Fire risk assessment contributions for the EU building logbook structure – Case study of Braga's city block

Miguel Chichorro Gonçalves, miguelcg@fe.up.pt
CONSTRUCT-Gequaltec, Porto University Faculty of Engineering, Porto, Portugal

Inês Leal Casas, ineslealcasas@gmail.com
Porto University Faculty of Engineering, Porto, Portugal

Pedro Mêda, pmeda@fe.up.pt
CONSTRUCT-Gequaltec, Porto University Faculty of Engineering, Porto, Portugal

Abstract
Urban fires mark, in the worst way, the history of most of the cities. Yet, these catastrophes have motivated improvements in several fields and construction is no exception. The EU Renovation Wave strategy offers a unique opportunity to rethink, redesign and modernize the buildings, making them fit for a greener and digital society. Among the measures to strength buildings information is the Digital Building Logbook; the common repository for all relevant data.
Fire risk data is, as seen, part of this relevant data. In order to produce outcomes at this level, the fire risk methodologies rely on other types of building data that must be also supported by the above-mentioned tools. The contributions in this paper rely on the disclosure of the minimum requirements in terms of data to perform massive Fire Risk (FR) analysis at city scale, as well as the required data to perform more complex analysis, based on the building logbooks. By doing it the outcomes contribute to the safety of buildings, namely in terms of fire risk, to strength the buildings information strategies, to improved renovation processes and to increase the resilience of cities.

Keywords: Design and Decision Support Systems; Smart Cities; Fire safety; Knowledge Management

1 Introduction

New construction methods, preventive and safety measures to preserve the most important good; the human life, among others have been gaining force under the resilient cities concept (Gernay *et al.* 2016). Urban fires occur on a daily base. Their impacts are getting lower and lower due to measures that are continuously being adopted. Notwithstanding, some achieve higher proportions, evidencing that there are still many gaps and challenges to accomplish. The results from the report accident of Grenfell tower fire highlight some of these gaps, where the digital record and the information traceability ability are must have requirements that should be guaranteed for all the built environment constituent parts (Hackitt 2018).

This paper develops a case study applied to a building block located in Braga urban centre, Portugal. The CHICHORRO 4.0 (Holistic Calculation of Construction Fire risk and Enabling Optimization of its reduction with Works) Fire Risk analysis model was applied, (Chichorro et al. 2015; Chichorro et al. 2016). The purpose was to diagnose the Fire Risk (FR) of a building as it stands to, from that and mainly, evolve to the optimization of the way in which Fire Safety in buildings is promoted, by calculating the fire risk after intervention. The model has defined numerous active and passive measures and even pre-defined sets of those, in order to reduce, when implemented in several successive amendments, the risk to an acceptable level, translating this into the approximation to the Fire Safety regulations in force. A simplification of the methodology fosters scaling the FR assessment to higher levels, as street, district or city. This vital importance data must, be traceable and be part of the "golden thread" of information *(Watson et al.* 2019). Therefore, building logbooks should support this data, providing elements at city scale to assess the fire risk and foster the automation and scalability of this type of analysis.

2 EU Building logbook and Data fields for Fire Risk

2.1 Digital Building logbook

Digital Building Logbook (DBL) is a common repository for all relevant building data. It facilitates transparency, trust, informed decision making and information sharing within the construction sector, among building owners and occupants, financial institutions and public authorities (Dourlens *et al.* 2021).

A digital building logbook is a dynamic tool that allows a variety of data, information and documents to be recorded, accessed, enriched and organised under specific categories. It represents a record of major events and changes over a building's lifecycle, such as change of ownership, tenure or use, maintenance, refurbishment and other interventions. As such, it can include administrative documents, plans, description of the land, the building and its surrounding, technical systems, traceability and characteristics of construction materials, performance data such as operational energy use, indoor environmental quality, smart building potential and lifecycle emissions, as well as links to building ratings and certificates. As a result, it also enables circularity in the built environment (Dourlens *et al.* 2021).

From this vast description and despite the absence of a specific reference, it can be understood that data related to fire risk analysis is also supported or, at least, envisaged.

