Process model for international building permit benchmarking and a validation example using the Israeli building permit process

Judith Fauth
Faculty of Civil and Environmental Engineering, TU Wien, Vienna, Austria
Tanya Bloch
Faculty of Civil and Environmental Engineering, Technion Israel Institute of Technology, Haifa, Israel, and
Lucio Soibelman
Astani Department of Civil and Environmental Engineering, University of Southern California, Los Angeles, California, USA

Received 13 June 2023
Revised 14 September 2023
6 November 2023
16 November 2023
19 November 2023
Accepted 20 November 2023

Abstract

Purpose – Building permitting is mostly a manual, labor intensive and time-consuming process. Initiatives for streamlining the process are not always helpful since they often fail to address the core problems within the process. A framework for modeling the permitting process can be useful to identify bottlenecks, core challenges and best practices. Hence, the authors aim to demonstrate and validate a previously suggested workflow for permit process modeling using the permitting process in Israel as a test case.

Design/methodology/approach – The authors implement qualitative expert interviews for data acquisition. The collected data are then processed for a qualitative data analysis. The results of the analysis are then validated using a focus group workshop in the field of building permits. In the test case the focus group consisted of Israeli experts.

Findings – The authors present a detailed overview of the as-is building permit process in Israel and the existing challenges. Through this test case, the authors found that the framework is applicable in different countries and that it can provide valuable insights into the core problems within the process. In addition, application of the same framework in different countries can provide comparable results that would allow the authors to identify best practices.

Originality/value – The major contribution of this work is the development and validation of a framework for building permitting process modeling which can be used to identify existing challenges and bottlenecks in the process. Implementing a structured and unified approach provides an opportunity to easily compare processes in different countries to identify best practices.

Keywords Construction permitting, Process modelling, Digital permit, Building permit

Paper type Research paper

Introduction

Every construction work, whether for erecting a new building, retrofitting or demolishing an existing one, requires a building permit to be issued by the relevant authority. As part of the process, the suggested design is inspected by professionals to verify that all building regulations in effect are met and best practices in construction are maintained. It is of high

This work was supported by the Minerva Stiftung enabling a research stay for JF. The authors acknowledge TU Wien Bibliothek for financial support through its Open Access Funding Programme.

Engineering, Construction and Architectural Management
Vol. 31 No. 13, 2024
pp. 121-139
Emerald Publishing Limited
0969-9988
DOI 10.1108/ECAM-06-2023-0593

societal interest to ensure that the built environment remains safe and functional. Permitting can be associated with higher housing costs as the impact of inefficient, costly, or lengthy permitting process is passed down to homeowners. Moreover, the time spent by authorities and multiple government agencies for issuing a permit also translates to the taxpayer's expenses.

Obviously, accelerating and optimizing the process of issuing a building permit is of high societal interest. To do so, one needs to first understand the existing process, its bottlenecks, strengths, limitations, and the opportunities for improvement. Hence, the main objective of this work is to establish a general framework for mapping the building permitting process, which would be applicable in different countries. Such a framework is expected to standardize the way that building permit process is analyzed, providing the basis for a global and meaningful comparison. Furthermore, it is important to understand that in current practice, the building permit process is outlined by the regulatory authority to define a timeframe for the steps. However, this form of representation does not express the relationships between the process steps, the stakeholders involved in the process, the dependencies between the steps and the handovers. The proposed framework puts all these aspects at the center instead of only looking at the time constraints. This is important for any improvement endeavor. Understanding the bigger picture of the problem is crucial to enable finding proper digital and automated solutions.

With the rapid technological advances and the digitalization of the Architecture, Engineering and Construction (AEC) industry (Papadonikolaki *et al.*, 2020), digitalization of the permitting process is a logical next step. However, existing research on the subject is mostly focused on the development of solutions, without a detailed analysis and understanding of the full process and its problems. In most cases researchers focus on specific parts of the permitting process, such as design review for checking either zoning regulations or code requirements (Onstein and Tognoni, 2017; Chognard *et al.*, 2018; Olsson *et al.*, 2018; Ciotta *et al.*, 2021). Others choose to investigate the digitalization aspect based on Building Information Modeling (BIM) (Nawari and Alsaffar, 2017; Chognard *et al.*, 2018; Ammar *et al.*, 2022; Ullah *et al.*, 2022). Yet, defining which sub-processes benefit from automation and the desired level of automation remains unaddressed. Information flow for digital permit processes is scarcely explored holistically. Current research methodologies deployed globally yield incomparable results. Bridging the gap between process investigation and digitalization efforts is essential. Existing efforts tend to be either top-down or bottom-up, failing to integrate into a comprehensive solution. Fundamental research is needed, particularly in defining automation levels for sub-processes and the overall permitting process.

The research by Noardo *et al.* (2022), for example, employed a classification method to assess the state of the art in Digital Building Permit (DBP) processes. The findings indicate disparities in addressing different steps of the DBP workflow, particularly in geoinformation use, BIM modeling, and data interoperability. Many key requirements (such as the alignment of the process on a higher level, or mindset change of public officers) remain unexplored or underrepresented. Overall, reviewed contributions often demonstrate limited implementation progress, with a focus on demonstrators and intermediate progress levels. Basic research and certain aspects of DBP are also insufficiently covered. To define a permitting process that overcomes the existing difficulties, but still provides properly controlled construction, safe buildings and well organized and maintained cities, we must first understand the current practice and its limitations (Bloch and Fauth, 2023).

Most of the existing work on DBP (e.g. (Plazza *et al.*, 2019; Whitell *et al.*, 2020)) is aimed at process visualization without using a consistent modeling approach, which leads to incomparable results. Leading towards digitalization, we must understand the process accurately. Thus, standards, recommendations, or guidelines for building permit process modeling are needed. To overcome this gap, the authors proposed and developed a conceptual building permitting process modeling framework (Fauth and Soibelman, 2022).

To validate the generalization of the proposed framework for building permit process modeling the authors used as a case study the complex building permit process in Israel. Recently, there have been several efforts attempting to streamline the permitting process in Israel, however the results have been disappointing (State comptroller, 2021). This suggests that different approaches need to be adopted for significant improvement. Hence the case of Israel was chosen for validating the framework for process modeling but also to evaluate the possible added value of implementing the proposed framework.

Background

Building permitting in Israel

Despite various initiatives implemented by the government to increase supply of dwelling units in Israel, based on recent reports (Israeli national economics council, 2021) the current supply still fails to meet the increasing demand. Furthermore, prices for housing keep escalating (Central Bureau of Statistics (CBS), 2023). Since long and inefficient permitting processes directly affect the time to produce dwelling units and the profit margins for developers, building permitting is one of the aspects that needs to be addressed in order to create larger supply of (affordable) housing. In Israel, one of the most significant initiatives in the building permit domain is a correction to the Israeli planning and building law, referred to as "amendment 101". The amendment which came to effect in 2016, is the realization of the government's decision on the matter in 2006, calling for substantial improvement of the quality of construction in Israel, while streamlining and simplifying the procedures involved. The amendment transformed the permitting process in Israel into a digital environment introducing significant changes to the process. We will not discuss all the significant changes, but we will mention a few to explain the scope of the amendment's impact.

