Research & Development Activity in the English and Welsh Fire and Rescue Services

2016

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FIRE AND RESCUE SERVICES’ RESEARCH AND DEVELOPMENT ACTIVITIES IN ENGLAND AND WALES

EXECUTIVE SUMMARY

This project establishes the current practices and economic value of Research and Development (R&D) activities in the UK Fire and Rescue Service (FRS). A clear picture of the costs of R&D activities will benefit the fire industry and help it to develop more cost-efficient methods of testing fire equipment, such as collaboration between services.

In this report, R&D is work done to find, create, and evaluate new equipment, vehicles and procedures.

13 out of the 48 (27%) Fire and Rescue Services in England and Wales were interviewed during the first half of 2016 to gain insight into what R&D the service does and how it is managed (no names of services or individuals are included in this report).

- What does ‘R&D’ mean to your service?
- What work do you/does your team do?
- How many people do R&D/are on the team?
- How much time is spent on R&D overall?
- How do you find out about new equipment/technology/practices?
- How do you choose and evaluate options?
- How does the rest of the service view R&D/your work/your team?
- How do other services view yours when it comes to R&D? How do you view them?
- Do you collaborate on R&D with other FRS’s/emergency services/manufacturers/suppliers?
- Who drives R&D?
- How much time is spent on ‘problem-solving’?

Rephrasing ‘research and development’ as problem-solving brought to light new examples with widespread involvement across different departments and teams. There is considerably more small-scale R&D happening than is formally recognised. Including problem-solving in R&D often doubled or tripled the initial estimate of time spent.

Two key trends emerge: every service does research and development, whether there are dedicated personnel or not; and services rely on both formal and informal networks to support R&D.

On average, metropolitan services have an equivalent of 5 people working full-time on R&D. County services have an average of 4 full-time R&D personnel, and combined and Welsh services have an average of 4.5 R&D personnel. These numbers combine the short-duration involvement of staff at all levels of the organisation with the more traditional operations support roles.
Combining time and salary estimates yields a value of £9.1 million spent each year on R&D. Given the estimations involved in the calculation, this is a minimum amount. The true figure is likely larger, possibly up to half as much again. A realistic range is that between £9 and £13 million is spent each year on R&D, on wages alone.

There are a number of R&D models and department structures across England and Wales, but the process for assessing new equipment and vehicles is almost the same in every service. These processes have varying levels of formality. Research in terms of equipment and firefighting technology is often not linked to existing or future infrastructure research and development, resulting in mismatched software, items performing well below their anticipated levels of efficiency, or at worst becoming obsolete.

The relationship between fire crews and R&D personnel is changing, with firefighters increasingly viewed as ‘end users’ and operational support teams as filling a customer support role. This reflects a change in dynamic between operational crews and office support, but also a recognition of the value of R&D and the difference it can make. Services are increasingly recognising the need to formalise and standardise feedback.

There are multiple formal, semi-formal and informal networks in operation within the Fire and Rescue Service. These networks create knowledge structures which are used in parallel, from shared presentations and seminars to casual conversations with peers in neighbouring services.

Even the smallest services are looking further afield for new technologies and procedures. This brings wider and deeper understanding and capability and the benefits are felt beyond the individual service, affecting capabilities nationwide.

Timing of purchases is driven by the life span and replacement cycle of existing equipment, budgetary pressures to stagger roll-out, and aligning three- or five-year plans with neighbouring services to benefit from the greater purchasing power of a combined order.

Regional collaboration and interoperability also influence choice of equipment, even if there is no joint purchasing in place. There are informal understandings between operational support departments to provide short-term loans of spare equipment to a neighbour, forming an unofficial safety net and business continuity, maintained through informal and semi-formal networks.

Two case studies are presented to illustrate how a theoretical metropolitan service and a small, county service differ in their approach to R&D.

**CONCLUSIONS**

The trend towards including firefighters in R&D is positive but must be supported by experienced staff and managed carefully to avoid bias.

Measuring the use and effects of new equipment ‘on the run’ would inform future R&D projects and ensure services are getting value for their money.

Research efforts are duplicated because of varying procedures, needs, risk acceptance and compatibility, and the pace of a changing market.
R&D is often unstructured, independent of other services and agencies, and duplicated. In most cases it results in defensible choices of equipment or technology, but in some cases it is simply not effective. We recommend three potential courses of action for improving the R&D practices of the fire services:

- **i. Organise R&D nationally** across all services, with single (or small groups of) services taking a leading role on the development of specific technologies.

- **ii. A central R&D hub**, funded by the fire services in collaboration, that reviews equipment in a standard format, produces technical reviews independently of any service and publishes those reviews in a manner that allows services to choose from a number of options, but furnished with independent, technical, scientifically robust data about the equipment in question.