Data is used for benchmarking and progress tracking of performance improvements and energy use, business planning, internal and external reporting, risk assessment and financial underwriting. The availability of consistent and reliable data can contribute to better design, construction and management of buildings, improved market information and transparency, creation of innovative services and business models, as well as more effective policymaking. In the perspective of the authors this data must be complemented for information that allow the fire risk (FR) analysis to support informed decisions about construction and real estate processes (Voltz *et al. 2020*).

2.2 DBL important aspects

Focusing on FR analysis and on the ability of DBL to support it, it is possible to identify some key features. These are following identified and classified as DBL functionalities, Data type and where should be collected and Data storage and ownership.

2.2.1 DBL functionalities

In terms of functionalities DBL should:

- allow an easy storage and access to the information, providing at the same time suited data framed with the role or purpose of the different actors that can have access to it;
- be easy to understand, to access and provide reliable information;
- ought to systematically log and store existing data and information;
- contribute to an increased awareness of the building's Fire Risk performance, material use over the lifecycle, etc.;
- enable traceability of materials and chemicals over the building's lifecycle.
- contribute to the harmonisation of data, making sure that different data types can be linked and matched in a reliable and time-efficient way. This recommendation is being highlighted mainly by digital experts and existing logbook implementers (Dourlens *et al.* 2021).

2.2.2 Data Type

To potentially capture some already existing data and to foster improved added-value, the DBL should find ways to link or interact with existing policy and market instruments, such as the Smart

Readiness Indicator, Energy Performance Certificates, LEVEL(s) and material passes/passports, and of course FIRE RISK performance.

A wide range of data sources is being considered, including administrative, building characteristics, energy performance data, operational, maintenance, and financial data. In this work we also consider the minimum data to perform buildings FR assessment.

2.2.3 Data storage and ownership

The data should be stored either by public authorities or continue being stored where it is currently being held. There are technologies that foster the data distribution but, more relevant, is the ownership of the data and the ability/permissions to see/edit that data. Related to FR performance there are some aspects that are sensitive. This is a practical example of the importance of working data availability definitions. In addition and as previously mentioned, the data needs to be up-to-date and reliable to be useful.

2.3 The role of DBL

The construction sector is complex and involves large numbers of stakeholders (with often conflicting interests) who have different information needs, use data in different ways and for different purposes (Dourlens *et al.* 2021). Most data is not available in one place and a systematic approach to organise and manage it is largely missing. One of the main barriers concerning data sharing is related to the fear of losing out to competition and automation, but also technological roadblocks in the form of a common data repository, data standards and interoperability. Whatever data may exist, it often remains static and not updated. Data and building's documentation, which is generated and kept in paper format, remains inaccessible to most users (East 2013). Therefore, systematised and optimised capture and processing of data into useful information supports investment decision-making, creates opportunities for innovation and uptake of energy efficiency and sustainability measures, processes and designs.

As digitalisation continues to move forward, it is likely to create increasing amounts of building related data as their use and their users. At the same time, opportunities to derive practical knowledge from this data are on the rise. The ability to systematically compile and analyse data from all relevant aspects, fosters entirely new applications for designing, constructing, operating, leasing, financing and purchasing real estate (Volt *et al. 2020*).

It is crucial to consider the data that allow assess the Fire performance (FR) of Buildings in the DBL contribution for the profile policy initiatives like the strategy "Renovation Wave" (European Commission 2019) and "A Europe fit for the digital age" (Desruelle *et al*. 2019), mainly because the human life is the most important assets inside of the buildings.

The pertinent selection of data fields related to the FIRE RISK analysis and structured in accordance to eight information categories is shown in Table 3: administrative, general, building descriptions, operation and maintenance, building performance, material inventory, smart readiness and finance (adapted from Volt *et al.* 2020).