One of the introduced changes was the addition of building control institutes as a supervisory entity in the process. Building control institutes are usually private bodies, certified by the Laboratory Accreditation Authority and licensed by the Minister of the Interior to conduct design review and supervise projects during construction. These procedures include design review during building permitting, visits to the construction site and control of many areas concerning the safety and stability of the structure. To ensure the quality of review and supervision, control institutes are obliged to employ authorized checkers trained by the approving authorities (such as the fire department, Homefront command, etc.) (Israel planning administration, 2023). Building control institutes are meant to coordinate the entire process of design review, instead of applicants seeking the approval of each regulatory body individually. The expectation was for a more centralized process (State comptroller, 2021). Still, there is not a significant impact on the building permit process considering the fact that the institutes work within a very narrow scope and are only responsible for residential buildings lower than 29 m.

Another important aspect of the transformation of the permitting process in Israel is digitalization. Much like in many other parts of the world tackling the same problems, Israel also made efforts to replace the paper-based permit request workflow with a digital interface. However, as in most countries, this digital interface is merely a tailored document management system with built in workflows and time constraints (Shahi, 2018). The state's system called "accessible permitting" was designed to support all the stages of permitting and execution online. It starts with applying for an information file and receiving the information, to applying and issuing a permit, ending with the management and control of the construction phase - application for approval to start of work, control of the actual construction and application and receipt of a certificate of completion. In practice however, according to the states comptroller report from 2021, the system is not fully fitted for the needs of the involved stakeholders, and many times it leads to duplicate and redundant work

(State comptroller, 2021). For example, the report showed that due to the lack of an efficient (automated) interface between the state's system to the systems of local committees, decisions are often made twice, once in each system. Furthermore, information like the issued date of the permit is often not accurately aligned in both systems (State comptroller, 2021).

Comparing the results for Israel with The World Bank's "Doing business" report in terms of "dealing with construction permits" for 2015 (World Bank, 2014) and 2020 (The world bank, 2023), the building permit process has shortened by only 9 days (from 209 to 200 days). This illustrates that despite the major changes implemented, in practice, we are seeing limited impact. We suggest that any approach capable of providing significant process improvement should be rooted in a better understanding of all steps and problems of the current process using better tools for process mapping and analysis. The significant changes implemented compared to the mild achieved results make the Israeli case remarkably interesting. By mapping the building permit process in Israel, we hope to be able to identify the issues within the process that have not been addressed yet. We believe that the proposed methodology for process mapping can be useful for identifying shortcomings and opportunities within the permitting process, in any country. To prove this statement, we first aim to validate the previously suggested methodology as a tool that can be used in various regions.

Diverse modeling types of building permit processes

Based on a recent literature review by Bloch and Fauth (2023), research dedicated to building permit process analyses is limited. Even though the number of relevant academic articles is low, countries and municipalities from all over the globe had their building permit process investigated. However, during this process a variety of approaches for describing and visualizing the building permit processes were implemented. While some articles describe the building permit process using words (Sonntag and Wimmer, 2003), or tables (Meijer and Visscher, 2006; Yaakup *et al.*, 2007; Karoui and Sassi, 2016), others introduced visualization tools to describe the process steps. For example, individual kinds of flow charts (Kettner and Diaz, 2000; Nawari and Alsaffar, 2017; De Lima-Omorog *et al.*, 2018; Shahi *et al.*, 2019; Fawzy and Magdi, 2020; Kim *et al.*, 2020; Whitell *et al.*, 2020), BPMN maps (Plazza *et al.*, 2019), and other types of visualization tools such as discrete event simulation (Feng *et al.*, 2009); or total free types of visualization (e.g. (Kpamma and Adjei-Kumi, 2013; Eirinaki *et al.*, 2016)) were used. Due to the different representations, it is particularly challenging to extract the process steps from all the different methods and it is even more difficult to align the process steps with each other. Therefore, comparing the processes in different countries often requires interpretations and assumptions.

Depending on the granularity of illustrating the process steps, different options of visualizations exist. For example, Costa *et al.* (2021) used a BPMN diagram to illustrate the Italian building permit case but needed to simplify it for better visibility and readability. Also, Shahi *et al.* (2019) and Schranz *et al.* (2021) modeled process steps in a free style way. This leads in most cases to the desired expression of the authors' intention but makes the information hardly comparable with other data sets due to its demand of interpretation. The Doing Business report instead was based on written explanation and subdivides subprocesses simply with bullet points (The World Bank, 2023). Other studies show frameworks such as the one proposed by Guler and Yomralioglu (2021) and Messaoudi and Nawari (2021) which need to be separated from the modeling of process steps since their frameworks consider concepts on a broader level instead of considering it at the level of process steps.

Framework for modeling building permitting process

A conceptual framework has been previously developed by the authors to model building permit processes, which consists of three main elements: processes, stakeholders, and

business rules. The framework considers all hierarchized process steps and stakeholders' influence on the process. Business rules define authority-specific requirements and circumstances and provide alternatives of action. In some countries, the law does not govern the processes of issuing building permits, resulting in varied processes that need to be analyzed. For example, internal process steps within municipalities vary due to the organization of the municipality (distinct roles, different departments, etc.) which may influence the entire building permit system. After data sets on building permit processes are acquired and analyzed, processes can then be modeled based on the proposed framework. The framework provides a consistent and comparable basis that allows other researchers to replicate building permit process models for their respective country, identifying shortcomings and best practices. It is essential to model processes based on a consistent framework to avoid distorted results when comparing processes based on different approaches and data sets. The framework is illustrated in Figure 1.

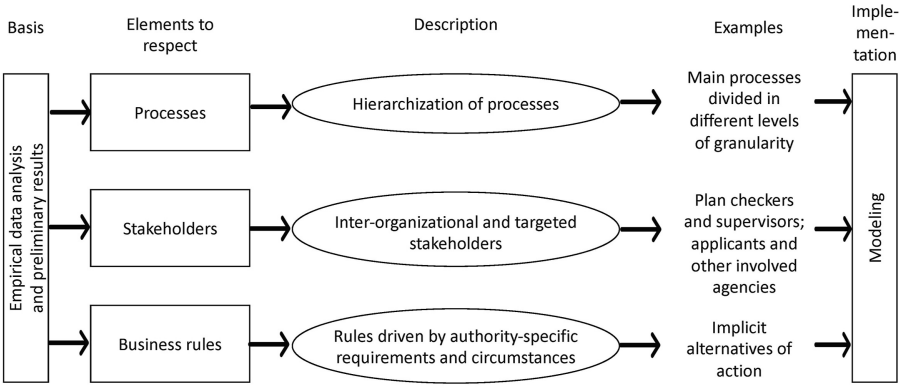
To conclude, understanding the building permitting process in its current state is essential for any further developments and improvements. A conceptual framework for a standardized building permit process modeling has been previously suggested and implemented in Germany and in the US. Further validation of that conceptual framework, from a global perspective, is required to substantiate the results. Israel has been striving to simplify and streamline the permitting process, while considering construction quality. Despite the efforts, reports show that the results achieved are not as expected. This makes Israel an interesting case for testing and validating the framework, which is the focus of this work.

