Measurement of Output and Productivity of the Fire and Rescue Service

A Conceptual Framework

March 2005
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Central Economic Advice Division & Fire and Rescue Service Directorate

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Executive summary

- This paper examines the key issues in measuring the output and productivity of the Fire and Rescue service (FRS) and was developed to support the work of the independent Atkinson Review, commissioned in December 2003 by Len Cook, National Statistician, to improve methodologies for measuring output and productivity for the National Accounts across the public sector. This paper assesses current measures, comments on the recommendations of the Atkinson Review and offers a new conceptual approach for further development of measures of output and productivity.

- The FRS has a number of distinctive features that make output and productivity measurement complex. Measuring the full impact of fire safety and prevention work is virtually impossible because the relationship between the activity and final outcomes (reduced fire deaths or property damage) is not observed. This requires measuring what has not happened.

- The FRS also has significant numbers of people on standby, against the possibility of unexpected events, some of which are extremely unlikely but could be extremely large in scale. The speed of response is important to the delivery of an effective service and the resources dedicated to generating each unit of output is influenced by considerations of each of these issues, as well as technological challenges and the safety of fire fighters, who can put their lives at risk.

- Currently, productivity of the FRS is measured as a ratio of outputs to inputs. Output of the FRS is measured using volume measures of three key activities: hours spent attending fires; hours spent on fire prevention inspections and community safety; and hours spent at special service incidents. The main problem with this is that it does not capture the effectiveness of fire prevention work and does not recognise the aim to attend fewer fires over time, which is a key objective of FRS policy.

- The key final recommendation of the Atkinson Review for the FRS was that “ONS should measure fire response output using an index based on consequential costs, which measure damage to life and property, but should also continue to calculate an alternative index based on response costs which reflect the costs to the Fire Service, and monitor the sensitivity of the index to different weights. We also recommend continued work on the output of fire prevention and non-fire activities.” This represents a modest improvement, but there remain some important shortcomings:

- Firstly, it captures no improvement in the effectiveness of fire prevention output. This means that if the FRS undertakes the same volume of prevention activities, but becomes more effective (e.g. through better targeting towards needs or better activities), there may be fewer fires for the FRS to attend. Perversely this will result in a measured net fall in output.
• Secondly, by weighting prevention and response output measures by expenditure, it assumes that the cost of providing the service is equal to the value of output. We would argue that there should be more value in preventing a fire than responding to it. The FRS could be deemed to be less productive if it undertakes relatively more fire prevention activity, if it is unable to reduce resources dedicated to emergency response.

• Our approach builds on the original ONS method and improvements suggested by the Atkinson Review, and propose a number of developments to the current measures, some of which were recognised by Sir Tony Atkinson in his final report:

  i) A new measure for safety and prevention output, based on a basket of FRS outcomes, weighted by the economic and social value of outcomes;

  ii) A fire response output measure that takes account of the ‘cover’ required and reflect changes in quality or outcome attributable to each unit of fire response output;

  iii) Quality adjustment to emergency fire response output, using response times; and

  iv) A more fire-specific price deflator for capturing volume of inputs.

• Ideally, a National Accounts output measure should measure the incremental impact of the FRS on welfare to society. For the FRS this is the value to society it adds by providing the capacity to respond in an emergency and the value of damage (lives, property) averted or saved through response and prevention.

• In practice, this is difficult to measure, particularly for activity targeted at preventing fires, so second-best solutions have been sought, making better use of available data and understanding of the FRS roles and responsibilities.

• The Atkinson Review and ONS method concentrates on values of output rather than outcomes, as determined by National Accounts criteria. However, our preferred approach to measuring productivity would be based on outcomes, as they provide more direct relevance to the management of the FRS. This paper suggests possible improvements to the National Accounts method, but there is also value in developing an outcome measure of productivity that is not published in the National Accounts.

• Indeed, it is recognised that no single measure will capture the productivity of complex public services. It is therefore important to assess FRS productivity in the context of a range of indicators.

• Direct measures of output are new to the UK and most other countries and so our experimental approach should not be seen as a prescriptive framework for output and productivity for the FRS, but will form part of a continuing process of development with ONS.
Further work is needed to capture fully the value of prevention output and the interaction between prevention and response outputs. Some key future developments are:

- Develop a better understanding of the effectiveness of fire safety activity i.e. their contribution to final outcomes. ODPM has evaluated recent Community Fire Safety (CFS) activity and is undertaking further research to model the effectiveness of prevention work;

- Develop a measure of the risk of fire damage occurring. This could be based on the long-term smoothed average of the number of fires;

- The introduction of Integrated Risk Management Plans (IRMPs), which all FRAs will be required to produce, could yield some useful information about local risk assessment and predicting the number of fires for setting priorities for intervention. This could help develop more robust weights for combining the mix of fire and SSI response outputs; and

- Develop value-based weights to more accurately reflect the contribution of FRS activities to achieving outcomes. This could be progressed in a number of ways, by making better use of available data and new research underway into the effectiveness of fire prevention and safety work.
CHAPTER 1
Introduction

1.1 Len Cook, National Statistician, commissioned Sir Tony Atkinson in December 2003 to conduct an independent review of government output and productivity. This was primarily “to advance methodologies for the measurement of government output, productivity and associated price indices in the context of the National Accounts”\(^1\). The scope of the Review covered the key areas of public sector spend, comprising Health, Education, Social Protection and Public Order and Safety. The Fire and Rescue Service (FRS) forms part of the wider Public Order and Safety spending block, which is dominated by the Criminal Justice System\(^2\).

1.2 The independence of the Review is widely recognised and appreciated, to ensure that statistics are robust and not open to manipulation. By working with the ONS and other Departments, the Atkinson Review was also able to draw on the knowledge of the specific government services within Departments and existing evidence available to ensure that the individual characteristics of services could be considered (and potentially captured) in developing National Accounts measures. The Office of the Deputy Prime Minister worked closely with the Atkinson Review team, ONS and other departments to support this work and explore potential improvements to FRS measures.

1.3 This paper examines the issues and considerations identified by ODPM in developing new measures of output and productivity of the Fire and Rescue Service and sets out a new conceptual approach. This work builds on current ONS methods and the principles set out by Sir Tony Atkinson in his Interim Report. It offers a technical discussion of our recommended approach, rather than a prescriptive framework, due to the complexity of the issues raised during this work. In parallel, Home Office led the development of a new conceptual framework for the Criminal Justice System and the wider Public Order and Safety function\(^3\).

1.4 The Atkinson Review Final Report was published on 31st January and set out a number of recommendations for improving the measurement of government output and productivity in the National Accounts. For the Fire and Rescue Service the key recommendation (10.4) was that:

- ONS should measure fire response output using an index based on consequential costs, which measure damage to life and property, but should also continue to calculate an alternative index based on response costs which reflect the costs to the Fire Service, and monitor the sensitivity of the index to different weights.

We also recommend continued work of fire prevention and non-fire activities.

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\(^2\) Covering responsibilities of Home Office, the CPS and the DCA, including Police, Correctional Services (prisons and probation), Crown Prosecution Service and the Courts.

1.5 This represents a modest improvement to the measurement of FRS output. However, the measures remain flawed in capturing fully the contribution of the FRS to total output, particularly in terms of the effectiveness of FRS fire prevention activity. This paper examines these issues and identifies a number of avenues for further development of output and productivity measures. However, it does not resolve all the challenges in measuring output and productivity, some of which may be difficult to achieve even in the longer term.

1.6 The remaining sections of the paper are summarised as follows:

- **Section 2** provides a background to the activities and structure of the Fire and Rescue service, including key trends and challenges;

- **Section 3** summarises the current ONS methods and discusses the weaknesses and areas for improvement;

- **Section 4** sets out the principles for measuring productivity and includes a discussion of considerations for measurement of FRS output;

- **Section 5** develops the considerations and ideal measures into a practical approach, based on available information, and a discussion of limitations and further avenues for development;

- **Section 6** looks at measuring inputs for productivity calculations;

- **Section 7** explains how inputs and outputs are combined for productivity calculations, whilst setting measures in the context of the wider policy and performance frameworks; and

- **Section 8** draws conclusions and recommendations about how this approach could be developed into improved measures of Output and Productivity.
CHAPTER 2
Background to the Fire and Rescue Service

2.1 Fire represents approximately 10% of the overall Public Order and Safety function of government, and approximately 0.2% of total GDP. The scope of this work comprises the entire FRS function, including the fire brigades, fire authority (local government) services, and central government activity (policy and administration) relating to the FRS.