2.4 DBL contributions to EU

The two most relevant priorities of EU Commission 2020 work programme are the European Green Deal and A Europe fit for the digital age (European Commission 2020). The DBL can greatly enhance these goals by playing a role in relation to the following policy initiatives (Dourlens-Quaranta 2020):

- **New Industrial Strategy for Europe** (improved data availability, common data protocols and collaboration within the value chain);
- **European Green Deal and the announced 'Renovation Wave' initiative** (The DBL is instrumental to gain a better overview of the building stock at all levels, to better assess the effectiveness of energy efficiency measures on a larger scale, tailor support measures, set benchmarks and strategies, monitor progress towards climate goals. Comprehensive information about buildings means that DBL users and value chain actors can make better decisions about how and when to renovate buildings);

- **Circular Economy Action Plan and Strategy for a Sustainable Built Environment** (The DBL can vastly contribute to improve the general transparency and efficiency of construction and real estate markets as well as empowering building owners to play a more active role in the circular economy);
- **European Data Strategy** (European way to digital transformation" which enhances open data, respects fundamental rights, and contributes to a sustainable, climate-neutral and resource-efficient economy);
- **Construction Product Regulation (CPR) review, Sustainable Product Policy and Digital Product Passports** (DBL and traceability of construction products can support the increase of recycling content and value from the recycling of materials).

2.5 Stakeholders / Benefits / Functionalities

A number of benefits could be linked to the DBL and applicable to stakeholders across the entire construction and built environment value-chain. Articulating clearly these benefits will help market actors to realise the actual value of information and, conversely, the risk of incomplete or unreliable data.

The main requirement of the DBL (and one that is not easy) is to gather all building-related data and to provide this through a smart and user-friendly interface, potentially available and accessible to different users. Most notably, building owners and occupants, the construction and real estate value chain, financial institutions and public authorities. Permissions should be granted under specific conditions, depending on who will be considered the 'owner' or 'owner's' of the DBL or upon the consent of the owner(s). To achieve this and as previously mentioned, the DBL should be equipped with some key features and functionalities.

By DBL features it is understood the intrinsic elements that make the instrument work and workable, meaning in a simple and yet effective way for the users, while the functionalities are services built around the DBL. The benefits, in turn, are the gained added value from the new and improved functionalities. Table 1 presents the benefits strictly from the point of view of the Fire Risk analyses in the great Stakeholders/Benefits matrix. The importance of specific benefits is proportional to the circle size. Table 2 represents the Functionalities and linked potential benefits, strictly from the point of view of the Fire Risk analyses and framed in the great Benefits/ Functionalities matrix.

Table 1. Mapping of stakeholder-specific Fire Risk benefits (adapted from Volt *et al. 2020*)

Stakeholders / **Benefits**	Access to information	Reduced risk	Trust, reliability, accountability	Better decision-making	Reduced administrative burden	Operation, use & maintenance	Resource optimisation, circularity	Regulatory compliance	Innovation	Value chain integration	Benchmarking
Landlords and owner-occupiers	•	⬤	●	⬤	•	⬤	•	⬤	⬤	⬤	⬤
Tenants	⬤	●	●			•			•	•	●
Designers	•	●	•	⬤	•	•	•	⬤	⬤	⬤	⬤
Investors	⬤	⬤	●	⬤	•	•		•	•	•	⬤
Banks and insurers	⬤	⬤	⬤	⬤	•	●		•	⬤	•	●
Material suppliers	•	⬤	⬤	⬤	•	⬤	⬤	⬤	⬤	⬤	⬤
Facility and building managers	⬤	●	•	⬤	●	⬤	●	⬤	●	⬤	●
Real estate agents	⬤	⬤	•	⬤	•	●		●	●	●	⬤
Valuers	⬤	⬤	●	⬤	●	•			•	●	⬤
Certifiers	⬤	⬤	●	•	•	•	•	●	●	●	⬤
Public authorities & policy makers	⬤	⬤	●	⬤	⬤	⬤	●	⬤	●	●	●

Table 2. Functionalities and linked potential Fire Risk benefits (adapted from Volt *et al.* 2020)

