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ForceViewer: A Starting Point Force Tool

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ABSTRACT

This document outlines the work done in developing ForceViewer, a tool that assists in producing a Starting Point Force. The document outlines the requirements for the tool, the tool itself and the structure of its code. ForceViewer was developed for the Capability Needs Analysis Directorate in Capability Development Group. The prototype tool graphically shows the Starting Point Force in any chosen year. The tool allows for interactive changes to the force and displays the impact on the overall capability. The force is composed of the current assets, the Defence Capability Plan projects and any interim endorsed capability additions. The purpose of the tool is to quickly determine and display the list of all major elements of the force structure in a chosen year. This Starting Point Force can then be given to Defence organisations such as Military Strategy and the Force Structure Review team for further analysis.

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ForceViewer: A Starting Point Force Tool

Executive Summary

The Capability Needs Analysis Directorate within Capability Development Group (CDG) is tasked to assemble the list of capabilities forming the Starting Point Force (SPF). This SPF is used by a number of organisations within Defence and in particular by the Force Structure Review (FSR) team. The SPF is usually assembled using Microsoft Word and Excel to store and derive which capability elements would be available in a given year. These tools however, are not very flexible in viewing the time dependence of the capabilities.

The need for a better tool that delivers the SPF was identified by Joint Operations Division, Joint Decisions Support Centre (JDSC) task. This was translated into a prototype called ForceViewer, and is the subject of this document.

ForceViewer graphically shows the SPF in any chosen year. The main use of the tool is to drag a time slider bar to the desired year and look at those capabilities present (left) in that year. The tool allows for interactive changes to the force and displays their impact on the overall capability. The force is composed of the current assets, the Defence Capability Plan projects and any interim endorsed capability additions. Further, ForceViewer allows links to be defined between capability elements by dragging the mouse from one element to another. The view of the links can also be filtered to show only the chosen types.

The discriminating data for the tool consists mainly of time, such as in-service and planned withdrawal dates, that determine when a capability element is available. In addition to the time data the tool can also incorporate the contributions of each major asset to various capability partitioning schemes, such as the Capability Tasks Effects (CTE) and the Joint Capability Areas (JCA). The data is sourced from the Key Defence Asset Review [1], the Defence Capability Plan [2] and the Defence White Paper [3]. ForceViewer reads and writes its data from Microsoft Excel spreadsheets.

ForceViewer has a main view that shows all capability elements in a given year grouped by service. A capability element is represented by a coloured rectangle with an icon at its centre. The rectangle also shows the number of capability elements in the chosen year. Other views of the data include a Gantt chart view showing when capability elements are present and a number of line charts that display the number of capability elements as a function of time. The different views can be filtered to present only those elements of interest, for example, displaying all capability elements belonging to a chosen Joint Capability Areas.

The lessons learnt by the JDSC in developing ForceViewer (in partnership with CDG), provide valuable information on how to develop an idea into a prototype tool. Similarly, CDG awareness in shaping the development of support tools, and the data required for it, increased as a result of this work. ForceViewer has proved useful, and a number of future improvements have been identified.

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1   Introduction

The Capability Needs Analysis Directorate within the Capability Development Group (CDG) is tasked to assemble the list of capabilities that form the Starting Point Force (SPF). This SPF is used by a number of organisations within Defence and in particular by the Force Structure Review (FSR) team. The SPF is usually assembled using Microsoft Word and Excel to store and derive which capability elements would be available in a given year. CDG currently does not have a tool that specifically assists in assembling the SPF. However, there is a need for a tool that is more flexible than Word and Excel.

A brief survey of potential tools revealed that although there are tools to organise capability by time frames, typically project management tools, no tool lets the user easily interact with the capability elements, the time data and their contributions to overall force level capability. Therefore, Joint Operations Division through the Joint Decision Support Centre (JDSC), has developed a prototype tool called ForceViewer to assist in producing and maintaining the SPF.

This prototype tool is designed to list the SPF in any chosen year. The force in this tool is composed of the current assets, the Defence Capability Plan (DCP) projects and any interim endorsed capability additions. The purpose of the tool is to quickly determine and display the list of all major elements of the force structure in the desired year. This SPF can then be given to Defence organisations such as Military Strategy and the Force Structure Review team for further analysis.

The data for the elements of the force consists mainly of time, such as in-service and planned withdrawal dates that determine when a capability element is available. In addition to the time data, the tool can also incorporate the contributions of each major asset to various capability partitioning schemes, such as the Capability Tasks Effects (CTE) and the Joint Capability Areas (JCA). Most of the data is sourced from the Key Defence Asset Review (KDAR) [1], the DCP [2] and the Defence White Paper [3]. Currently the Capability Needs Analysis Directorate is responsible for sourcing and maintaining the data and the tool.

2   Aims

The aim of this paper is to document ForceViewer: features, code structure, analytical approach and the work done in developing ForceViewer. Initially, ForceViewer was aimed at deriving a set of requirements for future tools that would assist CDG in their task of producing the SPF. As the FSR activities were brought forward, the aim was changed to also assist in the initial activities of the FSR by providing an interactive tool that not only shows the SPF, but also highlights the impact of changes to the force structure on capability.

