SFPE EUROPE

AN OFFICIAL PUBLICATION OF SFPE

INTERNATIONAL SURVEY OF FIRE ENGINEERING TOOLS – FUTURE WORK PLAN RECOMMENDATIONS

By: Greg Baker, Fire Research Group, New Zealand,
Colleen Wade, Fire Research Group, New Zealand,
Daniel Nilsson, University of Canterbury & Fire Research Group, New Zealand,
Per Olsson, Fire Research Group, New Zealand

RESREARCH PROJECT

This article provides an overview of the key findings of a research project, undertaken by Fire Research Group and the University of Canterbury, entitled *Development of Fire Engineering Practitioner Tools* which started in 2020 with funding support from the SFPE Educational and Scientific Foundation (**Foundation**). The objectives of the research project were to:

Objective 1: Understand how practicing fire engineers used fire engineering tools[1] in their common tasks and day-to-day workflows,

Objective 2: Identify the tools needed by them,

Objective 3: Identify the current gaps between common practices and the available practical tools, and

Objective 4: Given the knowledge from Objectives 1 to 3, propose future work to fill the gaps and develop new tools.

Full details of the project and its findings were published in a report entitled *Fire Engineering Practitioner Tools: Survey and Analysis of Needs* [1].

This new article focusses primarily on Objective 4, by providing details of the recommendations that were made by the research project team for a future work plan that would respond to the gaps between common practices and the available practical tools that had been identified by the researchers in relation to Objective 3.

INTERNATIONAL SURVEY RESULTS

[1] The term 'fire engineering tools' refers to any computer model, personal or in-house spreadsheet, hand calculation method, etc., that is used by fire engineering practitioners in engineering analyses.

The most significant part of the research project was an international survey of fire engineers and other industry participants who were familiar with and had personally used fire engineering tools within the last two-year period. One hundred and fifty-six participants completed the survey, representing 32 different countries and with 70% of the total respondents being members of SFPE International[2].

Survey participants were asked to identify tools that they had used under ten different type categories, with the results shown in Figure 1.

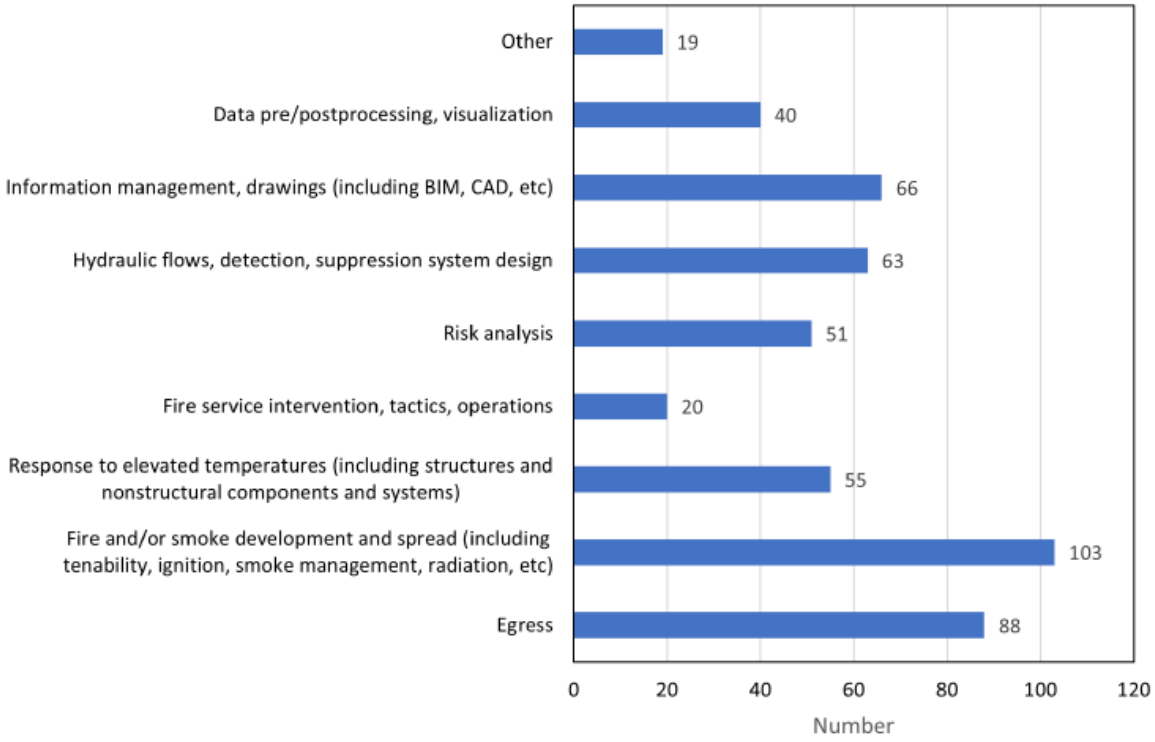

Figure 1. Types of fire engineering tools used in last 2 years.