2.2 The activities of the FRS, using this definition, are wide-ranging. The role of central government is focused on policy development, legislation and central targeted investment. This will also include some collective services, such as fire safety advertising campaigns. Individual FRAs provide a range of services, either directly (e.g. inspections), through the local fire brigades, or other contractors. Broadly, these services fall into three categories: fire safety and prevention, attending fire incidents and special service incidents. Examples of these services are given in Table 2.1.

<table>
<thead>
<tr>
<th>Table 2.1 Fire and Rescue services – examples</th>
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<tbody>
<tr>
<td><strong>Fire safety and Prevention</strong></td>
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<tr>
<td>e.g. Publicity campaigns</td>
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<tr>
<td>Talks, school visits</td>
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<tr>
<td>Home assessment visits</td>
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<td>Safety training</td>
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<td>Building inspections</td>
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<td>Investigations</td>
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2.3 A key role of the FRS, not included in this work, which has grown in importance in recent years is in building a capability to respond to major incidents, including terrorist attacks. The Government’s aim in building this resilience capacity is to ensure public safety by taking practical steps to reduce the likelihood of such incidents occurring and responding quickly and effectively when they do. A key part of the FRS response is the New Dimension programme, which provides mass decontamination and search and rescue equipment. There is clearly a value in developing an operational reserve to respond to such incidents, but for the purposes of this work and the Atkinson Review, direct measures of civil resilience output have not been considered. This is primarily as a result of the lack of output (i.e. major incidents) to observe. In order to extract this from development of an FRS measure, inputs directly related to resilience have also been excluded from this analysis, where possible.

2.4 The challenges facing the FRS have changed over time, and can be influenced by several factors, including lifestyles and attitudes, weather patterns and climate change (e.g. the incidence of environmental disasters), demographic profile (particularly the ageing population), risks from terrorism, and road traffic. The long-term trend in the number of fires has risen steadily, but the type of incident has changed, with more secondary (mostly outdoor e.g. grassland) fires, and relatively fewer building fires. However, the increase in number of fires has not been associated with an increase in fire-related deaths. In fact, this number has fallen significantly in the last 20-30 years.

2.5 There are also important technological challenges in providing a more productive response, by improving response times and incident handling. In response to these challenges the FRS has undergone significant changes and modernisation in recent years.

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Figure 2.1 Primary Fires (involving Property or Casualties) in the UK, by type, 1950-2003

1 2002 and 2003 data include an adjustment for incidents not recorded during industrial action
2 Recorded separately from 1981 only
Source: Fire Statistics, ODPM

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5 Some resilience activity that is not easily identified will still be covered by a standard FRS productivity measure. This may include time spent on training under the New Dimension programme, which will be included as an FRS input but unlikely to have a corresponding output.
years, particularly since Sir George Bain’s Independent Review of the Fire Service\(^6\). A key part of this has been a shift towards promoting community fire safety and a more targeted emergency response service, particularly through the introduction of Integrated Risk Management Plans (IRMPs) that each FRA will be required to develop. This approach is expected to contribute to the achievement of ODPM’s recently adopted Public Service Agreement (PSA) target in 2004 to reduce the number of accidental fire-related deaths in the home by 20% by 2010.

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**Figure 2.2** Secondary Fires (involving no Property or Casualties) in the UK, by type, 1981-2003\(^1\)

![Graph showing secondary fires by type from 1981 to 2003](source: Fire Statistics, ODPM)

**Figure 2.3** Fire-related deaths in the UK, 1950-2003\(^1\)

![Graph showing fire-related deaths from 1950 to 2003](source: Fire Statistics, ODPM)

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2.6 To support this, the Fire and Rescue services Act 2004 recognised formally for the first time the wider roles of the FRS to include a greater emphasis on fire prevention, as well as duties beyond fire fighting, such as rescues from road traffic accidents and responding to environmental disasters. In addition, technological developments will be implemented, such as the widespread facilitation of dynamic mobilising, through the FiReControl network of regional control rooms, which will dispatch those appliances closest to the incidents rather than those in the nearest fire station, and send data about risks direct to the appliance.

2.7 Indeed, much of current policy is moving in the direction of targeting activities according to risk. This is either by targeting the type of response or by location, such as finding the optimal location for a fire station, or targeting community fire safety work into areas of highest risk, at the most vulnerable or least accessible groups of potential fire victims. These changes provide a framework that should have a positive effect on productivity, by focusing more work on preventing fire, flexible working and strategic management to enable FRAs to work together in responding to incidents and targeting priorities according to risks.

2.8 However, although the downward trend in fire-related deaths since 1979 can be partly explained by mass smoke detector usage, Foam Furniture Flammability Regulations and increasing fire safety activity by the FRS, significant further improvements are likely to be incrementally harder to achieve as increased targeting towards harder to reach groups is required to sustain an improvement in prevention success. It will also continue to prove difficult to demonstrate causal links between outcomes and service activity.

2.9 There is an important distinction between output and productivity measures for the National Accounts discussed in this paper and the Atkinson Review, and performance measures that provide a framework for monitoring the efficiency and effectiveness of the FRS and local service delivery. The Atkinson Review argues that performance indicators need to be “precise, transparent and simple measures”, which can be selective in their coverage of activity, enabling more direct comparisons between performance of individual FRAs, or at regional and national level. In contrast, National Accounts measures need to be “as comprehensive as possible and to be consistent over time”; and can require complex adjustments to raw data, and will only demonstrate the combined effect of all activity at the national level, which can be more difficult to interpret.

2.10 These two types of measure may use similar data sources, but are created for different purposes and are not substitutes. There is a risk associated with identifying National Accounts measures as performance indicators for the management of public resources, particularly where identifying targets provide perverse incentives, and therefore needs careful interpretation and consideration.

2.11 For example, the Fire PSA target relates specifically to outcomes i.e. fire-related deaths. National income measures the contribution of the FRS activities to outcomes, which explains only part of the change in outcomes. We would not wish to measure FRS output as negative because there are fewer fire deaths as a result of a reduction in the number of smokers, for example, but how well it has succeeded in averting other factors that cause fires or fire damage.
CHAPTER 3
National accounts – current ONS methods

3.1 A key aim of the Review was to develop the traditional method of measuring government output, which assumed the value of output would be equal to the value of inputs, and for other areas, to develop current direct measures of output. The conventional method was applied essentially to overcome problems of measuring government output, where the output was either difficult to identify or the service supplied could not be valued as no market transaction took place. The ‘inputs = outputs’ convention means that any increase in government expenditure assumes an equal increase in value of output, allowing for no measured value added to inputs and, therefore, no improvement in productivity.

3.2 Since 1998, ONS has attempted to measure the volume of output directly, and by 2003 covered two-thirds of government output. From earlier experience of direct output measures in the 1950s and 1960s, it was clear that the measures should be designed and monitored carefully to ensure that they could capture changes in quality, technology and institutional change.

3.3 Working with the Atkinson Review, we have attempted to contribute to the development of direct output measures. The current ONS methods provide a useful starting point. The input price index and output volume (measured directly, where possible) together form an implied measure of productivity, using the following simple formula:

\[ \text{Productivity} = \frac{\text{Output}}{\text{Input}} \]

CURRENT OUTPUT METHODS

3.4 For the FRS, which forms part of the wider Public Order and Safety government function, ONS measures output directly, using volume measures of three key activities:

a) **Fighting fires:** Total hours spent attending fires, by type (e.g. primary, secondary\(^7\), chimney, false alarms). For false alarms, there is a breakdown by reason (good intent, due to apparatus, malicious);

b) **Preventing fires:** Total hours spent on fire prevention inspections (full inspections, re-inspections, examination of plans) and on community safety work, consisting mainly of giving talks to voluntary groups and advice to individuals; and

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\(^7\) Typically, **Primary** fires are those involving casualties or property; **Secondary** fires are all other fires, excluding chimney fires.
3.5 The output measures are weighted together to produce an aggregate output index for the FRS. The weight for an individual incident is based on the proportion of average staff hours spent on each type of incident. The total weight for each incident type is then the product of the weight for one incident and the number of such incidents in the base year, based on estimates derived from a single survey. For prevention, the output measure is total staff hours, so this is self-weighting.

CRITIQUE AND KEY FRS CHALLENGES

3.6 The Atkinson Review identified some shortcomings of the current measures, summarised as follows:

- Measuring the volume of incidents as a proxy for output includes perverse indicators, where output increases with, say a hot summer, or increased arson, and does not recognise the aim to attend fewer fires over time through prevention; and

- It lacks any adjustment to take account of the value of the property or lives it protects, or the value of FRS response to different incident types.

