PHASE 2 GRENFELL TOWER: LONDON FIRE BRIGADE AND COMPLEX BUILDING FIRES

Prof. José L. Torero CEng, RPEQ, FREng, FRSE, FTSE, FIFE, FSFPE, FICE, FCI

21st April, 2021

EXECUTIVE SUMMARY

This report is written in response to instructions provided to me by the Chairman and is part of a wider set of reports. This report is specific to point (b) of my instructions

b. The correlation between fire safety provisions (and the fire safety strategy for Grenfell Tower) and (i) the adequacy of the London Fire Brigade's ("LFB") procedures for dealing with fires in high-rise buildings, including any applicable procedures if compartmentation fails and (ii) the adequacy of training provided by LFB to its fire-fighters for dealing with fires in high-rise buildings, including any applicable procedures if compartmentation fails.

The tragic consequences of the Grenfell Tower fire highlight the significant shift in complexity that has occurred as a result of intricate façade systems being incorporated onto high rise buildings[1].

Functional requirements, guidelines and simple standardized tests, if not accompanied by an appropriate level of competency of all those using them, become insufficient tools in their own right, for establishing adequate performance[2] of systems where performance is a function of the interactions of the building and building envelope.

Therefore, the safe operation of buildings can only be achieved if there is consistency between the complexity of the building and the competency of all those involved in the design, build, and operation of the building.

In the case of fire safety, this includes the Fire and Rescue Services. The Fire and Rescue Services will only be capable of fulfilling their duties, as defined by the Fire and Rescue Services Act (2004), if the institutional structure of the Fire and Rescue Services and the professional attributes, qualifications, education and training of its members, result in a level of competency consistent with the nature and complexity of the buildings they are required to operate in.

According to the Fire and Rescue Services Act (2004) the fire and rescue authority must make provision for the purpose of (a) extinguishing fires, and (b) protecting life and property in the event of fires. A fire and rescue authority must, in particular, secure the provision of the personnel, services and equipment necessary to efficiently meet all normal requirements and secure the provision of training for personnel. Most importantly, the fire and rescue authority must plan for obtaining information needed on the building for the adequate fulfilment of their functions.

There is a strong societal expectation of the Fire and Rescue Services, reinforced by the Fire and Rescue Services Act (2004)[3], that the structure of the London Fire Brigade, and the policies that govern the organization, are conducive to the recruitment, education and training of professionals such that:

1. Through inspections, they are capable of gathering adequate information, identifying and enforcing rectification of issues that would result in a less than satisfactory outcome in the event of a fire in complex modern infrastructure,

---

[1] J.L. Torero, Grenfell Tower: Phase 1 Report, GFT-1710-OC-001-DR-01, May 2018.

[2] Performance is defined as adequately fulfilling all functions that support and enable the fire safety strategy to deliver an acceptable level of safety.

[3] Fire and Rescue Services Act (2004)

2. They recognise how their actions and strategies as responders intersect with the design philosophies of various types of buildings and the provisions within them to yield a satisfactory outcome in the event of a fire in complex modern infrastructure,
3. Their operational command structure functions such that commanders are capable of conducting an adequate dynamic risk assessment for any fire occurring in any building, independent of its complexity.
4. There is a further expectation that the commander and subordinates will communicate in a manner that enables a response that will lead to a satisfactory outcome.

Thus, there is an expectation that the Fire and Rescue Services can identify potential design and implementation failures that can affect the performance of a building prior to a fire event. Furthermore, in the event of a fire that progresses in a manner that is not consistent with expectations, that the London Fire Brigade can alter response procedures in a manner that enables them to fulfil their duties, as defined by the Fire and Rescue Services Act (2004),

An event so unusual in nature, that it is unforeseeable and capable of exceeding the response capacity of the London Fire Brigade, should have been eliminated by means of inspections and understanding of building behaviour.

Through Phase One of this inquiry[4] it has been shown that personnel from the London Fire Brigade responded in an effective manner to the initial event, a "one compartment fire." Nevertheless, it was clearly established that the London Fire Brigade failed to attain the expectations of the Fire and Rescue Services Act (2004) once the event progressed beyond the compartment of origin. It was also established, that given the recent history of large façade fires, the evolution of the fire at Grenfell Tower was foreseeable and that there was awareness within the London Fire Brigade of these fires and their potential consequences.

The purpose of an inspection conducted by the fire brigade is to gather adequate information, identifying and enforcing rectification of issues that would result in a less than satisfactory outcome in the event of a fire. In regards to response, a less than satisfactory outcome is a foreseeable event that negatively affects the fire brigade capacity to fulfil their duties per the Fire and Rescue Services Act (2004).

It is only the fire brigade inspector, through their training, that is capable of defining what is the information that needs to be gathered, how to obtain it and how to use it in a Risk Assessment. Furthermore, it is also incumbent on the fire brigade inspector to be capable to identify issues that, if not rectified, would result in a less than satisfactory outcome.

Given that the evolution of the Grenfell Tower fire was a foreseeable event, that there was awareness in the London Fire Brigade of such events and that the link between these fires and specific types of products was known, a competent inspection would have identified the potential for a large external fire. Furthermore, if the inspector would have not been capable, through inspection, of extracting sufficient information on the specific systems to enable an adequate Risk Assessment, it is incumbent on the inspector to seek this knowledge (ex. test results, desktop studies, etc.).

[4] Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, October 2019.

Therefore, in regard to Grenfell Tower, the London Fire Brigade failed to obtain the necessary information through inspections, to enable them to conduct an adequate Risk Assessment.

An adequate Risk Assessment would have identified the potential for the June 14th, 2017 scenario and would have determined two possible paths of action, rectification or a change in response tactics.

An adequate Risk Assessment would have alerted any individual possessing the appropriate professional attributes, qualifications and training to the fact that any fire occurring in Grenfell Tower had a significant potential to dismantle the existing fire safety provisions (i.e. fire safety strategy[5]). The structure and policies of the London Fire Brigade are currently not conducive to the recruitment, education and training of professionals with such attributes, qualifications and training.

Furthermore, during the events of June 14th, 2017, the London Fire Brigade failed to identify that an external fire breached one of the fundamental assumptions backing almost all aspects of the fire safety strategy of a tall residential building such as the Grenfell Tower, specifically the "stay-put" strategy. Identifying that the onset of external flame spread is not consistent with a "stay put" strategy and requires those in command to have a comprehensive knowledge of building behaviour during a fire event. None of the officers who were in command exhibited such a knowledge. Furthermore, the structure and policies of the London Fire Brigade are currently not conducive to the recruitment, education and training of professionals with such attributes, qualifications and training.

Finally, the Grenfell Tower Fire showed that the London Fire Brigade does not have an adequate operational command structure that allows information and orders to flow effectively, such that commanding officers may use the former to conduct a proper dynamic risk assessment, and use the latter to change strategy in accordance with this assessment. Departing from a well-established protocol, such as the "stay-put" strategy would have only been possible following a comprehensive dynamic risk assessment carried out by a suitably competent individual, and enacted via a strict command structure. It is important to add, that this is a two-way process by which an adequate command structure is also underpinned by the capacity to deliver an adequate dynamic risk assessment. The structure and policies of the London Fire Brigade are currently not conducive to the recruitment, education and training of professionals capable of conducting a comprehensive dynamic risk assessment under conditions as complex as the Grenfell Tower Fire.

Thus, the Grenfell Tower fire demonstrated that there is a confusion of competency and the current societal expectations of the Fire and Rescue Services are not being truly met.

Current building regulations rely very heavily on competent professionals to provide the necessary interpretation that will bridge the gaps and resolve the ambiguities left by functional requirements, guidelines and standardized tests. For example, a competent professional has to be capable of interpreting the requirement to "adequately resist the spread of fire over the walls ... having regard to the height, use and position of the building[6]" within the context of the needs of the fire safety strategy. These competent professionals include designers, builders, manufacturers but also the London Fire Brigade.

Currently, there is no consistency between the competency of all those involved in the interpretation of these functional requirements, guidelines and simple standardized tests, and the complexity of

[5] Fire Safety Strategy, as referred here, is not a specific document but a conceptual representation of the ensemble of measures introduced to guarantee adequate fire safety.

[6] Section B4. (1) External Fire Spread (ADB).

modern construction systems. Complexity has thus far exceeded competency and therefore, there is a need to re-equilibrate competency and complexity. This applies to designers, builders, manufacturers but also to the London Fire Brigade.

