et al., 2019). Additionally, a scarce consideration of urban services in strategic planning caused later issues with water drainage and sewage systems, besides spatial accessibility problems impacting public transport. Reducing the risk of increased hydraulic loads connected to the construction of the TH settlements required carrying out additional works in Camerino (NDCP, 2018b) and in Norcia (NDCP, 2018c). Similarly, the construction of a new control system for rainwater in *Collemagrone2* TH site in Amatrice became necessary, as well as the expansion of the ring road of Accumoli for ensuring a safe road access to the TH sites (NDCP, 2018d).

While the examples above evidence operational problems generated by gaps in strategic planning applied to TH management, the following best managerial practices also emerged, which could be formalised to streamline the process in the future. In *Campo 0* (Amatrice) and *San Pellegrino* (Norcia), the TH site location approval was done in parallel with the TH supply order, thanks to the efficient coordination of the responsible administration with the NDCP (Oggioni et al., 2019). Moreover, in several TH sites, the installation of the TH units was done while urbanisation works were still in progress (Fig. 7). This situation is modelled in Annex B using BPMN to show how the 'as-happened' variation has improved the 'as-planned' baseline process.

The results nonetheless indicate that, while executing more tasks in parallel can bring some benefits in TH management, this strategy can provide only limited advantages if the other issues which have been identified (Table 1) remain unaddressed.

5.2. Critical process components

This section examines the role of citizens in setting minimum urbanisation and housing requirements and in changing the regulatory framework (Section 5.2.1), besides issues related to process monitoring and management (Section 5.2.2). The inclusion of these aspects in the analysis enables reflecting on how TH assistance provision is influenced by preparedness activities (Nigg et al., 2006), governance/power issues (Valent, 2019) and disaster-activated community resilience mechanisms (Bolin & Stanford, 1991).

5.2.1. Community participation

The 'as-planned' BPMN shows several public and private actors interacting and making decisions throughout the TH supply and delivery process, but the displaced people appear to have a marginal role in this. Despite the model only captures the role officially assigned to citizens, which does not necessarily reflect how end-users impacted the process in reality,[11] it flags yet another core weakness of the strategic plan. Indeed, involving local communities in the process is known to lower the risk of unexpected or unsustainable planning outcomes (Jha et al., 2010; Platt & Drinkwater, 2016; Shariat Alavi et al., 2021) and, in reality, the relational and physical resources of local people helped compensate for the design flaws of the TH units; which often required maintenance and additional finishing works, such as applying a suitable protective varnish to the wooden floor of the front porch (Emidio di Treviri, 2018).

Citizens played an important role in informing requirements for building better TH units and sites, by reacting to managerial decisions (ministerial circular of the 16/1/2017, Presidenza del Consiglio dei Ministri, 2017) which, stepping back from original guidelines, limited urbanisation works to essential services only (e.g. by cutting on the provision of trees and street furniture). These generated inequalities between social spaces funded by the public and through private donations and contrasted with wishes of the local population for better collective structures and gathering spaces (Chioni et al., 2021). Citizens' aspirations, hence, culminated in some bottom-up initiatives (e.g., in *Capricchia* and *Cossito*, Amatrice), which strengthened local community bonds (Emidio di Treviri, 2018). In August 2020 the authors observed numerous physical adaptions made by the people to TH units and sites, including the: (i) use of fences to delimit private space; (ii) closure of the external porch to enlarge the houses; (iii) addition of tables in the common external spaces to trigger socialisation; (iv) use of available green areas for urban gardening (Fig. 8) to create food security, (Salaheldin Ismail Elsayed, 2018). What highlights the benefits of providing flexible/adaptable TH layouts (Davis, 1978; Wagemann, 2017) as this empowers communities to independently address their needs and enables coping better with uncertainty, since appropriate design specifications can be decided only once the context of the disaster becomes known (Johnson, 2007).

Citizens played an important role also from a policy perspective. Although TH should be delivered promptly to fulfil their role and prevent that squatter or improvised shelter are created to fill the housing gap (Bashawri et al., 2014; Chen et al., 2014; Davis, 1978; Félix et al., 2013), exposing people to new vulnerabilities, the Central Italy TH assistance process was excessively slow. The delays prompted individuals to buy TH solutions from the market and install them illegally on private plots; often in agricultural land and/or in unsafe locations, mostly devoid of urbanisation services. The case of a woman aged 95, who was evicted by public authorities from an unauthorised wooden temporary house located in a landscape protected area subjected to high hydrogeological risk in *Moreggini di San Martino* (Fiastra) made the news, as the woman then decided to occupy an old container from the 1997 Umbria and Marche earthquakes to remain close to her destroyed house (ANSA, 2017a, 2017b). The case put pressure on the government to authorise the 'temporary' use of hundreds of private TH solutions in the seismic crater. Finally, a new law (n.89/2018, later refined in the decree law n.162/2019) established that private TH units could be used until the end of the reconstruction or until the assignment of an adequate public accommodation if they met certain conditions such as the reversibility of the TH construction.

While the situation demanded such a resolution, Tanaka (2012) warns that such inconsistencies between pre-disaster directives and

[11] A systematic mapping of community inputs in the TH process would require dedicated studies possibly involving multiple field visits, engagement with local activists, and the application of appropriate social science research methodologies; what falls beyond of the scope of this paper.

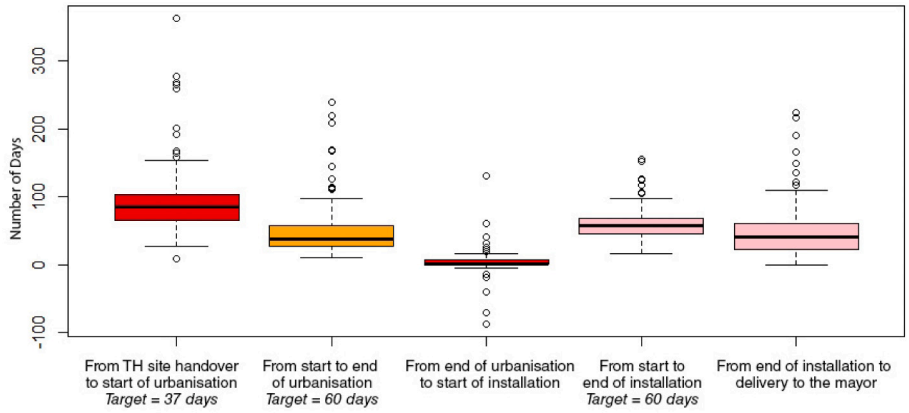

Fig. 7. Boxplot, number of days elapsed in all TH sites to reach the milestones set by the NDPC. Own elaboration based on (NDCP, 2020) data.

Table 1
Critical process activities, connected issues, and suggested mitigation strategies.

Critical activity	Issue	Recommendations
Assessment of damage and TH needs	Inefficient filing system	Develop flexible assessment systems which produce information with an increasing level of detail and require low to high technical skills
TH site selection (including complaints from landowners)	Lengthy process involving numerous checks	Pre-reserving candidate TH sites to accommodate future disasters in urban plans and avoid issues with landowners
TH site layout assessment	Conflicts among decision-makers	Centralise planning and decentralise execution. Include in strategic plans long-term maintenance indications, TH reversibility requirements, typological constraints, and criteria for setting the timeframe for proposals' resubmission. Consider future uses of TH sites in pre-planning.
Management and execution of bids for primary urbanisation works	Ad-hoc process subject to delays and operational problem	Define a sound audit process. Set up formal operational agreements with local actors and organisations in advance. Consider all services needs in strategic planning. Enable an efficient parallel execution of operative tasks.

Fig. 8. Urban gardening in interstitial spaces, *zona industriale B* TH site, Norcia.

post-disaster response leave room for discretionary policymaking which can hinder the attainment of strategic planning goals.

The formal exclusion of citizens from the Central Italy TH supply and delivery process can be linked to the following 'community clashes', whose consideration should inform the future specification of community-sensitive functional requirements for TH (Pezzica, Bleil de Souza, & Dunichkin, 2021):

- Acceleration of depopulation trends, due to excessive delays in TH assistance delivery (Emidio di Treviri, 2018) and to a lack of services' accessibility (Rotondo et al., 2020); which resulted in TH sites being populated mainly by the elderly.
- Dysfunctional units' design, due to a poor fit with the mountain context and limited adaptability. Specific issues emerged in relation to the possibility to open the entrance door from the inside; set roof inclinations and chimneys' heights suitable to prevent issues with the snow; piping and boilers' insulation. Additionally, people who were not completely autonomous suffered from a lack of space to house caregivers (Emidio di Treviri, 2018).
- Economic and technical inconveniences related to thermal comfort and water availability, due to an inadequate design of building services.

5.2.2. *Process monitoring and management*

Poor financial and time management of TH plans is widely recognised as a risk factor in post disaster recovery. However, the data gathered by the civil protection (NDCP, 2020; Annex C) to monitor progress in the TH process does not allow an effective control of intermediate deadlines in relation to project milestones. Projects' approval dates were not collated, making it difficult to check if the TH suppliers were able to meet their deadlines. In addition, no data was published about the duration of the initial situation assessment and about the time spent to select suitable TH sites.

Overall, the model evidences a lack of time constraints for most of the administrative decision-making process activities, with negative implications for time-management. This makes both the ideal timeframes for TH supply, mentioned in the "*Accordo Quadro*" and the actual time steps published by the NDPC, unsuitable proxies to assess and manage delays in TH provision and calls for better data collection and tracking. The complexity of the TH supply and delivery process makes analysing the causes of delays without the support of appropriate data and process models problematic, which obscures accountability and public support.