- **iii. A form of scientific service**, consisting of a relationship between the university sector and fire services, which gives short-term access to an academic at the early stages of an R&D project to guide the design of the project and ensure robustness.

Ultimately, the UK Fire and Rescue Service must decide between economies of scale created by regionalising, outsourcing and collaborating, or embracing individual R&D projects, but with a higher level of structure.

“If we have a plan, it’s a cunning one. You could pin a tail on it and call it a fox. If we have a plan.”
INTRODUCTION

This project establishes the current practices and economic value of Research and Development (R&D) activities in the UK Fire and Rescue Service (FRS). The fire industry has always been technologically reliant, and the success of operations and commitments to ensuring firefighter safety are fundamentally technological at heart. Furthermore, it is well accepted that FRS budgets are certainly unlikely to increase in the near future, and most probably decrease in real terms.

With this in mind, there are alternatives in terms of funding models and practice potentially available that could reduce costs and increase the efficiency of FRS-based R&D. However, in order to attempt to identify those cost or efficiency savings, we must gather a picture of what the current state of R&D activity and costs are within the UK FRS.

A clear picture of the costs of R&D activities in the UK FRS would be of benefit to the fire industry and help it to develop more cost-efficient methods of testing fire equipment, such as collaboration between FRS’s.

A number of recent reports have reflected upon research activity and technological advances within the Fire and Rescue sector, as well as allied sectors such as beach lifeguarding (Greatbatch & Livingstone, 2016).

This research activity builds on recommendations from the Knight Report (Knight, 2013) which found that there is a scope for efficiencies across the fire service, in operational and bureaucratic terms. The report also highlights that there is scope for collaboration in the design, commissioning and evaluation of equipment which could add to efficiency savings and speed uptake of appropriate technology.

The Chief Fire Officer’s Association (CFOA) have also commented in recent strategy documents on the need for enhanced efficiency and consistency in support services (CFOA 2015, page 8) and this research forms a part of the knowledge base for any attempt to fulfil that aspiration.

WHAT IS R&D?

In this research, R&D refers only to work done to find, create, and evaluate new equipment, vehicles and procedures. It does not include work being done on analysis of response times, identification of vulnerable population groups or any of the multiple other research lines being pursued by FRS’s.
WHO WAS INVOLVED?

13 out of the 48 (27%) Fire and Rescue Services in England and Wales were interviewed during the first half of 2016.

There are three types of Fire and Rescue Service in England: County, Metropolitan and Combined (NAO, 2015). See Figure 1. Of the services interviewed, two were metropolitan, three were county, seven were combined, and one was Welsh.

No names of Services or individuals are included in this report.

FIGURE 1 - GEOGRAPHICAL COVERAGE OF FIRE AND RESCUE SERVICES IN ENGLAND AND WALES, COLOURED BY TYPE.
The interviews were free-form and conversational, built around guiding questions:

- What does ‘R&D’ mean to your service?
- What work do you/does your team do?
- How many people do R&D/are on the team?
- How much time is spent on R&D overall?
- How do you find out about new equipment/technology/practices?
- How do you choose and evaluate options?
- How does the rest of the service view R&D/your work/your team?
- How do other services view yours when it comes to R&D? How do you view them?
- Do you collaborate on R&D with other FRS’s/emergency services/manufacturers/suppliers?
- Who drives R&D?
- How much time is spent on ‘problem-solving’?

These conversations were held face-to-face or by telephone with uniformed and non-uniformed staff, from firefighters to senior managers and across roles including operations support, fleet management, maintenance, logistics, training, procurement, and policy.

Freedom of Information Act (FOIA) requests to FRS’s were considered and rejected as a source of information on R&D activities and investment. FRS’s do not have this information to hand and would not have been able to provide it without carrying out internal research. Furthermore, the term ‘research and development’ has flexible and varying definitions, and using interviews could establish a standard definition and allow deeper questions to be asked and the answers explored.

The staffing numbers that were described in the interviews create an estimate of the time spent on R&D across the sector. These figures have been split into different ranks or roles, for example Station Manager, Chief Fire Officer and Firefighter. Combining the time with the hourly pay or salary for each role yields an estimate of the total money spent on R&D.

At the end of each interview, the last question asked about ‘problem-solving’. This is work done outside recognised R&D projects, dealing with operational support issues and everyday equipment difficulties. Without fail, rephrasing ‘research and development’ as a small-scale, informal, unmeasured activity brought to light a multitude of new examples with widespread involvement across different departments and teams. Conversation about problem-solving work and its scope often ran longer than the time spent discussing formal R&D.
RESULTS

Trends and similarities emerge between the different Fire and Rescue Services.

The first key finding is that every service does R&D. Whether there are dedicated personnel or not, every Fire and Rescue Service in England and Wales carries out research and at least some development on equipment and processes.