Aims, methodology and methods

We followed the process modeling framework formulated in (Fauth and Soibelman, 2022) to comprehensively map the permitting process in Israel. In addition to validating the proposed methodology for comprehensively mapping the permitting process in a standard way, we expected to find shortcomings and opportunities along the process.

Methodology

Since the Israeli building permit process has not been scientifically investigated, we had first to collect data. For this study qualitative expert interviews were chosen as the most



Source(s): Own work 2022

Figure 1.
Conceptual framework for building permit process modeling

appropriate method for data acquisition because preliminary research demonstrated that quantitative surveys are not suitable for collecting detailed and specific process information (Fauth, 2022). Qualitative research is used in theory-generating or inductive research, which allows, among other things, an in-depth understanding of complex phenomena and an exploration of subjective ways of thinking. In contrast to quantitative research, this also applies to a small number of cases (Gläser and Laudel, 2010). However, individual case investigations can be used for generalization (Flyvbjerg, 2006). To this end, qualitative expert interviews provided us with the ability to revisit questions when necessary, allowing us to achieve a level of detail not possible with quantitative surveys. This research consisted of four main phases: data collection, data preparation, qualitative data analysis and validation.

Data collection – The qualitative expert interviews were conducted with a semi-structured interview guideline based on the approach by Gläser and Laudel (2010) and according to the previous work of the authors. To verify the suggested methodology for mapping the building permit process, we conducted nine interviews with professionals from the Israeli industry that are involved in various stages of the process. Three of the interviewees are representatives of applicants, such as independent architects, construction developers and entrepreneurs. Six interviewees from the checking side, the interviewees are in high-ranking positions in the permitting departments of different municipalities. Each interviewee is from a different municipality in Israel, some from large and central cities in the country with a large volume of construction, and others from smaller cities. Additionally, professionals from the regulatory ministries were interviewed as well. The interviews took place from June 2022 until October 2022. All interviews took place online. Always, two interviewers (one speaks Hebrew) and one interviewee attended the interview. The interviewees were not prepared for the questions in advance. The interviews were recorded and automatically transcribed. The interviews were generally conducted in English. Overall, 10 h of audio recordings were collected. In terms of data saturation, which refers to the point at which new data collection and analysis cease to yield new or different insights (e.g. (Braun and Clarke, 2021)), the authors agreed on the point at which they have collected enough data to fully understand and explore the level of building permit processes under study.

Data preparation – In addition, we transcribed and cleared the transcripts. In some cases, interviewees explained specific content in Hebrew. Such parts were translated into English. One interview was mainly conducted in Hebrew which was also translated into English.

Qualitative data analysis – For the qualitative content analysis, the approach proposed by Gläser and Laudel (2010) was used and implemented in the software MaxQDA. While analyzing the transcripts in the software a coding system was created. Relevant text segments were assigned to respective codings. The coding system focused on two main parts: process steps and challenges. Within the main codings, sub-codings (or even further codings on lower levels) were created. For the process step part, each sub-process (or even lower level) had its own coding (e.g. content review, or participation of involved agencies). The list of codings can be found in Appendix .

Validation – To verify our results, we organized a focus group workshop with Israeli experts in the field of building permits. The workshop took place on March 2023 and lasted about two hours. It was a hybrid event meaning that participants joined in-person and online. The 10 participants were local architects, engineers, employees from municipalities, and representatives of ministries. No participant was involved in the interviews before. We prepared our results in the form of presentation slides. The authors split the workshop in different blocks (one for building permit process in Israel, one for identified challenges, etc.). In each block, the results were presented with support of graphs prepared by the authors followed by a discussion part before moving on to the next block. Uncertainties encountered while mapping the process were pointed out by the authors (e.g. statistical form).

Furthermore, the participants added little missing information (e.g. advance fee, or public announcement).

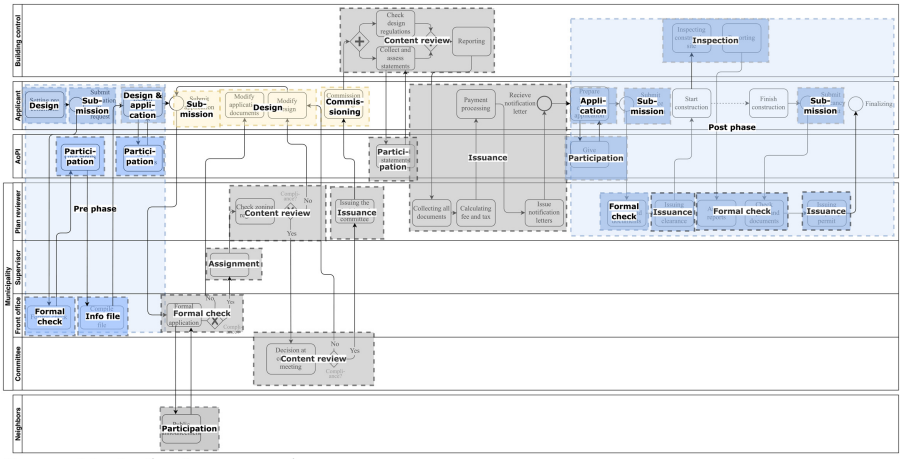
Results

The building permit process in Israel

In this section, the Israeli building permit process is described and visualized in detail based on the collected and analyzed data. Figure 2 illustrates an overview of the Israeli building permit process including its involved stakeholders. The stakeholders are municipality, neighbors (people affected by a building project), Agencies of Public Interest (AoPI) (other bodies of authorities and agencies to be involved and to give recommendations, e.g. environmental authority), applicant (person who submits the building application, usually building owners or engineers/architects in behalf of the building owner), and building control office (in Israel responsible for technical reviews for specific types of buildings). The municipality can further differentiate in specific roles such as plan reviewer (person who examine the building applications), supervisor (person who oversees a group of plan reviewers), front office (work area where only administrative actions take place), and committee (group of people appointed for a final decision of building applications). The process consists of three phases: pre-phase, "main phase" and post-phase. Note that the given map only presents one track of permitting, one that does not contain deviations and that consists of an application for a new residential building, up until 29m which falls within the scope of responsibility of the building control office.

In the pre-phase, the applicant prepares an initial preliminary design and submits a request for an information file. The front office checks the request and involves AoPI to compile the information file. The information file includes all information on regulations and laws relevant to the site. With this information file, the applicant starts the design of the building, and can apply for a permit.

Once the applicant finishes the design, the applicant starts the main phase by submitting the building request to the municipality. Within the municipality, first the front office checks formal conditions of the request and makes a public announcement which gives neighbors the opportunity to raise concerns about the planned building. If the application meets all formal requirements, the municipality supervisor assigns the building application to a plan



Source(s): Author's own work

Figure 2.
Overview of the Israel building permit process

reviewer in charge of it. The plan reviewer checks the documents and plans according to zoning, design, and policy requirements. If the requirements are not met, the applicant is required to modify the design, which happens in practice on an iterative basis. Once the requirements are met, the application goes to a committee, which decides on the permit. With an issued approval from the committee, and a list of conditions for approval provided by the committee, the applicant needs to commission a building control office for content review of engineering regulations (for residential buildings as explained in section 2.1). The building control officer is responsible for reviewing the design in terms of engineering and compliance to regulations defined by other AoPI (such as the fire department, Homefront command, etc.) The building control officer reports the results to the municipality. After collecting all documents, the municipality calculates fees and taxes. After the payment by the applicant, the letter of notification is issued by the municipality.