6. Discussion and global outlook

Although the use of strategic planning in TH management seems promising, the heterogeneity of its applications and the lack of

procedures and policy guidance, represent ongoing challenges in practice (Manning, 2020). As strategic plans can differ in scope and comprehensiveness, with implications for their outcomes, it is important to have mechanisms in place to reassess and revise strategies and plans (Bryson, 2018). In fact, while FEMA has engaged in strategic planning for post-disaster response since 2002, in early efforts, roles were unclear, inventory control was poor, TH procurement and siting agreements were lacking and procedures missing (Sapat et al., 2011).

The presented *post-mortem* analysis tells us how effective the Italian bureaucratic apparatus has been in providing TH housing assistance after the 2016–2017 earthquakes. It confirms that the "*Accordo Quadro*" and connected regulatory instruments, were rather limited in scope and short-sighted; what ended up encouraging the implementation of one-size-fits-all solutions, as posed by (Emidio di Treviri, 2018). The study also evidences an enduring gap between urban planning and emergency management in Italy, reflected in the lack of pre-disaster strategies for the selection and design of TH sites.

In fact, while supra-regional contracting agreements were in place before the Central Italy earthquakes, flaws in strategic planning - particularly at the local level - severely affected the effectiveness of the TH response and the capacity of local communities to recover. Missing or faulty plans, policies for TH long term use, community participation protocols, inclusion of vulnerable populations needs, and TH design, were flagged. Thus, strategic plans did not align TH activities with a common vision of urban resilience, to establish best pathways to achieve recovery aims, overall quality and performance, and value creation.

The study also confirms that a better alignment of TH-related decisions is needed at the strategic (the plan), the managerial (the process) and the operational (the activities) levels (Pezzica & Cutini, 2021). Although data gaps prevent making exact estimates, available information suggest that approval times are likely to have been longer than design times. Furthermore, results point that the implemented managerial process does not include intermediate mitigation strategies, meaning delays are likely if anything falls out of the plan. Faulty or missing auditing protocols and inadequate preparedness measures at different governance levels (discussed in Section 5) indicate significant shortfalls in strategic planning, which caused operational bottlenecks and delays.

Table 2 pins down the issues which, instead of relating to single critical activities as in Table 1, cut across the whole TH supply and delivery process. It also suggests policy recommendations and mitigation strategies to be tested. The list can then be expanded to include lessons from other countries. A collation of results from different ex-post analyses could result in benchmarks forming an inventory of information useful to inform corrective planning actions critical to achieve strategic planning goals. What can mobilise the development and refinement of policies based on knowledge across jurisdictions (Zulean, 2014). Particularly the US and Japan, which also have strategic agreements in place for TH procurement and rely on a fixed design for the units. These, to the best of the authors' knowledge, do not have formal *ex-post* analyses of TH process instantiations.

There is, therefore, an opportunity to transfer the proposed *post-mortem* evaluation and the use of BPMN to enable the examination of best practices in these contexts. For instance, the US includes pre-stock options, which are adopted to deliver a prompt TH assistance post-disaster (Perrucci & Baroud, 2021) and which could be transferred to the Italian case. Additionally, Japan is trialling new policies to take better into account residents' views and wellbeing in the planning of TH neighborhoods (Edgington, 2022); following critiques of its technocratic "plan-only" approach, justified by an alleged reduction of delivery time (Bris & Bendito, 2019). After the Tōhoku earthquake and tsunami some municipalities also started to develop new land parcels for housing recovery (Edgington, 2017).

Nevertheless, since contextualization determines best practice applicability (Abulnour, 2014), strategic planning proposals should cater for differences in each country's resources, regulations and governance structures. In the US, the supply and delivery of transportable TH units after disasters (manufactured homes and RVs/travel trailers) has been centrally managed by the federal government up until 2018, when the Disaster Recovery Reform Act first acknowledged the shared responsibilities of state/local authorities in TH response and recovery (Windle et al., 2019). Conversely, the general TH policy framework in Japan is determined at a national level, where funding is also allocated, while the prefectures (or delegated larger municipalities) select the location of TH sites in safe public-owned sites and ensure the delivery and installation of the TH units via the activation of different strategic agreements independently signed with the Japan Prefabricated construction suppliers and manufacturers Association; what can make standards vary across them (Bris & Bendito, 2019).

Table 2
Process planning flaws and proposed mitigation strategies.

Process planning flaws	Recommendations
Delays in TH supply and delivery are likely if anything falls out of the plan	Identify intermediate mitigation strategies and include them in a process model.
Design time likely to be shorter than approval time	Plan ways to speed up the external steps (i.e., damage assessment and site documentation) after disasters, but also conduct strategic evaluations (possible TH site locations and connected hydro-geological studies) in advance
Steps external to the TH supply process influence delivery time in an uncontrolled way (lack of reference time for most public administration processes)	Provide comprehensive reference times in the strategic plan to improve process assessment (this can also facilitate process simulation)
Mismatch between monitoring data and process milestones	Collect data at each intermediate step and resort to process engineering and project management techniques, besides potentially to process simulation, to improve time management
Inclusion of many ad-hoc processes in the main plan due to a lack of resilience of the strategic model	Structuring the ad-hoc processes; e.g., through a critical analysis/redefinition of key performance indicators and the prescription of tolerance thresholds, giving each step room to manoeuvre for proceeding without interrupting the flow
Operational problems potentially generated by managerial solutions	Separate related components and identify potential inter-level clashes to define preventive strategies
Delays and contradictory outcomes are likely if all stakeholders are not adequately considered	Plan in advance for the (time-efficient) inclusion of all stakeholders in the decision-making process related to TH supply and delivery.

Strategic planning for TH management should, hence, be informed by an understanding of both technical aspects and local administrative culture. Additionally, indicators used for process monitoring and management should be qualified by a context-based reading of planning intent.

From a methodological point of view, linking business process modelling and a meta-analysis of available data sources was instrumental to reconstruct the Central Italy TH supply and delivery process and support a nuanced understanding of critical activities and components.

Although the BPMN did not assist the examination of issues arising from complex decision-making tasks (e.g., deciding the location, number, dimension, density, and layout of TH sites), following the identification of procedural/administrative bottlenecks, it can inform improvements in time and cost management (e.g., via tasks' parallelisation, optimisation of information flows). In future applications, if data about all intermediate steps is systematically collated and available to run process simulations, more advanced BPMN analytical capabilities could be exploited to, e.g., estimate material resources, total service and waiting times, number of waits (for activities managed by an operator who must be free to execute them), costs, number of actors etc.

Deviations from the ideal process model could, in principle, be systematically mapped and comparatively studied by critically confronting planned and actual processes - what requires a separate modelling of specific process instances (as in Annex B) – to automatically spot inefficiencies and propose timely adjustments using process mining tools and engineering techniques. Furthermore, BPMN can help develop a workflow management system able to prevent technical problems, reduce community clashes, and speed up TH operational tasks.

Whenever building a model for each case is not feasible due to a lack of statistically significant information that allow to instruct the system, as in this study, useful information can nonetheless be extracted from the analysis of the tactical ad-hoc adjustments made to the prescriptive plan by humanitarian agencies. Additionally, similar efforts provide an input to digitalisation which facilities coordination and data collection towards process simulation.

7. Conclusions

This study provided evidence that strategic planning alone does not ensure the success of post-disaster TH assistance programs and that careful process planning and management is needed. It presented a full description of the Central Italy TH supply and delivery process and explored the negative impacts of allowing room for discretionary decisions in this, demonstrating how flaws in strategic plans and their implementation post-disaster contribute to slow down disaster recovery and create new vulnerabilities.

Although in principle strategic planning can help limiting resources' exploitation and corruption and ensure compliance with adequate safety standards in TH provision, it must respond to citizens' needs to generate value. The analysis provided insights on how contextual factors and local communities influence the recovery trajectory of disaster-affected cities, even if they are not formally included in the decision-making process. Moreover, it suggested the need to develop better protocols and intermediate auditing/mitigation strategies to ensure that strategic plans can achieve their objectives.

To help discussing strategic planning and its outcomes, this paper transferred knowledge from the field of management engineering to a different and challenging context of application - i.e., TH management - with a focus on the TH supply and delivery process. It used BPMN to reconstruct the workflow of the process 'as-planned' and qualitatively study both inherent flaws and 'as-happened' deviations to provide some practical recommendations for planning; an approach which can be reproduced in other contexts to support benchmarking.

The retrospective BPMN analysis enabled connecting the events that triggered the Central Italy TH supply and delivery process, its activities, the decisions that it involved, as well as the ordering of all these components, their outcomes, the responsible organisations and actors and, to an extent, their roles. In addition, it enabled pinpointing handovers points and where issues occurred in the post-disaster phase to highlight critical aspects to be improved. This was instrumental to find out about: (i) procedures requiring better structuring; (ii) missing or deficient intermediate and end-of-life assessments; (ii) activities prone to generate conflicts and/or delays; (iv) sustainability gaps.

The direct use of BPMN in pre-disaster strategic planning, however, presents important limitations and practical challenges that arise when the goal is to design well-structured processes because of missing contextual information, gaps in empirical data, and modelling uncertainties due to the contingent way in which decisions are made during emergencies. BPMN can nevertheless contribute to enhance the resilience of future strategic plans, and thus avoid TH assistance delays, by feeding information from past experiences (i.e., patterns of the schema, actors involved, process coordination system, time performance etc.) into new workflow and document management systems which support the TH supply and delivery process in real time, and monitoring systems which evaluate model performance and redesign. Furthermore, BPMN can foster the fast generation of novel hypothesis and simulate admissible instantiations to advance scenario-based planning. In combination with ICT and triangulation, BPMN would then support strategic planning and accelerate digital innovation in key urban emergency management processes such as TH, which, albeit unplanned, yet influence cities' structural changes well beyond the fast dynamics of emergency response.