There is currently no definition of what level of competency would be required of the Fire and Rescue Services, that would render them capable of satisfactorily addressing complex modern buildings. Furthermore, there is no definition of the skill or attribute verification approaches that should be used for the different roles within the Fire and Rescue Services so as to guarantee that those involved in inspection, command, response and control can deliver their tasks to a societally acceptable level.

The reform of the recruitment, education and training practises of the London Fire Brigade, and indeed the entirety of the Fire and Rescue Services, is a very complex matter that requires a detailed and comprehensive assessment. The Fire and Rescue Services Act (2004) has delivered the current structure, competencies and culture of the Fire and Rescue Services, thus its principles also need to be revisited.

Given that the need stems from the increased complexity of buildings and building practises, it is a matter that extends far beyond response tactics. It therefore involves matters that require deep understanding of engineering practises as well as recruitment, training and professional education.

The current structure and culture of the Fire and Rescue Services does not allow for this review to be driven from within the service. It is therefore essential that government enacts a comprehensive external evaluation of the Fire and Rescue Services as well as the Fire and Rescue Services Act (2004).

CONTENTS

1 INTRODUCTION

1.1. THE INQUIRY'S TERMS OF REFERENCE

The Inquiry's Terms of Reference have been approved by the Prime Minister and have been published on the Inquiry's website. The Inquiry has also published on its website a detailed provisional List of Issues which identify the matters with which its investigation will be concerned. This provisional List may be revised in due course.

1.2. STRUCTURE OF THE INQUIRY

The Chairman has indicated that Inquiry will be conducted in two phases. The present report pertains to Phase 2. The Chairman asked me to provide a report for Phase 2 on:

a. Your final conclusions on the relative contributions of the cladding design and materials to the fire spread at Grenfell Tower, taking account of the findings made in the Phase 1 report. This work will include collaboration with Professor Luke Bisby in relation to a programme of experimentation aimed at understanding and 1 quantifying the respective roles of the various materials and products that made up the cladding system at Grenfell Tower under a range of relevant fire conditions and system geometries. This work is to be undertaken By Professor Bisby with a team from the School of Engineering at the University of Edinburgh including Dr Angus Law and Dr Rory Haddon. The experimental work will be developed in on-going consultation with you and will aim to establish the manner and extent to which each component of the cladding system contributed to rate and extent of fire spread during the Grenfell Tower fire.

b. The correlation between fire safety provisions (and the fire safety strategy for Grenfell Tower) and (i) the adequacy of the London Fire Brigade's ("LFB") procedures for dealing with fires in high-rise buildings, including any applicable procedures if compartmentation fails and (ii) the adequacy of training provided by LFB to its fire-fighters for dealing with fires in high-rise buildings, including any applicable procedures if compartmentation fails.

c. An analysis of the adequacy of the current testing regime.

d. An overview of conclusions to be drawn about the Grenfell Tower fire, including the lessons to be learned when comparing the Grenfell Tower fire with other fires, both international and domestic.

The current Phase 2 Report corresponds to task (b).

1.3. STRUCTURE OF REPORT

The report will be structured around the facts gathered during Phase 1 of the Public Inquiry and compiled in the Chairman's Phase 1 report.[7] The general description of the structure of the necessary fire safety strategy for a high-rise residential building such as Grenfell Tower will be based on my Phase 1 report.[8] Thus this report should be read in conjunction with the Chairman's Phase 1 Report and my Phase 1 Report.

1.4. FIELD OF EXPERTISE

1.4.1. My name is José L. Torero. I am Professor of Civil Engineering and Head of the Department of Civil, Environmental and Geomatic Engineering at University College London. I also serve as Director of TAEC. Previously, I held the John L. Bryan Chair at the Department of Fire Protection Engineering and was the Director of the Center for Disaster Resilience at the Department of Civil Engineering at the University of Maryland, USA (2017-2019). Between 2012 and 2017 I was Professor of Civil Engineering and Head of the School of Civil Engineering at the University of Queensland, Australia. Before moving to Australia, I held the Landolt & Cia Chair for Innovation for a Sustainable Future at the Ecole Polytechnique Fédéral de Lausanne, Switzerland (2012) and the BRE Trust/RAEng Chair in Fire Safety Engineering at the University of Edinburgh (2004-2011). Between 2004 and 2011 I was also the Director of the BRE Centre for Fire Safety Engineering and in the 2008 to 2011 period I was Head of the Institute for Infrastructure and Environment, both at the University of Edinburgh. I have held other positions at CNRS (France), University of Maryland (USA), NIST (USA) and NASA (USA).

1.4.2. My field of expertise is fire safety; a field in which I have worked for more than 25 years. I was trained as a Mechanical Engineer obtaining a Bachelor of Science from the Pontificia Universidad Católica del Perú in 1989. In 1991 I obtained a Master of Science and in 1992 a PhD from the University of California, Berkeley, both in Mechanical Engineering with specialty in Fire Safety. I am a Chartered Engineer by the Engineering Council Division of the Institution of Fire Engineers (UK), a Registered Professional Engineer in Queensland and a full member of the Society of Fire Protection Engineers (USA).

1.4.3. I am a Fellow of the Royal Academy of Engineering, the Royal Society of Edinburgh, the Australian Academy of Technological Sciences and Engineering, The Institution of Civil Engineers, The Institution of Fire Engineers, the Society of Fire Protection Engineers and the Combustion Institute. In 2008 I was awarded the Arthur B. Guise Medal by the Society of Fire Protection Engineers (USA) and in 2011 the David Rasbash Medal by the Institution of Fire Engineers (UK) in recognition for eminent achievement in the education, engineering and science of fire safety. In 2016 I was awarded a Doctor of Science *Honoris Causa* from Ghent University, Belgium. I am the author of more than 500 technical documents in all aspects of fire safety of which more than 200 are peer review scientific journal publications. I have been invited to deliver more than 100

[7] Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, October 2019.
[8] J.L. Torero, Grenfell Tower: Phase 1 Report, GFT-1710-OC-001-DR-01, May 2018.

keynote lectures in conferences and professional fora worldwide of which more than 20 have been in the area of Fire Investigation.

1.4.4. I was the Editor-in-Chief of Fire Safety Journal (2010-2016), the most respected scientific publication in the field, Associate Editor of Combustion Science and Technology (1997-2008) and a member of the Editorial Board of Fire Technology, ICE Journal of Forensic Engineering, Fire Science and Technology, Case Studies in Fire Safety, Progress in Energy and Combustion Science and the Journal of the International Council for Tall Buildings. I am one of the Editors of the 4th Edition of the Fire Protection Engineering Handbook of the Society of Fire Protection Engineers (USA) and an author of several chapters. I am regularly in the Scientific Advisory Boards of most conferences in the field and a member of the Committee of many professional organizations. I chaired the Fire Safety Working Group for the International Council for Tall Buildings and Urban Habitat and was the vice-Chair of the International Association for Fire Safety Science.

1.4.5. I have been involved in numerous fire investigations many of which have been landmark studies. Between 2001-2010 I was involved in an independent investigation of the World Trade Center buildings 1 and 2 collapses. I was involved in the fire and structural modelling of the World Trade Center building 7 collapse in support of litigation and conducted an independent investigation of the fire growth and structural failure of the Madrid Windsor Tower Fire commissioned by the British Concrete Institute. I conducted a cause and origin investigation of the Texas City explosion and subsequent fires as well as a damage correlation analysis. I conducted dispersion fire modelling supporting the litigation of the Buncefield Explosion and of the Sego mine explosion (USA). I supported the fire service investigation of the Ycua Bolanos supermarket fire in Paraguay to establish the cause of the fire and to analyse the reasons for the fatalities. I conducted the fire investigation of La Rocha prison fire in Uruguay where 12 inmates died where we developed analytical and numerical model of fire growth in support of the investigation. I conducted the fire investigation of the San Miguel prison fire in Chile where 26 inmates died where we developed analytical and numerical models of fire growth in support of the investigation. I worked with the Scottish Fire Service on the Balmoral Bar fire investigation. I conducted the post-fire structural assessment of the Abu-Dhabi Plaza fire in Kazakhstan, probably the biggest ever fire of a building under construction. Recently, I led the fire investigation of the Ayotzinapa 43 murder case driven by the Organization of American States that encouraged the Mexican government to reopen the investigation. (*Science*, 11 March 2016, vol. 351 Issue 6278, pp.1141-1143 and *Science*, 29 April 2016, vol. 352, issue 6285, p.499) and by the National Academy of Science (USA) (http://www7.nationalacademies.org/humanrights/). I served as advisor to the Attorney General of Mexico in the subsequent investigation. I have given expert testimony in several forensic fire investigations worldwide.