A mock-up was developed to showcase the benefits of such a tool to CDG. This tool was then used to solicit further client requirements and developed into the current ForceViewer

prototype. ForceViewer is now used in CDG as an interim tool until the Chief Information Officer Group (CIOG) develops a comprehensive system, as part of the Defence Information Environment (DIE).

3 Requirements

The need for a tool that delivers the SPF was identified by the JDSC as part of its support to CDG and FSR. This lead to the building of a quick mock-up tool to show potential clients. This initial tool was presented to Capability Needs and Analysis staff, who recognised its benefits. An agreement was drafted between JDSC and CDG to developed a functional prototype that would deliver the starting point force in selected years. This functional prototype is ForceViewer; it serves to refine the requirements for this type of tool, providing an interim capability while other avenues are pursued.

An iterative prototyping approach was used to solicit the detailed requirements for Force-Viewer. This approach consists of the client reviewing the tool, identifying additional features and providing them to the development team who then incorporate those features into the prototype. Following a number of iterations, the following features were derived and implemented in ForceViewer:

- The ability to view the force in any given year, in each service and for each major category; namely, current assets, DCP and White Paper. This is the main view of the tool.

- The ability to change the viewing year using a slider bar, thereby changing the displayed force.

- The ability to represent fleets of major platforms (and sub-groups), for example, blocks of platform numbers.

- The ability to change any of the data parameters representing a capability element.

- The ability to set the contributions of the capability elements to selected warfighting effects partitioning scheme, such as CTE and JCA.

- The ability to set the location of the various capability elements as a function of time. This includes location of blocks of assets.

- The ability to set various dependencies between the capability elements and to display them.

- The ability to filter the view of the force using a range of criteria, such as service, CTE and JCA contributions, time, location and capability group.

- The ability to display the force as a Gantt chart and the ability to change time and number parameters in the Gantt chart itself.

- The ability to save and retrieve data sets. These are called scenarios in the tool.

- The ability to print and save the force in any chosen year in selected formats.

- The ability to save the screen as a picture for inclusion into Microsoft power point (for example).

- The ability to reset the scenario to its original state, after modifications have taken place.

- The ability to display and print a summary of all changes made during a session.

- The ability to add new a capability element to the various groups.

The list above is not exhaustive, however, it gives an indication of the types of quantitative and visual information that ForceViewer is required to have.

There was also a requirement for the tool to be available on the Defence Secret Network (DSN). However, the interim arrangement was to have ForceViewer on a stand alone computer, thereby providing a capability while an enduring solution was pursued.

4   Description

ForceViewer is a graphical tool that allows the user to add and remove capability elements and to display them as a function of time. Once the capability elements are defined, the main use of the tool is to drag a time slider to the desired year and look at what capabilities are present (left) in that year. The model has menus that allows for loading and saving the data. The data for ForceViewer is in Microsoft Excel format.

ForceViewer is written in Java 1.6 and, therefore, can be used on any platform that supports Java 1.6. Section 5.1 describes in detail the overall structure of ForceViewer.

The following sections outline the features of ForceViewer.