Although some recommendations for policy and practice were advanced in Section 6, more empirical research is needed to test them. Future studies should also further clarify how strategic planning, and proactive TH management, can be improved to concretely enhance the capacity of cities to cope with housing crises and foster a developmental recovery after disasters. In addition to making the process execution more efficient, future research can examine specific parts of the process, where structured starting data are available and develop policies and practical guidance to adapt the TH response to the physical, environmental, social, and economic requirements of the disaster-affected territory; possibly exploring a shift of focus from specifications to performance requirements.

CRediT authorship contribution statement

Camilla Pezzica: Data curation, Formal analysis, Investigation, Conceptualization, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing, Funding acquisition. **Valerio Cutini:** Conceptualization, Methodology, Supervision, Writing – review & editing, Funding acquisition. **Clarice Bleil de Souza:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Davide Aloini:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

None.

Data availability

The data used in this research is available online and referenced in the manuscript. The authors' elaboration of existing quantitative data by the NDCP is presented in Annex C.

Acknowledgments

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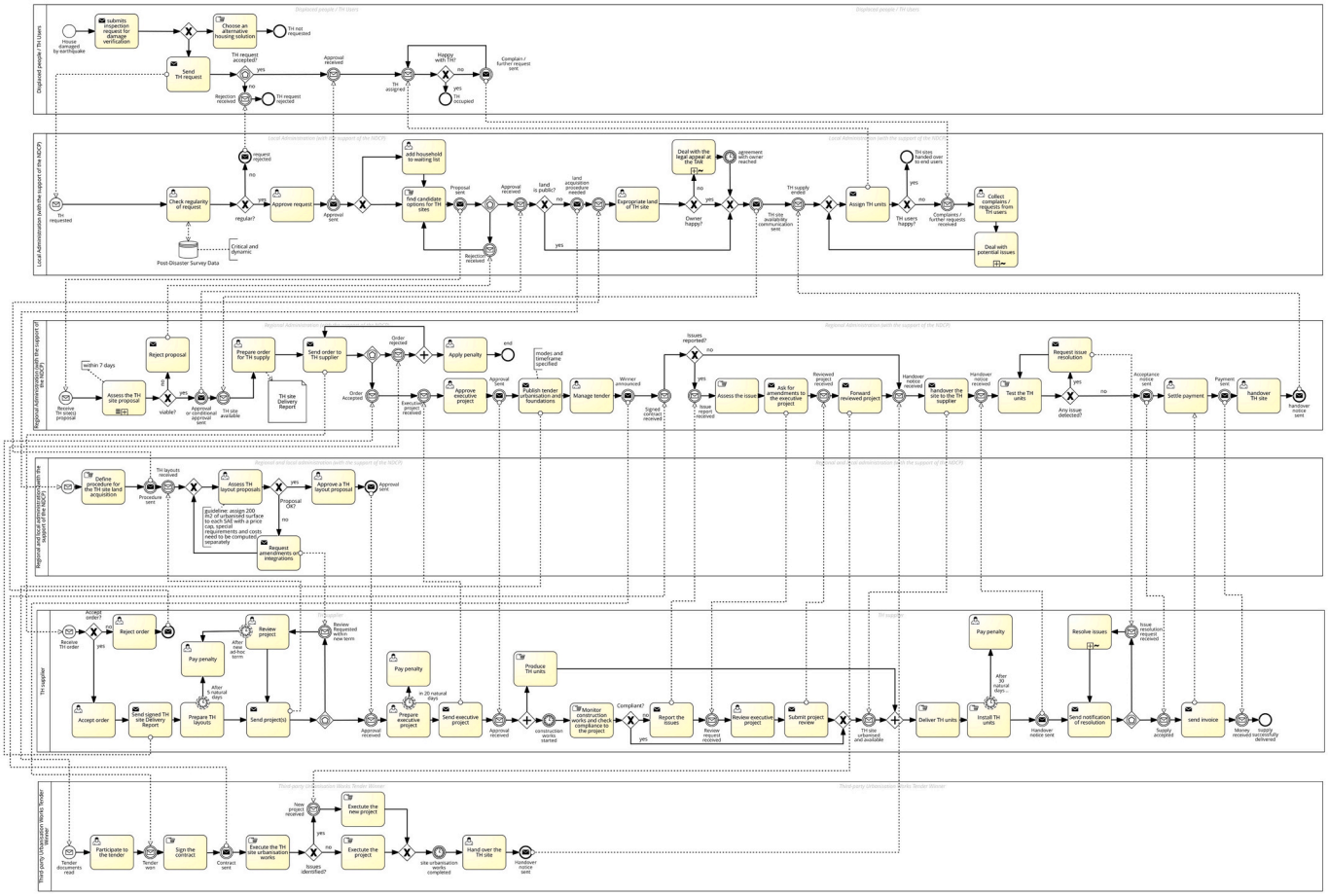
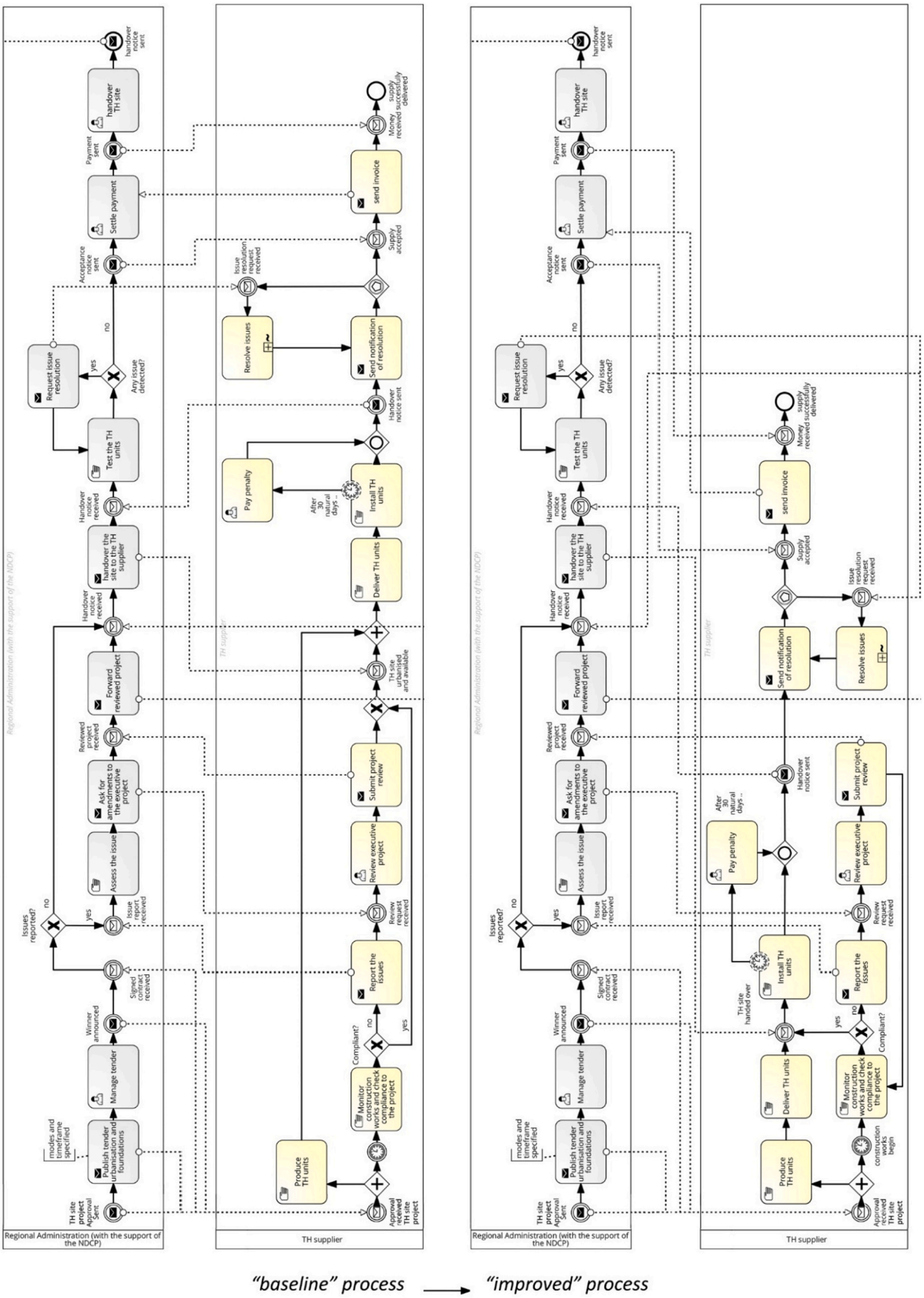
Annex A



Central Italy TH supply and delivery process modelled using BPMN 2.0.

Annex B



Baseline and improved TH installation process with task parallelism, BPMN 2.0.