1.4.6. I have developed novel methodologies for forensic fire investigation that have affected the manner in which fire investigation is conducted and its legal ramifications (V. Brannigan and J. L. Torero, "The Expert's New Clothes: Arson "Science" After Kumho Tire," Fire Chief Magazine, 60-65, July 1999.). For these studies I have received the William M. Carey Award for the Best Paper Presented at the Fire Suppression and Detection Research Application Symposium (C. Worrell, G. Gaines, R. Roby, L. Streit and J.L. Torero, "Enhanced Deposition, Acoustic Agglomeration and Chladni Figures in Smoke Detectors," Fire Technology, Fourth Quarter, 37, Number 4, pages 343-363, 2001), the Harry C. Bigglestone Award for the Best Paper Published in Fire Technology (T .Ma, S.M. Olenick, M.S. Klassen, R.J. Roby and J.L. Torero, "Burning Rate of Liquid Fuel on Carpet (Porous Media)" Fire Technology, 40,3, 227-246, 2004) and the Telford Premium Best Paper Award by the

Institution of Civil Engineers (J.L. Torero, "Forensic Analysis of Fire Induced Structural Failure: The World Trade Centre, New York" ICE Journal of Forensic Engineering, 164, 2, 69-77, 2011.). I was awarded the FM Global Best Paper Award for a paper on the precision of fire models and the required skills for fire modelling (G. Rein, J. L. Torero, W. Jahn, J. Stern-Gottfried, N. L. Ryder, S. Desanghere, M Lazaro, F. Mowrer, A. Coles, D. Joyeux, D. Alvear, J. A. Capote, A. Jowsey, C. Abecassis-Empis, P. Reszka, Round-robin study of a priori modelling predictions of the Dalmarnock Fire Test One, Fire Safety Journal, 44, 590-602, 2009.).

1.4.7. For more than 20 years I have been involved in the education and training of fire engineers, fire investigators and the fire service. I have developed training programmes on fire investigation for the Bureau of Alcohol Tobacco and Fire Arms (USA), fire investigators and fire brigades in the UK (University of Edinburgh short course in Fire Science and Fire Investigation, 2001-20012), the RAIB (UK) and the Police Scientifique of Lyon (France) among others. I have taught courses at Fire Service College Gullane, for the Queensland Fire and Emergency Services and for the fire services in numerous other countries (Costa Rica, Chile, Peru, Argentina, Singapore, Malaysia, etc.). I have developed curriculum and taught the Fire Protection Engineering programme at the University of Maryland, the Structural and Fire Safety Engineering course at the University of Edinburgh, the Civil and Fire Safety Engineering course at the University of Queensland and the International Masters in Fire Safety Engineering (Ghent, Lund and Edinburgh Universities). I was external examiner to the Fire Safety programme of Glasgow Caledonian University (UK) and I am on the Advisory Board of Worcester Polytechnic Institute (USA) Fire Protection Engineering programme. I am a Distinguished Visiting Chair Prof. in Fire Safety Engineering at the Hong Kong Polytechnic University.

1.4.8. In the period 2007 to 2010 I lead the development of the FireGrid project funded by the Department of Trade and Industry and in partnership with the London, Manchester, Strathclyde and Lothian and Borders Fire Brigades where a detailed study of the role of information on fire brigade emergency response was analysed. This project was featured in the 2007 BBC Horizon Documentary "Skyscrapers Fire Fighters" that has been shown in more than 30 countries. In 2010 I was awarded a GBP 2M grant by the Engineering and Physical Sciences Research Council UK to study the Real Fires for the Safe Design of Tall Buildings.

1.4.9. I have been involved in numerous advisory roles for industry and government many of them including the fire service. I was involved in the Nuclear Regulatory Commission (USA), PRiT Committee on Fire Modelling, a member of the Expert panel of the Fire and Resilience Directorate (Communities and Local Government, UK) and of the Forum of Chief Fire Officers of Scotland (SDAF). I was advisor to the Department of Transportation and Main Roads (Queensland, Australia), special advisor to the vice- President of Peru on the Utopia Club and Mesa Redonda fire investigations and a member of the CFOA Training Needs Analysis Gateway Review Group. I am currently special advisor to the Minister of Housing (Queensland) on issues of façade fires. I am a regular participant in standards development committees worldwide.

1.4.10 A full and up to date CV (current at the time of Torero's initial instruction as Expert Witness) has previously been provided to the Inquiry's Core Participants.

1.5. STATEMENTS

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

I was assisted in the production of this report Dr Adam Cowlard - Director and senior engineer at Torero, Abecassis Empis and Cowlard Ltd. Dr Cowlard holds a PhD in Fire Safety Engineering and an MEng in Civil Engineering from the University of Edinburgh. He has undertaken a wide range of consultancy and research work encompassing development of fire safety strategies for a wide range of complex infrastructure, development of design fires and heat transfer modelling, and fire and evacuation modelling. Dr Cowlard supported my work primarily on modelling, data analysis, reporting and reviewing.

I confirm that I understand my duty to assist the Inquiry on matters within my expertise, and that I have complied with that duty. I also confirm that I am aware of the requirements of Part 35 and the supporting Practice Direction and the Guidance for the Instruction of Experts in Civil Claims 2014.

I confirm that I have no conflict of interest of any kind, other than any which I have already set out in this report. I do not consider that any interest which I have disclosed affects my suitability to give expert evidence to the Inquiry on any issue on which I have given evidence and I will advise the Inquiry if, between the date of this report and the Inquiry hearings, there is any change in circumstances which affects this statement.

Signed:  Dated: 18th February, 2021

2 GENERAL CONTEXT

Issues of wellbeing such as safety, security and health necessitate regulation that is defined by public policy and is affected by public perception. If the general consensus is that existing regulation guarantees wellbeing, then there is typically no appetite for regulatory change. Regulatory change in terms of safety, security and health is therefore only made as a result of publicly perceived failure or disaster. This is the case for fire safety.

Disasters demonstrate that failure modes have arisen unnoticed. When they manifest themselves through a disaster, public awareness is raised and changes in public policy follow. The Grenfell Tower fire is a disaster that has exposed many weaknesses in the way public wellbeing is managed in the built environment. In particular, it has exposed inadequacies in the education and certification processes for engineers involved in matters that affect fire safety, weaknesses of the regulatory process, and the way the Fire and Rescue Services operate[9]. This document focuses specifically on the Fire and Rescue Service.

To fully establish the need for the Fire and Rescue Service to evolve, it is first essential to discuss the relationship between firefighting and the provision of building performance in the design process and beyond.

Currently, building and infrastructure development in the broad sense is conducted through design principles that are based on a series of fundamental assumptions and are executed via a range of design tools. The design can either be regulated by compliance with codes/standards or by explicit demonstration of adequate performance via professional/technical analysis (engineering). The design is then implemented and the building is assumed to provide adequate performance, including delivering societally acceptable levels of fire safety.

The Regulatory Reform (Fire Safety) Order 2005[10] requires for the responsible person to make an ongoing, suitable and sufficient assessment of the risks to which relevant persons are exposed. Regular monitoring provides the feedback loop that enables the assessment of performance during the life of the building. Hence, adequate performance assessment allows to determine if any specific action is required. Nevertheless, regular monitoring is only useful if the diagnostic tools are adequate and the professionals managing data are capable of converting it into useful information. Many good examples of good practise exist in high hazards industries where sensor networks provide extensive data, well-trained personnel constantly monitor and properly interpret the data to identify safety issues and maintain safe operations[11].

The definition of regular monitoring varies between systems and disciplines. In some areas it is a continuous, direct and quantitative measure of performance. A good example is energy production from solar panels. Sensors can measure how much energy is produced and the data enables the competent professional to define the true performance of the panels at any time. Water supply systems for hydrants and sprinklers can be monitored in a similar manner by sensors or by testing protocols that can deliver the state of a water supply network.[12] In both cases a true measure of performance is obtained. In the case of the measurements by sensors, the performance assessment is continuous while in the case of testing it will happen as part of the

[9] The Warren Centre, University of Sydney, Fire Safety Engineering, Education Report, 2019.