The second key finding is that as well as contacts made with manufacturers and suppliers, services rely on both formal and informal networks for discovering new ideas, comparing potential new purchases or procedures and fixing performance issues.

QUANTITATIVE RESULTS

The amount of time FRS personnel spend on R&D is hard to pin down. While an individual or team might have a good estimate of the resources they dedicate to finding and testing new equipment, it is less obvious how much time is contributed by fire crews, chiefs, training instructors and workshop staff. For the services participating in this study, numbers have been drawn from the interviews and supplementary research. For the other services, an estimate of time spent has been made based on interviewed services of the same type (metropolitan/county/combined/Welsh).

It is harder still to estimate time spent on ‘problem-solving’. This includes the short-notice, informal, urgent repairs and replacements requested by operational crews which form a large part of the role of the typical operations support person. Though small, these issues are nonetheless important. Time is spent checking what the problem is, tracing it back to the individual who reported it and gathering more details, investigating whether other stations and neighbouring services have encountered the same issue and, if so, whether a fix or workaround is available. If it is a widespread, critical or manufacturing problem which requires service-wide replacement or warranty negotiations with suppliers, it is usually elevated in status and priority to become another research project, either through a formal process or simply by bumping it up the list of active projects. The issue might be monitored by station or area managers for a period to determine its significance and impact before deciding whether a change is required. This time is usually not explicitly tracked, yet it is an integral part of the R&D process. Including problem-solving in research and development often doubled or tripled the initial estimate of time spent.

"The office is operational support, we’re there to support the crews. So if we’ve got a crew come in with a problem, does it need fixing now or can it wait? Quite often there’s something that you really need to resolve straight away. Basically we firefight but in an office."

Figures for average salaries of each of the positions have been drawn from publicly available data, current job advertisements, and existing FOIA requests about senior officer salaries.

Table 1 below shows the average number of personnel who work on R&D in each role. For example, for the metropolitan services, 1.5 Watch Managers means an equivalent of one and a half people working
in that role, full-time on R&D. For the purposes of this summary, the Welsh services have been grouped with combined services, the largest group in England, so as not to be immediately identifiable.

### TABLE 1 - FULL-TIME EQUIVALENT PERSONNEL WORKING ON R&D IN DIFFERENT ROLES

<table>
<thead>
<tr>
<th>Role</th>
<th>Average Metropolitan</th>
<th>Average County</th>
<th>Average Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefighter</td>
<td>0.9</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Watch Manager</td>
<td>1.5</td>
<td>1.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Station Manager</td>
<td>0.8</td>
<td>1.3</td>
<td>2</td>
</tr>
<tr>
<td>Group Manager</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Area Manager</td>
<td>0.3</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>CFO to ACFO</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Training Instructor</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Civilian (junior)</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>Civilian (mid)</td>
<td>0</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Civilian (senior)</td>
<td>0.5</td>
<td>0.2</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Total R&amp;D Personnel</strong></td>
<td><strong>4.7</strong></td>
<td><strong>3.9</strong></td>
<td><strong>5.5</strong></td>
</tr>
</tbody>
</table>

Across England and Wales, regardless of service size and approach to R&D, there are on average an equivalent of four or five people working full-time on research and development. On average, metropolitan services have 5 people always working on R&D. County services have an average of 4 full-time R&D personnel, and combined and Welsh services have an average of 4.5 R&D personnel.

These figures are conservative. They are based on the people and time described in interviews and on the average number of equipment research projects underway. For any individual service the amount of R&D activity has likely been underestimated, especially considering the largely untracked time contributed by senior, fire ground, training, and maintenance personnel.

Combining the time and salary estimates yields a value of £9.1 million spent each year on R&D. Given the estimations involved in the calculation, this is a minimum amount. The true figure is likely larger, possibly up to half as much again. A realistic range, therefore is that **between £9 and £13 million is spent each year on R&D, on wages alone**, so not a full economic costing (taking into consideration employer...
contributions to National Insurance, pension etc.). A Full Economic Costing figure would increase the estimate and the potential upper spend to more than £13 million annually.

QUALITATIVE RESULTS

Although there are a number of R&D models and department structures across England and Wales, the process for assessing new equipment and vehicles is almost the same. All the services interviewed followed a similar method, starting with discovery and ongoing efforts to keep abreast of new developments. When a need is identified, potential purchases are shortlisted and evaluated against each other. The results are compared and a recommendation is made to purchase. See Figure 2 for more detail.
Potential items are assessed using a decision matrix and scored against several criteria. Which of these qualities are considered most important depends on the project, and typically include:

- Suitability for requirements
- Usability
- Compatibility with existing equipment/vehicles
- Durability
- Upfront cost
- Lifetime cost
- Repair/replacement cost
- Ease of repair/maintenance
- Build quality
- Value for money
- Risk of supplier ceasing to trade/offer support
- Training requirements

Scores are weighted based on how important each of these aspects are and an overall score is created for each piece of kit (or vehicle). Weightings and relative importance of the criteria vary widely between services and depend on the size of the project, whether it is replacement or new technology and how many personnel were involved in the testing.