Benefits / **Functionalities**	Digital repository to store key documents (incl. design plans, certifications, proof of installations etc.)	Easy access to all relevant building related information according to different level of users & stakeholders	Operation, monitoring and maintenance plan (incl. notifications) different level of users & stakeholders	Overview of building performance (whole life resource consumption, resilience, adaptability, flexibility, health	Building renovation passport (renovation roadmap)	Traceability of building materials	Integration of BIM	Construction project management tools (assign roles, KPIs, accountability and liabilities during the different phases)	Value chain integration, aggregation of project and marketplace of services	Benchmarking, reporting and links to various certification and assessment schemes	Overview of the building stock
Enhanced access to information	●	●	●	●	●	●	·	·	·	●	●
Consumer protection and reduced associated risk of purchasing a property	●	●	●	●	●	•	·		●	●	●
Reduced time to fulfil administrative requirements as all information is accessible in one place	●	●	•	●	•	•	·	·	·	●	•
Increased trust and reliability	●	●	·	•	•	•	·	·	·	●	•
More accurate risk assessment and mitigation	●	●	●	●	●	●	·	·	·	●	●
Better informed decision-making (including energy and environment aspects, financing, investment, etc.)	·	·	●	●	•	●	·	·	•	●	●
Improved real estate value and value preservation of sustainable/energy-efficient buildings	●	●	●	●	●	●	·	·	·	●	●
Increased awareness of energy use and saving potential, health, accessibility, adaptability, flexibility and resilience; extending the useful life of the asset	●	●	●	●	●	●	·	●	•	●	●
Optimised operation, use and maintenance	•	•	●	●	•	●	·	·	●	·	·
Better use of resources across the whole life of the building	·	·	●	·	•	●	·	·	·	·	·
Synchronising maintenance cycles with renovation needs	·	·	●	·	●	●	·	·	·	·	·
Possibility to trace components	·	·	•	·	•	●	·	·	·	·	·
Checking compliance with certification	•	•	•	●	•	·	·	·	·	●	•
Accountability and quality assurance of construction and building works	•	•	•	•	•	·	·	·	·	●	•
Innovation through digitalisation, the creation of new business models and improved productivity	·	•	•	●	•	•				●	•

Table 1 allows us to assess which are the main benefits of knowing the fire risk of a building for stakeholders. These benefits allow addressing features that stakeholders can leverage in their own interest. For example, the benefit of the Fire Risk assessment provided in the DBL allows access to information on which the main stakeholders will be (grey in Table 1): tenants, investors, banks and insurers, building managers, real estate agents, valuers and certifiers. The access to the information enhances functionalities as: digital repositories, easy access, operation monitoring, maintenance plan and overview of building performance, but also a building renovation passport, traceability and certification (grey in Table 2). These tables allow stakeholders to perceive the importance of FR information from the buildings and the enormous potential impact that it has if implemented in the DBL. Fire Risk information is preventive and industry mainstream. The draft standard BS8644-1 - Digital Management of Fire Safety information is being developed to structure this information and disclosure it within DBL or similar tools.

2.6 Data Fields

Different building types may have different data needs, i.e. large commercial buildings can be documented in a more complete and granular manner, whereas a DBL for a smaller residential property will have fewer data entry points and records, simply because it is a less complex building with fewer data gathering opportunities (see Table 3). A common DBL and data template could work across all different building types. A common DBL for the entire building stock is, in fact, desirable and would avoid fragmentation and unnecessary market confusion.

The DBL must be considered a living document as the data it contains can be continuously updated to ensure it is relevant, useful and reliable. At this level it is important to understand that there are different types of data, meaning that there is static data, quasi-static data and dynamic data. Examples of these three types and following the same sequence are, geographical coordinates, window characteristics and water consumption.

The data presented in Table 3 of the original document is not an exhaustive list but a compilation of some of the most relevant data fields according to the result of the desk research and the mapping of existing initiatives. The relevance of certain data fields will inevitably be dissimilar for different users depending on the business area, lifecycle stage or building type as previously addressed. Some other information will have more universal pertinence. To be relevant, data fields and scope of data capture should be linked to particular functionalities and benefits. Here, and associated to the FR assessment CHICHORRO method, compiles the strictly data (one of the modes of assess of CHICHORRO) to that assess.