4.1   Main view

Figure 1 shows the main view of ForceViewer, that consists of a window showing all capability elements as small rectangles with an optional icon at the centre. At the top left hand side of ForceViewer is the time slider which is used to select the year that is shown on the main view. As the slider bar is altered the main view is changed accordingly, that is, it displays the capability elements that are present in the selected year. The main view consists of three rows representing *Current Assets*, *DCP Projects* and *White Paper* elements. A number of menus are present at the top of the window for input and output of data, selection of colours for the icons and classification of the data. To the right of the time slider bar are: the *Hide Inactive Elements* and the *Show Links* tick boxes. The *Hide Inactive Elements* filters the main view such that only the elements that are present in the selected year are displayed. When *Hide Inactive Elements* is off, the main view displays
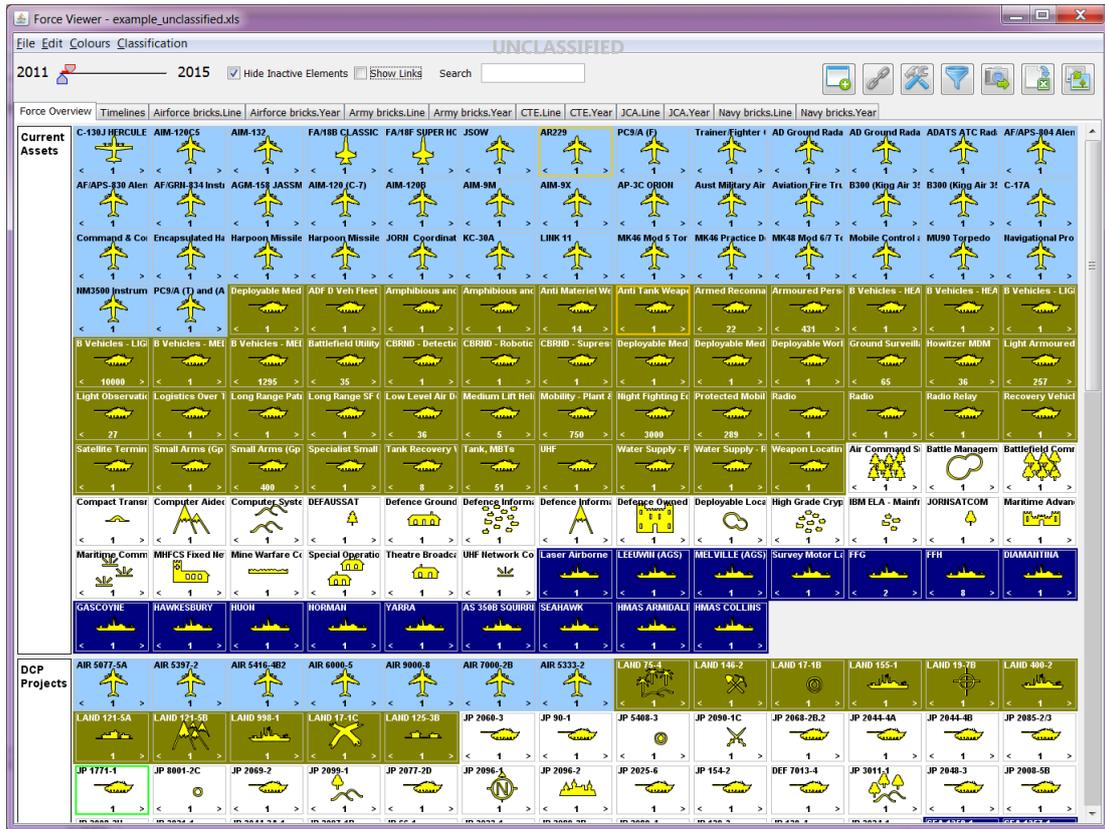
Figure 1: *Main view*

the active elements represented by the rectangles with icons plus the elements that were present in previous or future years represented by the empty rectangles. The *Show Links* displays the links emanating from the capability elements (see section 4.5).

On the right of *Show Links* is the search input text field. Here the user can type the name of a desired capability element to be highlighted in the main view, which helps find the capability of interest in the main view.

At the top right hand side of the main panel are a number of icons representing tools to add or modify capability elements, filter the view and screen capture. These tools are explained in more details in section 4.4.

Next to the *Force View* tab are other tabs for various charts, which are discussed in section 4.7.

4.2   Capability elements

The core component in ForceViewer is the capability element. This holds the data associated with each capability element and is graphically represented by a coloured rectangle with or without an icon at its centre. The layout of the information within the rectangle,

such as the icon, the name and the number can be customised by the user. The following describes the capability elements with the default layout. The colour of the rectangle represents the different armed services while the name of the capability element is at the top of the rectangle. Typically, rectangles with icons signify that the capability element is present in the selected year. Rectangles without an icon typically signify that the capability element is not present in the selected year. At the bottom of each rectangle are angle brackets $<\ >$ with a possible number in between, which represents the number of capability elements in the selected year. If only $<$ is present, it signifies that the element was present in previous years (down to the base start year, but not before). If only a $>$ is present, it signifies that this capability element will be present in the future.

Double clicking on a capability element will pop-up a dialog box. Figure 2 shows a typical dialog representing a capability element ready for editing. As can be seen from Figure 2-a, in addition to the *Asset/Project Number* and *Description*, the capability element belongs to the *Current Assets* group. The capability element can also be grouped (not shown in Figure 2) as *DCP Projects* or *White Paper*. This capability also belongs to a particular *Service* and a *Capability Brick*. These groupings are used by filters (see section 4.4) and in some charts (see section 4.7). The capability element has a quantity representing the number of platforms or representing a particular block of platforms. For each quantity block, five time events are recorded, namely In-Service Date (ISD), Planned Withdrawal Date (PWD), Initial Operational Capability (IOC), Final Operational Capability (FOC) and Life Of Type (LOT). ISD and PWD are used extensively to determine when a particular capability is present in a specified year. Currently IOC, FOC and LOT are recorded but not used.