Annex C

Municipality	Name of TH site	TH site handover	Start of urbanisation	End of urbanisation	Start of installation	End of installation	Delivery to mayor	ten (urban)	urb (works)	hand (site)	inst (TH)	del (mayor)	tot days
Accumoli	Accumoli Capoluogo (4sub)	08/11/2016	13/02/2017		14/04/2017		13/08/2017	97					278
Accumoli	Fonte del Campo	21/11/2017	27/03/2017		11/05/2017		29/09/2017	-239					-53
Accumoli	Grisciano	03/02/2017	22/03/2017	05/05/2017	08/05/2017	21/07/2017	01/08/2017	47	44	3	74	11	179
Accumoli	Grisciano Palazzo	03/02/2017	03/04/2017		02/06/2017		06/10/2017	59					245
Accumoli	Grisciano Palazzo - ampliamento	15/11/2018											
Accumoli	Illica	21/11/2016	30/01/2017	13/03/2017	13/03/2017	30/04/2017	12/06/2017	70	42	0	48	43	203
Accumoli	Libertino	21/11/2016	27/02/2017	03/04/2017	03/04/2017		03/07/2017	98	35	0			224
Accumoli	Macchia	23/11/2016	28/02/2017	08/04/2017	13/04/2017	29/05/2017	03/07/2017	97	39	5	46	35	222
Accumoli	Poggio d'Api	21/11/2016	14/02/2017	20/03/2017	20/03/2017	26/04/2017	12/06/2017	85	34	0	37	47	203
Accumoli	Roccasalli	20/02/2017	01/03/2017	05/04/2017	06/04/2017	10/07/2017	01/08/2017	9	35	1	95	22	162
Accumoli	Roccasalli 2	02/10/2017					20/02/2018						141
Accumoli	Terracino	23/11/2016	12/04/2017		27/08/2017	27/10/2017	12/12/2017	140			61	46	384
Accumoli	Tino	21/11/2016	28/02/2017		28/03/2017	21/04/2017	12/06/2017	99			24	52	203
Acquasanta Terme	Arli	18/04/2017	12/07/2017		21/08/2017	20/10/2017	18/01/2018	85			60	90	275
Amandola	San Cristoforo	08/05/2017	24/07/2017		30/08/2017	14/10/2017	14/12/2017	77			45	61	220
Amatrice	A. Anpas (Campo 1)	24/10/2016	24/11/2016		03/01/2017	30/04/2017	29/05/2017	31			117	29	217
Amatrice	A. Campo Sportivo (Campo 0)	14/10/2016	10/11/2016		10/12/2016	24/01/2017	15/03/2017	27			45	50	152
Amatrice	A. S. Cipriano 1 (Campo 2)	14/10/2016	18/07/2017		04/09/2017		30/11/2017	277					412
Amatrice	A. S. Cipriano 2 (Campo 3 - Trentinoi	14/10/2016	23/11/2017	23/04/2017	27/02/2017	20/03/2017	29/05/2017	405	-214	-55	21	70	227
Amatrice	Bagnolo	05/12/2016	27/02/2017	28/03/2017	23/03/2017	28/04/2017	01/08/2017	84	29	-5	36	95	239
Amatrice	Capricchia	13/02/2017	28/04/2017		12/06/2017	11/08/2017	12/08/2017	74			60	1	180
Amatrice	Casale	02/05/2017	10/07/2017	25/07/2017	26/07/2017		19/09/2017	69	15	1			140
Amatrice	Collecreta-Moletano	05/12/2016	27/02/2017	09/04/2017	10/04/2017	05/05/2017	31/05/2017	84	41	1	25	26	177
Amatrice	Collemagrone 1 (area 18)	23/11/2016	13/02/2017	04/04/2017	10/04/2017	07/07/2017	01/08/2017	82	50	6	88	25	251
Amatrice	Collemagrone 2 (area 18)	11/11/2016	27/02/2017		28/04/2017		15/09/2017	108					308
Amatrice	Collemagrone 3 (area 18)	21/04/2017	10/07/2017		03/10/2017		13/02/2018	80					298
Amatrice	Collemoresco	21/06/2017	07/08/2017		06/09/2017		30/11/2017	47					162
Amatrice	Collepagliuca	22/02/2017	03/04/2017	15/05/2017	26/04/2017	13/05/2017	22/06/2017	40	42	-19	17	40	120
Amatrice	Configno	13/02/2017	10/07/2017		25/07/2017	25/08/2017	19/09/2017	147			31	25	218
Amatrice	Cornillo Nuovo	21/06/2017	07/08/2017		28/08/2017		20/11/2017	47					152
Amatrice	Cornillo Vecchio	28/03/2017	15/05/2017		12/06/2017	27/07/2017	14/09/2017	48			45	49	170
Amatrice	Cossito	13/07/2017			15/11/2017		05/04/2018						266
Amatrice	Domo	13/07/2017	08/09/2017				15/01/2018	57					186
Amatrice	Musicchio	05/12/2016	21/02/2017	20/03/2017	20/03/2017	28/04/2017	12/06/2017	78	27	0	39	45	189
Amatrice	Nommisci	05/12/2016	13/02/2017	13/03/2017	27/02/2017	24/04/2017	05/06/2017	70	28	-14	56	42	182
Amatrice	Nommisci 2	13/07/2017	13/09/2017		12/10/2017		28/02/2018	62					230
Amatrice	Patarico	13/03/2017	26/07/2017		06/09/2017		30/11/2017	135					262
Amatrice	Pinaco Arafranca	13/07/2017	20/10/2017		15/11/2017		28/02/2018	99					230
Amatrice	Poggio Vitellino	06/03/2017	15/05/2017		12/06/2017	26/07/2017	10/08/2017	70			44	15	157
Amatrice	Prato-Cascello	06/03/2017	13/02/2017	15/03/2017	13/03/2017	24/04/2017	29/05/2017	-21	30	-2	42	35	84
Amatrice	Preta	29/05/2017	24/07/2017		12/10/2017		06/02/2018	56					253
Amatrice	Retrosi	05/12/2016	01/03/2017	10/04/2017	10/04/2017	06/06/2017	22/06/2017	86	40	0	57	16	199
Amatrice	Rocchetta (area 12)	11/11/2016	13/01/2016	31/03/2017	23/03/2017	26/04/2017	12/06/2017	-303	443	-8	34	47	213
Amatrice	S. Giusta	15/05/2017	07/08/2017		05/09/2017	30/10/2017	28/11/2017	84			55	29	197
Amatrice	S. Tomasso 1	05/12/2016	21/02/2017	20/03/2017	21/03/2017	24/04/2017	05/06/2017	78	27	1	34	42	182
Amatrice	S. Tomasso 2	21/06/2017	07/08/2017		05/09/2017		04/12/2017	47					166
Amatrice	S.Angelo	14/10/2016	17/12/2016	10/04/2017	11/04/2017	09/06/2017	01/08/2017	64	114	1	59	53	291
Amatrice	S.Lorenzo a Pinaco	05/12/2016	13/02/2017	13/03/2017	13/03/2017	24/04/2017	05/06/2017	70	28	0	42	42	182
Amatrice	Saletta	23/11/2016	06/02/2017	18/03/2017	20/03/2017	21/04/2017	12/06/2017	75	40	2	32	52	201
Amatrice	Scai	26/03/2017	15/05/2017		31/05/2017	26/07/2017	08/08/2017	50			56	13	135
Amatrice	Sommati	22/02/2017	26/04/2017	29/05/2017	29/05/2017	26/07/2017	08/08/2017	63	33	0	58	13	167
Amatrice	SS. Lorenzo e Flaviano	05/12/2016	06/03/2017	14/04/2017	26/04/2017	09/06/2017	22/06/2017	91	39	12	44	13	199
Amatrice	SS. Lorenzo e Flaviano 2	27/09/2017	24/11/2017				27/02/2018	58					153
Amatrice	Torrita 0 (area 22)	30/12/2016	28/02/2017		03/04/2017	03/05/2017	12/06/2017	60			30	40	164
Amatrice	Torrita 1	04/04/2017	12/06/2017	12/07/2017	12/07/2017		23/08/2017	69	30	0			141
Amatrice	Torrita 1 bis	04/04/2017	12/06/2017	12/07/2017	11/09/2017		25/11/2017	69	30	61			235
Amatrice	Voceto	02/05/2017	16/10/2017		16/11/2017		13/03/2018	167					315
Arquata del Tronto	Borgo 2	27/03/2017	08/06/2017	23/07/2017	24/07/2017	06/10/2017	28/11/2017	73	45	1	74	53	246
Arquata del Tronto	Borgo 3	17/07/2018											
Arquata del Tronto	Borgo Arquata del Tronto	18/11/2016	28/02/2017	19/05/2017	19/05/2017	18/07/2017	22/09/2017	102	80	0	60	66	308
Arquata del Tronto	Faete	27/12/2016	03/05/2017	23/07/2017	24/07/2017	02/10/2017	18/12/2017	127	81	1	70	77	356
Arquata del Tronto	Pescara del Tronto1	18/11/2016	18/01/2017	12/03/2017	13/03/2017	27/04/2017	17/06/2017	61	53	1	45	51	211
Arquata del Tronto	Piedilama	27/12/2016	06/04/2017		04/06/2017	20/07/2017	14/08/2017	100			46	25	230
Arquata del Tronto	Pretare	27/12/2016	03/04/2017		04/06/2017		13/09/2017	97					260