Table 3. A selection of data fields to the Fire Risk analysis (adapted from Volt *et al. 2020*)

Data category	Data field	Type of data	Where is the data stored today?	Core data	N/E (1)	S/D (2)	1,2,3 (3)
Administrative information	building identifier	Alfa-numerical code	Public registry	X	N	S	1
	Building typology (4)	Text	Public registry	X	N	D	1
	Address	Text	Public registry	X	N	S	1
	DBL prepared by	Name/contact	New data	X	n/a	S	1
	DBL last edited	Date	New data	X	n/a	S	1
General information	built	Date	Public registry	X	N	S	1
	Safety manual (5)	Descriptive	Audit		N	S	2
Building descriptions and characteristics	Design and plans of the building	Linked data	Developer	X	N	S	1
	Building height	M	Building owner	X	n/a	S	1
	Conservation State	Descriptive	New data	X	n/a	S	1
	Floor area	M2	Building owner		N	S	1
	Number of floors	#	Building owner		N	S	1
	Façade types	Descriptive	Developer, Audit		Both	S	1
	Roof type	Descriptive	Developer, Audit		Both	S	1
	Windows and door types	Descriptive	Developer, Audit		Both	S	1
	Access to Fire Brigade	Descriptive	New data	X	n/a	D	1
	Distance of hydrant	M	New data	X	n/a	D	1
	Fire Safety Plan	Descriptive	Public registry	X	Both	S	1
	Building surroundings	Descriptive	Public registry		Both	S	1
	Historical context (6)	Descriptive	Public registry	All	E	S	1
Building operation use	Number of occupants	Number	Building owner	X	E	S	1
Building performance	FR rating	scale	FR rating	X	Both	S	1
Building material inventory	Fire resistance class	Rating	Product/material		N	S	2
	Fire reaction class	Rating	Product/material		N	S	2
Smart readiness							
Finance	Other costs	EUR	Building owner		E	D	1

Legend: Yelow: New and very important information to de DBL to characterize dynamically the FIRE RISK
Green: Information already in the DBL
Orange: Information already in the DBL but is necessary to adapt to the FIRE RISK analysis
White: Relevant information to the contextualization of FIRE RISK analysis

Notes: (1) New (N) or existing (E) building (2) Static (S) or dynamic (D) (3) Ease of collection (1 - easy, 2-medium, 3 – difficult
(5) signalisation, illumination, detection (6) Blueprint plans or heritage of the building and municipality)
(4) Building typology (It is important to substitute de proposal building typology: Single-family residential = S, multi-family buildings - M, Office = O for: I-Housing II - Parking lots III - Administrative IV - School V - Hospitals and nursing homes VI - Shows and public meetings VII - Hoteliers and restaurants VIII - Commercials and transport stations IX - Sports and leisure X - Museums and art galleries XI - Libraries and archives XII - Industrials, and warehouses

3 Risk Assessment of Urban Fire

3.1 Introduction

The Fire Protection and Safety in Buildings (FS) gains new dimensions in older buildings, where building typology followed lower regulatory requirement vis-à-vis the legislative requirements in force today, thus resulting in a greater vulnerability. Interventions in such buildings should be made based on an assessment of fire risk in order to better evaluate the degree of safety and identify key shortcomings, so the most appropriate measures can be adopted in order to reduce the risk to levels considered acceptable. The proposed method - CHICHORRO - differs from other fire risk assessment methods, by proposing specific criteria considered relevant for the maintenance of desirable scenario conditions to evacuate the buildings. This method also distinguishes itself from the others, through the quantification of the influence of the fire safety devices, reducing the time of evacuation of buildings. Considering the recurrence of casualties resulting from urban fires, urges a convenient study of the buildings fire risk, especially in older urban centres in order to produce maps for this type of risk and intervention plans that allow for a better response and enhance the mitigation urban fires effects. (Gonçalves 2015; Teixeira 2019; Casas, 2021). Following or in parallel to it, all the information must be saved in a repository as the DBL.

3.2 CHICHORRO FIRE Risk Analysis

To better understand the data origins and the outcomes, this section addresses the CHICHORRO fire risk method that relies on 4 global fire risk dimensions: POI – Fire probability; CTI – Fire full consequences; DPI – Fire propagation (how it happens); ESCI – The effectiveness of the firefighting and assistance measures.