Figure 2-b shows that this capability element can also be at a particular location for a given duration described by the *First Date* and *Last Date* fields. Figure 3-a shows the
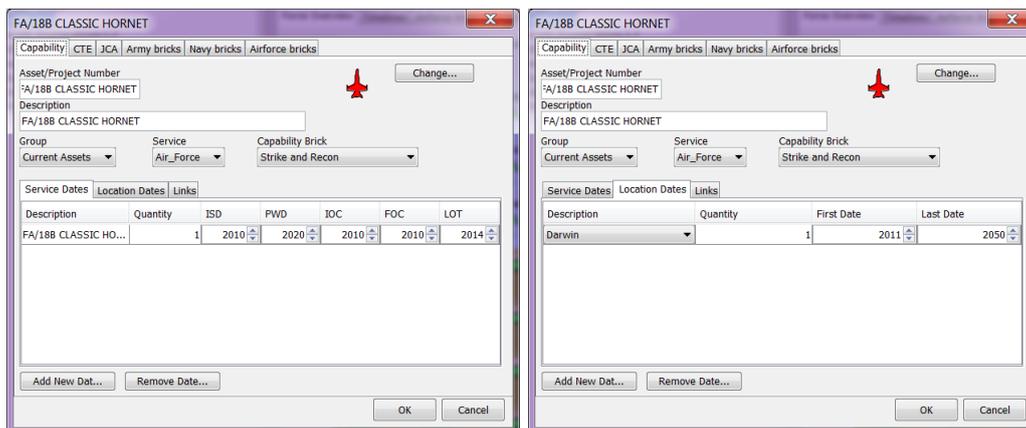
Figure 2: *Capability element dialog box. a) Service Dates tab, b) Location Dates tab*

capability element contribution to the Joint Capability Areas (JCA) partitioning scheme. Similarly Figure 3-b shows the capability element contribution to the defined *Navy Capability Bricks*. The partitioning schemes and other contribution definitions are setup in the input Excel workbook (see section 5.2) and are fully customisable. The capability elements contributions are used to calculate the overall force contribution as a function of
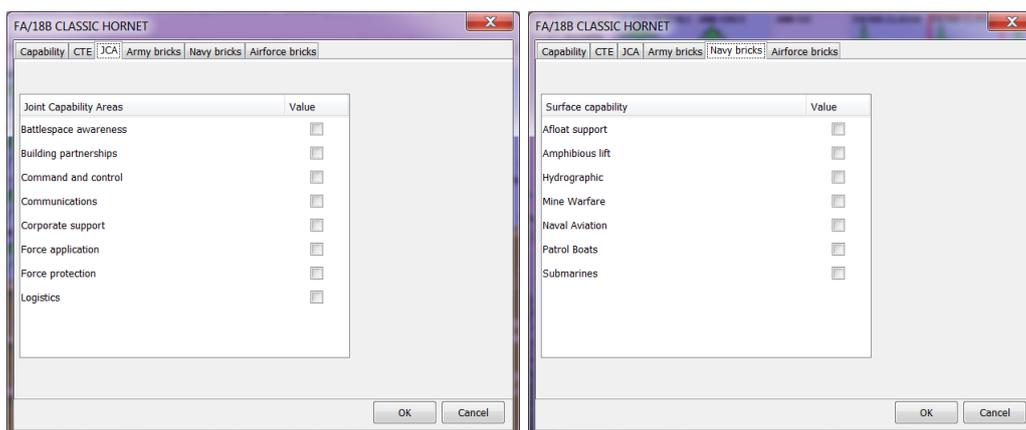
Figure 3: *Capability element dialog box. a) JCA tab, b) Navy bricks tab*

time with the results shown in various charts (see section 4.7).

4.3   Time slider

The year selection slider, as shown at the top left of Figure 1, is the main instrument for selecting the year to be displayed in the main view and in some charts. The bottom slider knob sets the base start year and the top knob sets the year to be displayed in the main view. That is, the main view will show all capability elements present in the year as defined by the slider top knob year. All elements with icons are current capability elements and all elements without an icon are elements that were present in previous years up to the base start year or will be present in the future. Present elements in the selected year have their quantity displayed between the angle brackets $<$ and $>$.

4.4   Filters

The main view in ForceView can become busy due to the number of capability elements present. To facilitate viewing selected groups of elements, a set of filters were implemented. The filters are actioned by clicking on the filter button (the button that looks like a funnel) at the top right hand side of ForceViewer. The ensuing dialog box is shown in Figure 4. As the different filters are selected the main view and the charts that depend on the selected year will be changed accordingly. Further, the filters can be combined, through a logical AND operation.

4.5   Links

Displaying links between capability elements is a feature of ForceViewer. This is achieved by selecting the *Show Links* tick box. Links are constructed between capability elements
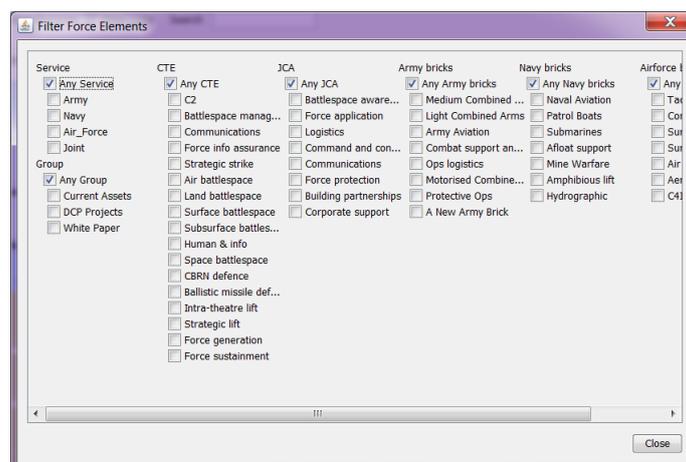
Figure 4: *Filters dialog box*