As shown in Figure 1, the most commonly used tool type was the 'fire and/or smoke development' type with 66% of usage, followed by the 'egress' type with 56%, and then the 'information management, drawing' type with 42% and 'hydraulic flows, detection, suppression' type in fourth position with 40% usage.

Respondents to the survey were also asked to name up to five different tools that they had used over the last two-year period under the various tool type categories that they had nominated, with the full list[3] of named tools shown in Figure 2.

As can be seen in Figure 2, the most popular tool (nominated by 56% of the survey participants) was in the 'fire and/or smoke development' type category, namely the CFD (computational fluid dynamics) tool, FDS [2], followed by the tool Pathfinder [3] (in the 'egress' type category nominated by 40% or respondents), and in third position, a tool in the 'data pre-post-processing, visualization' type category called Pyrosim [4] which was nominated by 24% of survey participants.

[2] The 70% did not include people who were a member of a local SFPE Chapter, but not a member of the US-based SFPE.

[3] A tool needed to be named by at least two respondents to feature specifically in the report.

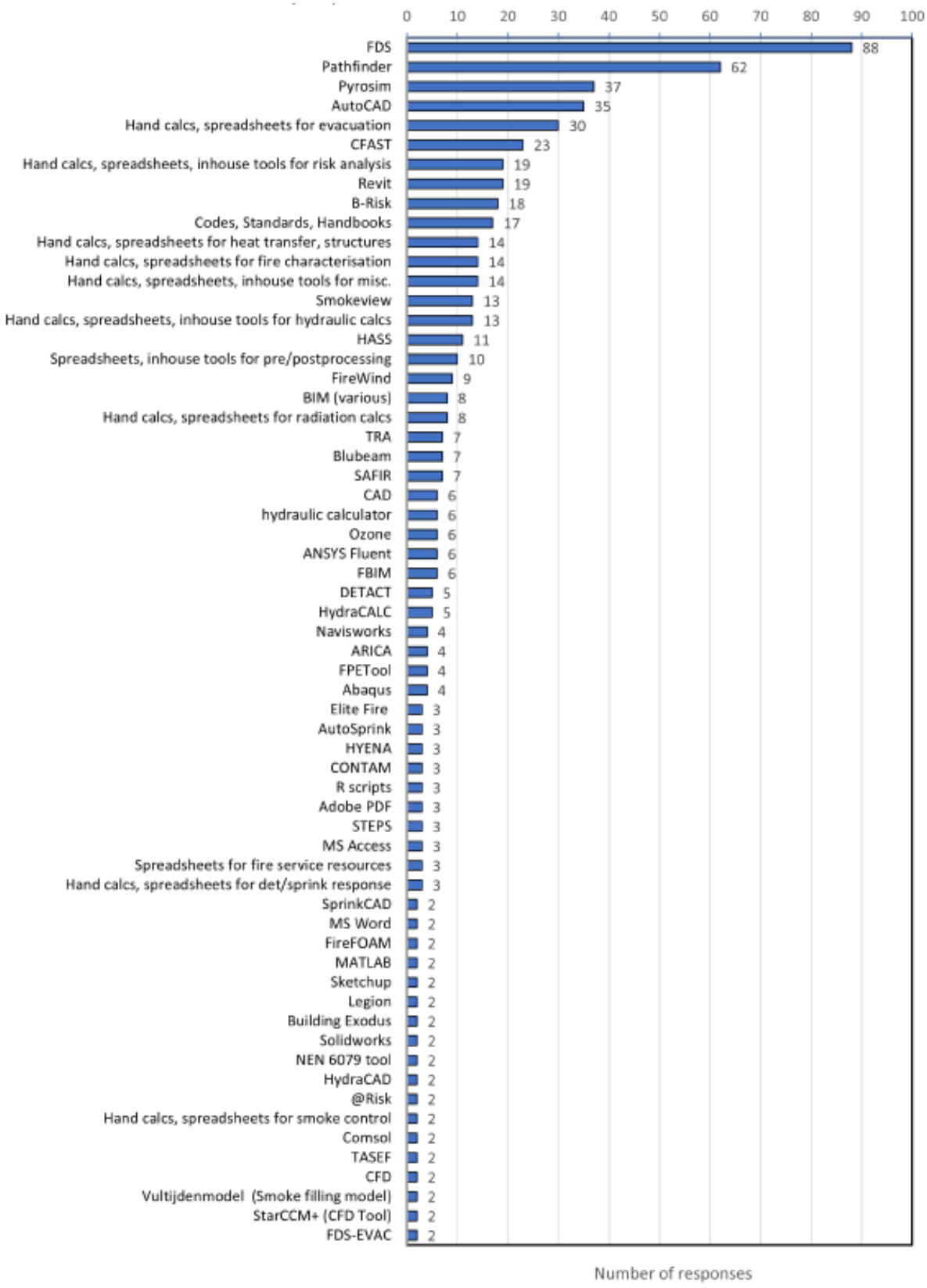

Figure 2. Specific fire engineering tools identified by respondents across all tool type categories.

With reference to the data shown in Figure 2, while it was not surprising to the research team that well-known computer software such as FDS, Pathfinder and PyroSim accounted for seven of the top ten placed tools, less intuitively obvious to the researchers *a priori* were the other three tools

nominated not being actual computer software. In this latter group were hand calculation and spreadsheet tools (in 5th and 7th place, respectively) and the category of 'codes, standards and handbooks' tools (in 10th place). This trend of non-computer software (or what can collectively be termed 'manual'[4] tools) in the top ten tools used continued within the top twenty tools, with 'manual' tools taking another six places between the 11th and 20th position, giving a total of nine out of twenty, or 45%, of nominated tools in the top twenty being the so-called 'manual' tools (non-computer software).

In addition to the full project report [1], an article was also recently published in the SFPE's magazine *Fire Protection Engineering* [5] which primarily focussed on Objective 1 and Objective 2 noted above, giving a more complete summary of the data and findings from the international survey.