The combination of these 4 dimensions enables a full view of fire risk analysis and resulting implications for both the individuals and the property. The expressions for the calculation of fire risk in CHICHORRO are following presented. These include descriptors for the building conditions presented during the analysis.

$$\mathrm{RI} = P \times G \tag{1}$$

Where:

- RI – Fire Risk;
- P – The probability of a fire event;
- G – The seriousness of the consequences of a fire.

$$G = CTI \times (DPI + ESCI)/2 \tag{2}$$

Where:

- CTI – The full consequences of a fire;
- DPI – How a fire propagates;
- ESCI – The effectiveness of firefighting and assistance measures.

$$CTI = \frac{2 * CPI_{CI} + CPI_{VHE} 2 * CPI_{VVE}/2}{3} \tag{3}$$

Where:

- CPI_{CI} – Partial Consequences of a Fire, associated with a Fire Event Scenario;
- CPI_{VHE} – Partial Consequences of a Fire, pertaining to Horizontal Escape Rout;
- CPI_{VVE} – Partial Consequences of a Fire, pertaining to Vertical Escape Routes.

To sum up, fire risk in CHICHORRO is derived from expression 5 below, (Casas 2021):

$$RI = POI \times \ CTI \times (DPI + ESCI)/2 \tag{4}$$

The CHICHORRO method has two ways of assessing the fire risk:

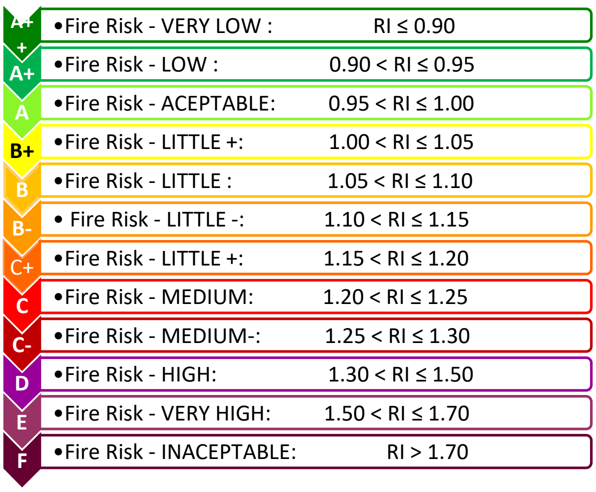
- The first is to carry out this analysis by comparing the building under study with a repository of 1125 previously studied cases, through a minimum of 9 building data and which have already been mentioned in Table 3, plus the calculation of the FR index.
- The second form to calculate FR, which implies a careful analysis of the building, is where more than 30 building parameters are evaluated, integrating all the pertinent information of the Fire Safety Engineering (FSE).

It is only intended to adopt as data to be included in the DBL the 9+1 fields mentioned above, minimizing the information to storage (Table 3). In this way, the introduced parameters are:

- Typology of building;
- Year of Construction / Rehabilitation of the Building;
- Building height;
- Position of fire scene in the building;
- Conservation status: Good, Medium or Bad;
- Distance from the Hydrant to the Building;
- Access to firefighters' vehicles;
- Fire scene area / Number of people;
- FSE devices: Signalling, Lighting and Detection
- FR index

3.3 Fire Risk index

The application of the fire risk assessment methodology can be of high interest for the development of a classification to be applied to existing buildings (recent and old) or to those that will be targeted for rehabilitation processes. It is also possible to apply to new ones. This proposed classification will allow studying the risk of urban fire steadily, producing risk mapping and providing fire risk maps, with the aim of identifying the areas of higher risk, setting priorities and strategies for risk mitigation and management in urban areas. Figure 1 shows the proposed fire risk buildings classification according to the previous CHICHORRO analysis. This classification is detailed in 12 categories as follows: A++, A+ , A, B+, B, B-, C+, C, C- D, E and F respectively, where the first one corresponds to a fire risk equal or smaller than 0.9, the last one to a fire risk higher than 1.7, and the remaining ones at value ranges corresponding to intermediate fire risk. The CHICHORRO method has as very important aspect, consider the acceptable Fire Risk depends on building construction year taking into account the progress in construction technological and fire regulations evolution in the last decades, Figure 1. Older buildings licensed with fire safety legislation prior to the current cannot be required to comply with a fire risk equivalent to compliance with current legislation (FR = 1.0).