by dragging the mouse from a capability element to another, while the *shift* key is pressed. Once the mouse is released a links selection dialog pops-up (see Figure 5). The user can then select the type of links the association represents. The link types, as with most parameters, are defined and are fully customisable through the Excel spreadsheets.
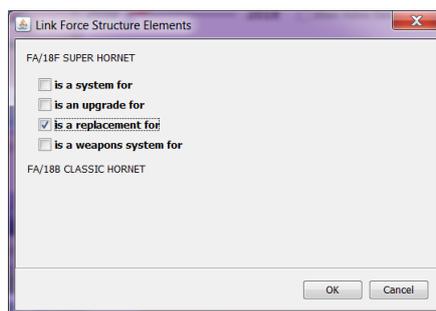
Figure 5: *Links dialog box*

4.6   Time lines

In addition to the main view, the list of capability elements can also be viewed as a Gantt chart, which is often referred to as time lines. The second tab in ForceViewer is *Timelines* as shown in Figure 6. The vertical gray bar indicates the current year as set by the time slider bar. Each time-line represents a capability element and shows the time duration between the ISD and the PWD of that capability element. A time-line can be moved from one date to another simply by dragging it with the mouse. The ISD and PWD of that capability element will be adjusted accordingly. The user can modify these dates by dragging the ends of the time line. Double clicking on a time-line pops-up a dialog box of the capability element as shown in Figure 2. Filtering the view using the filters function also changes the time-lines display.
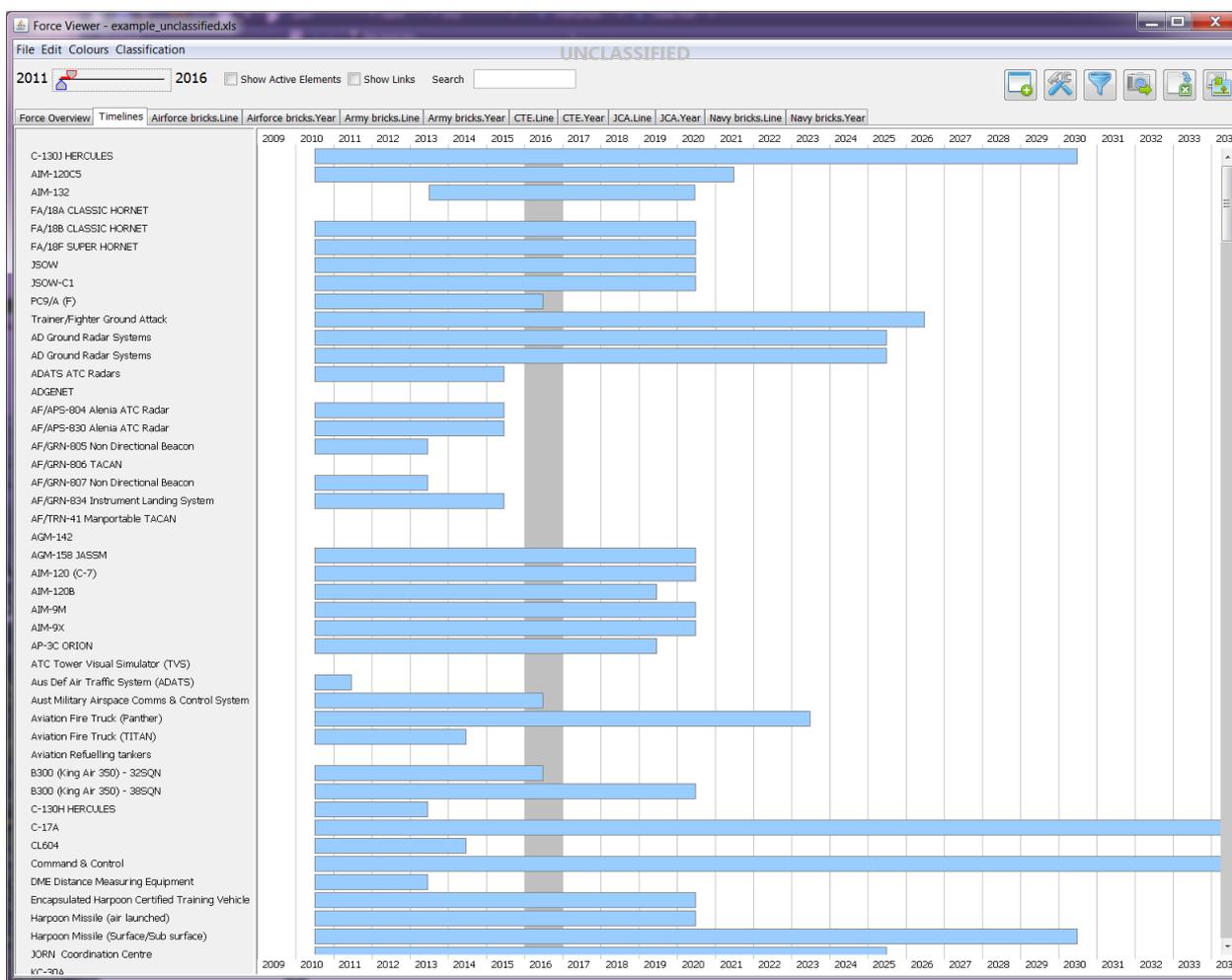
Figure 6: *Timelines tab*

4.7 Charts

ForceViewer can display two types of charts of capability over time. The first type of chart displays the total contributions as a function of time. Figure 7 is an example of this type of chart. The second type of charts shows the contributions in the selected year, as determined by the time slider; Figure 8 is an example of this type of chart.