[10] The Regulatory Reform (Fire Safety) Order 2005.

[11] J. Hackitt, Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report, Crown Copyright, May 2018.

[12] I. Stoianov, Grenfell Tower Inquiry, Phase 2 Report, the provision and use of water for fighting the fire at Grenfell Tower on 14 June 2017.

ongoing assessment required by the Regulatory Reform (Fire Safety) Order 2005.[13] In the case of sprinklers, a similar assessment of the water supply can be conducted leading to a direct assessment of performance of the sprinkler in what pertains the supply of water to the sprinkler. In what pertains the performance of a sprinkler as a means to control the fire, the performance assessment methodology that satisfies what is required by the Regulatory Reform (Fire Safety) Order 2005[14] is of a different nature. A physical inspection of the sprinkler system will establish that their state is as per the design and an inspection of the building will show that the fire load is as per the design. If the case were both remain consistent with the design, then the inspector assumes that performance is as per the design and therefore adequate. While this is not a direct measure of performance, it still satisfies the Regulatory Reform (Fire Safety) Order 2005.[15]

In respect to most fire safety provisions, ongoing performance assessment is indirect and therefore not truly quantified beyond the design process. It is assumed that if a provision introduced through the design process remain unaltered, then performance should be as dictated by the design. In a similar manner, an adequate relationship between building performance and firefighter intervention is introduced through the design process. So, if all building provisions pertaining fire fighter operations are verified through inspection to remain as per design, then it can be inferred that firefighting operations will be enabled by the building design.

It is in the design process where provisions are made to support firefighting activities and these are based on preconceived modes of operation or known policy. Thus, the design process will deliver a building where the fires that can occur ("design fires"[16]) are only those that can be fought using existing protocols ("operational protocol"). And, by definition, firefighting protocols are designed to be effective when responding to those "design fires." The link between the "design fire" and the "operational protocol" is therefore a two-way link. It is expected that the fire and rescue services will verify that this two-way link is consistent with their operation protocols.[17]

In what concerns fire safety, the inspection is perceived as the relevant approach to monitoring. The inspection guarantees that all fire safety provisions defined during design remain and therefore it can be inferred that the expected performance, as conceived at the moment of design, is maintained. There is, therefore, an expectation that those conducting the inspection have the necessary knowledge and competencies in respect to building design, to enable them to perform such a diagnostic effectively.

It is not possible to offer infallible guarantees that all fires will be as anticipated, therefore Fire and Rescue Services have to possess a means to provide an adequate response to events that differ from the "design fire." The dynamic risk assessment is the most common means to achieve this.

As explained above, the implementation of an appropriate feedback loop is of particular importance in fire safety because design decisions are intended to limit the range of outcomes of a fire. This limited range of outcomes enables Fire and Rescue Services to define a specific range of response protocols which responders can be trained to carry out efficiently and safely. The feedback loop is therefore important information that is intimately linked to the capability of the Fire and Rescue Services to respond adequately in the event of a fire. It is for this reason that the Fire and Rescue Services Act (2004) requires the fire and rescue authority to plan

[13] The Regulatory Reform (Fire Safety) Order 2005.

[14] The Regulatory Reform (Fire Safety) Order 2005.

[15] The Regulatory Reform (Fire Safety) Order 2005.

[16] The term "design fire" is commonly used by fire safety engineers and not by fire and rescue services when referring to operations. Nevertheless, the meaning (i.e. a fire event of sufficiently high probability) applies both to the design of a fire safety strategy or operational protocols for firefighter response that are an integral part of such a strategy.

[17] Fire and Rescue Services Act (2004)

by obtaining necessary information regarding a building, and then ensure they have the necessary equipment and competency to enable the adequate fulfilment of their functions in the event of a fire in this building. This information must inevitably include the performance of all relevant building systems. It is important to note that as the complexity of the building and its fire protection systems increases, the degree of competency required of those gathering the information inevitably increases.

When designing for wind or earthquakes a probabilistic distribution of loads can be established and embedded within a regulatory framework. As society changes its tolerance to risk, or as the urban sprawl evolves, different criteria can be used to describe the loads that need to be considered to continually ensure performance. Nevertheless, the probabilistic distribution of these loads will not change as earthquakes and wind are independent of the infrastructure they interact with. This is not the case with fires where changes in design practises can radically transform the nature of a fire event, and by extension therefore, the nature of the environment and challenges that Fire and Rescue Services are required to face.

Fire safety is therefore one of the areas where building regulations are generally only modified either because of external pressure (i.e. economic, architecture, functionality, etc.) or because of lessons learned from a disaster. This is particularly important for high-rise buildings where the underpinning assumptions of regulation are stretched to their limits and therefore the impact of performance failure will likely be more profound.

The Grenfell Tower was designed on the basis of regulations relevant to the period when it was built. As was the case with many other very similar buildings, it was assessed as being compliant after it was refurbished between 2012 and 2016. When a building is assessed as being compliant, there is an implicit expectation by occupants, owners and management that adequate levels of fire safety exist. The building was constructed in 1972-74 using conventional construction means and then it was refurbished between 2012 and 2016 by the Kensington and Chelsea Tenant Management Organization. The refurbishment added to the building a new façade, that consequently reduced the building's energy consumption and improved its aesthetic. The building was also reconfigured in certain areas so that the occupants could experience higher living standards. In principle, the refurbishment of the building satisfied all the sought-after drivers and constraints.

On June 14th 2017 a small fire started in the kitchen of one of the flats[18]. The fire was not out of the ordinary and could be assumed to be a very high probability event for a building of that nature. The expected performance (i.e. the "design fire") was that such a fire would remain within the unit of origin and therefore flames and smoke would not compromise other units.

The compartmentalization, recommended by government issued guidance, aims to contain the fire within the unit of origin and thus allows implementation of what is called a "stay-put" strategy. This implies that with the exception of the occupants in the unit of origin, all other occupants can remain in their units and wait safely until either the fire brigades control the fire or the fire burns out. A "stay-put" strategy leads to certain advantageous attributes such as the limited means of egress as suggested by government issued guidance (one stair) and inclusiveness policies that enable ageing populations and populations with disabilities to remain in their units safely and thus live securely in upper levels.

[18] Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, October 2019.

JTOR00000002_0014

Statistics show that of more than 8,000 fires in high-rises in the UK in the last 20 years, only two cases justified generalized evacuation[19]. Thus, a strong perception that building regulations support the operational protocols of the Fire and Rescue Services is backed by statistical confidence.

There is an expectation that through inspections, the Fire and Rescue Services could identify if a specific design could allow a fire to exit the unit of origin. Furthermore, those in command of firefighting operations should be capable of determining the implications of a fire progressing beyond the compartment of origin and how this pertains to firefighting protocols. If such performance was to be accepted, then adequate firefighting and rescue strategies need to be implemented as an alternative to "stay-put."

As clearly articulated in my Phase One report[20], there was sufficient evidence from fires worldwide, that indicated that certain façade systems represented a significant risk to external fire spread and therefore the safe implementation of a "stay-put" strategy. Therefore, according to the Fire and Rescue Services Act (2004), it was essential to identify through inspection any façade systems that allowed for external fire spread, to quantify the nature of this external fire spread, and to establish any implications to firefighting and rescue operations. According to the requirements of the Fire and Rescue Services Act (2004), in the case of foreseeable events, firefighting and rescue protocols should have been implemented to guarantee an acceptable outcome.

It is clear that the attributes and competencies of those conducting the inspection and establishing alternative firefighting and rescue protocols would be very different for the original Grenfell Tower design than for the refurbished building. The latter would have required a much deeper understanding of Fire Safety Engineering principles as well as construction methods and practises.

3 PRESUMPTION OF COMPETENCY AND OUTCOME

There is a strong public perception that the firefighter is a competent authority in all matters pertaining to fires. Independent of legal regimes, this perception extends to the building approval process and building inspections. This perception is also very strong within the fire service itself, where there is a clear sense of ownership of everything related to fires. Buildings on fire are after all, the workplace of the fire service. Therefore, the fire service is an unavoidable stakeholder in the design, construction, operation and maintenance of a building.