Building construction year	Fire risk acceptable value
Before 1951	1.25
Between 1951 and 1967	1.20
Between 1968 and 1974	1.15
Between 1975 and 1990	1.10
Between 1991 and 2008	1.05
After 2008	1.00

Figure 1. Proposal building classification according to fire risk, [4]

4 Case study of Braga's city block

The case study is a city block in Braga city historical center, namely The Urban Rehabilitation Area (ARU). That ARU aims to set territorial boundaries where, due to buildings degradation, insufficient equipment or public spaces there is the need for a detailed and careful rehabilitation. The illustrations below evidences the results of the Fire Risk method CHICHORRO application to a single block before (Figure 2), and after building renovation (Figure 3) (Casas 2021).
This Risk Management Analysis Model aims to allow the user a more simplistic and quick analysis of the fire risk associated to a building and, as previously mentioned, requires a reduced number of parameters to obtain the FR result (Table 3). The FR calculation model allows a second analysis to be made, applying one of several possible sets of intervention measures (passive and active) aimed at reducing this FR result that is, approximating it to a more acceptable value of fire risk as indicated at Figure 1.

Figure 2. Map with the FR grading scale

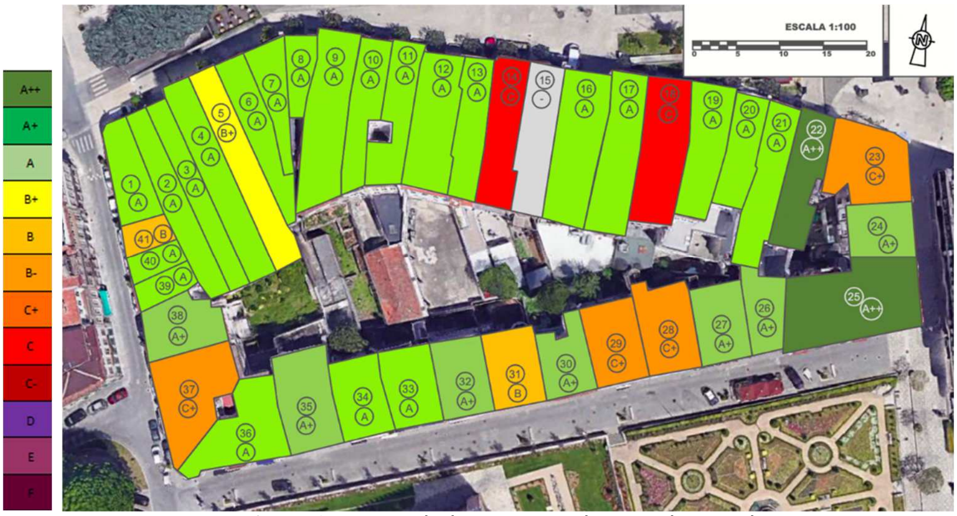


Figure 3. Map with the intervened FR grading scale.

In order to implement the risk analysis, it was necessary to carry out a field survey to obtain some descriptors necessary for the Risk Management Analysis Model, such as the conservation state, the type of use, the building height or the hydrants coordinates. The *in loco* collected data was transferred to an Excel spreadsheet in order to facilitate the data post-processing, which consisted of the introduction of the gathered descriptors in the numerical model. The model was executed for each building individually, with the respective input data and the results, namely the Acceptable Fire Risk and the Fire Risk following the model classification. In a second phase, all Fire Risk values were calculated simulating six sets of pre-existing interventions defined in the model.

5 Conclusions

The proposed method allows the assessment and awareness of the fire risk in urban areas so that, in cases where it proves to be unacceptable, possible interventions can be done to improve the Fire Protection and Safety in Buildings. Considering the recurrence of casualties resulting from urban fires, construction trends should also seek to evaluate the fire risk in buildings, especially in older urban areas, so as to draw a mapping of this risk and contingency plans for intervention that allow for a better response and enhance effects mitigation in the case of urban fires.
From the case study highlights that the fire risk values are higher than the acceptable in 29.27% of the buildings in the block. With this knowledge and considering the possibility of implementing intervention measures, it was possible to reduce these values. The goal and aim of this study is to raise awareness for the importance of including the main and dynamic information processed under the Fire Risk assessment of buildings in the Digital Building Logbook. As it was evidenced, the data required to perform fire risks assessments is in part already used for other purposes and the one that is specific of this analysis, fosters many possibilities to perform assessments and improve the knowledge on the building and its surroundings. This is the pure example of how, by working the right data with the right tools, namely DBL, it can turn to structural information for the stakeholders at building and town scale, as well as for the construction industry and buildings lifecycle.