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Arquata del Tronto	Spelonga	27/12/2016	30/04/2017		09/08/2017	26/10/2017	01/12/2017	124			78	36	339
Basciano	Basciano	14/06/2017	28/09/2017	09/10/2017	18/10/2017		29/12/2017	106	11	9			198
Basciano	Madonna delle Grazie	13/06/2017	28/09/2017	09/10/2017	18/10/2017		29/12/2017	107	11	9			199
Bolognola	Villa di Mezzo	10/04/2017	24/07/2017				31/01/2018	105					296
Borbona	Borbona Capoluogo	21/04/2017	27/07/2017	16/10/2017	17/10/2017		31/01/2018	97	81	1			285
Cagnano Amiterno	San Cosimo	28/05/2018	20/07/2018	14/08/2018	27/08/2018	26/10/2018	21/11/2018	53	25	13	60	26	177
Caldarola	Campo Sportivo	18/04/2017	26/06/2017		18/09/2017		10/05/2018	69					387
Caldarola	Monastero	09/06/2017	18/09/2017		05/10/2017		22/02/2018	101					258
Camerino	Arcofiato	24/08/2017	17/05/2018	06/07/2018	07/07/2018	20/08/2018		266	50	1	44		
Camerino	Loc. Le Cortine	27/04/2017	31/07/2017		05/10/2017		13/08/2018	95					473
Camerino	Loc. Le Cortine - Ampliamento	20/11/2017	16/04/2018	17/06/2018	09/07/2018	02/08/2018		147	62	22	24		
Camerino	Loc. Vallicelle A	05/06/2017	08/08/2017		30/10/2017		24/08/2018	64					445
Camerino	Mergniano San Savino	30/09/2017	15/01/2018	06/05/2018	07/05/2018	24/06/2018	28/07/2018	107	111	1	48	34	301
Camerino	Morro	12/07/2017	18/09/2017	22/10/2017	23/10/2017		24/03/2018	68	34	1			255
Camerino	Piegusciano	20/07/2017	18/09/2017	15/05/2018	16/05/2018	02/07/2018	07/08/2018	60	239	1	47	36	383
Camerino	Rocca Varano	13/09/2017	15/01/2018	01/07/2018	02/07/2018	19/08/2018	29/09/2018	124	167	1	48	41	381
Camerino	S. Erasmo	07/08/2017	06/11/2017	03/06/2018	04/06/2018		27/08/2018	91	209	1			385
Camerino	San Paolo - Via Ottaviano	05/07/2017	18/09/2017	25/04/2018	26/04/2018	20/06/2018	08/08/2018	75	219	1	55	49	399
Camerino	San Paolo - Via Ottaviani - Ampliamen	20/11/2017	05/02/2018	14/03/2018	15/03/2018	16/05/2018	08/08/2018	77	37	1	62	84	261
Campli	Piancarani di Campli	01/09/2017	16/11/2017		10/01/2018		27/03/2018	76					207
Camporotondo di Fiastr	Belloni	10/04/2017	06/07/2017		17/09/2017		17/01/2018	87					282
Campotosto	Capoluogo Poggio Cancelli	04/05/2018											
Campotosto	Capoluogo Trasanna	04/05/2018											
Campotosto	Colle Vicciarello	04/05/2018	20/09/2018	17/11/2018	19/11/2018	24/04/2019	18/07/2019	139	58	2	156	85	440
Campotosto	Mascioni	04/05/2018	20/09/2018	21/10/2018	23/10/2018	30/12/2018	08/07/2019	139	31	2	68	190	430
Capitignano	Capitignano III	15/05/2017	21/08/2017		06/09/2017		24/01/2018	98					254
Capitignano	Stazione (Capitignano I)	15/05/2017	21/08/2017		17/09/2017		31/01/2018	98					261
Cascia	Avendita	06/03/2017	26/05/2017		07/07/2017	17/08/2017	24/08/2017	81			41	7	171
Cascia	Capoluogo (Padule) - Lotto 1	09/03/2017	21/07/2017		10/10/2017		19/03/2018	134					375
Cascia	Capoluogo (Padule) - Lotto 2	09/03/2017	21/07/2017		03/10/2017		12/04/2018	134					399
Cascia	Capoluogo (Padule) - Lotto 3	31/07/2017	27/11/2017		28/12/2017		14/03/2018	119					226
Cascia	Cerasola	31/07/2017	27/11/2017		28/12/2017		21/04/2018	119					264
Cascia	Col Forcella	31/07/2017	27/11/2017		28/12/2017		19/03/2018	119					231
Cascia	Colle Avendita	06/03/2017	12/06/2017		10/07/2017		07/09/2017	98					185
Cascia	Maltigliano	06/03/2017	14/07/2017		21/08/2017	20/10/2017	24/11/2017	130			60	35	263
Cascia	Manigi	11/04/2017	14/07/2017	03/08/2017	04/08/2017		11/10/2017	94	20	1			183
Cascia	SAE Isolate (San Giorgio)	11/04/2017	14/07/2017	03/08/2017	04/08/2017	02/10/2017	26/10/2017	94	20	1	59	24	198
Cascia	Santa Trinita	31/07/2017	27/11/2017		28/12/2017		21/04/2018	119					264
Cascia	Tazzo	05/05/2017	14/07/2017		29/08/2017		24/11/2017	70					203
Castelraimondo	Castelraimondo (Campo Sportivo)	07/06/2017	08/08/2017		10/10/2017		21/04/2018	62					318
Castelsantangelo sul Ne	Gualdo	17/02/2017	22/05/2017	09/07/2017	10/07/2017		24/09/2017	94	48	1			219
Castelsantangelo sul Ne	Nocria	07/04/2017	26/07/2017		18/09/2017		30/12/2017	110					267
Castelsantangelo sul Ne	Nuova area P.le Piccinini	07/06/2017	07/08/2017		16/10/2017	18/03/2018	24/03/2018	61			153	6	290
Cessapalombo	Campo Sportivo Centro 1	10/04/2017	10/07/2017	22/07/2017	04/08/2017	03/10/2017	25/11/2017	91	12	13	60	53	229
Cittareale	Cittareale Capoluogo	29/09/2017	20/11/2017		10/01/2018	09/03/2018	04/04/2018	52			58	26	187
Cittareale	Collicelle	29/09/2017	20/11/2017				24/04/2018	52					207
Cittareale	Conca	29/09/2017	18/04/2018	02/07/2018	03/07/2018	07/08/2018	05/09/2018	201	75	1	35	29	341
Cittareale	Loc. Cupello	29/09/2017	20/11/2017			15/04/2018	25/05/2018	52				40	238
Cittareale	Molo Coletta	29/09/2017	04/12/2017	22/01/2018	23/01/2018	15/04/2018	25/05/2018	66	49	1	82	40	238
Cittareale	Pallottini	29/09/2017	04/12/2017	22/01/2018	23/01/2018	15/04/2018	24/04/2018	66	49	1	82	9	207
Cittareale	Santa Croce	29/09/2017	09/04/2018		21/06/2018	07/08/2018	21/08/2018	192			47	14	326
Colledara	Capoluogo	23/03/2017	24/08/2017		04/01/2018		21/03/2018	154					363
Colledara	Ornano	23/03/2017	24/08/2017		25/10/2017	25/12/2017	08/02/2018	154			61	45	322
Cortino	Capoluogo	18/05/2017	21/08/2017	26/09/2017	27/09/2017		27/12/2017	95	36	1			223
Cortino	Casanova	18/05/2017	21/08/2017	26/09/2017	27/09/2017		27/12/2017	95	36	1			223
Cortino	Collegilesco	18/05/2017	21/08/2017	30/09/2017	07/10/2017		27/12/2017	95	40	7			223
Cortino	Pagliaroli	18/05/2017	21/08/2017	26/09/2017	27/09/2017		27/12/2017	95	36	1			223
Cortino	Vernesca	18/05/2017	21/08/2017	26/09/2017	27/09/2017		27/12/2017	95	36	1			223
Crognaleto	Cesacastina	20/07/2017	28/09/2017		10/11/2017	19/12/2017	31/07/2018	70			39	224	376
Crognaleto	Frattoli	20/07/2017	05/04/2018	27/06/2018	09/07/2018	22/10/2018	21/02/2019	259	83	12	105	122	581
Crognaleto	Nerito	20/07/2017	28/09/2017				29/12/2017	70					162
Crognaleto	San Giorgio	20/07/2017	28/09/2017		27/10/2017	26/12/2017	31/07/2018	70			60	217	376
Crognaleto	Tottea	20/07/2017	28/09/2017		20/11/2017	15/02/2018	31/07/2018	70			87	166	376
Fiastra	Acquacanina/Cerreto	12/04/2017	05/06/2017	23/07/2017	31/07/2017		05/01/2018	54	48	8			268
Fiastra	Capoluogo	12/04/2017	12/06/2017		11/08/2017		15/12/2017	61					247
Fiastra	Fiegni	12/04/2017	22/05/2017	02/07/2017	03/07/2017	24/09/2017	06/10/2017	40	41	1	83	12	177