3.7 Some further issues include:

- Time spent in anticipation of an incident i.e. the resources required to provide adequate fire ‘cover’ is allocated equally to each output, and could be developed using new information;

- The data on staff hours used for weighting the output measures are based on a single sample survey that has not been updated and these could be improved; and

- It reflects the volume of activity rather than the effectiveness or quality of that activity in terms of the impact on final outcomes. For example, the number of fires attended says nothing about how quickly the FRS responded, or what techniques were used when they arrived.

3.8 We would expect a good FRS to respond to fewer fires over time, as more are prevented. With the current measure of output, it is not clear whether the interplay between response and prevention output measures generates an accurate net effect. For example, if the FRS becomes more effective at preventing fires, but maintains the same volume of prevention activity, it should have fewer to attend. This could result in a perverse result, whereby overall output falls despite an improvement in the service.

3.9 The consideration of output weights in terms of the time taken to deal with incidents may also not be helpful. Whilst the time taken to deal with a fire may be one measure of the productivity of the fire service, the resources needed to provide ‘cover’ are more likely to inform considerations of the productivity of operational activity. This is particularly relevant, as discussed in the previous section, following policy developments in operational activity towards greater targeting of services according to risk and flexibility in operations to ensure more productive use of time.
CHAPTER 4
Productivity concepts and considerations for the FRS

KEY PRINCIPLES IN MEASURING PRODUCTIVITY

4.1 The Atkinson Review Interim Report set out some key principles (see Annex A) that all new measures should follow, which helped inform the approach set out in the following chapter. Principle A states that the objective should be to measure output from government spending in terms of its incremental contribution to individual or collective welfare, in the same way as market output. To explore the issues of measuring productivity in the FRS, it is useful to identify the key elements of the input and output sides of the productivity equation in the case of the FRS, and to explain the relationship between inputs, activities, outputs and outcomes:

- **Inputs**: the labour, operating costs (goods & services bought in) and capital, all of which can be captured using the market value of labour, goods and services and capital consumed over time;

- **Activities**: these are the actions undertaken by the FRS e.g. fire safety talks, building inspections, responding to fires, attending road traffic accidents;

- **Outputs**: the service provided by the FRS of saving lives and limiting property damage through both fire prevention and response to incidents; and

- **Outcomes**: the end result on fire-related deaths, injuries and damage to property, but can be affected by a number of other factors, such as the weather, careless behaviour or the number of smokers. ODPM has responsibility for an overall FRS target to reduce the number of accidental fire-related deaths in the home by 20%, averaged over the eleven-year period to 31 March 2010.

4.2 Measuring the success of the FRS should ideally involve the measurement of outcomes, as the FRS aims to reduce the number of fire-related deaths, for example. However, there are difficulties in measuring the FRS contribution to some outcomes, such as lives saved as a result of fire safety work, and outcomes are also dependent on external factors.
4.3 Measuring output rather than outcomes can therefore be used as a proxy and, similarly, where output data is not available, activities could be measured, particularly if there is a clear link between the impact of activities undertaken on final outcomes. If the relationship between outputs and outcomes, or activities and outcomes is stable over time, then the change in the indicator will accurately reflect the movement of outcomes. This means, however, that the effectiveness of activities or outputs needs to remain constant, which may not always be the case (and is not actually desirable, if we are seeking to improve service delivery). Moreover, it also assumes that the relationship between activities or outputs and outcomes is observable. The further away from outcomes the proxy, the more assumptions need to be made, and the less accurately the measure is likely to capture outcomes.

CONSIDERATIONS FOR THE FRS

The ideal measure

4.4 To fulfil Principle A, the ideal measure of output for the FRS would be the damage averted as a result of FRS intervention. This measures the incremental impact of FRS intervention on final outcomes. However, the added value of the FRS is likely to be two-fold: firstly, it adds value by averting damage by direct emergency response intervention and fire safety and prevention measures; secondly, there is a less tangible ‘ex ante’ value to society of having a fire service ready to respond in the case of an emergency.

4.5 In the private sector, added value is measured using the market price or, in a competitive situation, by marginal cost (where price is likely to be equal to marginal cost of delivery). However, for the FRS there is no market price as no market transaction takes place. The average cost could be used where marginal cost cannot be identified, but is not sufficient, as this is unlikely to capture the value to society of having a fire service.

4.6 Measuring the FRS contribution to outcomes is therefore very complex, as it essentially requires testing the counterfactual i.e. what would have happened in the absence of the FRS? This is particularly difficult conceptually for fire safety and prevention work, which seeks to prevent fire damage by raising awareness of fire safety and changing people’s behaviour to minimise the risk of fire or fire damage. The link between the FRS prevention activity (e.g. fire safety talks) and final outcomes (e.g. reduced fire deaths) is indirect and can be affected by several external factors and variation, such as weather or the number of smokers. The number of lives ‘saved’ by the fire service cannot be measured directly because it is often difficult to tell whether a person would have died without FRS intervention. This means that the relationship between FRS activity and outcomes is difficult to observe, and it is also not clear whether the relationship is stable, as there is likely to be a trade-off between the impact of prevention and response output on outcomes.
4.7 It is recognised by ONS and the Atkinson Review\textsuperscript{9} that the output of elements of some public services that are ‘collective’ (rather than delivered to individuals)\textsuperscript{10} may be very difficult to define. This is the case for some FRS activity, and for the wider Public Order and Safety services (defined by ONS as a collective service), particularly for fire prevention, such as a fire-safety awareness campaign. Direct output measurement would be preferred, if possible, but the Atkinson Review report argues that where there are ‘considerable obstacles’ to overcome it is acceptable to settle for an activity index that captures changes in quality.

4.8 ODPM has therefore considered alternative methods to proxy the FRS contribution to outcomes, or its value to society. Tests of individuals ‘willingness to pay’ would be one way, which to some extent is captured through insurance premiums. However, this approach is not well developed for Fire, so measures of the value of life and property at risk of fire, which measures the potential damage that could be averted, is preferred. ODPM has developed over recent years, estimates of the \textit{Economic Cost of Fire}\textsuperscript{11}, based on fire output statistics combined with Department for Transport valuations of fatalities and serious injury and insurance claim data for properties. Property loss ‘saved’ by FRS intervention cannot, however, be measured directly and are estimated, because insurance claim records are not always available and many properties are not (fully) insured.

4.9 A key consideration in assessing the relative merits of different methods of output measurement is the potential interaction between fire prevention and response. The fire service has several methods available to prevent and mitigate the effect of fire and other emergencies, including fire prevention and safety advice (Community Fire Safety, building inspections etc), legislative fire safety enforcement and attendance at incidents. Success in the FRS, measured through an apparent fall in the number of lives lost or the amount of property damage incurred, cannot simply be apportioned to one of the three activities, and therefore it is very difficult to make direct measures of output and productivity in any of the three areas individually.

\textbf{Coverage and attribution of expenditure}

4.10 To generate robust productivity estimates, the coverage of expenditure on individual outputs should be as comprehensive as possible. The output covered in the current ONS measures for the FRS is complete, requiring complete coverage of expenditure. However, the proportion of output covered by expenditure may vary, depending on how much expenditure is directly related to what are therefore recognised as ‘productive’ activities. This may mean that increasing the volume of inputs not directly related to output could lead to a fall in productivity. However, if the new inputs enabled the FRS to work more efficiently and reduce unit costs of generating each output, or enabled more output to be delivered, productivity would increase\textsuperscript{12}.


\textsuperscript{10} ‘Individual’ services are those consumed by individual households and ‘collective’ services are provided to society as a whole (e.g. public administration and defence)

\textsuperscript{11} \textit{The Economic Cost of Fire: estimates for 2000}, ODPM 2003; an update to 2003 data is forthcoming.

\textsuperscript{12} However, not all efficiency gains will be represented in a productivity measure, only where the volume (not the monetary value) of inputs changes.
4.11 Where output-specific resources are employed, attribution of expenditure to outputs is relatively straight-forward, but there are a number of considerations in the FRS (and in some cases for all public services) that are not so straight-forward. For example, it is not immediately clear how overheads are associated with individual outputs. Where possible, these should be assigned to activities that directly deliver output, or if there is no valid distribution by activity, then to be allocated equally by output.

4.12 Similarly, there may be inputs associated with what might be considered ‘unproductive’ activity, where there is no output of direct value to society. This suggests that they should not be captured in an output measure, however, the expenditure on unproductive activities should count towards successful outcomes, so that improvements in the proportion of productive activity can be captured.