6 Acknowledgments

This work was financially supported by: Base Funding - UIDB/04708/2020 of the CONSTRUCT - Instituto de I&D em Estruturas e Construções - funded by national funds through the FCT/MCTES (PIDDAC).

References

BS 8644-1 Digital management of fire safety information. Part 1: design, construction, handover, asset management and emergency response – Code of Practice.

Chichorro G. M., A. Correia, (2015), "Risk Assessment of Urban Fire - Method for the Analysis and Management of Existing Buildings", edited by Building Pathology, Vol. 8, J.M.P.Q. Delgado (Ed): SUSTAINABLE CONSTRUCTION, Springer-Verlag, ISBN: 978-981-1 0-0650-0.

Chichorro G., M., Ferreira, R., Correia, A., (2016), "Risk Assessment of Urban Fire – Proposal of a Model for Analysis and Management of Existing Building" – ICUR 2016, international Conference on Urban Risks, Lisbon 30 June-2 July.

Desruelle, P. et al. (2019) Digital Transformation in Transport, Construction, Energy, Government and Public Administration. Seville. doi: 10.2760/689200.

Dourlens S. & Carbonari G., De Groote M., Borragán G. & De Regel S., Toth Z., V. J. & G. J. (2021) Study on the Development of a European Union Framework for Digital Building Logbook - Final Report. Brussels. doi: 10.2826/659006.

East, E., Nisbet, N., Liebich, T. (2013) 'Facility Management Handover Model View', Journal of Computing in Civil Engineering, 27(1), p. 7. doi: https://doi.org/10.1061/(ASCE)CP.1943-5487.0000196.

European Commission (2019) The European Green Deal, COM(2019) 640 final. Brussels.

European Commission (2020) A Renovation Wave for Europe, COM(2020) 662 final. Brussels.

Gernay, T. et al. (2016) 'Urban Infrastructure Resilience to Fire Disaster: An Overview', in Procedia Engineering. Elsevier Ltd, pp. 1801–1805. doi: 10.1016/j.proeng.2016.08.782.

Gonçalves, Miguel Chichorro (2015), "Avaliação de risco de incêndio urbano – Proposta de um método para análise e gestão do edificado existente, 1º Congresso "Reabilitação de edifícios e SCIE", Ordem dos Arquitetos, 30 de novembro.

Hackitt, D. J. (2018) Building a Safer Future - Independt Review of Building Regulations and Fire safety. London. Available at: www.gov.uk/government/publications%0A.

Inês Leal da Silva Casas, (2021), "Implementação e melhoria do modelo de Avaliação de Risco de Incêndio CHICHORRO – Avaliação do RI do Centro Urbano de Braga", Dissertação de Mestrado, Faculdade de Engenharia da Universidade do Porto.

J. P. Teixeira, (2018), "Melhoria e Implementação do Software do Modelo CHICHORRO de Avaliação de Risco de Incêndio de Edifícios", Dissertação de Mestrado, Faculdade de Engenharia da Universidade do Porto, 2018.

Jonathan Volt & Zsolt Toth et al (2020), "DEFINITION OF THE DIGITAL BUILDING LOGBOOK, Report 1 of the Study on the Development of a European Union Framework for Buildings' Digital Logbook", EUROPEAN COMMISSION, Executive Agency for Small and Medium-sized Enterprises (EASME), Unit A.1.2 — Competitiveness & Internationalization.

Sophie Dourlens-Quaranta & Giulia Carbonari (2020), "Study on the Development of a European Union Framework for Digital Building Logbooks", FINAL REPORT, EUROPEAN COMMISSION, Executive Agency for Small and Medium-sized Enterprises (EASME), Unit A.1.2 — Competitiveness & Internationalization.

Watson, R., Kassem, M. and Li, J. (2019) 'Traceability for Built Assets: Proposed Framework for a Digital Record', (July), pp. 496–501. doi: 10.3311/ccc2019-068.