Traditionally, buildings were designed and built in a manner that buildings compliant with regulations delivered consistent and robust fire performance. Buildings had robust attributes, such as simple solutions for compartmentalization, that limited fire growth within very predictable bounds. While variations have always been possible, statistics show that these variations were rare and the departure from standard behaviour was limited. The Fire and Rescue Services had very well-defined targets for which response protocols could be structured and performance expectations defined.

In a system where the range of behaviour of a fire can be assumed to be a function of regulatory compliance and thus largely predictable; predefined strategies, such as "stay-put" can be implemented, and firefighters can be trained in delivering a standardised but broadly applicable response (plan execution). Training does not have to be extensive and does not need to involve a comprehensive understanding of complex building behaviour.

[19] C. Todd, Phase One Expert Report, Grenfell Public Inquiry, March 2018.
[20] J.L. Torero, Grenfell Tower: Phase 1 Report, GFT-1710-OC-001-DR-01, May 2018, pp. 56-61.

Within a building typology, such as residential buildings, the expectation is that a fire will be contained and therefore firefighting will be limited to a single unit. The "design fire" that firefighters are tasked to control will be the single unit fire and will be no different at ground level or any higher floor.

Any variation from the norm then becomes a matter for a dynamic risk assessment (plan formulation) defined by those preparing to interact with the fire. For a dynamic risk assessment to be effective, the fire event must be understood by those conducting the assessment. Thus, a dynamic risk assessment is only expected to extend firefighting protocols to variants that are reasonably close to a more typical fire event (the "design fire").

Firefighters that directly interact with the fire will have the greatest capacity to acquire information and therefore the natural tendency is for those individuals to conduct the dynamic risk assessment and consequently make all subsequent decisions. Fires evolve rapidly in time, so time is at a premium, and firefighters will generally privilege a rapid decision to the transfer of information to a command unit.

While hierarchies exist in the Fire and Rescue Services, they are generally not enforced effectively during an event. Direct decision making by those interacting with the fire appears as the primary operational mode.

Conducting a dynamic risk assessment is therefore not necessarily the prerogative of the officer in command but there is a presumption that all responders are equally responsible and qualified to deliver these assessments. The role of the command unit is therefore naturally diminished and the necessary competency to conduct an adequate dynamic risk assessment is presumed to be shared by all responders.

The level of competency required to successfully conduct a dynamic risk assessment is directly linked to the extent that a building's characteristics have to enable a fire to depart from the standard characteristics (i.e. the "design fire"). The more complex the building, the more the potential for a significant departure and the more difficult it therefore becomes to identify the course that will be followed by the fire. Consequently, the competency required from those performing a dynamic risk assessment is intimately linked to building complexity. Furthermore, research has shown that the situational awareness necessary for an effective dynamic risk assessment is intimately related to the nature of the training and education of the responder[21].

Building regulations together with protocols of approval and inspection aim to provide assurances that a building will behave as expected. There is therefore a high expectation that standard firefighting protocols can be applied more or less universally (plan execution) but there is also a presumption that departures from the expected behaviour will be sufficiently minor that firefighters at any level will be capable of conducting an effective dynamic risk assessment. Therefore, current training and education within the Fire and Rescue Services strongly favours straightforward plan execution[22] and any wider role in the design process is deemed of lesser importance.

Many other stakeholders have criticized the involvement of the Fire and Rescue Services in building approvals and inspections (in the UK and abroad). As a result, their role has, in some cases, diminished nevertheless it is still required for them to be consulted as part of the Building Control approval process. Criticism resulted

[21] Cohen-Hatton, S.R. and Honey, R.C., Goal-Oriented Training Affects Decision-Making Processes in Virtual and Simulated Fire and Rescue Environments, Journal of Experimental Psychology: 2015, Vol. 21, No. 4, 395–406.
[22] Cohen-Hatton, S.R. Butler, P.C. and Honey, R.C., An Investigation of Operational Decision Making in Situ: Incident Command in the U.K. Fire and Rescue Service, Human Factors, Vol. 57, No. 5, August 2015, pp. 793–804.

from a strong feeling, within the construction sector, that firefighters were not delivering an adequate service. The construction industry has consistently questioned the timeliness of response as well as the quality of the assessments and inspections. The result has been a push for exclusion of the Fire and Rescue Services from the design process. This is a phenomenon that has happened worldwide but the root of the perceived inadequacy has never been clearly explored[23].

The fire service has continually objected to losing control, nevertheless public policies have followed market demands, pushing for a more streamlined process of approvals and inspections that has a reduced involvement of the Fire and Rescue Services. This has resulted in confusion and tension because the Fire and Rescue Services cannot, for reasons stated above, be entirely excluded from these processes.

Total exclusion would take away responsibility from the Fire and Rescue Service because they would no longer be involved in the delivery of fire safety in buildings, which therefore places the onus on others (e.g. engineers, builders, TMO's, etc.) to guarantee the delivery of a building with characteristics that result in a fire that firefighters can fight using standard protocols (i.e. the "design fire"), or else is consistent with their capacity to conduct a dynamic risk assessment.

Given that the relationship between "design fires" and "operational protocols" is a two-way relationship and therefore full exclusion of the Fire and Rescue Services is not possible, it is essential to have a clear definition of the necessary competency of all those participating in approvals and inspections. This definition of competency has been elusive[24] and once again has resulted in confusion. Instead of necessary synergistic cooperation between knowledge in building behaviour and response, what has resulted is a competition of what knowledge is more or less relevant. This competition has, ultimately, resulted in diminishing the importance of those within the Fire and Rescue Services itself with a degree of competency in regard to building behaviour in favour of those with greater experience in response.

Therefore, the relationships between building behaviour, expectations of building performance, capability to conduct an adequate dynamic risk assessment, firefighting and rescue tactics and the necessary competency and training of the Fire and Rescue Services is currently unclear.

The Fire and Rescue Service will have a comprehensive training process for the task of fighting fires that are consistent with the traditional expectation of fire behaviour. Only in rare exceptions will this not include at least a component of understanding building performance. The education and training structure of the Fire and Rescue Services is consistent with a professional practice[25], nevertheless, the view that dominates among the Fire and Rescue Services is that their education and training should primarily contribute to developing practical professional skills in the form of familiarity with equipment, and methods and techniques to enable them to operationally handle various kinds of accidents in a confident and safe manner[26]. Furthermore, the internal image of the competent firefighter has arguably, until very recently, been largely tied to practical experience, a well-trained body[27] and to someone of concrete use to society through damage-limiting initiatives[28].

---

[23] The Warren Centre, University of Sydney, Fire Safety Engineering, 2019.

[24] The Warren Centre, University of Sydney, Fire Safety Engineering, Education Report, 2019.

[25] R. Holmgren, Nordic Journal of Vocational Education and Training Vol. 4 2014.

[26] R. Holmgren, Nordic Journal of Vocational Education and Training Vol. 4 2014.

[27] R. Holmgren, Nordic Journal of Vocational Education and Training Vol. 4 2014.

[28] Baigent, D. One More Last Working Class Hero. A Cultural Audit of the UK Fire Service. Fitting-in Ltd & The Fire Service Research and Training Unit, Anglia Polytechnic University, 2001.

JTOR00000002_0017

When it comes to the capability of fire fighters to assess building performance, the focus on operational orientation and prescriptive approaches is not considered sufficient to meet contemporary safety and preparedness requirements in societies undergoing rapid change[29,30]. Of course, this traditional view does not reflect the evolving role of the fire brigade in many jurisdictions. For example, in Australia the fire brigade serves two roles – the traditional role of intervention and response which elicits the above image, and one of a referral body which is invited (although not mandated) to weigh in on complex fire safety issues as part of the regulatory framework.

Given that it is not possible to circumvent the fire services' role in in building design, construction, operation and maintenance practices, it is of fundamental importance to review education, training and accreditation practices within the fire service. It is clear that the current presumption of competency is not consistent with the complexity of modern building solutions.