4.13 An important consideration in measuring ‘productive’ inputs is that a distinctive feature of the FRS, as an emergency response, is the requirement to maintain an operational reserve available to respond to any given incident, at any time, in any place. Although this expenditure may not be associated with an obviously ‘productive’ activity (i.e. attending incidents), there is still a value in maintaining this operational reserve and it should not be excluded from the productivity measure. Where possible, as with overheads, expenditure on provision of fire ‘cover’ should be assigned to emergency response output. In addition, HM Fire Safety Inspectorate recommends specific designated ‘stand-down’ time for fire officers, which is also a consideration for increasing ‘productive’ time inputs and balancing with working conditions.

4.14 The volume of resource required to provide this reserve will be influenced by productivity and efficiency arguments, but also by practical and political considerations, such as safety issues and working conditions (e.g. the number of fire fighters required per fire engine) and the public acceptability of local decisions relating to the strategic management of the FRS (e.g. moving pumps and fire stations).

4.15 It stands to reason, therefore, that resources will not be utilised for a proportion of time on standby. For a large proportion of FRS activity (i.e. response), implied productivity will be determined to some extent by the number of incidents that occur. This means that to some extent, labour and capital productivity (e.g. utilisation of fire appliances) may be affected by the optimum amount of fire ‘cover’ achieved and flexibility between response and other activity that can be undertaken whilst providing adequate cover. Ideally, the FRS would want to optimise provision, and if the risk of fire is reduced over time (e.g. through better prevention), this reserve may change as a result, but that may be limited by what is considered a politically acceptable level of fire cover.

**Weighting**

4.16 The FRS, like many other public services, does not deliver identical services, as each fire attended, or fire safety activity will be different, depending on the scale of the incident or the potential impact of damage (or lives) averted. Society attaches a different value to each of these incidents. For example, we would value attending a fire in a school, above one in an abandoned car. Accounting for the mix of output in terms of the outcome is therefore important, and the measure would need to disaggregate the type of output as far as possible and assign appropriate values (weights) to each to reach an aggregate measure.
4.17 The System of National Accounts requires that the growth of each item 'must be weighted by their economic importance as measured by their values'. However, ONS methods traditionally apply a cost-based system, i.e. assigning weights based on their contribution to total expenditure. ODPM have considered both methods in this analysis, each of which will generate different results to the output and productivity estimates. These methods are discussed further in section 5 and section 7.

4.18 A cost-based method assigns weights to outputs in proportion to each activity's share of total inputs. This represents the marginal cost of supply. This may not, however, be an accurate measure of the economic value of the output, particularly where it is supplied in a non-competitive market, such as the FRS. It reflects the cost of provision rather than the impact of each unit of activity on overall outcomes (e.g. fire deaths). This system awards a higher weight to the outputs that use the most resource, regardless of their impact on final outcomes (or the value to society), meaning that productivity changes are driven by the cost of delivering each unit of output.

4.19 Value weights measure output according to their value to society, giving a higher weight to those valued most highly by society. We would prefer this system in principle, as a more appropriate measure of the contribution of the FRS to final outcomes. However, in practice, measuring society's values of the FRS is complex, and is discussed in more detail in later sections.

Quality adjustment

4.20 Quality adjustment is necessary where the output measure fails to capture changes in effectiveness. As effectiveness improves or deteriorates the relationship between outputs and outcomes changes, which requires a compensating adjustment. For example, if an activity measure is adopted as a proxy for the contribution to outcomes, no change in output or productivity will be captured if each unit of activity becomes more effective. Therefore, capturing the mix of outputs and their relationship with outcomes over time is also important. For example, the balance between contribution to outcomes delivered by FRS prevention and response is likely to be changing as modernisation changes are implemented in an attempt to improve the effectiveness of the service.

4.21 Quality in the FRS is essentially a measure of the effectiveness of the service provided, in terms of final outcomes. For example, output can increase if the FRS responds to more fires. However, this says nothing about how quickly they respond, whether the best equipment is used, or whether the fire officers use the best techniques to limit the damage incurred. In terms of fire safety activities, a measure of quality would reflect how good each activity was at raising awareness of fire safety, changing people's behaviour and, ultimately, reducing the number of fires that start. Each output indicator should ideally capture these potential improvements by adjusting them up or down in line with changes in a suitable quality measure to represent the added value of the FRS.
5.1 The primary functions of the fire service are to prevent fire and mitigate the effect of fires (and other emergencies) in terms of life and property losses, when they occur. The value of the FRS activities, whether responding to fires, road traffic accidents or raising awareness of fire safety, is therefore in the damage that these services mitigate. The ideal measure of total output would therefore be the value of damage mitigated by FRS intervention. As the value (or cost) of damage incurred can be seen as a measure of failure of the FRS to prevent damage, any decline in this indicator can, therefore, be interpreted as an increase in FRS output.

5.2 However, the relationship between the various FRS services and this measure of output may not be stable, as there are several ways in which the FRS can influence it, as discussed in the previous section. In practice, it has been helpful to separate, where possible, the three main elements of FRS activity and examine their contribution to outcomes and develop measures based on best use of available information, building on the current ONS method. These measures are:

- **Responding to fires**: a weighted measure of response to a mix of fire incidents, quality adjusted using response times;

- **Special Service Incident response**: an activity index, representing the volume of non-fire incidents attended; and

- **Fire safety and prevention**: a basket of outcome-based measures, using a set of weights to derive a composite measure.

5.3 In future, new methods could be developed, and there are a number of avenues that could be explored, which are discussed throughout this section.

**RESPONDING TO FIRES**

5.4 There are three main improvements that can be made to the current measure of fire response, with further developments discussed at the end of this section:

- replacing activity indicators with output measures that reflect changes in quality or outcome attributable to each unit of fire response output;

- introducing an overall quality adjustment; and

- increasing the level of detail at which output indicators are measured.
5.5 The ideal measure of output for the fire response activity would be the costs averted by the response of the fire service. However, as with fire prevention, this counterfactual is very difficult to measure. The simplest proxy for the damage mitigated is the number of fires that the FRS attends.

5.6 This measure of activity is simplistic in that FRS attendance at all fires is accorded the same value. As discussed in section 4, society places a different value on responding to different incidents. Different types of fires are likely to cause more damage than other types e.g. a fire in a dwelling is likely to be more damaging than a secondary grassland fire. Ideally, this would be addressed by weighting each type of incident by the value of lives or property that could be affected by fire, multiplied by the likelihood of a fire occurring.

5.7 The long-term trend in fires could be used as a basis of estimating the probability of fires occurring, but would need to be developed further over time. In the interim, ODPM’s Economic Cost of Fire publication is a useful proxy for the relative value of fire damage. This includes the average cost of each fire type, both in terms of the ‘consequential’ cost of damage to life and property and the direct ‘response’ cost to the FRS from responding in terms of labour and capital used. Either of these estimates could be used to capture the value of an FRS response to each type of fire by adjusting the basic volume of fires attended to take account for the mix of output.

5.8 Weighting by the response cost is simpler to calculate, but does not reflect the full value to society of averting the damage caused by each. This is because the marginal cost of responding to a secondary grassland fire is similar to a dwelling fire, but the outcome of each is likely to be very different in terms of deaths, injuries and property damage. Our preferred approach would apply weights based on the ‘consequential’ cost of each type of fire (Annex D). However, a large proportion of fires attended represent secondary fires and false alarms. As these currently have no measured consequential cost, applying just the consequential costs as weights effectively means that a large proportion of FRS activity will add nothing to output. In practice, some combination of the response and consequential costs may be more appropriate.

5.9 There are more general considerations with using activity as the measure of output. The number of fires in a given year is determined by a number of variables, of which some are beyond the control of the FRS, such as the weather. At the same time, the FRS is working to reduce the number of fires through CFS work, meaning that success in one area of their work may reduce output in another. The trade-offs between these outputs should be monitored over time and is discussed further in section 7.

5.10 Changes in the quality of service (or, its contribution to final outcomes) may not be captured fully by adjusting for the mix of outputs. A further improvement could capture changes in quality according to the speed of response.

5.11 Research has shown a quantifiable relationship between response time and fatalities in dwelling fires\textsuperscript{14}. Research also suggests a link between response times and property damage in dwelling fires\textsuperscript{15}. As response times are recorded for all primary fires that the FRS attends, we recommend that the index be adjusted to take account of this measure of quality. This method is set out in detail in Annex C. At present only data linking response times and outcomes for dwelling fires, and not all types of fire is available.

5.12 This is not the only measure of quality, however, as this will not capture improvements in training that enable fire fighters to save more lives, or improvements in technology employed in tackling fires more effectively. Moreover, the marginal cost of saving lives through improving response times may not be the same as through prevention. Where a significant number of people die before the FRS is called out, this may be tackled more cost-effectively through prevention.

5.13 Over time, quality may be captured better through the cost of fire estimates, as the average value of damage incurred in each type of fire would be expected to fall as response improves. Alternatively, data collection methods could be developed to record the estimated number of live rescues at each incident.