“When the biggest thing was what the users thought of the equipment. If the cost outweighs what the users thought then there’s no point in getting people involved in carrying out evaluations.”

These processes have varying levels of formality, can be carried out by a single person or by everyone involved in the project and are later collated into a summary. Cost is either included in the scoring matrix or assessed separately after a technical recommendation has been made. Depending on the service and the overall project cost, the final decision might be made by the project lead or a shortlist of acceptable choices might be passed to a senior manager to decide.

For services engaged in medical co-responding, whatever shape that takes, there is increased requirement for R&D. Even if equipment or training is provided by the health partner, input is needed to address requirements for stowage, logistics, policies and new vehicles.

“Changing suppliers involves more than just buying different appropriate equipment. There may already be constraints that restrict the choice of potential items, such as existing support structures, support contracts that might be shared with other services, retraining costs and rewriting of operation procedures, lag of introduction, and replacing exiting items.

“E’m tooled up for that chassis type. We’ve got all the training for maintenance, we’ve got all the special tools, all the parts and everything else. As soon as we start going into different chassis manufacturers, we’re going to double our training, we’ve got to buy more special tools, so there’s lots of run-on costs, let alone the driver training side of it, training familiarisation and all the rest that goes with it.”

There are a number of innovative projects being considered or trialled, drawing on emerging technologies such as RFID tagging, the ‘Internet of Things’, ‘Digitizing the Fireground’, VR / AR (virtual / augmented reality) visualisation, HUDs (heads-up displays), and UAVs (unmanned aerial vehicles, or
‘drones’). However, research in terms of equipment and firefighting technology is often not linked to existing or future infrastructure research and development, resulting in mismatched software, items performing well below their anticipated levels of efficiency, or at worst becoming obsolete.

Services are increasingly recognising the need to formalise and standardise feedback. Having a single format and a specific time for evaluations allows the results to be compared objectively. The exact details and length of evaluation depend on the project, with pilot runs of new vehicles typically taking longer than equipment trials.

Testing might be carried out in specially-arranged scenarios or controlled environments, or it might be assessed ‘on the run’, where it is carried and used in everyday operations, by a nominated crew. Similarly, some services make a distinction between the feedback given by training instructors and by firefighters.

Where firefighters carry out the testing, some services make an effort to get different roles, levels of experience and physical attributes (gender, height, strength etc.), but this is typically not well structured or scientifically rigorous.

Firefighters and active duty personnel are increasingly being involved all stages of the R&D process, and many services consider it essential. Equipment suggestions and requests for improvements often come from operational crews, which are then involved in the testing and evaluation process. Their input into the evaluation stage helps define the criteria by which equipment is judged, and promotes acceptance of the end result. Ultimately, equipment exists to help and be used by firefighters. However, it is rare for there to be an ongoing review process, so equipment selected as appropriate is not evaluated at a wider scale in the following years, across all stations or vehicles, or as demand or tactics change.

“We’ve had research and development groups [on stations] in the past but the problem is the station staff are so transient. You only ever hear when the kit fails. They’re reticent to report positive stuff back, so it’s very difficult sometimes to get a balanced judgement.”

“If we send things out to station we’ll tell the crews to use it as they would every day: don’t look after it, use it like you would do at a normal job, for realistic trials. Don’t do anything you wouldn’t have done, do everything you would.”

“We’ve got a makeup of whole time and retained personnel, we try and get a distribution across that so that each viewpoint has an input into the equipment being trialled.”

“They see a problem they’ve come up with or identified and then see a solution a year later on the fire truck, they’re over the moon. They feel that management have listened, and we do listen.”

“The last thing you want is for them to highlight an issue that you’ve never considered. At least that way if you’ve involved them then it’s harder for them to come back and say ‘we were never asked, and there’s a problem.’”

“There’s no point in us delivering product which is just going to gather dust or be used as a paperweight.”
The relationship between fire crews and R&D personnel is changing, with firefighters increasingly viewed as ‘end users’ and operational support teams as filling a customer support role. This reflects a change in dynamic between operational crews and office support, but also a recognition of the value of R&D and the difference it can make.

Some services take this further, promoting two-way communication and cooperation between stations and support offices. Stations or fire crews are asked to run R&D projects, especially if the suggestion came from them, with support and guidance from R&D staff. This can increase acceptance and investment in the new technology and foster an understanding of the process of evaluating equipment, and budgetary and logistical constraints. In several cases, this appreciation of R&D has a wide and lasting effect. However, care must be taken to educate and support the crews in running a project, and to avoid bias in the end result.