The contributions shown in Figure 8 represent the number of capability elements in the CTE for that year. While the contributions to CTE over time are shown in Figure 7 .

ForceViewer can also cater for quantitative value contributions within a defined scale. The chart in this case would show the sum of all contributions.
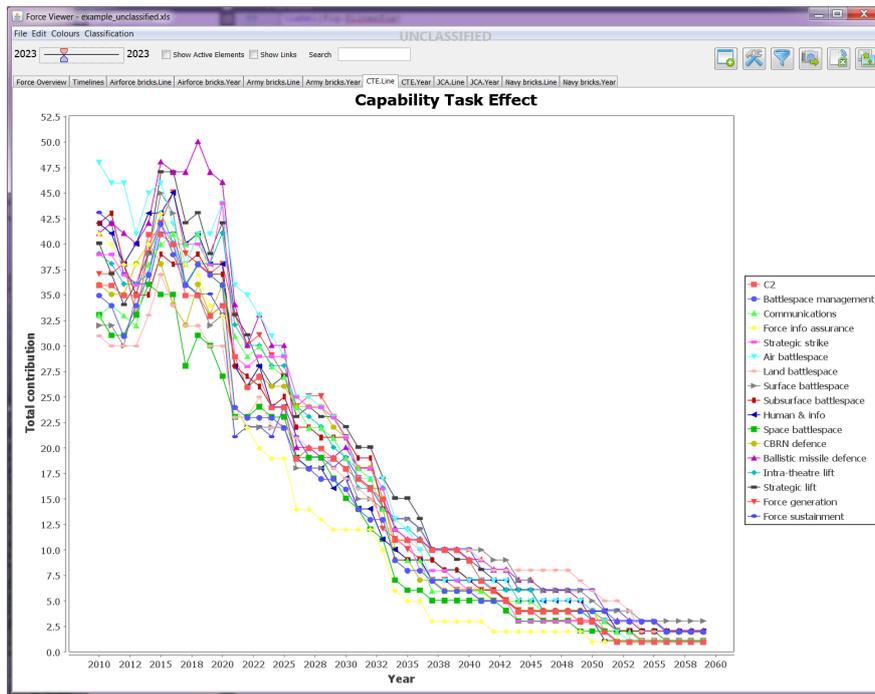
Figure 7: *Total contributions chart*
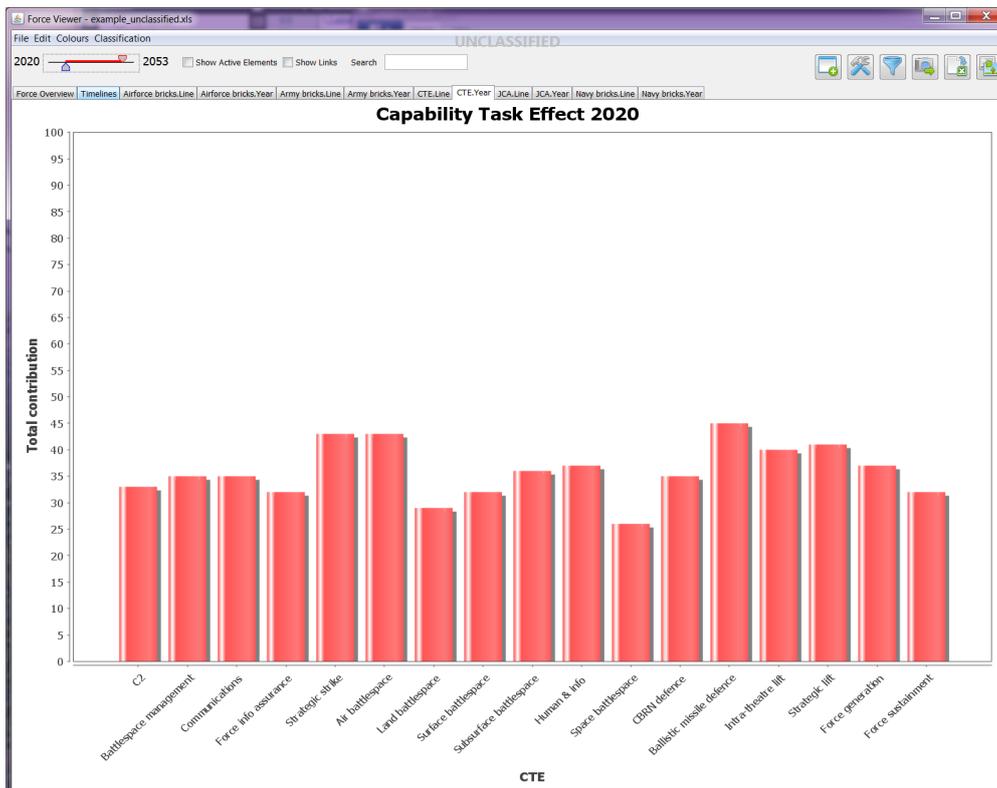
Figure 8: *Year contributions chart*
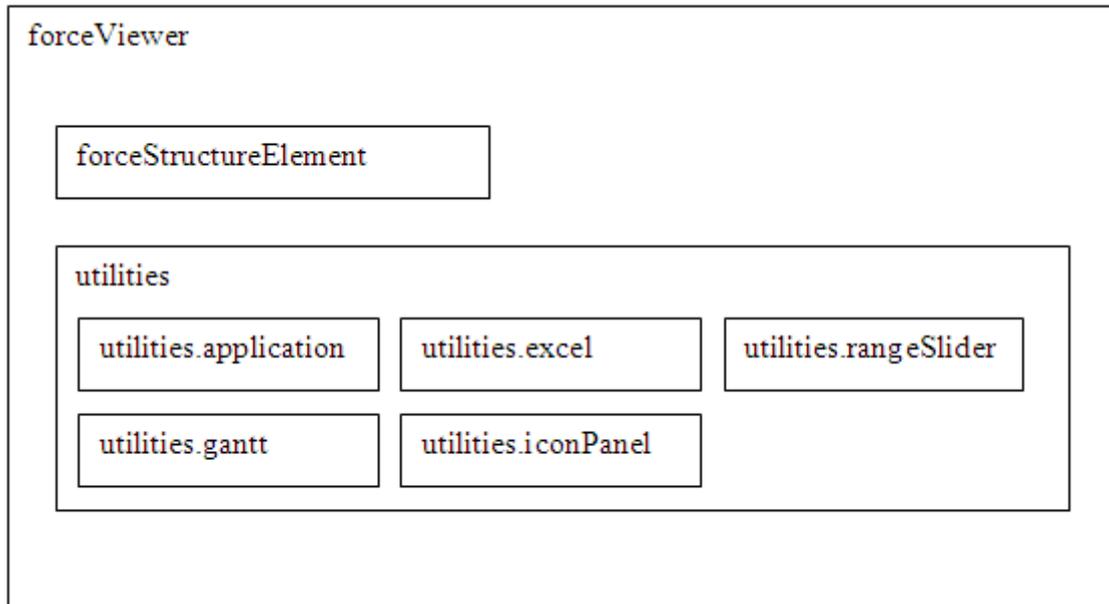
Figure 9: *Code Structure*