The post-phase summarizes the process steps after the notification letter of the building permit is issued. Before the construction starts, a starting approval or "digging permit" is required. Therefore, the applicant needs to collect statements from other AoPI and submit them together with an application to the municipality. If all statements and documents are correct and without concerns, the building's construction can begin. During construction, the building control office inspects the construction site. When the construction is finished, the applicant requests an occupancy permit from the municipality. If the building passes its final inspection and all the required approvals are provided, the municipality issues an occupancy permit, and the building can start its operation phase.

Other findings – shortcomings in the Israeli permitting process

The interviewees were not directly asked about the challenges in the process, instead they were asked to describe the permitting process in detail. Nevertheless, several challenges were described, and repeated several times by different interviewees. These challenges were also analyzed during the qualitative content analysis. In most cases, the interviewees explained the problems through examples, which were then examined and clustered into 10 groups as described in (Table 1).

Figure 3 presents an overview of how often a challenge was mentioned by applicants or by plan checkers. It is interesting to point out the issue of "subjectivity" which was mentioned 10 times, nine of which by applicants, but only once by an interviewee from a municipality. Similarly, "Inconsistency" was mentioned five times by applicants and only once by an interviewee from a municipality. The aspect of "professionalism" was also mentioned 10 times, in an analogous manner by applicants and municipalities. As shown in Figure 3, most of the issues are agreed upon between the applicants and the authorities.

The identified challenges were discussed during the expert workshop as well. During the discussion, all challenges were agreed upon except two, which in the eyes of the experts are simply a "given state" and not a challenge *per se*. This is concerning the fact that there are multiple stakeholders in the process, and the fact that applicants keep asking for deviations which was defined in the workshop as a "cultural aspect" that will not change. The rest of the issues were agreed upon.

Based on the interviews and the workshop, we could conclude that there are two major challenges that govern the existing permitting process; one is the high complexity of regulations and the resolution to which checkers are obligated to check in the permitting process, and the other is the human factor which encapsulates "subjectivity" and "professionalism".

Discussion

As discussed before, the building permitting domain covers a wide range of different and diverse processes and concepts. Since decades, most of the research in the field focused on

#	Challenge	Description	Example
1	Ambiguity	Some of the requirements can be understood in different manners, there are gray areas in the laws and regulations, which are eventually resolved during decision making. In addition, often the requirements set in the beginning of the process (the information file) are general, and can change during the initial design phase	Interviewees mentioned that there are a lot of interpretable terms and conditions in the process. For example, the information file refers to the municipal guidelines, but these can change very fast and they are obligatory
2	Subjectivity	City officials get re-elected, and each person has their own personal views and preferences which are transformed into policies and decisions in the permitting process. This cause differences across municipalities, but also within specific municipalities between the plan checkers	Interviewees mentioned that preferences of individuals cause problems. Applicants say that smoothness of review process depends on an individual plan checker
3	Instability	Both municipalities and other involved parties are authorized to change policy whenever needed. This can happen often and have a great effect in the early design stages	Interviewees mentioned the intense pressure to be on time with the law. When a law changes, in the worst case, a completely new design needs to be made and the review phase starts at the beginning
4	Many regulations	In Israel there are several levels of requirements that must be considered in the permitting stage. First, the planning and building law, development plans, regulations per subject (like regulations for calculating taxes and fees), codes and standards (mostly for the engineering aspect), guidelines implemented by third body parties (like the Homefront command), municipal design guidelines and policies	Interviewees mentioned the challenge of keeping the overview of the different regulations themselves, the awareness of the responsibility of the law and their changes
5	Many stakeholders	Many stakeholders are involved in the permitting process both from the applicant side and from the approving side. Each has their own perspective and their own goals	The interviewees mentioned the challenge to coordinate and to communicate with all stakeholders as they are not basically connected
6	Early design phase	The committee approves a permit based on a very initial design, considering mostly the zoning aspect of the application, under several conditions (requirements)	Interviewees mentioned that conforming to all the conditions requires changes in the basic geometry of the building, which is not possible after the committee's approval happens very often
7	Deviations	Some predefined deviations from the relevant development plan are permitted by law, adding rights to the developer. However, when asking for these deviations, the permitting process requires participation by neighbors. A different type of deviation are requests that do not completely follow the policy of the municipality, and the municipality is authorized to accept or decline	Interviewees mentioned that there is high economic pressure to achieve the most profitable output which requires deviations. The economic pressure comes from the general high prices for land in Israel but also because of an additional tax In extreme cases, this challenge can even arise rivalry between applicants if for example an applicant feels treated unfairly towards others
8	Workload	Municipalities are understaffed, causing applications to pile up	Interviewees mentioned a low motivation of the plan reviewers
9	Professionalism	There is currently a lack of experts in several disciplines, as many engineers retire but young professionals do not find the job attractive. In addition, often designers as well as workers of the public sector are not highly paid, making skilled engineers to look for other opportunities	Interviewees mentioned that the lack of experts causes frustration on both sides of the process what makes communication even harder
10	Inconsistency	Since a vast number of requirements need to be considered during permitting, there are often mismatches in the regulations and conflicts between the different involved bodies	Interviewees mentioned this inconsistency for example between the regulations of all the involved stakeholders to the guidelines and policies of the municipality

Table 1.
Challenges identified from the interviews

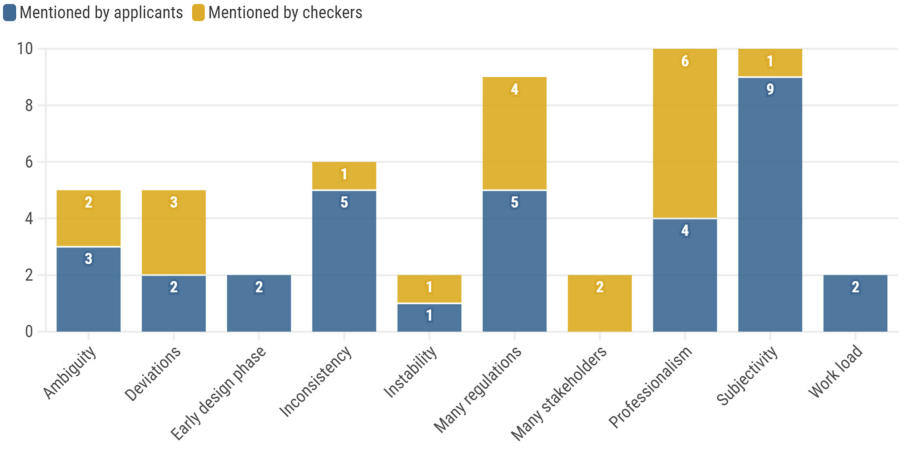


Figure 3.
Challenges identified from the interviews divided to challenges that were mentioned by applicants and challenges that were mentioned by plan checkers