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Fiastra	Polverina	12/04/2017	22/05/2017	11/06/2017	19/06/2017		23/08/2017	40	20	8		133
Force	Fontevecchia	08/05/2017	13/07/2017		27/09/2017		20/01/2018	66				257
Gagliole	Selvalagli	10/04/2017	09/08/2017		07/09/2017		20/01/2018	121				285
Gualdo	Località Valle	10/04/2017	05/07/2017		03/08/2017	06/10/2017	07/12/2017	86			64	62	241
Leonessa	Leonessa capoluogo	07/08/2017	12/10/2017		10/01/2018	09/03/2018	25/04/2018	66			58	47	261
Leonessa	Terzone	07/08/2017	12/10/2017		30/11/2017		20/02/2018	66					197
Montecavallo	Monte Cavallo Capoluogo Loc. Piè del	10/04/2017	05/07/2017				23/08/2017	86					135
Montegallo	Balzo	18/04/2017	14/07/2017		06/09/2017		22/04/2018	87					369
Montegallo	Uscerno	18/04/2017	11/07/2017		06/09/2017		29/12/2017	84					255
Montereale	Capoluogo	28/08/2017	30/10/2017		01/12/2017	05/04/2018	31/07/2018	63			125	117	337
Montereale	S. Giovanni di Paganica	28/08/2017	30/10/2017	21/11/2017	24/11/2017		26/04/2018	63	22	3			241
Montorio al Vomano	Montorio 1	08/06/2017	10/10/2017	02/11/2017	07/11/2017		05/03/2018	124	23	5			270
Montorio al Vomano	Villa Maggiore	08/06/2017	20/11/2017		06/12/2017		04/04/2018	165					300
Muccia	Contrada Varano	03/05/2017	05/07/2017		02/10/2017		24/03/2018	63					325
Muccia	Costafiore	10/04/2017	10/07/2017		28/08/2017	20/10/2017	26/10/2017	91			53	6	199
Muccia	Massaprofoglio	10/04/2017	13/07/2017	03/08/2017	04/09/2017		07/12/2017	94	21	32			241
Muccia	Pian di Giove A	07/06/2017	05/07/2017		20/09/2017		10/02/2018	28					248
Muccia	Pian di Giove B	07/06/2017	05/07/2017		09/08/2017	03/10/2017	22/12/2017	28			55	80	198
Norcia	Agriano	19/04/2017	13/07/2017	10/08/2017	11/08/2017		05/11/2017	85	28	1			200
Norcia	Ancarano	30/03/2017	10/07/2017		01/08/2017	21/10/2017	05/11/2017	102			81	15	220
Norcia	Casale di Serravalle	19/07/2017	28/09/2017				28/02/2018	71					224
Norcia	Catelluccio di Norcia	22/05/2018	15/10/2018	22/11/2018	02/04/2019	28/06/2019	09/07/2019	146	38	131	87	11	413
Norcia	Forsivo	19/04/2017	13/07/2017		08/09/2017	11/11/2017	15/12/2017	85			64	34	240
Norcia	Frascaro	19/04/2017	21/07/2017		02/09/2017		15/12/2017	93					240
Norcia	Loc. Campi	30/03/2017	10/07/2017	02/08/2017	03/08/2017	16/09/2017	05/11/2017	102	23	1	44	50	220
Norcia	Madonna delle Grazie 1	31/07/2017	02/10/2017		06/11/2017		28/02/2018	63					212
Norcia	Madonna delle Grazie 2	31/07/2017	02/10/2017		16/11/2017		24/04/2018	63					267
Norcia	Madonna delle Grazie 3	29/06/2018	25/03/2019	06/05/2019	07/05/2019	06/07/2019	09/07/2019	269	42	1	60	3	375
Norcia	N. Montedoro	30/03/2017	13/07/2017	03/08/2017	04/08/2017	20/10/2017	08/12/2017	105	21	1	77	49	253
Norcia	N. XX SETTEBRE 3	09/11/2017	19/02/2018	05/04/2018	24/04/2018	22/06/2018	31/07/2018	102	45	19	59	39	264
Norcia	N. XX Settembre	03/10/2016	28/11/2016	05/03/2017	08/12/2016	05/03/2017	05/03/2017	56	97	-87	87	0	153
Norcia	N. XX Settembre 2 (Cupa)	19/04/2017	13/07/2017	06/08/2017	07/08/2017		08/12/2017	85	24	1			233
Norcia	N. Zona Industriale "A"	22/11/2016	27/01/2017	06/04/2017	25/02/2017	18/04/2017	09/05/2017	66	69	-40	52	21	168
Norcia	N. Zona Industriale "B"	20/12/2016	18/04/2017		11/05/2017		27/09/2017	119					281
Norcia	N. Zona Industriale "C" - Misciano	15/06/2017	28/08/2017		27/09/2017		28/02/2018	74					258
Norcia	N. Zona industriale "D"	09/07/2018	25/03/2019	30/04/2019	02/05/2019	26/06/2019	09/07/2019	259	36	2	55	13	365
Norcia	Nottoria	19/04/2017	09/08/2017		19/09/2017		15/12/2017	112					240
Norcia	Piediripa	19/07/2017	28/09/2017		06/11/2017		23/12/2017	71					157
Norcia	Popoli	03/06/2017	28/09/2017		06/11/2017		23/12/2017	117					203
Norcia	San Pellegrino	03/10/2016	01/12/2016	16/02/2017	08/12/2016	16/02/2017	18/02/2017	59	77	-70	70	2	138
Norcia	San Pellegrino 2	19/04/2017	07/08/2017	02/09/2017	05/09/2017	31/10/2017	12/11/2017	110	26	3	56	12	207
Norcia	San Pellegrino 3	19/07/2017	26/09/2017	25/10/2017	20/11/2017	08/01/2018	03/02/2018	69	29	26	49	26	199
Norcia	Savelli	03/06/2017	09/08/2017		19/09/2017		23/12/2017	67					203
Norcia	Valcaldara	19/07/2017	28/09/2017	26/10/2017	06/11/2017	16/12/2017	03/02/2018	71	28	11	40	49	199
Petriolo	Via Madre Teresa di Calcutta	10/11/2017	10/02/2018	29/07/2018	31/07/2018	24/09/2018	11/01/2019	92	169	2	55	109	427
Pieve Torina	Antico	07/03/2017	12/06/2017		31/07/2017		07/12/2017	97					275
Pieve Torina	Appennino	07/03/2017	05/06/2017	16/07/2017	17/07/2017	26/09/2017	11/11/2017	90	41	1	71	46	249
Pieve Torina	Casavecchia	07/03/2017	05/06/2017		10/07/2017	17/09/2017	11/11/2017	90			69	55	249
Pieve Torina	La Serra	07/03/2017	13/06/2017		04/09/2017		07/12/2017	98					275
Pieve Torina	Lottizzazione Rosi - Le Piane	07/03/2017	22/05/2017		26/06/2017		18/01/2018	76					317
Pioraco	Ristorante Laila	19/05/2017	03/08/2017		13/09/2017		03/03/2018	76					288
Posta	Posta I	06/09/2017	14/11/2017		31/01/2018	30/03/2018	19/06/2018	69			58	81	286
Posta	Steccato I	06/09/2017	24/11/2017	21/01/2018	22/01/2018	30/03/2018	19/06/2018	79	58	1	67	81	286
Preci	Capoluogo	06/03/2017	06/06/2017		31/08/2017	24/10/2017	23/12/2017	92			54	60	292
Preci	Capoluogo II - Faito area 1	09/11/2017	19/02/2018	19/03/2018	20/03/2018	16/05/2018	08/06/2018	102	28	1	57	23	211
Preci	Capoluogo II - Faito area 2	09/11/2017	19/02/2018	31/03/2018	03/04/2018	25/05/2018	08/06/2018	102	40	3	52	14	211
Preci	Castelvecchio	06/03/2017	06/06/2017		19/07/2017	16/09/2017	06/12/2017	92			59	81	275
Preci	Corone	06/03/2017	06/06/2017	03/08/2017	04/08/2017	03/10/2017	06/12/2017	92	58	1	60	64	275
Preci	Piedivalle	06/03/2017	06/06/2017		19/07/2017	16/09/2017	06/12/2017	92			59	81	275
Rocca Santa Maria	Cona Faiete	24/05/2017	21/08/2017	01/09/2017	26/09/2017		21/12/2017	89	11	25			211
Rocca Santa Maria	Paranesi Ciarelli	24/05/2017	21/08/2017	01/09/2017	26/09/2017		21/12/2017	89	11	25			211
Rocca Santa Maria	Villa Maggiore	24/05/2017	21/08/2017	01/09/2017	26/09/2017		21/12/2017	89	11	25			211
San Ginesio	Campo Sportivo (via del Tramonto)	11/05/2017	13/07/2017		28/08/2017		09/12/2017	63					212
San Ginesio	Pian di Pieca	15/05/2017	13/07/2017		04/09/2017		23/12/2017	59					222
San Ginesio	Santa Maria d'Alto Cielo	11/05/2017	13/07/2017		30/08/2017		23/12/2017	63					226
San Severino	Rione San Michele (Lotto 1)	18/04/2017	19/06/2017		04/09/2017		20/12/2017	62					246

. (*continued*).

References

Abulnour, A. H. (2014). The post-disaster temporary dwelling: Fundamentals of provision, design and construction. *HBRC Journal, 10*(1), 10–24. https://doi.org/10.1016/j.hbrcj.2013.06.001

Adeyeye, K., & Albadra, D. (2008). In *Time and temporality in transitional post-disaster architecture — The University of Bath's research portal*.

Alexander, D. (1989). Preserving the identity of small settlements during post-disaster reconstruction in Italy. *Disasters, 13*(3), 228–236. https://doi.org/10.1111/j.1467-7717.1989.tb00712.x

Alexander, D. (2013). An evaluation of medium-term recovery processes after the 6 April 2009 earthquake in L'Aquila, Central Italy. *Environmental Hazards, 12*(1), 60–73. https://doi.org/10.1080/17477891.2012.689250

ANSA. (2017, November 14). *Sisma, arriva la norma "salva-Nonna Peppina."*.

ANSA. (2017, December 30). *No a dissequestro casetta nonna Peppina*.