5 Structure

5.1 Code

The graphical user interface (GUI) of the tool, as described above is contained in the ForceViewer package as depicted in Figure 9. The GUI is dependent on the two packages *forceStructureElement* and *utilities* described below.

The package *forceStructureElement* contains the classes that represent a capability / force structure element; it contains the code to read and write the force structure from the Excel file discussed below in section 5.2.

The package *utilities* contains the following :

- An application framework *utilities.application* that handles windows positions, recent file handling and applications properties.

- A Microsoft Excel interface package *utilities.excel* This package is an extension of the Apache POI Microsoft Office library. The apache library is not programmatically simple to use. This extension simplifies most of the sheet handling routines.

- A generic Gantt chart package is contained in *utilities.gantt*. An example of the output is shown in Figure 6.

- An icon panel package *utilities.iconPanel* handles the display of the generic block icons in a panel. The main icon panel is show in figure 1.

- The two part range slider is found in *utilities.rangeSlider*. This allows the setting of two values in a range. See section 4.3 for the description of its use.

These utilities do not have any dependencies on each other or on the first two packages and can be used as the basis for other applications.

A number of open source libraries are used to extend the basic Java programming language.

5.2   Data

ForceViewer data is organised into a number of spreadsheets within a Microsoft Excel workbook. The main reason for using Excel as the repository of data is that significant amounts of data are currently in Excel, specifically the DCP and the KDAR. In addition, Excel is readily available on the DSN and allows users to share classified data amongst each other. It also enables the data to be stored in Defence document control systems such as 'Objective' for version control and change tracking.

There is no intention that the user modify any of the force element data directly in the workbook. All changes should be made via the ForceViewer program. However, ForceViewer does not have the ability to change base data such as the data set definitions and force element groups. This has to be done manually in the workbook. This has to be done carefully as ForceViewer assumes that this base data is in the correct format and does very little error checking. This can result in the program being unable to start.

As ForceViewer is a prototype, some of the names used within the spreadsheet are historical oddities. This is to maintain backward compatibility with existing spreadsheets. For example, ForceStructureElement is used to describe a capability element.