Firefighter training is clearly insufficient to understand the intricacies of modern buildings and in particular all potential forms of behaviour in the event of a fire. The profile of those recruited to the service is aligned with the activities of a first responder and therefore individuals entering the service generally are more focused on, and afford more value to, direct interaction with the fire. The acquisition of leadership qualities from recruitment, and development through training and education have been recognized, nevertheless, there is no similar recognition for the need for technical competency in regard to the intricacies of building performance (for example the building fabric[31]). Therefore, it cannot be expected that fire fighters will develop general knowledge and understanding in this regard in isolation. The lack of technical knowledge on building performance is further reinforced by years of training and tradition that also favours direct interaction with the fire.

As noted above, this situation is evolving and, in some jurisdictions (ex. LFB), fire brigades do now employ or qualify staff as fire engineers specifically to fulfil roles as reviewing or inspection bodies, however it must be noted that this is definitely the exception to the rule. Further, performing this role as reviewer/inspector requires these employees to possess an adequate skillset which enables them to fulfil this role. Importantly, this in turn requires the Fire and Rescue Service to define the necessary knowledge base and skillset of an individual that can technically challenge the competent fire engineer in matters of building fabric, in order to recruit appropriately.

An attempt to introduce building related technical competency in the Fire and Rescue Services was made through the introduction of higher education programs at Glasgow Caledonian University (GCU) and the University of Central Lancashire (UCLan). These programs are directed towards the Fire and Rescue Services and they introduced design, regulatory, and engineering principles to enhance the technical competency of a small number of firefighters. In principle, the graduates of these programmes should be able to direct activities such as design review or building inspection however the establishment of these programs does not seem to have had the desired outcome, and no detailed review of the impact of these programs has been conducted so far to demonstrate otherwise.

[29] Baigent, D., Hill, R., Ling, T., Skinner, D., Rolph, C. & Watson, A. Training Firefighters today as tomorrow's emergency workers. Cambridge: Fire Service Research and Training Unit at APU, 2003.
[30] Childs, M. Beyond training: new firefighters and critical reflection. Disaster Prevention and Management, 14 (4), 558-566, 2005.
[31] Carr, B., National Fire Academy, Managing Officer Program, Examination of the Promotional Process within the Fire Service, March 20, 2017.

JTOR00000002_0018

The new regulatory framework set by Dame Judith Hackitt[32] is structured around three fundamental concepts; leadership, competence and a new Joint Competent Authority (JCA). The latter is stated as, "comprising Local Authority Building Standards,[33] fire and rescue authorities and the Health and Safety Executive to oversee better management of safety risks in these buildings (through safety cases) across their entire life cycle." From the onset, the Hackitt report presumes that adequate levels of competency exist within all three groups, and in particular the fire and rescue authority. Furthermore, it assumes that the fire and rescue authority is the de facto "competent authority" in all matters pertaining fire safety.

"The FRAs (fire and rescue authorities) will bring fire safety expertise to the JCA ensuring fire safety measures are properly considered, in place and maintained (for example, by ensuring awareness of measures to reduce the risk of fire and the means to escape from fire). The expectation would be that they would, on behalf of the JCA, continue to provide specific technical fire safety input during the design, construction and refurbishment stages. But the FRAs could predominate, on behalf of the JCA, during the occupation and maintenance phase, particularly in the delivery of the ongoing safety case review process."

This is consistent with the analysis presented above where it was recognized that society perceives the Fire and Rescue Service as the "competent authority." On this basis, it is clear that guaranteeing competency within the Fire and Rescue Services on all matters pertaining to relevant building technologies is fundamental if this new framework is to be implemented. Furthermore, a clear definition of competency and the means of attaining it, unavoidably become a requirement in Dame Hackitt's new regulatory framework.

4 CONFUSION OF COMPETENCY

The increased complexity of buildings has resulted in a clear need for Fire and Rescue Service personnel to develop and apply a set of skills and attributes, necessary to understand building performance in the event of a fire, and enable adequate response during one. These skills and attributes are consistent with a professional engineering framework.[34]

Currently, such a framework does not exist so the Fire and Rescue Services are called upon, by the Fire and Rescue Services Act (2004), to fulfil a role that should be reserved for a competent professional. The strong internal and external presumption of their competency reinforces the involvement of the Fire and Rescue Services in providing such assessments and advice, which in actual fact is way beyond what is required by the by the Fire and Rescue Services Act (2004).

It is clear that this involvement is not backed by the necessary education and training. In a similar manner, other stakeholders, are called upon to deliver design, execution, inspection and maintenance of complex buildings also without any accreditation requirements. The result is a profound confusion over who should be performing engineering roles, and ultimately, a lack of competency of those who currently undertake them.

This confusion of competency is evident in the Hackitt review where Dame Hackitt identifies six key professions whose work is essential to fire safety.

---

[32] J. Hackitt, Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report, Crown Copyright, May 2018.

[33] J. Hackitt, Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report, Crown Copyright, May 2018.

[34] The Warren Centre, University of Sydney, Fire Safety Engineering, Education Report, 2019.

"5.14. The interim report identified a minimum of six key professions whose work is essential to the fire safety of HRRBs:

- engineers;
- those installing and maintaining fire safety systems and other safety-critical systems;
- fire engineers;
- fire risk assessors;
- fire safety enforcing officers; and
- building control inspectors."

This list presented should have only included one profession, "engineers." Those installing and maintaining fire safety systems and other safety-critical systems should either be engineers or should be supervised by engineers. These systems are integral parts of a holistic fire safety strategy and therefore cannot be seen as the independent, isolated responsibility of those installing the systems. "Fire Engineers" are engineers, and fire risk assessors, fire safety enforcing officers and building control inspectors should be engineers or be supervised by engineers.

The Fire and Rescue Services as a body are also an integral part of the fire safety of High-Rise Residential Buildings (HRRBs), therefore the same professional skills have to be expected from those representing their interests. If a subdivision/segregation of individual skills/disciplines is encouraged, as described by section 5.14 of the Hackitt report, then fire safety will never be implemented in a rational and holistic manner. None of the stakeholders (including the Fire and Rescue Services) will ever understand how their role contributes to the strategy as a whole, and none will achieve the objective of guaranteeing that finished buildings deliver safety adequately. In the case of Fire and Rescue Services, this means never guaranteeing the capability of effectively responding to a fire.

Finally, the Hackitt report establishes that "The government should create a new structure to validate and assure guidance, oversee the performance of the built environment sector and provide expert advice." The Hackitt report discusses efforts being conducted by the Local Authority Building Standards[35] to improve the levels of competency. While these efforts are clearly important, the most pressing issue is to clarify roles and responsibilities between the Local Authority Building Standards[36] and the fire and rescue authorities in the JLC. In the absence of a clear definition of roles and responsibilities, and a detailed framework to certify competency, the JCL will not foster leadership or quality, which will only add to the enormous confusion of competency that currently characterizes fire safety.

5 THE EVIDENCE

Section 7 of the Fire and Rescue Services Act 2004[37] indicates that:

1. A fire and rescue authority must make provision for the purpose of—
    a. extinguishing fires in its area, and
    b. protecting life and property in the event of fires in its area.

[35] J. Hackitt, Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report, Crown Copyright, May 2018.
[36] J. Hackitt, Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report, Crown Copyright, May 2018.
[37] Fire and Rescue Services Act 2004

2. In making provision under subsection (1) a fire and rescue authority must in particular—
    a. secure the provision of the personnel, services and equipment necessary efficiently to meet all normal requirements;
    b. secure the provision of training for personnel;
    c. make arrangements for dealing with calls for help and for summoning personnel;
    d. make arrangements for obtaining information needed for the purpose mentioned in subsection (1);
    e. make arrangements for ensuring that reasonable steps are taken to prevent or limit damage to property resulting from action taken for the purpose mentioned in subsection (1).

In the context of the Grenfell Tower fire, points 1(a), 1(b), 2(b) and 2(d) are of particular importance[38]. Only if these points are fulfilled it is possible to establish adequate provisions of personnel, services and equipment (2(a)), make arrangements for dealing with calls for help (2(c)) and make arrangements for ensuring that reasonable steps are taken to prevent or limit damage to property resulting from action taken during response (2(e)).

It is important to note that the obligations described in the Fire and Rescue Services Act 2004 are not only limited to events where pre-planned tactics and protocols apply, but also include those events where the building does not behave in the manner expected. The Fire and Rescue Services are required to have contingency plans for these types of events, as well as to provide training for those who might be called to command such events.[39]

At the core of the problem is the fact that the refurbishment of Grenfell Tower was executed using specific building technologies and practises that enable a small and perfectly foreseeable kitchen fire[40] to initiate external fire propagation of a magnitude that thwarted the LFB in fulfilling its obligation as per the Fire and Rescue Services Act 2004.