Source(s): Author's own work

automated code compliance checking (such as (Han *et al.*, 1997; Pauwels *et al.*, 2011; Dimyadi and Amor, 2013; Malsane *et al.*, 2015; Preidel and Borrmann, 2016; Zhou and El-Gohary, 2016; Macit Ilal and Gunaydin, 2017; Kim *et al.*, 2019; Temel and Basaga, 2020; Guo *et al.*, 2021; İlal and İlal, 2022; Zhou *et al.*, 2022; Bloch *et al.*, 2023)). Even when considering that code checking is an important part, it is just one step within the entire building permit process focusing only on a part of the content check within the review. To make significant contributions that would greatly affect the efficiency of permitting processes, it is crucial to investigate the process as a whole and not focus on one specific step. Aspects such as stakeholder involvement and communication, process requirements, information flow and organizational issues are only some examples of issues that are not being thoroughly investigated in this domain. The proposed study aims to fill that gap by providing valuable insight into the bigger picture of building permitting – the process.

When comparing our study with existing work as was mentioned in section 2, we were able to conclude that previous research (such as Whitell *et al.*, 2020; Fawzy and Magdi, 2020) did not gain the level of detail needed for further development. Previous work using BPMN diagramming (e.g. Plazza *et al.*, 2019) still does not provide detailed, explainable, and reproducible solutions because of the chosen level of simplification and aggregation without following expectable guidelines. That means that existing studies on building permit process descriptions and modeling are incomparable with each other or include a wide range of interpretation. This is due to the different perspectives or focus that those studies were originally intended to. Using (Schranz *et al.*, 2021) as an example, the article describes the process in thorough way but focuses on the participation of neighbors and its support with BIM models. Furthermore, the work presented in this article is focused on a previously developed framework for mapping building permitting processes following well defined workflow and guidelines. Our aim was to validate the framework in a global perspective, using the Israeli building permit context as a case study. The observation of the diverse modeling types and the difficulty to compare the process confirms the review work by Bloch and Fauth (2023) which concluded that the research in this domain is fragmented, and that a systematic and detailed view on the "big picture" is much needed. This review article considered international literature on the process of building permitting and provides a comprehensive list of existing processes mentioned in the reviewed articles but points also to

the lack of comparability. Another observed issue is the terminology used within the literature. Often terms used in the national language are directly translated while losing their meaning, or the same term is used but has a (partly) different meaning. The framework applied in this article was tested before in Germany, the USA (Fauth and Soibelman, 2022), and Italy (Fauth *et al.*, 2023). The results go in line with the findings in this study. Even the investigation of the Israeli case, with the special case of the preliminary information request or the involvement of a privatized agency, enriches our global understanding of the building permit process.

In this context, the validation of the conceptual framework proposed by Fauth and Soibelman (2022) was successful. The maps produced were confirmed by the local expert group. The framework works for municipalities, applicants involved in the process, and the building control office. The mapping shows that the framework could also work for other countries with different circumstances. According to the framework, we included process steps, stakeholders, but also paid attention to business rules within the respective organization. It needs to be noted that we generalized the process steps since we interviewed different organizations.

The framework provides a basis for a unified and comparable process representation, even though the modeling language does not need to be necessarily the same rather than all elements need to be included in the representation. We used a simplified BPMN illustration in the workshop which turned out to be a particularly effective way to communicate the building permit process and its sub steps. To consider the aspect of a hierarchical representation of the building permit process a schematic overview was also used to support the simplified BPMN. Anyway, there is the need for more research and case studies with a broader population to allow the recommendation of the most suitable notation. Surely, the representations will always depend on the message the authors want to convey. The same is true for the level of detail the respective study requires. However, if data sets should be compared accurately, a similar quality of the data is needed. The expert interviews were a very appropriate method to capture and discuss the content we needed, and the focus group workshop was a suitable method for validating our results.

The building permit process in Israel is marked by many stakeholders, and a lot of decentralized subprocesses. This may reduce the process's efficiency related to time and human resources. In Israel, even with the country-wide implementation of the online system (with exceptions), the length of the process did not really change. This study provides a starting point for the investigation of this issue. Future studies should investigate the steps needed for successful digitalization. Participants in the focus group workshop mentioned that the digital system is not well fitted to all scenarios that may happen during the process. That underlines the demand of a process change (and investigation) before digitalization. However, more research on the interface of processes, technologies, and humans is needed. In addition, our study confirms the complexity of the building permit process. That underlines the need that current situations and circumstances need to be understood before we try to find automated solutions.

Using the expert interviews as the research method, we identified shortcomings and opportunities throughout the building permit process from different perspectives as we interviewed different stakeholders in the process. Interestingly, even though the participants often complained about each other, they mostly reported the same challenges (just from distinct perspectives).

Shortcomings and opportunities

Challenges cannot be assigned to specific process steps as they are all related to the entire process. It is a matter of balancing the subjectivity of human interpretations, which entails

time-consuming processes (with many iterative discussions with the relevant authorities), and the objectivity of machines, which are fast but limited in their capabilities (no deviations or discretion is possible, etc.). The faster the process, the more limited the leeway for deviations. The same is true for ambiguities; the more precise the law, the less leeway there is for deviations in the first place. In general, we can see that the identified challenges that were mentioned by many of the interviewees are interrelated. As illustrated in Figure 4 (a), ambiguity provides opportunity for flexibility, but then the subjectivity increases. Ambiguity and subjectivity both limit possible automation which results in timely processes (denoted in red). Lowering ambiguity and flexibility will also reduce subjectivity and fasten the process (denoted in blue).

Similarly, as illustrated in Figure 4 (b), when many regulations from various regulatory bodies must be considered, there is a high chance for inconsistencies within the regulations. The experts are expected to be knowledgeable in various domains and keep track of the most recent regulations, which makes it difficult to meet the expected level of professionalism. And again, the more requirements need to be met, the longer the process (denoted in red in the figure).

Process mapping turned out to be valuable not only to provide an in-depth understanding of the permitting process but also to identify the key challenges in the process as they come up from the people engaged in the process on a daily basis.

It seems that both applicants and representatives of the authorities agree that the existing process is problematic and are keen to make changes. The framework for modeling the permitting process demonstrated to be a tool for gaining valuable insights, both from the implemented qualitative methodology and from the produced maps. In this case, it is evident that the vast number of regulations that are coming in from different AoPIs causes many of the difficulties. In addition to being raised by the interviewees, we can also see this from the BPMN map which is decentralized and illustrates many handovers. One of the initiatives that have not been implemented yet in Israel is defining a unified building code (State comptroller, 2021) and we can see from this research that this kind of change is likely to have a significant impact, in comparison to the changes implemented so far. The proposed framework for modeling the permitting process was validated, proved to be applicable to different countries, and valuable for identifying underlying issues that otherwise are difficult to uncover.