**RESPONDING TO SPECIAL SERVICES INCIDENTS (SSIS)**

5.14 The issues faced in measuring output of SSI response are similar to those faced in measuring fire response output. Again the ideal measure would be the costs mitigated by FRS response to special services. These costs are multi-faceted due to the variety of special services attended, including lives saved, flood damage averted, and congestion costs eased.

5.15 There is no equivalent to the cost of fire estimates for SSIs. This means that current measures are effectively weighted equally, giving undue weight to less ‘important’ outputs, such as lift releases, rather than live rescues from RTAs. Anecdotal evidence suggests that response to road traffic accidents (RTAs) are regarded as the most important by FRS professionals, as these were most likely to involve potential fatalities. Any weights developed in future would need to include an estimate of the relative value of attending each incident given by the scale of potential impact (e.g. fatalities, property damage, traffic congestion) and the likelihood of an incident occurring.

5.16 Information collected and estimated in the development of Integrated Risk Management Plans could be helpful in deriving these weights. Alternatively, an estimate of the number of fatalities per incident could be developed to indicate the relative average consequential cost of SSIs. This would, however, only capture one element of the cost.

5.17 Since the FRS currently has no responsibilities for preventing SSIs, other activities, such as fire safety, will not have an impact on output. However, this means that output will be driven by essentially exogenous influences.

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\textsuperscript{14} Response Time Fatality Relationships for Accidental Dwelling Fires, Entec, October 1999.

\textsuperscript{15} Further Development of Risk Assessment Toolkits for the UK Fire Service. Entec, March 1999.
FIRE SAFETY AND PREVENTION

5.18 Ideally we would wish to measure outcomes directly, with the inverse being a measure of FRS success i.e. a fall in the number of deaths. However, this depends on a constant relationship between FRS activities, outputs and final outcomes. As outcomes are influenced by a number of other factors, it is difficult to establish whether this relationship is constant.

5.19 Measuring precisely the incremental impact of FRS fire prevention activity on the damage caused by fire is virtually impossible since it requires knowing the counterfactual – what fire damage would have occurred without the prevention activity. Furthermore, fire response activity will also have an effect on the damage mitigated and lives saved. There is some recent evidence that we can apply, but at present the links to final outcomes are still relatively weak and difficult to quantify sufficiently to provide a useful measure of the effort expended versus the benefit gained.

5.20 There are two ways to approach output measurement of fire safety work, either to use outcomes (e.g. accidental fire deaths) as a proxy for output, or to use the volume of activity. There are drawbacks to each, considered in this section. An outcome indicator will capture a complete set of FRS activity, but is likely to be affected by several external factors, and has to assume that the FRS contribution to outcomes is a constant proportion. An activity measure will need to have a clear link to final outcomes, and be adjusted to capture that element of quality.

Outcome measure

5.21 Our preferred approach would be based on the measurement of outcomes. As there are several outcomes that the FRS is concerned with, a basket of indicators is needed. ODPM propose several key indicators that are appropriate for this purpose, that are all outcomes over which the FRS should have an influence. These include fire fatalities, the number of deliberate fires, malicious false alarms (causing significant costs to the FRS in providing a response) and the number of commercial fires.

5.22 This then requires a set of weights to construct an aggregate index. Aggregating using a simple mean would overestimate the cost of a false alarms compared to fatalities. As with the Fire response measure, this could be overcome by weighting the indicators by their estimated value to society, given by the Economic Cost of Fire model. Any output measure would be an inverse of the weighted outcomes, so that, for instance, a reduction in fire deaths results in an increase in the output indicator. These indicators, with weights are summarised as follows:

- Number of fire fatalities, weighted by the statistical value of life;
- Number of serious fire injuries16, weighted by the statistical cost of a serious injury;
- Number of building fires, weighted by the average value of property damage per building fire; and
- Number of malicious false alarms, weighted by the average cost of the FRS responding to a false alarm.

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16 All injuries involving burns and 25% of injuries from being overcome by smoke or fumes are regarded as serious. Assumptions from “The Cost of Fires. A review of the information available” (1997) by Donald Roy, Home Office.
5.23 Clearly, there are a number of other factors that influence all of these outcomes, for example the number of smokers, changes in demographics or new building regulations. Nevertheless, research has shown that prevention work\textsuperscript{17} has significant impacts on the number of fires. The evidence on FRS impact on false alarms is less clear, but the service is working to reduce the number of calls. This measure will need to be monitored continuously against any available evidence or corroborative measures and refined over time.

**Activity measure**

5.24 An alternative, activity-based output measure for fire safety, preferred by the Atkinson Review\textsuperscript{18}, would use the total hours spent on delivering CFS work. This would capture a range of activities (e.g. visits, inspections, events). ODPM collect detailed data on the hours worked by fire fighters on fire safety activities, which would provide a more robust activity measure than the survey-based data used in the current method.

5.25 However, this method would not capture the effectiveness of the prevention output, and it is likely that the relationship between activities and output could change over time, as fire prevention and safety work is targeted better towards areas or groups at greatest risk. This measure would therefore need to be adjusted to capture any change in the effectiveness of the activities. There are a number of potential indicators that could be developed as quality adjustments, such as:

- The number or type of prevention activities targeted at high risk groups, assuming that this is where the FRS is likely to have the greatest impact;

- The level awareness of fire safety issues in the areas where prevention work is targeted, as a measure of the likely impact on changing behaviour or attitudes (and therefore reducing the risk of fires occurring through careless behaviour);

- The proportion of pupils, businesses or the Public who change their behaviour after attending a fire safety event; this is extremely difficult to measure, but could be indicated by some carefully targeted survey questioning, or incidence of those subsequently developing a risk assessment or evacuation plan;

- The proportion of households with operational smoke alarms (or those present and activated when a fire is attended); or

- Accidental dwelling fire deaths, as a measure of overall success based on final outcomes.

\textsuperscript{17} Evaluation of Community Fire Safety, Forthcoming research report, ODPM.

\textsuperscript{18} This follows Sir Tony Atkinson’s recommendations for the treatment of collective services, of which he argues the FRS has elements; paragraphs 6.12-6.16, Atkinson Review: Final Report, January 2005.
FURTHER DEVELOPMENT

5.26 There are a number of developments that would improve the FRS output measurement, described below:

i) Develop a better understanding of the effectiveness of fire safety activity i.e. their contribution to final outcomes. ODPM has evaluated recent Community Fire Safety (CFS) activity and is undertaking research to model the effectiveness of prevention work;

ii) Develop a measure of risk of fire damage occurring. This could be based on the long-term smoothed average of the number of fires;

iii) The introduction of Integrated Risk Management Plans (IRMPs), which all FRAs will be required to produce, could yield some useful information about local risk assessment and predicting the number of fires for setting priorities for intervention. It should make possible more precise measurement of response data relating to each incident and improve regional and national comparisons. This could support particularly the development of more robust weights for combining the mix of fire and SSI response outputs; and

iv) Refine quality adjustments, particularly if an activity measure of prevention is used; further research and consultation with fire professionals may help to refine quality adjustments for response output, such as the number of live rescues achieved.
CHAPTER 6
Measuring FRS inputs

6.1 To measure productivity it is important to examine the breakdown of inputs and their contribution to output. In particular, where investment in future capacity is made, such as training, which is expected to generate output over time. This requires careful attribution of inputs to outputs, and some consideration of the time lags involved before outputs are produced. Moreover, where it is not possible to calculate a market price for outputs and volume measures are adopted, these should be compared to an equivalent volume measure of inputs. This requires stripping out price effects in the input data to reflect only the change in unit of output per unit of input.

ATTRIBUTION OF INPUT TO OUTPUT

6.2 The inputs of the FRS are measured by public expenditure, including that by central government and local FRAs. The inputs include fire officers' and other employees' time, targeted investment, capital consumption, such as use of fire appliances and administration.

6.3 Ideally, we would want to measure the exact input for every output, such as the time spent, goods and services involved and capital consumed in attending each fire, or saving one life through fire safety events. However, attribution of input to output is not straightforward, not least because the nature of the FRS means that resources are often 'pooled' to provide several types of service. For example, capital investment in fire appliances can be used both for responding to fires and in attending road traffic accidents (RTAs). Similarly, the range of goods and services bought in to service a fire station will contribute to delivery of a whole range of FRS services. Developments in management information and tailoring of equipment appropriate for different services, may result in more accurate and exclusive attribution in future.