Throughout Phase 1, evidence was gathered that the LFB did not manage, through inspection or other means, to obtain adequate information and subsequently identify the nature of the hazards introduced by the refurbishment of the Grenfell Tower.[41,42] It is apparent that, even if all information would have been made available, there was no capacity within LFB to correctly interpret this information[43]. Furthermore, LFB could not extract the requisite information from the many past high-rise building fires involving external spread, that

---

[38] Section 7.2 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 1, October 2019.
[39] Section 27.3 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[40] J.L. Torero, Grenfell Tower: Phase 1 Report, GFT-1710-OC-001-DR-01, May 2018.
[41] Section 27.21 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[42] Section 27.24 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[43] Section 27.25 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

JTOR00000002_0021

could have enabled them to conduct an adequate dynamic risk assessment. In particular, they were not capable of distilling lessons from the Lakanal House fire[44] that could have allowed the LFB to be better prepared to fulfil their obligations per Part 1, Section 7 of the Fire and Rescue Services Act 2004.

Evidence shows that the LFB effectively implemented their response protocols to tackle a one-unit fire. The testimonies make evident that the initiating event was effectively controlled[45].

Once the event was no longer a one-unit fire, the response should have been driven by a dynamic risk assessment[46]. The dynamic risk assessment should include contingency plans "which should cover the spread of fire beyond the compartment of origin, the possible need for multiple rescues and the need for an operational evacuation plan in case "stay put" became untenable."[47], up to and including total evacuation of the building.[48]

LFB personnel, including those in command, were not capable of conducting an adequate dynamic risk assessment once it became obvious that the fire was propagating externally[49,50,51]. As a result, many decisions that were made or not made, misjudged the nature of the event[52,53]. This resulted in ineffective actions[54] and inadequate information being transmitted between members of the LFB[55], and between them and the occupants inside the building who were seeking help.[56,57,58]

---

[44] Section 28.97 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[45] Section 28.11 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[46] Section 7.46 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 1, October 2019.

[47] Section 27.1 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[48] Section 27.2 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[49] Section 28.14 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[50] Section 28.17 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[51] Section 28.8 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[52] Section 28.14 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[53] Section 28.5 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[54] Section 28.16 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[55] Section 28.17 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[56] Section 28.14 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[57] Section 28.97 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[58] Section 29.71 to 29.78 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

JTOR00000002_0022

Actions taken were not consistent with a proper command structure[59,60]. In particular, the management of information and communications[61,62,63] were representative of individuals in charge of their own actions and not of a response which is characterized by an effective, coordinated command structure.[64,65,66] This applies to both personnel attending the fire and those in the control rooms.[67,68]

In general, evidence shows that the LFB did not exhibit the type of command structure required to handle an event of the complexity of the Grenfell Tower Fire.

At the core of these failures is a profound misunderstanding of risk[69] within modern buildings created by inadequate education and training[70]. From the evidence gathered, it can be established that the training provided to members of the LFB was not adequate to understand the complexities of modern buildings, in particular high-rise buildings. Furthermore, it became apparent that there is a strong disregard for training and education pertaining to building behaviour.[71,72]

It is clear that the inadequacy of training and education crosses through all ranks of the LFB[73,74]. The misunderstanding of risk at the highest level of command is such that statements made during testimony not

---

[59] Section 28.105 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[60] Section 28.76 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[61] Section 28.108 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[62] Section 28.88 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[63] Section 28.99 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[64] Section 28.17 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[65] Section 4 - Section 29.44 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[66] Section 29.29 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[67] Section 28.97 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[68] Section 28.103 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[69] Section 27.9 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[70] Section 27.1 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[71] Section 27.24 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[72] Section 27.16 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[73] Section 28.47 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.
[74] Section 28.20 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

only show an absolute lack of knowledge of past fire events[75], but also a complete misunderstanding of the behaviour of modern high-rise buildings[76].

The fundamental misunderstanding that the primary role of the Fire and Rescue Services is to fight the fire is apparent at all command ranks[77]. There is clear evidence that the LFB considers that if the fire cannot be fought there is no alternative path of action or role.[78] The perception that the fire has to be fought, subordinating all other actions, is shared by all ranks of the LFB command. This perception was at the heart of the inadequate dynamic risk assessment conducted during the Grenfell Tower fire[79] and is a key weakness of the training and structure of the LFB.

Repeated actions while responding to the Grenfell Tower fire showed that the LFB has a culture where adequate command structures are not robust. Furthermore, testimonies provided no evidence that technical knowledge associated to building behaviour is valued. Such a culture disables the capacity of the Fire and Rescue Services to operate effectively under conditions where a dynamic risk assessment becomes necessary. Current trends in building technologies and processes will inevitably result in the LFB having to operate under these conditions more frequently. Dynamic risk assessments will only become more complex and command decisions more challenging.

Most importantly, this culture manifests itself as an enormous level of unawareness of the key technical issues to be considered[80], a complete disregard of the need to enhance the technical competency of the fire service, and an absolute insensitivity to the mistakes made.[81]

The inconsistency between the required technical knowledge and the entitlement of those in command makes it very difficult to imagine the Fire and Rescue Services conducting a profound enough self-examination such as that required to deliver the necessary reforms. This is clear from some of the subsequent documents produced by the LFB describing changes being implemented in response to the Grenfell Tower Fire.[82] In that sense I am compelled to echo the statements of the Phase 1 report: "only serves to demonstrate that the LFB is an institution at risk of not learning the lessons of the Grenfell Tower fire."[83]

---

[75] Section 27.14 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[76] Section 27.10 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[77] Section 28.17 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[78] Section 27.18 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[79] Section 28.114 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[80] Section 27.17 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[81] Section 28.55 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

[82] Grenfell Tower Progress Report: Update from London Fire Commissioner, Fire, Resilience and Emergency Planning Committee, Executive Director of Secretariat, 16 October 2019. Grenfell Tower Improvement Progress, Assistant Commissioner – GTIRT, Official, 10 October 2019. (JTO00000001)

[83] Section 28.55 - Grenfell Tower Inquiry: Phase 1 Report, Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017, Chairman: The Rt Hon Sir Martin Moore-Bick, Volume 4, October 2019.

6 A REQUIRED NEW APPROACH

The Grenfell Tower fire has provided clear evidence that the Fire and Rescue Services are required to incorporate sufficient understanding of building behaviour in their activities. The knowledge associated to building behaviour will only be effective if it is introduced within a context where this knowledge is respected and valued. Respect and value are critical because they demonstrate the recognition that this information is important for making response effective.

Currently, the prevailing culture of the Fire and Rescue Services only assigns value to plan execution[84] and the tools and training associated to following predefined protocols. This culture confines the nature of inspections and the current command structure. Interventions in fires that incorporate modern building technologies require plan formulation[85]. Plan formulation is only enabled by relevant information fed into a dynamic risk assessment. Well interpreted information is a necessary prerequisite to the development of a dynamic risk assessment. Given the short time-scales of fire growth, the execution of an alternative plan, issued from a dynamic risk assessment, requires a rigorously adhered to command structure, accompanied by adequate communications.

The acquisition of information prior to any event is essential, because if an inspection cannot identify and interpret serious mistakes in the design, implementation and maintenance of a building, and ensure that they are corrected, the nature of the potential fire might still exceed the capacity of the Fire and Rescue Services. It is clear that a building like Grenfell Tower would respond so poorly to a fire, that not even the best possible response would have resulted in an acceptable outcome. Purely from the perspective of response capabilities, a building such as Grenfell Tower should have never been approved and no inspection should have allowed the building to continue its operation.

The Grenfell Tower fire has demonstrated that the culture of the LFB is profoundly associated to a traditional firefighting culture[86] that cannot generate the quality of plan formulation required by the modern built environment. This culture prevails across all ranks of the LFB and stifles every possibility for the organic growth of the technically driven culture that values and respects the skills necessary to form a dynamic risk assessment driven plan.

The creation of a culture that rebalances priorities is necessary to promote acquisition of the skills and attributes essential for the Fire and Rescue Services to operate in the modern built environment. The new culture requires a profound reformulation of hierarchy within the LFB that enables those with the appropriate skills and attributes to conduct plan formulation, to progress in the command structure. Currently, this culture does not exist and the LFB command shows a strong bias towards those individuals who have demonstrable skills and attributes when it comes to consistent repetition of pre-defined protocol.