The major tabs within the workbook are:

The master list of capability elements are contained within the *ForceStructureElements* worksheet. Each force structure element has a unique identification 'id' assigned to it, which is used as an identifier in other tabs. If this 'id' is changed manually, data associated with it will be lost.

The data associated with each capability element are defined in the *DataSets* worksheet. Each data set is defined in a separate column across the sheet. The data stored for each capability element can either be a single value for each element; a separate value for each year that the element is in service; or a single value that is then divided equally across the years of service, known as a spread value.

Each data set can have any number of defined values against which data is stored. Importantly the values can easily be added to the list, however, if a value name is changed the program will lose all data associated with that value unless the relevant column is changed in each of the data storage sheets described below.

The data for each capability element, as defined in the DataSets worksheet, are stored in a corresponding worksheet. The naming convention of these worksheets is as follows :

If the data set has a data range of either Single or Spread, then there will be a sheet named *FSE to DataSet*, where *DataSet* is the name of the data set. For example, the worksheet *FSE to JCA* will contain the values for the JCA data set.

The intersection of the row / column is the value for the ForceStructureElement / DataSet value pair. To allow for more efficient storage of data by Excel, the value is left blank if a value pair is false or zero (depending on the data type).

If the data set has a data range of either Year, then there will be a sheet named *FSE DataSet - Data Value*, for each value in the data set. The worksheet will have a column for each year of active service by the capability element. For example, the worksheet *FSE Costs - Acquisition* will contain the values for the Costs data set Acquisition value.

The service dates for each capability element are found in the *ServiceDates* worksheet. The value stored is a number for each year representing the 1st of July for that year.

There a number of other base data worksheets contained in the workbook, with the name and content being self-explanatory. However, as stated before, caution should be exercised as values are used in a number of places and could render the entire workbook invalid.

6   Improvements and recommendations

ForceViewer is a prototype that was developed to provide a tool for CDG and also to solicit client requirements. Section 3 lists the requirements as desired by the client for this initial capability. Following this initial set of requirements future possible enhancements were identified. These include:

- Inclusion of cost data.

- Inclusion of personnel data.

- Inclusion of Fundamental Input to Capability (FIC) data.

- Direct link between the tool and data stored in CDG Sharepoint.

- The ability to set capability goals as a function of time.

- The ability to display the difference between the capability goals and the selected force option.

- Advanced assets and projects dependencies.

These enhancements would fit well into the current tool structure, except for capability goals and advanced dependencies. The last three items in the list provide a functionality

to ForceViewer that goes beyond its original design of an SPF tool. We suggest that such features be part of a separate tool that specifically caters for the use of those features.

The initial requirement for ForceViewer was a tool that could be used on the DSN. Given the lengthy process to allow software to be installed on the DSN, ForceViewer was developed as a stand alone tool. ForceViewer could nevertheless be setup on the DSN by requesting the DSN authorities to install Java 1.6 or above and requesting ForceViewer be installed. Installing ForceViewer on the DSN would make the tool accessible to a broader set of users and keep the classified data within the appropriate environment. These are significant benefits that are worth considering.

ForceViewer could also be improved by transforming it into a collaborative multi-user tool. This would allow collaboration between organisations responsible for different data sets within ForceViewer, for example the KDAR and the DCP.

CIOG is developing a comprehensive system as part of the Defence Information Environment (DIE), that may see this type of tool being part of its infrastructure. Capability Needs Analysis Directorate have had discussions with CIOG in this regard for future versions of ForceViewer.

7   Conclusions

The need for a tool to assist in determining the starting point force was identified and proposed to CDG. As a result, a prototype tool ForceViewer, was developed to provide CDG with an interim capability in determining and managing the starting point force data. In addition to a tool, ForceViewer has provided a conduit to consider the types of decision support and data requirements for CDG tasks. The task of assembling the SPF using ForceViewer provided insights into the process and support structure required by CDG to commission decision support tools.

The lessons learnt by the JDSC in developing ForceViewer (in partnership with CDG), provide valuable information on how to develop an idea into a prototype tool for the client. Similarly, CDG awareness in shaping the development of support tools, and the data required for it, increased as a result of this work.

This document has described the features and the structure of an SPF tool. The tool developed has proved useful to the client and a number of future improvements have been identified. Deployment onto the DSN was not achieved, however, future development avenues through CIOG have been identified and are being pursued. This future path will lead in due course to the fielding of a robust solution for the CDG starting point force task.

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19. ABSTRACT

This document outlines the work done in developing ForceViewer, a tool that assists in producing a Starting Point Force. The document outlines the requirements for the tool, the tool itself and the structure of its code. ForceViewer was developed for the Capability Needs Analysis Directorate in Capability Development Group. The prototype tool graphically shows the Starting Point Force in any chosen year. The tool allows for interactive changes to the force and displays the impact on the overall capability. The force is composed of the current assets, the Defence Capability Plan projects and any interim endorsed capability additions. The purpose of the tool is to quickly determine and display the list of all major elements of the force structure in a chosen year. This Starting Point Force can then be given to Defence organisations such as Military Strategy and the Force Structure Review team for further analysis.