Bashawri, A., Garrity, S., & Moodley, K. (2014). An overview of the design of disaster relief shelters. *Procedia Economics and Finance, 18*, 924–931. https://doi.org/10.1016/s2212-5671(14)01019-3

Betke, H., & Seifert, M. (2017). BPMN for disaster response processes – A methodical extension. *Lecture Notes in Informatics (LNI), Proceedings - Series of the Gesellschaft Fur Informatik (GI), 275*, 1311–1324. https://doi.org/10.18420/in2017_132

Boano, C. (2009). Housing anxiety and multiple geographies in post-tsunami Sri Lanka. *Disasters, 33*(4), 762–785. https://doi.org/10.1111/j.1467-7717.2009.01108.x

Bolin, R., & Stanford, L. (1991). Shelter, housing and recovery: A comparison of U.S. disasters. *Disasters, 15*(1), 24–34. https://doi.org/10.1111/j.1467-7717.1991.tb00424.x

Bologna, R. (2007). *Strategic planning of emergency areas for transitional settlement*. Firenze University Press. https://doi.org/10.1400/79735

Borsekova, K., & Nijkamp, P. (2019). In K. Borsekova, & P. Nijkamp (Eds.), *Resilience and urban disasters: Surviving cities*. Edward Elgar Publishing.

Bris, P., & Bendito, F. (2019). Impact of Japanese post-disaster temporary housing areas' (THAs) design on mental and social health. *International Journal of Environmental Research and Public Health, 16*(23). https://doi.org/10.3390/IJERPH16234757

Bryman, A. (2016). *Social research methods*. Oxford University Press.

Bryson, J. M. (2018). *Strategic planning for public and nonprofit organizations: A guide to strengthening and sustaining organizational achievement* (5th ed.). Wiley.

Chang, Y., Wilkinson, S., Seville, E., Potangoroa, R., & Correspondence, A. (2010). Resourcing for a resilient post-disaster reconstruction environment. *International Journal of Disaster Resilience in the Built Environment, 1*(1), 65–83.

Chen, P. T., Yao, G. C., Yu, C., Liu, L. F., Wen, J. H., & Huang, C. H. (2014). A comparison of residents satisfaction with temporary housing: A case study of two temporary housing types in southern Taiwan. *Journal of the Chinese Institute of Engineers, Transactions of the Chinese Institute of Engineers, Series A/Chung-Kuo Kung Ch'eng Hsuch K'an.*. https://doi.org/10.1080/02533839.2014.904476

Chioni, C., Pezzica, C., Cutini, V., Bleil de Souza, C., & Rusci, S. (2021). Multi-scale configurational approach to the design of public open spaces after urban disasters. In S. Eloy, D. Leite Viana, F. Morais, & J. Vieira Vaz (Eds.), *Advances in Science, Technology & Innovation5th international symposium formal methods in architecture (5FMA)*. Springer Nature.

Choi, S. O. (2008). Emergency management: Implications from a strategic management perspective. *Journal of Homeland Security and Emergency Management, 5*(1). https://doi.org/10.2202/1547-7355.1372/HTML

CONSIP, & NDCP. (2014). *Accordo Quadro Soluzioni abitative in emergenza e servizi ad esse connesse per conto del Dipartimento della Protezione Civile* (2nd ed.).

Contreras, D., Blaschke, T., & Hodgson, M. E. (2017). Lack of spatial resilience in a recovery process: Case L'Aquila, Italy. *Technological Forecasting and Social Change, 121*, 76–88. https://doi.org/10.1016/j.techfore.2016.12.010

Da Silva, J. (2007). Quality and standards in post-disaster shelter. *The Structural Engineer*, 25–32.

Davidson, C. H., Johnson, C., Lizarralde, G., Dikmen, N., & Sliwinski, A. (2007). Truths and myths about community participation in post-disaster housing projects. *Habitat International.*. https://doi.org/10.1016/j.habitatint.2006.08.003

Davis, I. (1978). *Shelter after disaster*. Oxford Polytechnic Press.

Decreto Legislativo 14 Marzo.(2013).

Edgington, D. W. (2017). 'Building back better' along the Sanriku coast of Tohoku, Japan: Five years after the '3/11' disaster. *Town Planning Review, 88*(6), 615–639. https://doi.org/10.3828/TPR.2017.38

Edgington, D. W. (2022). Planning for earthquakes and tsunamis: Lessons from Japan for British Columbia, Canada. *Progress in Planning, 163*, Article 100626. https://doi.org/10.1016/J.PROGRESS.2021.100626

Eid, M. S., & El-adaway, I. H. (2018). Decision-making framework for holistic sustainable disaster recovery: Agent-based approach for decreasing vulnerabilities of the associated communities. *Journal of Infrastructure Systems, 24*(3), Article 04018009. https://doi.org/10.1061/(ASCE)IS.1943-555X.0000427

El-Anwar, O., & Chen, L. (2016). Automated community-based housing response: Offering temporary housing solutions tailored to displaced populations needs. *Journal of Computing in Civil Engineering, 30*(6), 04016019. https://doi.org/10.1061/(ASCE)CP.1943-5487.0000588

Emidio di Treviri. (2018). *Sul fronte del sisma. Un'inchiesta militante sul post-terremoto dell'Appennino centrale (2016–2017)* (DeriveApprodi).

Fayazi, M., & Lizarralde, G. (2018). Conflicts between recovery objectives: The case of housing reconstruction after the 2003 earthquake in Bam, Iran. *International Journal of Disaster Risk Reduction, 27*, 317–328. https://doi.org/10.1016/j.ijdrr.2017.10.017

Félix, D., Branco, J. M., & Feio, A. (2013). Temporary housing after disasters: A state of the art survey. *Habitat International, 40*, 136–141. https://doi.org/10.1016/j.habitatint.2013.03.006

Félix, D., Monteiro, D., Branco, J. M., Bologna, R., & Feio, A. (2015). The role of temporary accommodation buildings for post-disaster housing reconstruction. *Journal of Housing and the Built Environment.*. https://doi.org/10.1007/s10901-014-9431-4

Forino, G., & Carnelli, F. (2019). Introduction to the special issue "The L'Aquila earthquake 10 years on (2009–2019): impacts and state-of-the-art.". *Disaster Prevention and Management: An International Journal, 28*(4), 414–418. https://doi.org/10.1108/dpm-08-2019-394

Gehl, J., & Svarre, B. (2013). *How to study public life*. Island Press.

Goodwin, J. (2012). The possibilities and pitfalls of doing a secondary analysis of a qualitative data set. In *SAGE secondary data analysis* (v3-177-).

Greer, A., & Trainor, J. E. (2021). A system disconnected: Perspectives on post-disaster housing recovery policy and programs. *Natural Hazards, 106*(1), 303–326. https://doi.org/10.1007/s11069-020-04463-1

Hofmann, M., Betke, H., & Sackmann, S. (2015). Process-oriented disaster response management: A structured literature review. *Business Process Management Journal, 21*(5), 966–987. https://doi.org/10.1108/BPMJ-07-2014-0069

Hosseini, A. S. M., de la Fuente, A., & Pons, O. (2016). Multicriteria decision-making method for sustainable site location of post-disaster temporary housing in urban areas. *Journal of Construction Engineering and Management, 142*(9), Article 04016036. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001137

Hosseini, S. M. A., Farahzadi, L., & Pons, O. (2021). Assessing the sustainability index of different post-disaster temporary housing unit configuration types. *Journal of Building Engineering, 42*, Article 102806. https://doi.org/10.1016/J.JOBE.2021.102806

Imperiale, A. J., & Vanclay, F. (2019). Command-and-control, emergency powers, and the failure to observe United Nations disaster management principles following the 2009 L'Aquila earthquake. *International Journal of Disaster Risk Reduction, 36*, Article 101099. https://doi.org/10.1016/j.ijdrr.2019.101099

Jha, A. K., Barenstein, J. D., Phelps, P. M., Pittet, D., & Stephen, S. (2010). Safer homes, stronger communities: A handbook for reconstructing after natural disasters. In *Safer homes, stronger communities*. The World Bank. https://doi.org/10.1596/978-0-8213-8045-1.

Johnson, C. (2007). Strategic planning for post-disaster temporary housing. *Disasters, 31*(4), 435–458. https://doi.org/10.1111/j.1467-7717.2007.01018.x

Kır, S., & Yazgan, H. R. (2018). Hesitant fuzzy axiomatic design technique: A case for humanitarian relief. *Journal of Intelligent & Fuzzy Systems, 34*(6), 4181–4189. https://doi.org/10.3233/JIFS-171872

Krieger, A. E. (2019). Disaster housing for urban environments [Naval Postgraduate School Monterey United States]. https://apps.dtic.mil/sti/citations/AD1080310.

Manning, S. R. (2020). Strategic planning in emergency management: Evaluating the impacts on local program quality. *Journal of Homeland Security and Emergency Management, 17*(3), 1–39. https://doi.org/10.1515/JHSEM-2019-0051

NDCP. (2009). In G. M. Chianello, R. Raschi, & M. Rebuffat (Eds.), *Manuale per la compilazione della scheda di 1° livello di rilevamento danno, pronto intervento e agibilità per edifici ordinari nell'emergenza post-sismica (AeDES)*. Italiani nel Mondo.

NDCP. (2016a). Ocdpc n. 394. In *Ocdpc n. 394 del 19 settembre 2016*. https://www.regione.marche.it/Portals/0/USRM/normativa/OCDPC/OCDPC_394_mod.pdf#:~:text=Ord.%2019%20settembre%202016%2C%20n.%20394%20%281%29%20Ulteriori,Abruzzo%20il%2024%20agosto%202016.%20%28Ordinanza%20n.%20394%29.

NDCP. (2016b). Ocdpc n. 405 Del 10 Novembre 2016. https://www.protezionecivile.gov.it/it/normativa/ocdpc-n–405-del-10-novembre-2016—ulteriori-interventi-urgenti-di-protezione-civile-conseguenti-agli-eventi-sismici-che-hanno-colpito-il-territorio.