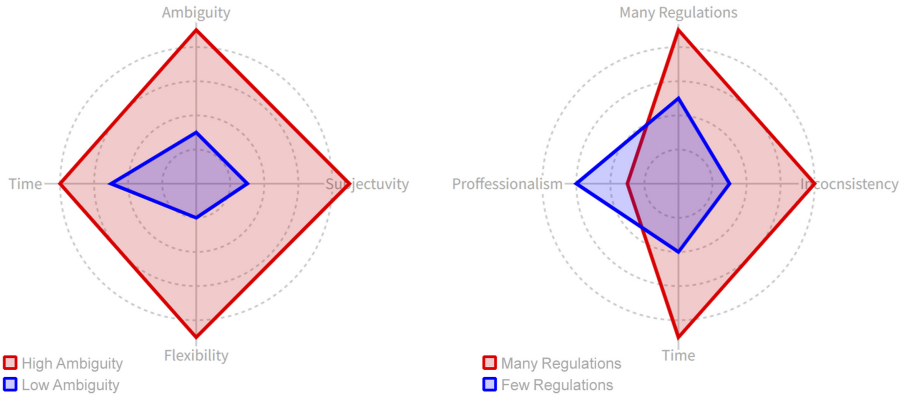


Figure 4.
Interrelated challenges in the permitting process. (a) Relationship between ambiguity, subjectivity, flexibility and time. (b) Relationship between many regulations, inconsistency, professionalism, possible automation and time

Source(s): Author's own work

Limitations and directions for future research

The proposed mapping is based on 9 interviews from 9 different organizations which shows the limitation of the approach. However, the population is comparable to other examples where the framework was used. The limited number of participants also limits the opinions on the challenges we have identified. The opinions are subjective. It cannot be ruled out that additional challenges may be identified by additional interviewees. However, we are confident that we reached the point of data saturation with our sample size in relation to the chosen qualitative approach.

In addition, the participants both in the interviews and in the workshop are mostly representatives of authorities and applicants. Other stakeholders in the process (such as policy makers), were not interviewed. As each stakeholder is driven by their own objective, they might have a distinct perspective on the process and the problems. The point of view of the policy makers still needs to be investigated. Such work can also follow the qualitative research approach. However, the interview guidelines will need to change since some policy makers may be involved in specific points in the process.

The framework was created to provide the scientific community in this field a unified way to replicate and understand their own building permit processes. Future work will show the flexibility and the limitations of the framework which might include cultural or regulatory contexts. In addition, we see potential to enhance the building permit process studies in the direction of sociopolitical and economics. For example, a significant contribution could be the dynamic between the different stakeholders but would foresee the involvement of experts from the field of behavioral analysis.

The most prominent direction of future work is deriving the best practices from the obtained process maps. This requires a detailed investigation of the properties of each process, to develop a system for scoring them individually and to compare between them. This is currently the subject of ongoing work.

While applicants primarily highlighted concerns of "subjectivity" and "inconsistency," these aspects were less emphasized by municipality representatives. Further investigating this divergence could offer valuable understanding of potential biases within the system and the viewpoints of various stakeholders.

Conclusions

As a first step towards improvement, we must first accurately understand the current state in the domain of building permitting, including challenges, limitations, and opportunities for change. We believe that the basis for that understanding is the development of a detailed mapping of the building permitting process in different countries, following a structured, standard, and accurate methodology to ensure the acquisition of a comparable data set. Thus, this work demonstrated the feasibility of such a workflow for the building permit process modeling, aiming to overcome the problem of inhomogeneous data and representations that makes comparisons and benchmarking extremely difficult.

The validation stage included the implementation of the suggested workflow for mapping the building permitting process in Israel. Our findings from this implementation are as follows.

(1) Although the framework was developed based on the processes in a federal state, it was successfully implemented for modeling the permitting process in Israel, demonstrating its flexibility.

(2) The main outcome of implementation of the framework was a detailed BPMN model of the building permit process in Israel. The BPMN maps were further validated by an expert workshop, which demonstrate that the obtained results are accurate.

(3) The same workflow for process modeling is also useful for identifying challenges within the building permit process.

(4) The study shows that the validation of the framework fills a research gap to a more homogenous building permit process modeling and representation.

The framework was created to provide the scientific community in this field a unified way to replicate and understand their own building permit processes. Future work will show the flexibility and the limitations of the framework which might include cultural or regulatory contexts.

The primary implication is an effort to enhance the building permit review process in Israel, with potential application of the proposed framework in other countries due to the prevalent lengthy and bureaucratic nature of such processes worldwide. Balancing theory and practicality, the study shared its findings with a control group through a workshop. It is noteworthy that the authors not only presented their results to the public but also sought public input, reflecting a genuine commitment to align collected findings with daily life and comprehend existing correlations. This approach aims to instigate changes in the current operational process. The study's potential positive impacts extend to various sectors of society, including economic benefits (reduced process duration, lower fees), social improvements, and commercial advantages (accelerated housing completion, income for developers, and addressing the increasing housing demand needs). Any noteworthy progress and improvement of the building permitting process needs to be routed in a deep understanding of its current state. Overlooking this step might lead to ineffective actions that would not contribute to improvement of the process, thus causing recourse loss. To make further progress, we must analyze the obtained processes in detail, from different perspectives, in a comparative manner. This will lead to identification of problems, bottlenecks, and potential directions for meaningful and effective solutions.

References

Ammar, A., Nassereddine, H., AbdulBaky, N., AbouKansour, A., Tannoury, J., Urban, H. and Schranz, C. (2022), "Digital twins in the construction industry: a perspective of practitioners and building authority", *Frontiers in Built Environment*, Vol. 8, 834671, doi: 10.3389/fbuil.2022.834671.

Bloch, T., Borrmann, A. and Pauwels, P. (2023), "Graph-based learning for automated code checking – exploring the application of graph neural networks for design review", *Advanced Engineering Informatics*, Vol. 58, 102137.

Bloch, T. and Fauth, J. (2023), "The unbalanced research on digitalization and automation of the building permitting process", *Advanced Engineering Informatics*, Vol. 58, 102188, doi: 10.1016/j.aei.2023.102188.

Braun, V. and Clarke, V. (2021), "To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales", *Qualitative Research in Sport, Exercise and Health*, Vol. 13 No. 2, pp. 201-216, doi: 10.1080/2159676X.2019.1704846.

Central Bureau of Statistics (CBS) (2023), Central Bureau of Statistics (CBS), available at: https://www.cbs.gov.il/he/Statistics/Pages/%D7%9E%D7%97%D7%95%D7%9C%D7%9C%D7%99%D7%9D/%D7%9E%D7%97%D7%95%D7%9C%D7%9C-%D7%9E%D7%97%D7%99%D7%A8%D7%99%D7%9D.aspx (accessed 20 April 2023).

Chognard, S., Dubois, A., Benmansour, Y., Torri, E. and Domer, B. (2018), "Digital construction permit: a round trip between GIS and IFC", in Smith, I.F.C. and Domer, B. (Eds), *Advanced Computing Strategies for Engineering*, Springer International Publishing (Lecture Notes in Computer Science), Cham, pp. 287-306, doi: 10.1007/978-3-319-91638-5_16.