6.4 In practice, therefore, linking the volume of inputs to individual outputs requires a pragmatic approach, applying estimates and assumptions about how resources are shared between activities. Currently, ONS attributes FRS inputs to output on the basis of estimated time spent at a small number of incident types\(^\text{19}\). These assumptions can be further refined using departmental resource accounts, estimates in local government accounts, and data relating to time inputs at incidents, recorded in monitoring reports by FRAs.

\(^{19}\) Based on once-off survey data.
6.5 These refinements (described in Annex B) could include estimates already collected in local government accounts\(^{20}\) on expenditure split by fire safety and emergency response. This does, nonetheless, rely on accurate estimates provided by individual FRAs and their ability to attribute a range of expenditure items to each activity, which is often not straightforward, particularly in the case of overheads or where the same items of equipment are used to provide a number of services.

6.6 Further attribution of response expenditure to fire and special services incidents could be made on the basis of the proportion of time spent at each type of incident, as used to calculate the fire output weights (the unit cost of responding to incidents). For example, if we know that 50% of fire officers' time is spent providing cover or attending fires, we assume that 50% of costs are related to fire outputs. For central government expenditure, these can be attributed equally to the three broad outputs (safety, fire and special services), unless resource accounting information suggests otherwise, such as an investment program targeted at fire safety.

6.7 This means that time spent on CFS activity is attributed to CFS output and time spend 'waiting' to respond to incidents is attributed in proportion to the likelihood of each type of incident occurring (given by the average time spent attending each incident type). Creating an operational reserve of trained and fully 'kitted' fire fighters who work on CFS unless a major incident requires their attendance, means that it is possible to maintain a constant resource input, whilst potentially generating a greater output, and therefore increased productivity.

6.8 The contribution of inputs to outputs should also be tested for any potential time lags between expenditure and output delivery. For example, training and recruitment costs in the FRS are relatively high compared to other Local Government services, and we would not expect the output from this investment to be delivered in the same year. This may only distort productivity figures if this investment is 'lumpy' over time, due to large recruitment drives, or new training is rolled out across the FRS, particularly if the training were to be a requirement to meet regulatory or organisational change that would not be intended to have any direct impact on output or productivity. These effects should be monitored over time and considered in any interpretation of productivity figures.

DEFLATORS

6.9 An important element of the productivity measure is to capture the volume of input against output, so that, for example, an increase in inputs reflects a rise in the volume of inputs and not the monetary cost. The Atkinson Review and ONS recommend the use of deflators to strip out the effects of price changes and, where possible to improve exiting measures by using sector-specific deflators in place of generic ones, such as the GDP deflator. Ideally, detailed expenditure data should first be split by three areas of spend: pay, non-pay (goods and service bought in), and capital consumption to construct a composite deflator for the FRS to reflect any specific patterns and types of spend unique to the FRS.

\(^{20}\) At present estimates are available from CIPFA Fire Service Statistics, but 2004-05 outturn data will include this breakdown in Local Authority Revenue Expenditure and Financing England, produced by ODPM.
6.10 For pay, current ONS methods already apply a fire-specific pay index that captures both operational (fire officers) and clerical staff. For central government the public sector average earnings index is used. Further work is needed to ensure that changes in the FRS pension costs are properly reflected in the deflators used.

6.11 For procurement of goods and services, there is considerable scope to improve on current ONS methods, which use aggregate price indicators. ODPM already collect a limited amount of information on the goods and services purchased by FRAs, and will be looking to improve this data source as part of its response to the Atkinson Review. Specific price indicators, such as existing components of the Retail Prices Index or Producer Prices Index, then need to be matched to the different goods and services purchased by the FRS.

6.12 Capital consumption estimates are still at an experimental stage, so the current ONS methodology uses estimates of capital consumption as the measure of capital input and a generic deflator is applied by ONS.

6.13 There are some potential risks, however, in developing sector specific deflators. It is a helpful approach in measuring national productivity, but it does not reflect efficiency concerns that are a key focus of public sector service delivery. It may be particularly misleading where there are efficiency measures attached to a pay deal, as in the recent case of the FRS, whereby the measure may show that output of the FRS is improving with no change to inputs (volume), yet it actually costs the government more to achieve. Some efficiency gains (or indeed inefficiencies) may not be captured using this method, such as savings achieved through better procurement practice and value for money considerations. This further emphasises the need to assess the National Accounts measures in the context of other performance indicators.

FURTHER DEVELOPMENT

6.14 There are two main developments that would improve the input data, described below:

i) Ensure that changes in FRS pension costs are properly reflected in deflators; and

ii) Continue to develop more detailed sector-specific price deflators, subject to improvements to data collection of goods and services purchased by individual FRAs.
7.1 Each of the three broad output measures described (fire safety, fire response and special service incidents) can be combined into a composite output measure using appropriate cost or value-based weights.

7.2 The productivity measure, as recommended by the Atkinson Review, would then be estimated by dividing the volume of total outputs by the volume of real inputs. This would be expressed as an index of volume change, showing comparisons of output per input over time.

WEIGHTING

7.3 To calculate an aggregate output measure for the FRS, it is necessary to sum output across the three activities. As discussed in section 4, alternative weighting methods yield different results. For the three output measures, a cost-based approach is likely to undervalue the contribution of fire safety and prevention output of the FRS, as we would not expect the cost of supply to reflect the full value of preventing fire deaths and property damage. Annex D demonstrates this in more detail.

7.4 A further perverse effect could occur if the amount of fire ‘cover’ required cannot be adapted in line with the reduced risk of fire brought about by better prevention activity. Using cost-based weights, we would expect that prevention would be more cost-effective way of averting fire damage, but as a result would be given a lower priority than fire response. An increase in prevention output would lead to a reduction in the number of fires that the FRS attends, which may result in a net fall in output, regardless of contribution to final outcomes.

7.5 Over time, the reduced risk from fire, brought about by better preventative measures, may mean that resources could be shifted away from response, which could shift productivity back up. However, if a level of fire cover is reached beyond which is not politically acceptable or practically feasible, this may not be feasible, making it harder to make the resource savings necessary to bring about further improvements in productivity. Reaching this level may depend on the success of new measures to make the response more flexible and targeted towards risk in the most effective and efficient way.

7.6 The preferred weighting method for the FRS would be based on the social value of outputs. It should recognise that preventing a fire is better than putting it out. This requires developing a better measure of the relative value of fire prevention work and emergency response. Evidence from FRS modelling of response and fire-related deaths suggests that a proportion of fire-related fatalities (approximately 50%) occur before the FRS is alerted. These outcomes can only be affected by FRS through fire prevention and safety initiatives.
7.7 The current state of evidence linking the contribution of FRS activity to outcomes, however, is not sufficient to derive a robust set of value-based weights. As such, the ONS measure of productivity will continue to underplay the importance of fire prevention work. To estimate value-based weights on this basis, it would be necessary to summarise the expected impact on fire-related deaths and property damage of a marginal change in fire prevention activity. This could be compared to the relative impact of emergency response, using a valuation based on the Cost of Fire estimates. Clearly, further work is required to develop a more appropriate weighting system.

7.8 The effect on productivity of these alternative weighting methods is different, and is described in more detail, with examples, in Annex D.

**THE ROLE OF WIDER PERFORMANCE MEASURES**

7.9 The Atkinson Review recognises that ‘no single number, however carefully constructed, can fully capture the performance of complex public services with multiple objectives’.21 This emphasises the importance of developing and monitoring a range of performance measures to corroborate the findings and interpretation of National Accounts output and productivity measures. This is described as a process of ‘triangulation’ that considers a range of alternative sources of information. For the FRS, these measures might include:

- The department’s PSA target to reduce the number of fire-related deaths, and sub-target for malicious fires;
- Best Value Performance Indicators to measure performance over time of individual fire and rescue authorities;
- Utilisation rates of fire appliances, given by the proportion of time spent attending incidents, particularly any change over time;
- Alternative sources of research evidence relating to the contribution of FRS to outcomes e.g. research that evaluates or models the effectiveness of community fire safety initiatives;
- Data emerging from Integrated Risk Management Plans, and modelling of local risks; and
- Comprehensive Performance Assessment, which began this year for the first time in the FRS. FRAs will be judged against a rounded corporate assessment and rated using the same five categories used for local authorities. CPA is primarily about corporate performance rather than operational effectiveness, and as such will not directly provide relevant information for output measurement, but should provide useful corroborative performance evidence.

FURTHER DEVELOPMENT

7.10 There are two main developments that would improve the composite productivity measure, described below:

i) If expenditure weights are applied, improve weights with more robust data on allocation of resources to the three main outputs

ii) Preferred: Develop value-based weights to more accurately reflect the contribution of FRS activities to achieving outcomes. This could be progressed in a number of ways, by making better use of available data and new research underway into the effectiveness of fire prevention and safety work.
8.1 Measuring the output and productivity of the FRS, and the public sector more generally is extremely complex and difficult. It is recognised by Sir Tony Atkinson and ONS that no single measure will capture the productivity of public services fully and it is therefore important to assess the output and productivity measures in the context of a range of indicators.