There are many different systems in use for submitting suggestions and feedback for R&D. Input might be sought via an intranet portal, online form or digital suggestions-box. Other services rely on emails to support staff, paper forms, R&D visits to stations or even opportunities for crews to speak to senior managers directly. There seems to be no correlation between service type or size and the feedback methods preferred, with each service taking its own approach.

“Our ethos is we’re very much customer-focused. We’ve gone from being ‘we are the owners of kit and SOPs and everything else’ to ‘we are a supplier and our end users are our customers’, so we’re very much working with them now. Then you get end user buy-in before you’ve even bought it.”

“They took complete ownership. They were training people on it, doing the demonstrations and everything else. We’ve just had a debrief and they’ve said they really enjoyed and welcomed the new approach, the fact that they owned it. It’s theirs. It wasn’t being done to them. They were doing it and managing it.”

“If they take the time to give feedback and suggestions I think we should take the time to answer it.”
There are multiple formal, semi-formal and informal networks in operation within the Fire and Rescue Service. Formal networks include the Chief Fire Officer’s Association (CFOA), industry conferences, technology working groups and large-scale collaboration projects like the Structural Fire Kit. Semi-formal networks encompass FINDS and other forums, and informal networks include social meetings, fact-finding phone calls and visits, and individual relationships, often built up over several years. These networks create knowledge structures which are used in parallel, from shared presentations and seminars to casual conversations with peers in neighbouring services. Enquiries and mutual updates though informal networks are a rich source of knowledge but the time invested in them is often hard to justify.

These multiple levels of formality are mirrored in the use of equipment. At the formal end are standard operating procedures (SOPs) and official documentation. Slightly less formal are tips and efficiencies passed on during training. At the informal end is knowledge derived from experiences and problem-solving ‘on the run’. If an issue arises with a piece of equipment while at an incident, the supports from another item have the same fittings and can be used instead. Another piece could be used for something completely different to its intended purpose, but which might save a life when there is no other option. This kind of ever-changing operational knowledge is impacted by new or replacement equipment and can, in turn, inform research and development projects. It also influences, consciously or not, the scoring and feedback from firefighters involved in evaluating new kit.

Health and Safety efforts can have both positive and negative effects on R&D, often at the same time. A drive towards improving safety can raise equipment standards but fear of good ideas being shut down can stifle innovation or lead to common practices and workarounds which are kept ‘under the radar’. A perceived disconnect on the fire ground between restrictions imposed by SOPs and the actual risks presented at incidents can lead to frustration and feelings of limited capability. This impacts performance and firefighters’ attitude towards new equipment, but can also be a driver towards suggestions from fire crews for better kit or practices.

Services are looking further afield for new technologies and procedures, to Europe, North America and beyond. R&D and specialist teams are looking for international best practices, learning from countries where risks such as wildfire and flooding in countries are more extreme and frequent. This brings wider and deeper understanding and capability and the benefits are felt beyond the individual service. However, it can be difficult to secure funding and travel requires a level of trust.

“We speak to other fire and rescue services to see what they’ve done and how they’ve done it, just to learn from them and any mistakes.”

“It helps cut costs but the other benefits you get, the relationships and understanding of things and just the general discussion of things, it’s hard to put a price on that. But it’s valuable.”

“Unless you’ve got your senior team fully briefed on what you’re looking at and your vision, there is a challenge that when opportunities come to travel or go somewhere to look at something, there’s a perception that it’s a ‘bit of a jolly’... There’s almost an expectation that "we need to do R&D and innovate but we want you to do it from your desk". If you’ve got an R&D and innovation department, you’ve got to let them innovate and go and research.”
Timing of purchases is largely driven by the life span and replacement cycle of existing equipment. It is also influenced by budgetary pressures to stagger the roll-out of new equipment across the fleet and hence spread the costs over a longer period. Where services are trying to increase collaboration with their neighbours, expected purchases may be brought forward or pushed back in order to align three- or five-year plans and benefit from the greater purchasing power of a combined order.

Some services rely on regional groupings, others on select neighbours, and others still combine the two approaches to find networks that work for them and can be maintained with an acceptable amount of time and effort.

Regional collaboration and interoperability also influences choice of equipment, even if there is no joint purchasing in place. Most services maintain an awareness of what equipment and vehicles their neighbours use. There are also informal understandings between operational support departments to provide short-term loans of spare equipment to a neighbour if something happens to make their kit unusable, such as a widespread maintenance issue or sudden safety concern. This forms an unofficial safety net, maintained through informal and semi-formal networks, and promotes openness and greater interoperability. However, this collaborative spirit is not equally geographically distributed, with some areas having far more collaboration and communication than others.