Ciotta, V., Ciccone, A., Asprone, D., Manfredi, G. and Cosenza, E. (2021), "Structural e-permits: an openbim, model-based procedure for permit applications pertaining to structural engineering", *Journal of Civil Engineering and Management*, Vol. 27 No. 8, pp. 651-670, doi: 10.3846/jcem.2021.15784.

Costa, S., Comai, S., Mastrolembo Ventura, S. and Ciribini, A.L.C. (2021), "Digital building permit and small-sized local authorities in Italy", Digital Building Permit: A State of Play. I EUnet4DBP International Workshop on Digital Building Permit, pp. 54-56, Online Conference: EuroSDR.

De Lima-Omorog, C., Sias, J.N.S. and Benosa, B.D.-P. (2018), "eBPS: electronic building permit system", *2018 IEEE 10th International Conference on Humanoid, Nanotechnology, Information Technology,Communication and Control, Environment and Management (HNICEM)*, pp. 1-6, doi: 10.1109/HNICEM.2018.8666279.

Dimyadi, J. and Amor, R. (2013), "Automated building code compliance checking–where is it at", *Proceedings of CIB WBC*, pp. 172-185.

Eirinaki, M., Dhar, S. and Mathur, S. (2016), "A cloud-based framework for smart permit system for buildings", *2016 IEEE International Smart Cities Conference (ISC2). 2016 IEEE International Smart Cities Conference (ISC2)*, Trento, Italy, IEEE, pp. 1-4, doi: 10.1109/ISC2.2016.7580821.

Fauth, J. (2022), "A process-oriented decision model for determining the permitability of construction projects", Dissertation, Bauhaus-Universität Weimar, doi: 10.25643/BAUHAUS-UNIVERSITAET.4602.

Fauth, J., Pasetti Monizza, G. and Malacarne, G. (2023), "Understanding processes on digital building permits – a case study in South Tyrol", *Building Research and Information*, Vol. 51 No. 5, pp. 518-532, doi: 10.1080/09613218.2023.2178372.

Fauth, J. and Soibelman, L. (2022), "Conceptual framework for building permit process modeling: lessons learned from a comparison between Germany and the United States regarding the as-is building permit processes", *Buildings*, Vol. 12 No. 5, p. 638, doi: 10.3390/buildings12050638.

Fawzy, H. and Magdi, D.A. (2020), "Proposed system for effective adoption of E-government to obtain construction permit in Egypt", in Yang, X.-S., Sherratt, S., Dey, N. and Joshi, A. (Eds), *Fourth International Congress on Information and Communication Technology*, Springer Singapore (Advances in Intelligent Systems and Computing), Singapore, pp. 15-32, doi: 10.1007/978-981-15-0637-6_2.

Feng, P.P., Tommelein, I.D. and Ballard, G. (2009), "Modelling the effect of the alternative review processes: case study of a state permitting agency", *Proceedings of the Construction Research Congress*.

Flyvbjerg, B. (2006), "Five misunderstandings about case-study research", *Qualitative Inquiry*, Vol. 12 No. 2, pp. 219-245, doi: 10.1177/1077800405284363.

Gläser, J. and Laudel, G. (2010), *Experteninterviews und qualitative Inhaltsanalyse als Instrumente rekonstruierender Untersuchungen. 4. Auflage*, VS Verlag (Lehrbuch), Wiesbaden.

Guler, D. and Yomralioglu, T. (2021), "A reformative framework for processes from building permit issuing to property ownership in Turkey", *Land Use Policy*, Vol. 101, 105115, doi: 10.1016/j.landusepol.2020.105115.

Guo, D., Onstein, E. and Rosa, A.D.L. (2021), "A semantic approach for automated rule compliance checking in construction industry", *IEEE Access*, Vol. 9, pp. 129648-129660, doi: 10.1109/ACCESS.2021.3108226.

Han, C.S., Kunz, J. and Law, K.H. (1997), "Making automated building code checking a reality", *Facility Management Journal*, September/October, pp. 22-28.

İlal, M.E. and İlal, M.E. (2022), "Integrating building and context information for automated zoning code checking: a review", *Journal of Information Technology in Construction*, Vol. 27, pp. 548-570, available at: doi: 10.36680/j.itcon.2022.027.

Israel planning administration (2023), "Building permitting system and process", *Israel planning administration* (accessed 20 April 2023).

Israeli national economics council (2021), "The strategic plan for housing for the years 2017-2040 follow up", available at: https://www.gov.il/BlobFolder/news/news_doch310122/he/news_file_strategic%20plan%202021.pdf (accessed 20 April 2023).

Karoui, S. and Sassi, M.B. (2016), "Bridging the gaps between laws and their application: a Tunisian case study", *Proceedings of the 9th International Conference on Theory and Practice of Electronic Governance*. ICEGOV '15-16: 9th International Conference on Theory and Practice of Electronic Governance, Montevideo Uruguay: ACM, pp. 50-53, doi: 10.1145/2910019.2910028.

Kettner, M. and Diaz, J. (2000), "Document management in building authorities with the aid of a workflow management system, in computing in civil and building engineering (2000)", *Eighth International Conference on Computing in Civil and Building Engineering (ICCCBE-VIII)*, Stanford, California, United States, American Society of Civil Engineers, pp. 1102-1109, doi: 10.1061/40513(279)143.

Kim, H., Lee, J.K., Shin, J. and Choi, J. (2019), "Visual language approach to representing KBimCode-based Korea building code sentences for automated rule checking", *Journal of Computational Design and Engineering*, Vol. 6 No. 2, pp. 143-148, doi: 10.1016/j.jcde.2018.08.002.

Kim, I., Choi, J., Teo, E.A.L. and Sun, H. (2020), "Developement of K-BIM E-submission prototypical system for the openBIM-based building permit framework", *Journal of Civil Engineering and Management*, Vol. 26 No. 8, pp. 744-756, doi: 10.3846/jcem.2020.13756.

Kpamma, E.Z. and Adjei-Kumi, T. (2013), "Construction permits and flow of projects within the Sunyani Municipality, Ghana", *annual meeting of International Group of Lean Construction (IGLC-21)*, Fortaleza, Brazil.

Macit Ilal, S. and Gunaydin, H.M. (2017), "Computer representation of building codes for automated compliance checking", *Automation in Construction*, Vol. 82, pp. 43-58, doi: 10.1016/j.autcon.2017.06.018.

Malsane, S., Matthews, J., Lockley, S., Love, P.E. and Greenwood, D. (2015), "Development of an object model for automated compliance checking", *Automation in Construction*, Vol. 49, pp. 51-58, doi: 10.1016/j.autcon.2014.10.004.

Meijer, F. and Visscher, H. (2006), "Deregulation and privatisation of European building-control systems?", *Environment and Planning B: Planning and Design*, Vol. 33 No. 4, pp. 491-501, doi: 10.1068/b3109.

Messaoudi, M. and Nawari, N.O. (2021), "Virtual permitting framework for off-site construction case study: a case study of the state of Florida", in Toledo Santos, E. and Scheer, S. (Eds), *Proceedings of the 18th International Conference on Computing in Civil and Building Engineering*, Springer International Publishing (Lecture Notes in Civil Engineering), Cham, pp. 757-771, doi: 10.1007/978-3-030-51295-8_52.