FUTURE WORK PLAN

Although not covered in the article in the *Fire Protection Engineering* magazine [5], survey participants identified gaps and future needs that existed between the tools that were considered necessary by the respondents, and what was currently available and in use. A gap analysis exercise then provided the basis to investigate the future needs for the fire engineering profession, which in turn led to a consolidated future workplan for both the Foundation and the SFPE itself being developed and proposed by the project team.

As part of the gap analysis, the responses from survey participants on gaps and future needs were grouped by the research team into eight different categories, namely: 1. Data; 2. Documentation, guidance and education; 3. Integration; 4. New tools; 5. Physics and conceptual submodels; 6. Regulatory; 7. User experience; and 8. Validation. The gap analysis under these eight categories resulted in 20 recommendations being developed by the research team.

It was clear to the research team that a total of 20 recommendations would be unmanageable, so a further exercise was undertaken to prioritise the full set of recommendations. The primary basis used by the researchers for this prioritisation process was the existing SFPE Research Roadmap [6].

The prioritisation exercise led to three priority themes being identified, as follows, with an associated eight work plan recommendations:

1. **Priority Theme 1 – Data**:
    a. Recommendation 1.a: Develop a request for proposals (**RfP**) that specifically focuses on identifying and prioritizing data needs for fire engineering purposes and how those priority needs might be addressed.
    b. Recommendation 1.b: Identify opportunities to update (existing), develop (new), populate, host, maintain and fund fire engineering databases – it is assumed that such opportunities would be beyond the means of the Foundation/SFPE and would therefore follow a 'shared model' approach with industry, academia, etc.
    c. Recommendation 1.c: Develop formal SFPE guidance on data and databases for fire engineering.
2. **Priority Theme 2 – Integration**:

[4] The term 'manual' refers to both hand calculations (e.g., using a hand calculator), spreadsheets (considered here as an automated form of hand calculation), tools developed in-house (not available for use external to the organisation), and the like.