“Sometimes you’ve got to make a judgement call to extend things past their projected end date because you don’t have any money, or it’s actually quite in good order and you can extend its life.”

“Wherever we can, particularly if it’s a significant cost to the service, then we will collaborate with other services, because it does normally work out a little bit cheaper.”

“The way each service works is different, so you kind of align yourself with a similar type of organisation”

“We have lots of cross-border work with those services. It makes sense to try and get the same equipment.”

“If we’ve all got the same equipment, there’s some resilience there as well. If something goes wrong, we can borrow off each other, a business continuity thing.”

“Then you can take that research or the results and put your localisms on it. It just cuts down the work massively and there’s a reassurance that people in the same industry have spent the time doing it.”

“It’s always nice to be regional with everything we can but it’s still got to work for us as an individual service. Take on board everything that everyone else is doing and then go ahead with the plan that fits our service best.”

“Each service seems to take a risk in one area and we’re not all in the same area, thank goodness, so you share the load. Because of the limited finances now, I think we are very cautious. I don’t think we would spend any money on a risk, something that we really weren’t sure was going to bring us appropriate benefit.”

Large projects like the Structural Fire Kit take the principles of cooperation and ‘sharing the load’ to a wider, even national, degree and allow R&D on a scale a single service cannot achieve. Large-scale projects and regional joint-purchasing arrangements increase a service’s buying power but do raise concerns in some services about the long-term effect on companies and industries within the UK market, and the risk of creating monopolies or reducing future choices.
Relationships between services and suppliers are actively being changed in some areas. Exchanging of ideas and field testing of prototypes is considered by some services to be mutually beneficial, especially with local manufacturers. Services who have developed these relationships are aware that care must be taken to preserve impartiality in future R&D projects. In the same way that firefighters appreciate being involved in R&D projects, services themselves value the opportunity to influence product development and market direction. Sometimes development speed is judged to be too slow to warrant investing this time, particularly with new or small companies trying to break into the market.

There is a growing recognition that purchasing something is not enough to solve a problem and not the end of the story, especially with software solutions and concepts like ‘digitising the fireground’. More time and money are required to set things up and get them going than the number on the price tag.

“We're looking to work with suppliers more so that they can put money and effort into designing concept stuff for us, where the payoff is they get our knowledge and experience and our vision, but they then get the commercial rights to it later.”

“Suppliers do ask us questions: ‘We’ve got this. What would you like to be able to do with it?’”

“I think the fire and rescue services are getting better at research and development but we’re like magpies. We get blinded by the shiny stuff and don’t then plan for the longevity or the implementation. The original project was ‘we’ll just buy it.’ That was the answer, you know?”
CASE STUDIES

Two broad case studies are presented below. They are each a combination of observations and comments from a number of services and are intended to illustrate trends. Neither case study represents a particular service. Quotes are drawn from multiple services.

CASE SERVICE A

Service A is a large, metropolitan service which covers multiple urban areas. There are rural areas too, as well as ports and airports, motorways and industrial zones.

A team of 8 sits within the Operations Support department. They control R&D, equipment replacement and SOPs, and work closely with Fleet Management. The team has been expanded in the last few years, with new people and new perspectives brought in. It has allowed them to take a fresh look at existing systems and evaluate their current and future effectiveness.

While a lot of the team’s time is spent on maintaining equipment, problem-solving and replacing kit with updated versions, it also dedicates significant resources to investigating new technologies and staying abreast of industry developments. This happens whether or not there is a current need or interest in the system or product, so that the service can make informed decisions in a timely manner if the need arises.

Equipment replacement projects and new technology support each other, whether by design or by chance. Maintaining awareness of what new technologies or resources are available means that if an opportunity appears, Service A can assess how it fits with the long-term goals and direction. Focus is on medium- and long-term support for the service.

“Everything the Service does is challenged: why do we do that? Does it work? Do we need to do it?”

“It might not be something that we’re looking at now but something will change, something might happen, an equipment failure, and it might be high priority then.”

“There’s not one thing we’re doing which is actually standalone, it’s all part of this bigger picture.”

“50% is horizon scanning, looking at the market, going to the fire shows, seeing something that offers value in some shape or form, which could be either a cost saving, improvement in health and safety or improve operations readiness. The other half of it is we’ve got a problem with this kit or it’s out of date, or it’s no longer made.”
CASE SERVICE B

Service B describes itself as small and rural. The Operations Support officer estimates 20 to 25% of her time is spent on R&D. Problem-solving takes up a large proportion of the rest, and there are other support requirements to deliver as well.