Nawari, N.O. and Alsaffar, A. (2017), "The role of BIM in simplifying construction permits in Kuwait", *AEI 2017. AEI 2017*, American Society of Civil Engineers, Oklahoma City, OK, pp. 855-866, doi: 10.1061/9780784480502.072.

Noardo, F., Guler, D., Fauth, J., Malacarne, G., Mastrolembo Ventura, S., Azenha, M., Olsson, P.O. and Senger, L. (2022), "Unveiling the actual progress of Digital Building Permit: getting awareness through a critical state of the art review", *Building and Environment*, Vol. 213, 108854, doi: 10.1016/j.buildenv.2022.108854.

Olsson, P.-O., Axelsson, J., Hooper, M. and Harrie, L. (2018), "Automation of building permission by integration of BIM and geospatial data", *ISPRS International Journal of Geo-Information*, Vol. 7 No. 8, p. 307, doi: 10.3390/ijgi7080307.

Onstein, E. and Tognoni, M.G. (2017), "'Building permits' as proof of concepts in merging GIS and BIM information: a case study", *BIM 2017*, Alicante, Spain, pp. 155-166, doi: 10.2495/BIM170151.

Papadonikolaki, E., Krystallis, I. and Morgan, B. (2020), "Digital transformation in construction-Systematic literature review of evolving concepts", *Proceedings of the Engineering Project Organization Conference (EPOC) 2020*, Engineering Project Organization Society (EPOS), available at: https://img1.wsimg.com/blobby/go/19ec593e-0c9c-4cf8-a445-b774ad9dacfa/downloads/Papadonikolaki%20Morgan%2CKrystallis.pdf?ver=1603331614481

Pauwels, P., Van Deursen, D., Verstraeten, R., De Roo, J., De Meyer, R., Van de Walle, R. and Van Campenhout, J. (2011), "A semantic rule checking environment for building performance checking", *Automation in Construction*, Vol. 20 No. 5, pp. 506-518, doi: 10.1016/j.autcon.2010.11.017.

Plazza, D., Röck, M., Malacarne, G., Passer, A., Marcher, C. and Matt, D.T. (2019), "BIM for public authorities: basic research for the standardized implementation of BIM in the building permit process", *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, doi: 10.1088/1755-1315/323/1/012102, 012102.

Preidel, C. and Borrmann, A. (2016), "Towards code compliance checking on the basis of a visual programming language", *Journal of Information Technology in Construction (ITcon)*, Vol. 21 No. 25, pp. 402-421.

Schranz, C., Urban, H. and Gerger, A. (2021), "Potentials of Augmented Reality in a BIM based building submission process", *Journal of Information Technology in Construction*, Vol. 26, pp. 441-457, doi: 10.36680/j.itcon.2021.024.

Shahi, K. (2018), "Evaluation of current construction permitting process in city of Toronto and future of permitting in the global construction industry", PhD Thesis. University of Toronto (Canada).

Shahi, K., McCabe, B.Y. and Shahi, A. (2019), "Framework for automated model-based e-permitting system for municipal jurisdictions", *Journal of Management in Engineering*, Vol. 35 No. 6, 04019025, doi: 10.1061/(ASCE)ME.1943-5479.0000712.

Sonntag, M. and Wimmer, M. (2003), "Legal aspects of one-stop government: the case of applying for a building permission", in Traunmüller, R. (ed.) *Electronic Government*. Berlin, Heidelberg: Springer Berlin Heidelberg (Lecture Notes in Computer Science), pp. 385-392, doi: 10.1007/10929179_70.

State comptroller (2021), "Streamlining the permitting process", available at: https://www.mevaker.gov.il/sites/DigitalLibrary/Pages/Reports/7098-10.aspx?AspxAutoDetectCookieSupport=1 (accessed 23 April 2023).

Temel, B. and Basaga, H. (2020), "Investigation of IFC file format for BIM based automated code compliance checking", *Journal of Construction Engineering, Management and Innovation*, Vol. 3 No. 2, pp. 113-130, doi: 10.31462/jcemi.2020.02113130.

The world bank (2023), "Doing business", available at: https://archive.doingbusiness.org (accessed 19 April 2023).

Ullah, K., Witt, E. and Lill, I. (2022), "The BIM-based building permit process: factors affecting adoption", *Buildings*, Vol. 12 No. 1, p. 45, doi: 10.3390/buildings12010045.

Whitell, M., Cao, Y., McCabe, B.Y., Shahi, A., De Lint, M. and Shahi, K. (2020), "Standardizing ontario's permitting process for E-permitting implementation", *Construction Research Congress 2020. Construction Research Congress 2020*, American Society of Civil Engineers, Tempe, AZ, pp. 1339-1348, doi: 10.1061/9780784482889.143.

World Bank (2014), "Doing business 2015: going beyond efficiency", *The World Bank (doing business)*, 12th ed. doi: 10.1596/978-1-4648-0351-2.

Yaakup, A., Johar, F., Sulaiman, S. and Ngah, M.C. (2007), "Computerised planning approval system for a local authority in Malaysia", *10 th International Conference on Computer in Urban Planning and Urban Management*, available at: www.Eprints.utm.my/4273/1/YaakubAhris2007_computer_in_urban_planning.pdf (accessed 11 February 2010).

Zhou, P. and El-Gohary, N. (2016), "Domain-specific hierarchical text classification for supporting automated environmental compliance checking", *Journal of Computing in Civil Engineering*, Vol. 30 No. 4, 04015057, doi: 10.1061/(ASCE)CP.1943-5487.0000513.

Zhou, Y., She, J., Huang, Y., Li, L., Zhang, L. and Zhang, J. (2022), "A design for safety (DFS) semantic framework development based on natural language processing (NLP) for automated compliance checking using BIM: the case of China", *Buildings*, Vol. 12 No. 6, p. 780, doi: 10.3390/buildings12060780.

Appendix

List of codings
Codesystem
Digitalization BIM
System
Communication
Difficulties
Wrong calculations
Order of design approval or committee
Rejections to buy time
Old TABAs
Disconnected subprocesses and information
Many participants
Political influences
Personal preferences
Theory vs reality
Revolution
High demand of housing and high prices
Understaffed
Differences between municipalities
Late involvement of third parties
Long time
Diversity in law and quality
Deviations
Consistency among plan checkers
Building control
Disagreements
Interpretation
Easements
Counting the time is different
New law 2016
Adoption from Britain
Conditions
Modifications and deviations
New reform
Process
Final review
Design approval
Carry out/changing the TABA
Digging permit
Site inspections
Another committee for revisions afterward
Preparation
Starting clearance
Appeal
Formal check
Submission
Occupancy permit
Work start form
Deviations
Final signature/issuance
Get conditions
Assignment

Table A1.
List of codings

(*continued*)

List of codings
Building control
Paying fee
Municipal check
Alternatives
Participation of third parties
Neighbors
Preconditions
Planning design
Requesting information file
Information file
Committee discussions
Structure of organization
Committee

Source(s): Authors' own creation

Table A1.

Corresponding author
Judith Fauth can be contacted at: judith.fauth@tuwien.ac.at