8.2 Measuring output and productivity of the FRS is particularly difficult, not least because elements of the service are ‘collective’ and have no directly observable discrete output. In many aspects of the FRS the relationship between the activity and final outcomes (reduced fire deaths or property damage) is not observed, particularly in fire prevention. There is also a value in providing fire ‘cover’, which requires resources to be ‘inactive’ for a proportion of time when not responding to incidents, which will be determined by the level of risk, but also by political, technological and safety factors. A further complication is added by the interaction between two of the key FRS outputs, where success in prevention leads to a reduction in response output.

8.3 ODPM has attempted to develop a pragmatic solution to improve current methods, making better use of available information. Due to the experimental nature of this work it will form part of a longer term development with ONS. We recommend the following developments, which we believe are an improvement on current measures of fire and rescue service output and productivity:

- A new measure for safety and prevention output, based on a basket of FRS outcomes, weighted by the economic and social value of outcomes;
- A fire response output measure that takes account of the ‘cover’ required and reflect changes in quality or outcome attributable to each unit of fire response output;
- Quality adjustment to emergency fire response output, using response times; and
- A more fire-specific price deflator for capturing volume of inputs.

8.4 This takes the current methodology forward, particularly by capturing more fully the contribution of the FRS to final outcomes, i.e. the value to society. Regardless of National Accounts requirements, there is still value in developing an outcome measure of output and productivity that is not published in the National Accounts.
8.5 Nonetheless, there remain drawbacks with these measures, which will require further work, particularly in capturing fully the effectiveness of fire prevention output and with the use of expenditure weights in combining prevention and response outputs, which can lead to perverse results. Without resolving these issues there is a risk that measures of output and productivity of the FRS will be misleading.

8.6 There are a number of avenues that could be explored to develop these measures, including:

i) Develop a better understanding of the effectiveness of fire safety activity i.e. their contribution to final outcomes. ODPM has evaluated recent Community Fire Safety (CFS) activity and is undertaking future research to model the effectiveness of prevention work;

ii) Develop a measure of risk of fire damage occurring. This could be based on the long-term smoothed average of the number of fires;

iii) The introduction of Integrated Risk Management Plans (IRMPs), which all FRAs will be required to produce, could yield some useful information about local risk assessment for setting priorities for intervention. This could help develop more robust weights for combining the mix of fire and SSI response outputs and could inform analysis of optimal provision and perhaps further inform analysis of the appropriate mix of prevention and response activity;

iv) Further research and consultation with fire professionals may help to refine quality adjustments, such as the number of live rescues achieved;

v) If expenditure weights are applied, improve weights with more robust data on allocation of resources to the three main outputs;

vi) Develop value-based weights (preferred) to more accurately reflect the contribution of FRS activities to achieving outcomes. This could be progressed in a number of ways, by making better use of available data and new research underway into the effectiveness of fire prevention and safety work;

vii) Ensure that changes in FRS pension costs are properly reflected in deflators; and

viii) Continue to develop more detailed sector-specific price deflators, subject to improvements to data collection of goods and services purchased by individual FRAs.
ANNEX A
Principles from the Atkinson Review
Interim Report

As in section 11.1 pp 127-128 of the Interim Report.

**Principle A:** The objective should be to measure output from government spending in terms of its incremental contribution to individual or collective welfare, in the same way as market output.

**Principle B:** The procedure of defining direct output indicators within a government function should start by seeking to identify the services provided by government to households and firms, and attempts made to find data to reflect these services as comprehensively as possible (rather than working back from available indicators). Where, initially, it is necessary to apply an indicator from another service, this should be explicit. The coverage of indicators within a function should be reassessed on a regular basis.

**Principle C:** Formal criteria should be set in place for the further extension of direct output measures. Specifically, the conditions for introducing a new directly measured output indicator should be that (i) it covers adequately the full range of services for that functional area, (ii) it makes allowance for quality change, (iii) the effects of its introduction has been tested service by service, and (iv) the context in which they will be published has been fully assessed, in particular the implied productivity estimate.

**Principle D:** Measures should cover the whole of the United Kingdom; where systems for delivering public services and/or data collection differ across the different countries of the United Kingdom, it is necessary to reflect this variation in the choice of indicators.

**Principle E:** The measurement of inputs should be as comprehensive as possible, and in particular, should include capital services; consideration should be given to the split between current and capital spending.

**Principle F:** Criteria should be established for the quality of price deflators to be applied to the input spending series; they should be sufficiently disaggregated to take account of changes in the mix of inputs and should reflect full and actual costs.

**Principle G:** Independent corroborative evidence should be sought on government productivity, as part of a process of ‘triangulation’, taking account of the timing of inputs and outputs.

**Principle H:** Value should be seen as adjusted for quality; for each service, explicit consideration should be given to the incorporation of quality change as an element of value added; for each spending function, consideration should be given to the extent to which quality change is captured by the changing activity mix, and to the way in which output measures for government should be adjusted for increased real value in an economy with rising real GDP.
## ANNEX B

### Attribution of input to output

**Box 1  Attribution of inputs and outputs – key assumptions**

| Local Government | Pay | • Total split by % spend on CFS and emergency response¹  
|                 |     | • Emergency response pay is allocated in proportion to appliance 
|                 |     |   hours at (a) Fires and (b) Special Service Incidents²  
|                 |     | • Assumes labour hours per type of incident follows same pattern 
|                 |     |   as appliance hours  
|                 | Procurement | • As for pay, above  
|                 | Capital | • Assumes CFS capital consumption is 5% of total capital³  
|                 |         | • Other capital allocated to Fire and Special Services as above²  
| Central Government | Pay | • Admin expenditure (Pay), apportioned equally to 3 output measures  
|                 | Procurement | • Program spend (Resource); assign each program to one of 
|                 |         |   three activities⁴.  
|                 |         | • Minus, grants to local authorities  
|                 |         | • Plus, Admin expenditure (non-pay), apportioned equally to 3 
|                 |         |   output measures  
|                 | Capital | • Program spend (Capital); assign each program to one of 
|                 |         |   three activities⁴.  

¹ CIPFA; forthcoming LGF statistics, ODPM.  
² ODPM (FDR1) appliance hours per primary fire incident x no. incidents.  
³ Based on breakdown of Welsh Local Authority expenditure by activity, Welsh Assembly.  
⁴ Using RAB codes to identify the principal purpose of program spend.
ANNEX C
Quality adjustment: Fire Response

Analysis of fire incidents has established and quantified the link between the number of fatalities and response time. This can be expressed as 5-minute time bands for response, with the average number of fatalities per 1,000 casualties quantified for each time band. From this, it is possible to calculate the number of fatalities per 1000 casualties that are prevented by responding within each time, compared to responding in 21 minutes or more (which is assumed to be equal to not responding at all). For example, if FRS response within 6 to 10 minutes is 80% as effective as a response within 1 to 5 minutes, the weight will be 0.8.

Response time data is available disaggregated by each incident type. However, our quality adjustment measure only adjusts for the speed of response to dwelling fires since a link has only been established in dwelling fires. Nonetheless, dwelling fires account for approximately 90% of fire deaths, so this seems a reasonable proxy for overall quality of FRS emergency fire response.

Experimental research suggests a similar link between response time and the extent of fire spread in dwelling fires.

<table>
<thead>
<tr>
<th>Response Time (minutes)</th>
<th>Fatalities per 1,000 casualties</th>
<th>Fatalities prevented by response, compared to no response</th>
<th>Quality weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 5</td>
<td>50</td>
<td>200</td>
<td>1.00</td>
</tr>
<tr>
<td>6 to 10</td>
<td>100</td>
<td>150</td>
<td>0.8</td>
</tr>
<tr>
<td>11 to 15</td>
<td>150</td>
<td>100</td>
<td>0.6</td>
</tr>
<tr>
<td>16 to 20</td>
<td>200</td>
<td>50</td>
<td>0.4</td>
</tr>
<tr>
<td>21 plus (no response)</td>
<td>250</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>
ANNEX D
Weights

Applying weights to different fire incidents
We propose that FRS response to fires should be weighted by the value to society of attending different types of fire. A proxy for this value can be obtained from the ODPM’s Economic Cost of Fire publication. This publication estimates the average costs imposed on society by each type of fire. This consequential cost includes the value of property damage and human costs, as well as the cost of lost business. Ideally environmental costs would also be included if these could be reliably measured.