R&D is focused on replacing and upgrading equipment and vehicles. There is awareness of larger trends and future possibilities, but with limited time and budget most effort is spent on maintaining current capabilities. Informal networks highlight different approaches taken by larger services, and regional groups or workshops allow an overview of new technologies.

A large proportion of the firefighters are part-time. The training requirements for new equipment are an important concern due to the limited time available to retained firefighters, both for initial training and upkeep. This has an effect on what is purchased and training time is given greater weighting when scoring potential equipment. Promising new kit has been rejected in the past because the training aspect of roll-out would have been impossible.

The service picks its battles, balancing limited funds and a need for new technologies. Its approach is to continually improve and modernise but to do so in select, carefully considered areas. Every purchase must deliver an appreciable improvement soon after implementation. There is one area where the service has invested, bringing in a step-change in technology to dramatically increase capability. Assessment was extensive and rigorous prior to purchase and it has made a huge difference at incidents.

“I don't think we know all that we need as a service. We probably only do R&D where we think ‘how can we do this differently?’ Or we have an issue and we need to describe how we're going to get over that.”

“Training time for on-call firefighters is a massive implication in choosing equipment. They do 2 hours a week training so to cram all their training into that 2 hour period is quite a challenge.”

“You can't fault it, it's a good system, and it's just very expensive. Now, when you try and make every penny count, it's hard to justify spending the money.”

“It's expensive but it is just such a useful tool in our service. You don't have a car and then go back to a horse because it's cheaper to run.”
Obsolescence is a risk, especially since there is little leeway to remove or replace equipment before its lifespan ends. New equipment should be future-proof, both against iterative improvements and game-changing new possibilities. In practice, this means that modular equipment is attractive, with the option of upgrading certain aspects at a lower cost if the need arises. Multi-purpose tools are also beneficial, where even if one function is no longer needed, the kit is still used and the investment not wasted. This applies not just to equipment but to skills and training. When considering a break-out new technology, there is concern that infrequent use will mean investing in it is not feasible, even if it is financially possible.

With limited or no workshop capabilities, any equipment purchased must be ready to use and roll-out straight away. Where manufacturers offer modularity or modifications to their products, these allow some flexibility, otherwise many purchases are simply off-the-shelf and standard. Built-in ways to adjust or modify equipment increases the chances that it will suit the particular needs of Service B.

While R&D is considered important, limited resources mean that Service B does not attempt to take the lead in any developments. It also does less hands-on testing than larger services, especially for non-critical and non-PPE items. While fire crews and training instructors do get involved in evaluating options, emphasis is placed on capitalising on the work done by other services, including the use of frameworks for purchases.

“We really can’t spare the people and have the personnel to do something like that. It is not labour intensive but it is critically trained. It’s quite a skill and you will get very high skills decay.”

“You do feel a bit hamstrung sometimes, certainly with us being a smaller service. If you go to a bigger one, they have a technical services centre where they look after and service all of their kit, so they can look at [R&D] from a slightly different angle.”

“We are happy to take others’ recommendations and not necessarily insist that we do everything ourselves. Again, driven by cost really, because we haven’t the infrastructure to support that.”

“One of the big metropolitan services, they said ‘we’ll take you through everything, show you everything that we’ve got and give you costings. You can have all our research paperwork.’ They’re quite willing to share everything, warts and all, in what they’ve been through.”
Service B is risk-averse and purchases equipment which will deliver significant improvements or minimise disruption and retraining requirements. It does not engage in speculative research, preferring to modify existing kit, possibly in collaboration with manufacturers but only where this does not take up too much time.

Reaching the end of an item’s projected lifespan does not necessarily mean it will be replaced, even if it is out of warranty. The year before it ends, upgrade costs are compared with likely repair costs, safety concerns, manufacturers’ recommendations and the probability of failure. Extending the life of equipment brings considerable cost savings, but this is not typically considered when assessing new purchases and their longevity.

“We don't have enough budget to make mistakes, essentially, because we've got a small pot of money and in general we will only go with tried and tested manufacturers and let them do the research and development.”

“What we can't do is throw all the old stuff away, which is perfectly good, and buy the new, even though it would make sense for us to do it as quickly as possible. Stuff exits when it's no longer financially viable, as you would with your own car: it doesn't matter how old it is as long as it's safe for use, meeting the needs and not costing more than is economical to keep. We've got to be more thrifty now.”

“And it would be great, no kidding. Why wouldn’t you have it if you could afford it? It was never on the table for us. Cost prohibitive.”
RECOMMENDATIONS

It is clear that R&D has formed a central part of fire service organisation since its inception, and the services have always prided themselves on their innovation, openness to change and problem solving abilities. Furthermore, there are clearly trends within fire R&D that draw from commercial project management techniques and academia that are positively influencing the manner in which R&D is conducted.