[84] Cohen-Hatton, S.R. Butler, P.C. and Honey, R.C., An Investigation of Operational Decision Making in Situ: Incident Command in the U.K. Fire and Rescue Service, Human Factors, Vol. 57, No. 5, August 2015, pp. 793–804.
[85] Cohen-Hatton, S.R. Butler, P.C. and Honey, R.C., An Investigation of Operational Decision Making in Situ: Incident Command in the U.K. Fire and Rescue Service, Human Factors, Vol. 57, No. 5, August 2015, pp. 793–804.
[86] Baigent, D. One More Last Working Class Hero. A Cultural Audit of the UK Fire Service. Fitting-in Ltd & The Fire Service Research and Training Unit, Anglia Polytechnic University, 2001.

JTOR00000002_0025

This new culture will enable the Fire and Rescue Services to gather and interpret information adequately and to use this information for the effective management of a fire scene where on-the-spot plan formulation and strict command practices are necessary.

Figure 1 presents a conceptual map of skills and attributes that are necessary for a Fire and Rescue Service to operate in an effective manner within the modern built environment. The three branches have distinctive and essential skills and attributes. The three branches must continuously interact through training and education to guarantee that all necessary skills and attributes are present in each branch, but also to reinforce the value of each specific role. For a structure of this nature to thrive it is necessary that a culture of value and respect for all the different skills and attributes is developed.

The Engineering Branch must include professional Fire Safety Engineers as well as professionals of other disciplines where strong interactions are necessary to guarantee fire safety (e.g. architects, structural engineers, etc.). This branch is responsible for information gathering and for providing training and education in relevant matters to responders and officers. Only through the introduction of the skills and attributes of the Engineering Branch can the Fire and Rescue Services have the capability to play a direct and effective role in the approvals process. Its responsible members will be accredited by their relevant engineering professional organizations thus eliminating the confusion of competence, as the skills and attributes of these new personnel in Fire and Rescue Services will be aligned with all other professionals (engineers, architects, etc.) responsible in delivering fire safety to the public. It will provide a single competency standard for approvals authorities, design/construction engineers and all other professional stakeholders.

The role of the officer is associated to all the skills and attributes relevant to plan formulation and includes only individuals with a profile and attributes appropriate for strategizing, leadership and logistical skills. The Officers Branch is characterized by a deep relationship between these aforementioned skills and all relevant professional skills.

The skill requirements of the Responders Branch will inevitably be defined by the other two branches to meet the evolving needs.

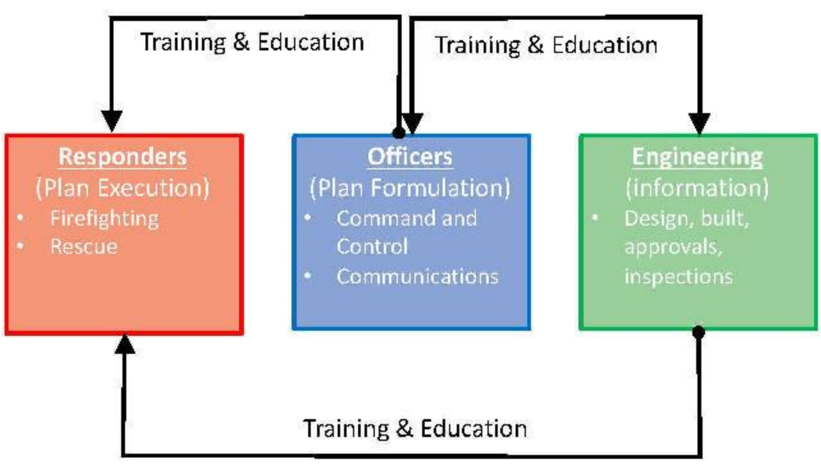

Figure 1 - Conceptual skills and attributes diagram for the Fire and Rescue Service

An element of fundamental importance to enable a system of this nature to be effective is a coherent structure for training and education. Currently, firefighter training is conducted by the Fire Service Colleges and external contractors and is coordinated by officers. Firefighting training can remain under this structure, nevertheless, the coordination of training and education activities for the Responders Branch should be jointly shared by the Officers and the Engineering Branches. The Engineering branch will comply with training and educational practises defined by the relevant professional institutions. This will guarantee a balanced delivery of all relevant aspects. The pedagogy that results in an adequate acquisition of knowledge will have to be carefully studied. The Engineering Branch will be responsible for coordinating training and education for the Officers on matters related to building technology while the Officers Branch will provide training for Engineers in all matters pertaining to operational requirements.

This suggested new approach towards the Fire and Rescue Services is purely conceptual. Currently, there are many unresolved questions related to the training and education of all three branches. Professional institutions have not adequately defined the skills and attributes of a modern fire safety engineer[87] and pedagogies that are capable of delivering these skills and attributes are still in their infancy.[88,89] Furthermore, it is clear that such a drastic change of culture within the Fire and Rescue Services will face many complex barriers. Therefore, this simple representation should only be regarded as a recognition that a broader set of distinct skills and attributes are necessary for a modern Fire and Rescue Service to deliver the type of response necessitated by the modern built environment.

It is essential to recognize the complexity of this proposed transformation because only then can the necessary resources be deployed to study the problem and provide implementation paths that will truly deliver what is necessary. The formulation of a transformation path can only be achieved by a multi-disciplinary group that, while potentially incorporating members of the Fire and Rescue Service, must not be led by them. This group needs to have external leadership because the current culture of the Fire and Rescue Services does not allow for the required level of self-criticism and introspection.

It is important to state, given that this inquiry stems from the events at Grenfell Tower, that the issues raised in this report should not be assumed as unique to the LFB. It is my strong opinion that these issues are in fact endemic to all Fire and Rescue Services, nationally and globally. Thus, while I insist that the Fire and Rescue Services should not lead this review, the justification for this position is equally applicable to any national or international Fire and Rescue Service. It is also important to reiterate that this will be a multi-year effort that needs to challenge the nature of the Fire and Rescue Services as well as the fire safety engineering profession.

[87] J.L. Torero, "Fire Safety Engineering: profession, occupation or trade?" International Fire Professional Magazine Vol. 1 No. 1 July 2012, Institution of Fire Engineers, UK.
[88] The Warren Centre, University of Sydney, Fire Safety Engineering, Education Report, 2019.
[89] M. Woodrow, L. Bisby, J.L. Torero; A nascent educational framework for fire safety engineering; Fire safety Journal, vol. 58, pp. 180-194, 2013.

JTOR00000002_0027

7 SUMMARY

The characteristics of the London Fire Brigade are very similar to many other Fire and Rescue Services globally. While this report has focused on the London Fire Brigade, most of these statements will apply to Fire and Rescue Services across the United Kingdom and internationally.

The Grenfell Tower fire demonstrated that the London Fire Brigade, in its current structure is not capable of delivering the role that society expects from this institution.

The nature of the modern built environment and current construction practises requires a Fire and Rescue Service that is capable of conducting Plan Formulation when faced with complex modern infrastructure. This must include all components of the Plan Formulation process; from information gathering, its interpretation, its use in a dynamic risk assessment, the handling of communications and an effective command structure to deliver an appropriate response.

The London Fire Brigade still operates in a Plan Execution mode which is no longer sufficient. For the London Fire Brigade to deliver the level of service expected by society when operating in respect to complex modern infrastructure, it requires a deep transformation that involves not only improvement of skills and professional attributes but also requires a drastic change of culture.

At the core of this change of culture is transforming the value structure of the organization to introduce respect and value for technical knowledge. Currently, the culture of the London Fire Brigade exhibits, at all levels, a total disregard for technical competency and the understanding of building performance.

The necessary transformation requires a deep, extensive and fundamental review of the structure of the London Fire Brigade as well as a redefinition of skills and attributes of those employed by the London Fire Brigade. This report does not provide such a review but a simple conceptual structure that could serve as a starting point.

The review of the London Fire Brigade, and in general any Fire and Rescue Services, must be a long term, extensive and multi-disciplinary effort. The current culture prevailing in the London Fire Brigade, and Fire and Rescue Services globally, prevents them from leading such a review.

JTOR00000002_0028