The Economic Cost of Fire also estimates the average cost to the FRS of responding to each type of incident, in terms of labour and capital costs (the ‘response cost’).

Either of these estimates could be used to capture the value of an FRS response to each type of fire by adjusting the basic volume of fires attended to take account for the mix of output. However, the response cost would not capture the full value to society as it is simply the cost of attending an incident regardless of the potential rescues or property damage averted.

Total output would be aggregated using the method set out below.

In this example, we assume that there are three fire types: A, B and C, with the consequential costs $a$, $b$ and $c$ respectively. The average consequential cost of all fire is $d$.

<table>
<thead>
<tr>
<th>Fire type</th>
<th>No. of fires</th>
<th>Consequential cost</th>
<th>Weighting</th>
<th>Contribution to response output</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$X$</td>
<td>$a$</td>
<td>$a/d = \alpha$</td>
<td>$X\cdot \alpha$</td>
</tr>
<tr>
<td>B</td>
<td>$Y$</td>
<td>$b$</td>
<td>$b/d = \beta$</td>
<td>$Y\cdot \beta$</td>
</tr>
<tr>
<td>C</td>
<td>$Z$</td>
<td>$c$</td>
<td>$c/d = \chi$</td>
<td>$Z\cdot \chi$</td>
</tr>
<tr>
<td>All fires</td>
<td>$X+Y+Z$</td>
<td>$d$</td>
<td></td>
<td>$X\cdot \alpha + Y\cdot \beta + Z\cdot \chi$</td>
</tr>
</tbody>
</table>

Total output

For some categories of fire, particularly those covering less common incident types, average response costs can fluctuate significantly from year to year, due to unusually large incidents that require a number of fire appliances to attend. As a result, it may be more appropriate to calculate weights on the basis of data from more than one year, or to apply a smaller number of categories that may represent less variability of average costs.
COMBINING OUTPUT MEASURES USING WEIGHTS

Each of the three output measures is combined by applying a weight \((\alpha,\beta,\lambda)\) as follows:

\[
\text{Total Output of FRS} = \alpha \times \text{Output of Fire Safety activity} + \beta \times \text{Output of Fire response} + \lambda \times \text{Output of SSI response}
\]

\[
\text{Productivity of FRS} = \frac{\text{Total Output}}{\text{Total FRS Input}}
\]

The implications of different weighting methods: A simple illustration

One way to test the appropriateness of our methodology is to analyse what the likely effect of different policy measures would be on productivity. For the sake of simplicity, we have only analysed the effect on fire prevention and fire response, since the volume of special service incidents is determined by largely exogenous variables. It is assumed that improvements in fire prevention output will reduce the number of fires that the FRS attends.

One potential scenario shown in the example box below, is that the FRS improves the effectiveness of its fire safety activity (for example by better targeting), without increasing the amount of staff hours spent on this type of work. As a result, fire prevention outcomes (e.g. the number of fire deaths) improve. A fire prevention index, measured in relation to these outcomes increases. However, fire prevention measured in terms of activity remains constant. This example demonstrates the advantage of an output measure able to capture changes in the quality or effectiveness of prevention work.

The improved fire prevention work reduces the amount of fires attended by the FRS and therefore reduces fire response output. Assuming that the majority of FRS resource is allocated to response (providing cover and attending incidents), with response and prevention output being allocated weights on the basis of their share of total expenditure, a unit change in response is given, say, a 5-times greater weight than a unit change in prevention. As a result, aggregate output (and in this example, total productivity, since inputs are constant) falls whether prevention is measured by outcomes or activity. However, the fall is more pronounced when prevention is measured by activity.
Example 1 illustrates that even if prevention is measured in terms of outcomes, the use of expenditure weights may result in better prevention work actually leading to a reduction in aggregate FRS output if the declines in response output outweighs these improvements in prevention output.

Anecdotal evidence suggests that, pound-for-pound, additional resource for fire prevention provides greater beneficial impact on outcomes than additional resource for response.

This suggests that value weights would produce different results to cost weights. Example 2 explores the effect of using alternative weighting mechanisms. This measure may lead to perverse results.

<table>
<thead>
<tr>
<th>Worked example 1 Prevention work becomes more effective (Hypothetical data)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input index</strong></td>
</tr>
<tr>
<td>Prevention OUTCOMES</td>
</tr>
<tr>
<td>Prevention ACTIVITY</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td><strong>Total Output (if prevention is measured by outcomes)</strong></td>
</tr>
<tr>
<td><strong>Total Output (if prevention is measured by activity)</strong></td>
</tr>
</tbody>
</table>

Note: In this example, expenditure on response is 5 times greater than on prevention
In the example, prevention outcomes improve by 10%, feeding through to a 10% reduction in response output. One interpretation is that FRS output has improved, since fire outcomes have improved and the FRS provides the same level of emergency cover (i.e. the same service with better outcomes). To capture this improvement, change in prevention output would need to be greater than a unit change in response output would lead to an increase in aggregate FRS output (and in this example, productivity). An approach weighting a unit change in prevention output less than a unit change in response output (such as an expenditure weighting approach), would lead to a decline in FRS output overall.

Again, as total inputs remain constant in this example, aggregate productivity is equal to total output.

<table>
<thead>
<tr>
<th>Worked example 2</th>
<th>The effect of alternative methods of weighting prevention and response (Hypothetical data)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>Output indices</strong></td>
<td></td>
</tr>
<tr>
<td>Prevention</td>
<td>100</td>
</tr>
<tr>
<td>Response</td>
<td>100</td>
</tr>
<tr>
<td>Total Output (if prevention weighting&gt;response weighting)</td>
<td>100</td>
</tr>
<tr>
<td>Total Output (if prevention weighting&lt;response weighting)</td>
<td>100</td>
</tr>
</tbody>
</table>

Improved risk management, better utilisation of vehicles and more flexible working practices might enable the FRS to provide the same response output (attending incidents) whilst utilising less resource. In this scenario productivity would increase, under both weighting systems. This suggests that some aspects of fire service modernisation may result in improvements in productivity.
ANNEX E

Assessment of current ONS methods and recommended approach

The Atkinson Review recommendation 6.1, was that for any government services, current direct measures of output should be improved, where needed, by:

a) Widening the coverage of output volume indicators for each function;
b) Increasing the level of detail at which output indicators are measured;
c) Adopting a more reliable data source;
d) Revisions of the weighting process;
e) Replacing activity indicators with output measures that reflect changes in quality or outcome attributable to a unit of output;
f) Introducing or revising an overall quality adjustment;
g) Improving timeliness and in-year indicators; and
h) Improving UK coverage by making full use of measures from Scotland, Wales and Northern Ireland.

Our recommendations for further developments are as follows:
## Assessment of ODPM proposals against criteria for change (as identified in Atkinson Review)

<table>
<thead>
<tr>
<th>Criteria for change</th>
<th>Current ONS method: Strengths and weaknesses</th>
<th>ODPM proposed improvements: Strengths and weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Current measures include complete coverage of FRS activity</td>
<td>No change</td>
</tr>
<tr>
<td>(b)</td>
<td>Fire response output breakdown by 4 categories and SSIs by 2 categories; allocation of input to output is based on limited survey data on fire safety, and does not reflect effectiveness</td>
<td>More detailed disaggregation of fire response output;</td>
</tr>
<tr>
<td>(c)</td>
<td>Allocation of input to output is based on limited survey data on fire safety, and does not reflect effectiveness</td>
<td>New fire safety input data more robust than one-off survey data and improves allocation of input to output, based on FRA accounts</td>
</tr>
</tbody>
</table>
| (d)                 | All outputs are measured in same units (hours), so easy to sum across the three activities, but:  
  - Hours spent providing ‘fire cover’ are not included, which underestimates the weight for fire response output  
  - No account of effectiveness of output, given by value to society  
  - Increasing fire prevention work may reduce productivity if it results in fewer fires (attending a fire will increase output by more than preventing it) | New weights based on consequential cost of fire take account of the different value to society of attending different incidents; But, until value weights can be defined for aggregating prevention and response, cost-based weights may still result in fall in productivity if fire prevention leads to fewer fires |
| (e)                 | Current activity measures for prevention and each type of response represent resource costs only and take no account of changes in quality or the outcome attributable to a unit of output (Value to society) | New measure of fire prevention based on a weighted basket of outcomes. But, this may need further work to account for the effect of exogenous factors. |
| (f)                 | Activity measures are used to proxy for contribution to outcomes, and need quality adjustment if continued to be used. | Fire response output can be adjusted using response times.  
  As a second best improvement to prevention output (above a new outcome-based measure of output), we suggest ways in which a quality-adjusted activity measure could be developed. |