NDCP. (2017). *Terremoto centro Italia: Fondo di Solidarietà dell'Unione Europea, oltre 23 miliardi di euro i costi dell'emergenza e la stima dei danni - Comunicato Stampa*.

NDCP. (2018a). I numeri del sisma in Centro Italia. https://emergenze.protezionecivile.gov.it/static/f438b5ebc904a11a47dd5db891db0fbb/Relazione_di_aggiornamento_numeri_dell_emergenza_22_agosto_2018_.pdf.

NDCP. (2018b). *Ocdpc n. 510 Del 27 Febbrario 2018*. https://www.protezionecivile.gov.it/it/normativa/ordinanza-n–510-del-27-febbraio-2018–ulteriori-interventi-urgenti-di-protezione-civile-conseguenti-agli-eventi-sismici-che-hanno-colpito-il-territor.

NDCP. (2018c). Ocdpc n. 518 Del 4 Maggio 2018. https://www.protezionecivile.gov.it/it/normativa/ocdpc-n–518-del-4-maggio-2018–ulteriori-interventi-urgenti-di-protezione-civile-conseguenti-agli-eventi-sismici-che-hanno-colpito-il-territorio-dell.

NDCP. (2018d). *Ocdpc n.538 Del 10 Agosto 2018*. https://www.protezionecivile.gov.it/it/normativa/ocdpc-n-538-del-10-agosto-2019–ulteriori-interventi-urgenti-di-protezione-civile-conseguenti-agli-eventi-sismici-che-hanno-colpito-il-territorio-dell.

NDCP. (2020, August 28). *Terremoto Centro Italia: le Sae-Soluzioni abitative in emergenza*. Sito Del Dipartimento Della Protezione Civile - Presidenza Del Consiglio Dei Ministri. https://mappe.protezionecivile.gov.it/it/mappe-emergenze/mappe-terremoto-centro-italia-2016/soluzioni-abitative-emergenza.

NDPC. (2019). Terremoto Centro Italia: le Sae-Soluzioni abitative in emergenza - Dettaglio dossier. http://www.protezionecivile.gov.it/media-comunicazione/dossier/dettaglio/-/asset_publisher/default/content/terremoto-centro-italia-le-sae-soluzioni-abitative-in-emergenza.

Nigg, J. M., Barnshaw, J., & Torres, M. R. (2006). Hurricane Katrina and the flooding of New Orleans: Emergent issues in sheltering and temporary housing. *The Annals of the American Academy of Political and Social Science, 604*(1), 113–128. https://doi.org/10.1177/0002716205285889

Nunavath, V., & Prinz, A. (2015). Norwegian emergency management process by using business process modeling notation. In *Proceedings of the 8th IADIS international conference information systems 2015, IS 2015* (pp. 205–210).

O.M.G.. (2014). Business process model and notation. BPMN 2.0 https://www.omg.org/spec/BPMN/About-BPMN/.

Oggioni, C., Chelleri, L., & Forino, G. (2019). Challenges and opportunities for pre-disaster strategic planning in post-disaster temporary housing provision. Evidence from earthquakes in Central Italy (2016–2017). *Italian Journal of Planning Practice, IX* (1), 96–129.

Pan, A. P. (2011). A constructive genetic algorithm for the P-median location problem of typhoon emergency shelter in China coastal rural areas. *Key Engineering Materials, 480–481*, 1215–1220. https://doi.org/10.4028/www.scientific.net/KEM.480-481.1215

Parrinello, G. (2020). *Fault lines: Earthquakes and urbanism in modern Italy*. Berghan Books.

Patel, S., & Hastak, M. (2013). A framework to construct post-disaster housing. *International Journal of Disaster Resilience in the Built Environment, 4*(1), 95–114. https://doi.org/10.1108/17595901311299026

Peinel, G., Rose, T., & Wollert, A. (2012). In *The myth of business process modelling for emergency management planning*.

Perrucci, D., & Baroud, H. (2020). A review of temporary housing management modeling: Trends in design strategies, optimization models, and decision-making methods. *Sustainability, 12*(24), 10388. https://doi.org/10.3390/SU122410388

Perrucci, D. V., & Baroud, H. (2021). Temporary housing operations: A simulation-based inventory management approach using the newsvendor model. *International Journal of Disaster Risk Reduction, 65*, Article 102512. https://doi.org/10.1016/J.IJDRR.2021.102512

Pezzica, C., Bleil de Souza, C., & Dunichkin, I. V. (2021). In *, 1174(1). Developing functional requirements for temporary housing by integrating axiomatic design with the 5 gaps model of service quality* (p. 012014). https://doi.org/10.1088/1757-899X/1174/1/012014

Pezzica, C., Chioni, C., Cutini, V., & Bleil de Souza, C. (2020). Assessing the impact of temporary housing sites on urban socio-spatial performance: The case of the central italy earthquake. In O. Gervasi, & et al. (Eds.), *Lecture notes in computer science: Vol. 12251. Computational science and its applications – ICCSA 2020* (pp. 324–339). Springer Cham. https://doi.org/10.1007/978-3-030-58808-3_24.

Pezzica, C., & Cutini, V. (2020). When time matters: Mid-term housing provision after disasters. In J. M. Montaner, Z. M. Martínez, & G. B. Pani (Eds.), *Proceedings of the IV international congress of sustainable collective housing* (pp. 264–269). Congreso Internacional De Vivienda Colectiva Sostenible.

Pezzica, C., & Cutini, V. (2021). Linking space syntax and cluster analysis to design and plan temporary housing neighborhoods: A taxonomy of sites in Norcia. *Journal of Design for Resilience in Architecture and Planning, 2*(Special Issue: Space Syntax), 89–114. https://doi.org/10.47818/DRArch.2021.v2si037

Pezzica, C., Cutini, V., & Bleil de Souza, C. (2021). Mind the gap: State of the art on decision-making related to post-disaster housing assistance. *International Journal of Disaster Risk Reduction, 53*, Article 101975. https://doi.org/10.1016/j.ijdrr.2020.101975

Platt, S., & Drinkwater, B. D. (2016). Post-earthquake decision making in Turkey: Studies of Van and İzmir. *International Journal of Disaster Risk Reduction, 17*, 220–237. https://doi.org/10.1016/j.ijdrr.2016.03.010

Presidenza del Consiglio dei Ministri. (2017). *Circolare della Presidenza del Consiglio dei Ministri del 16/01/2017*.

Rotondo, F., Marinelli, G., & Domenella, L. (2020). Shrinking phenomena in Italian inner mountainous areas. Resilience strategies. In O. Gervasi, B. Murgante, S. Misra, C. Garau, I. Blečić, D. Taniar, … Y. Karaca (Eds.), *Vol. 12253. Lecture notes in computer science (LNCS)* (pp. 195–206). Cham: Springer. https://doi.org/10.1007/978-3-030-58814-4_14.

Salaheldin Ismail Elsayed, D. (2018). Perceiving urban resilience within post-quake recovering processes. An experimental approach for emergency housing in Emilia Romagna, Italy. In *Research for development* (pp. 333–349). https://doi.org/10.1007/978-3-319-61988-0_26

Sapat, A., Li, Y., Mitchell, C. M., & Esnard, A.-M. (2011). Policy learning and policy change: Katrina, Ike and post-disaster housing. *International Journal of Mass Emergencies and Disasters, 29*(1). http://ijmed.org/articles/555/.

Shariat Alavi, M., Fallahi, A., Mottaki, Z., & Aslani, F. (2021). Post-disaster sheltering process after the 2019 floods, in Golestan province, Iran. *International Journal of Disaster Resilience in the Built Environment*. https://doi.org/10.1108/IJDRBE-03-2021-0023/FULL/XML

Sienkiewicz-Małyjurek, K. (2014). Strategic approach and initiatives streamlining emergency operations in Poland. *Academic Journal of Interdisciplinary Studies, 3*(1). https://doi.org/10.5901/AJIS.2014.V3N1P385

Soini, J., & Polancic, G. (2010). Toward adaptable communication and enhanced collaboration in global crisis management using process modeling. In *PICMET '10 - Portland International Center for management of engineering and technology, proceedings - Technology management for global economic growth* (pp. 981–990).

Sukhwani, V., Napitupulu, H., Jingnan, D., Yamaji, M., & Shaw, R. (2021). Enhancing cultural adequacy in post-disaster temporary housing. *Progress in Disaster Science, 11*, Article 100186. https://doi.org/10.1016/J.PDISAS.2021.100186

Tanaka, S. (2012). A sustainable public procurement system for large-scale natural disasters: The case of the temporary housing program after the East Japan. *Earthquake*, (45). http://id.nii.ac.jp/1085/00001117/.

TCI. (2016). Terremoto Centro Italia. https://terremotocentroitalia.info/.

UNDRR. (2015). Sendai Framework for Disaster Risk Reduction - UNDRR. https://www.unisdr.org/we/coordinate/sendai-framework.

United Nations. (2017). *The new urban agenda - Habitat III*.

Valent, G. (2019). Disaster recovery and violence in neoliberal times: Community and spatial fragmentation in L'Aquila. *Disaster Prevention and Management: An International Journal, 28*(4), 446–459. https://doi.org/10.1108/DPM-01-2018-0032

Wagemann, E. (2017). Need for adaptation: Transformation of temporary houses. *Disasters, 41*(4), 828–851. https://doi.org/10.1111/disa.12228

Windle, M., Quraishi, S., & Goentzel, J. (2019). *Disaster housing construction challenges in America exploring the role of factory-built housing*.

Zulean, M. (2014). In *Emergency preparedness in the European Union* (pp. 1–5).