For example, including fire crews in the R&D process is a positive trend. Wider perspectives make evaluating and choosing new equipment and vehicles a more robust process and counter any potential opposition to change. The confidence of firefighters is borne of experience and competence (Desmond, 2007), and so new tools must prove their value in high pressure situations before they can be accepted and relied upon.

“Half the battle is keeping the crews onside with the new stuff you bring in.”

However, firefighter involvement must be carefully managed. Suggestions and feedback from the fire ground are hugely valuable and innovative sources of input. On the other hand, fire crews are not normally aware of all the possibilities on the market and are naturally inclined to prefer familiar technology unless substantial benefits can be demonstrated. If a suggestion comes from an operational crew and the same crew is involved in the R&D, there will inevitably be a bias. If this is recognised, it can be accounted for.

Where fire crews take on an R&D project themselves, they need guidance. The majority have little or no background in structured research, operational support, logistics, policy writing, budgetary control, project management or any of the other skills required in running an R&D project, so support and direction must be provided by those who do. However, fire services themselves often lack personnel or institutional experience in these areas.

While some services try to track how new equipment is used and how often, there is no long-term or large scale monitoring of effectiveness. Services cannot judge how a purchase has impacted operations and whether their expectations of it are borne out in practice. Measuring the use and effects of new equipment ‘on the run’ would inform future R&D projects and ensure services are getting value for their money.

Keeping up to date with what technologies and systems are available on the market takes considerable time and resources. It is common to seek recommendations or R&D documentation from others services but often a service needs to evaluate equipment or vehicles itself anyway. Every service has different procedures, needs, risk acceptance and compatibility to consider and what works for one service might not suit its neighbour.

“Even if we’ve had a recommendation, we always do our own testing. Everybody does the same job in the country but we’ve got different risks, different ways of working, different policies.”

“Sometimes you’re not reinventing the wheel, the wheel’s just moved on. New innovations are happening all the time.”

The pace of change and progress also leads to duplication of research efforts. R&D investigations can be out of date in a matter of months as new products and systems enter the market. If implementation and roll-out takes a long time, the former best standard may have been superseded. With some items,
many services are using old-fashioned versions because the rate of improvement is much faster than the lifespan replacement rate. Services would benefit from a faster R&D process and more flexibility in updating existing equipment. This could be achieved by promoting modularity in equipment (where possible), suppliers offering upgrade options, and by encouraging closer and more widespread R&D collaboration between services.

In summary, there is clearly a great deal of R&D occurring and importance and pride are placed in the activity. However, it is often unstructured, independent of other services and agencies, and duplicated. In most cases it results in defensible choices of equipment or technology, but in some cases it is simply not effective. We recommend three potential courses of action for improving the R&D practices of the fire services:

i. Organise R&D nationally across all services, with single (or small groups of) services taking a leading role on the development of specific technologies. This would require complete openness and dialogue across all services, but would reduce duplication of activity. The results of that R&D activity would then need to be disseminated freely to all other services. There would also need to be a standard of robustness, defensibility and general scientific method applied to the activity in order to make it fit for purpose.

ii. A central R&D hub, funded by the fire services in collaboration, that reviews equipment in a standard format, produces technical reviews independently of any service and publishes those reviews in a manner that allows services to choose from a number of options, but furnished with independent, technical, scientifically robust data about the equipment in question. Considering the amount of money currently being spent on suboptimal R&D activity across the services at present, this would actually represent a saving.

It is recommended that this hub employ established scientists, with a mix of research and operational staff, and have a physical presence. It should be entirely independent and publish its findings in technical, trade, internal “white paper” formats as well as peer-reviewed academic literature. It could also potentially act as a form of research council, supporting or even funding small, outsourced experiments.

The organisation would need to demonstrate that it is independent of commercial partnerships, conflicts of interest or favourable relationships with specific services, as well as maintaining the high level of academic dissemination described above.

iii. A form of scientific service, consisting of a relationship between the university sector and fire services, which gives short-term access to an academic at the early stages of an R&D project to guide the design of the project and ensure robustness. This could be organised regionally, with a pool of suitably qualified academics having an arrangement with local fire services within that region, and potentially supported by a training programme to identify and address typical problems associated with experimental design.
Ultimately, the UK Fire and Rescue Service must decide between economies of scale created by regionalising, outsourcing and collaborating, or embracing individual R&D projects but with a higher level of structure. With future challenges to fire service budgets, these decisions will take on even greater importance. As firefighters and services will be expected to do more with less, the quality and appropriateness of equipment will become more critical and money can no longer be wasted on poor research practices.

“Every day we’re modernising, we’re changing. We can’t stop that, that’s life, you know? So we’ve got to embrace it.”
REFERENCES


ACKNOWLEDGEMENTS

Thanks to all the Fire and Rescue Services and individuals who agreed to take part in this research.