    a. Recommendation 2.a: Develop an RfP to investigate the feasibility and opportunities for increased and improved tool and model integration including:
        i. BIM/CAD add-ins generally;
        ii. Fire-evacuation models;
        iii. Fire-finite element analysis (generically known as FEA) models;
        iv. Fire-hydraulic models; and
        v. Linkages to quantitative risk analysis (**QRA**) models.
    b. Recommendation 2.b: Develop a publicity campaign that highlights opportunities to utilise BIM more frequently and effectively in fire engineering applications.
3. **Priority Theme 3 – New Tools**:
    a. Recommendation 3.a: Establish a Working Group to undertake work to identify and prioritize needs for hand-calculation/spreadsheet methods.
    b. Recommendation 3.b: Engage with international academic institutes to include priority topics as post-graduate student projects to develop spreadsheet tools.
    a. Recommendation 3.c: Develop an RfP that specifically focusses on existing QRA models and usage in fire risk assessment applications and which links to the content of the existing[5] SFPE Risk Guide [7].

In addition to the recommendations for future work by the Foundation/SFPE noted above, the research team also made a series of more general recommendations not linked directly to survey responses, as follows:

4. Repeat a fire engineering tools usage survey on a regular basis (every three years).
5. Develop a new SFPE Engineering Guide which covers all aspects of best-practice fire engineering tool usage, and that includes a full listing of current models, updated on the same cycle as the regular survey.
    a. The new Guide should also be developed to complement the existing *SFPE Engineering Guide - Guidelines for Substantiating a Fire Model for a Given Application* [8];
    b. Approach the SFPE Subcommittee for Standards Oversight with recommendations for associated new work items; and
    c. Establish Task Group to oversee development of the new Guide.
6. Conduct regular SFPE education/training for fire engineers on best practice fire model usage.
7. Regularly promote and publicise best-practice fire model usage to the SFPE membership.
8. Engage with SFPE Subcommittee for Research and Innovation to ensure that fire engineering tool usage has suitable prominence and representation in future versions of the SFPE Research Roadmap.

CONCLUSION – CALL TO ACTION

Just over a year since the future work plan was presented to the Foundation at the conclusion of the research project, it is encouraging to see the research starting to gain some traction with a recently released request for proposals[6] from the Foundation relating to Priority Theme 2. The research team is optimistic that further recommendations from the project will come to fruition in

[5] It should be noted that an updated second edition of the Fire Risk Assessment guide is expected to be published in late 2022.
[6] See RfP on Foundation webpage Foundation BIM RfP.

the future, and hence maximise the beneficial impact of the research project on the practice of fire engineering internationally.

REFERENCES

[1] Wade, C., et al. (2021) *Fire Engineering Practitioner Tools – Survey and Analysis of Needs*, FRG Report 2102015/1: SFPE Educational and Scientific Foundation Inc, URL: https://higherlogicdownload.s3.amazonaws.com/SFPE/c2f91981-c014-4bec-97f4-1225586937ac/UploadedImages/Final_Report_with_Cover_Page.pdf.

[2] McGrattan, K., Hostikka, S., McDermott, R., Floyd, J. and Vanella, M. (2019) *Fire Dynamics Simulator User's Guide. NIST Special Publication 1019 Sixth Edition Revision: FDS6.7.1*: National Institute of Standards and Technology, Gaithersburg, MD, US, URL: dx.doi.org/10.6028/NIST.SP.1019.

[3] Thunderhead Engineering (2021) *Pathfinder User Manual., Version: 2021-4*, 14 September 2021: Thunderhead Engineering, Manhattan, KS 66502, USA, URL: https://support.thunderheadeng.com/docs/pathfinder/2021-4/user-manual/.

[4] Thunderhead Engineering (2020) *PyroSim User Manual, Version 2020-2*, 24 September 2020: Thunderhead Engineering, Manhattan, KS 66502, USA, URL: https://files.thunderheadeng.com/support/documents/pyrosim-user-manual-2020-2.pdf.

[5] Baker, G., et al. (2022) *Results Are In – International Fire Engineering Tools Survey*, Fire Protection Engineering, Q1 2022 Issue #93, pp. 18-24, URL: https://www.fireprotectionengineering-digital.com/fireprotectionengineering/q1_2022/MobilePagedReplica.action?pm=2&folio=18#pg20.

[6] SFPE Research Roadmap, URL: https://www.sfpe.org/research/research-roadmap.

[7] SFPE (2007) *SFPE Engineering Guide – Fire Risk Assessment*: Society of Fire Protection Engineers.

[8] SFPE (2010) *SFPE Engineering Guide – Guidelines for Substantiating a Fire Model for a Given Application*: SFPE.