



DEVELOPMENT OF USER- FRIENDLY TOOL FOR SPECIFICATION OF HIGHWAY WORKS

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Abstract- In the construction industry, worldwide, there are certain standards or specifications for the design, construction and maintenance of infrastructure. In the United Kingdom, Standards for Highways are used for the preparation of the construction contracts. Depending on the type of works, different guidance documents are available. These guidance documents are very lengthy and consist of various appendices. It is commonly acknowledged that these are not user friendly and require improvement in preparation and implementation. Review of literature has shown that no such tools are readily available for highway contracts. The aim of this paper is to develop a tool for the preparation of specification for highway works, to reduce the preparation time, to develop the consistent document and improve quality. Volume 1 and 2 of The Manual of Contract Documents for Highway Works (MCHW) was considered in the development of this tool. After the addition of technical data, using the MCHW, past specifications were examined to determine a consistent format. Macros were used to program the tool on a Microsoft Word document. First, the variable words, within the template, were identified and tagged so they could be coded. The user interfaces were then created and reviewed to ensure that they were user friendly. The specification was then tested on a project where works were to be completed. After testing, it was concluded that, with the step by step guide, the tool was user friendly and easy to use. This helped save time, when completing the specification, by more than 50% and reduced the overall cost of project.

Keywords- Manual of contract document for highway works (MCHW), Highways England (HE), Specifications, appendices, tool.

1 INTRODUCTION

In the United Kingdom, for all highway construction works procurement processes, with or on behalf of Highways England (HE), the Standards for Highways are used for the preparation of the construction contracts. They provide the essential documents for the design, construction and maintenance of highways [1]. Depending on the type of works to be completed, there are different manuals providing guidance notes. The Manual of Contract Documents for Highway Works (MCHW) provides the documents required for the preparation of contracts for trunk road works. Trunk roads are motorways and all-purpose roads for which the overseeing organisations are responsible. MCHW was first published in 1992 and consists of six volumes and an introduction incorporating the mandatory requirements of EU legislation [1]. Table 1 details the type of volumes included in MCHW.

The Specification for Highway Works is Volume 1 of the MCHW. It contains the requirements and approval procedures during construction, improvement or maintenance work, goods or materials on trunk road networks. The specification can be used to ensure that the works meet the required standard whilst helping contractors to price the projects. Volume 2 of the MCHW gives advice and guidance on how to implement the information given in Volume 1 and provides examples of Appendices for contracts. Technical data and project specific information is included within the contracts. The remaining volumes are not considered in the scope of this paper.



Table 1: MCHW volumes

Volume	Name
0	Manual Contract Document for Major Works and Implementation Requirements
1	Specification for Highway Works
2	Notes for Guidance on the Specification for Highway Works
3	Highway Construction Details
4	Bills of Quantities for Highway Works
5	Contract Documents for Specialist Activities

To assist in the designing and constructing of highways, tools are commonly used to handle sets of data [2,3]. Fox et.al have researched 'Practical Tools for Low-Carbon Road Design and Construction'. They found that tools can add value during the design, construction and reporting by simplifying the process, ensuring clarity and improving the quality. Furthermore, comparison studies have been completed in the past on the MCHW. For example, Eadie et al. investigated, through surveys, the most popular methods of measurement for civil engineering work. They concluded that the MCHW was not user friendly [4,5]. A literacy research has shown that no such tools are readily available for highway contracts. This paper, therefore, illustrates the development of the tool for the Specification for Highway Works.

WSP regularly work with HE, requiring the Specification for Highway Works to be used to develop contracts. Currently, this is extremely time consuming as the content of the contracts are bespoke for each project. This paper describes a tool which significantly reduces the time to fill in the contract, helping to save money on future projects. It ensures no aspects of the contract are missed which could result in the contract being rejected. Further to this, the tool allows for the contracts to be user friendly and the quality of the contracts is maintained [6,7].

2 METHODOLOGY

Figure 1 shows a flow diagram of the methodology for developing the specification template tool.

2.1 Background Information

For the specification, the up to date information and consequent formatting needed compiling into a single report to enable it to be used as a template for the tool. To complete this, Volume 2 of the MCHW, which contains guidance notes for the Specification for Highways Works, was used to ensure that the Appendices were included. Volume 1 was also used as it included technical data. Originally, only the general and bearings sections were included in the template, however, now the tool is operational, the remaining sections have been incorporated. After adding the technical data, using the MCHW, past specifications were examined to determine a consistent format and to confirm what other information was needed. An example of this was background information regarding the project and works to be completed. This also helped to incorporate the cover pages and other information included within the specification. Using previous projects, parts of their specifications were identified that could be useful for the tool.

2.2 Creating the tool

Once the formatting and the template was completed, Macros were used to program the tool on a Microsoft Word document. First, the variable words, within the template, were identified and tagged so they could be coded. An example of the variable words included the name of the project, the project number and the date. To tag the variable words, the words were highlighted and then, within Developer, Design Mode were selected, and the properties changed to include a tag. Afterwards, the user interfaces were created, and peer reviewed to ensure they were user friendly. The first user interface included the variable information that would be consistent throughout the report, such as the project name. The



next user interface was to specify which Appendices and sections needed to be within the specification. These were split into tabs so that the user could easily see which Appendices were relevant for the works they wanted to complete. For example, there was a “general” tab and a bearings tab which led to the relevant Appendices and sections. The final user interface included the variable information that needed to be filled in, based upon which sections and Appendices were included within the specification. Once the information was incorporated in the user interfaces, it was formatted.

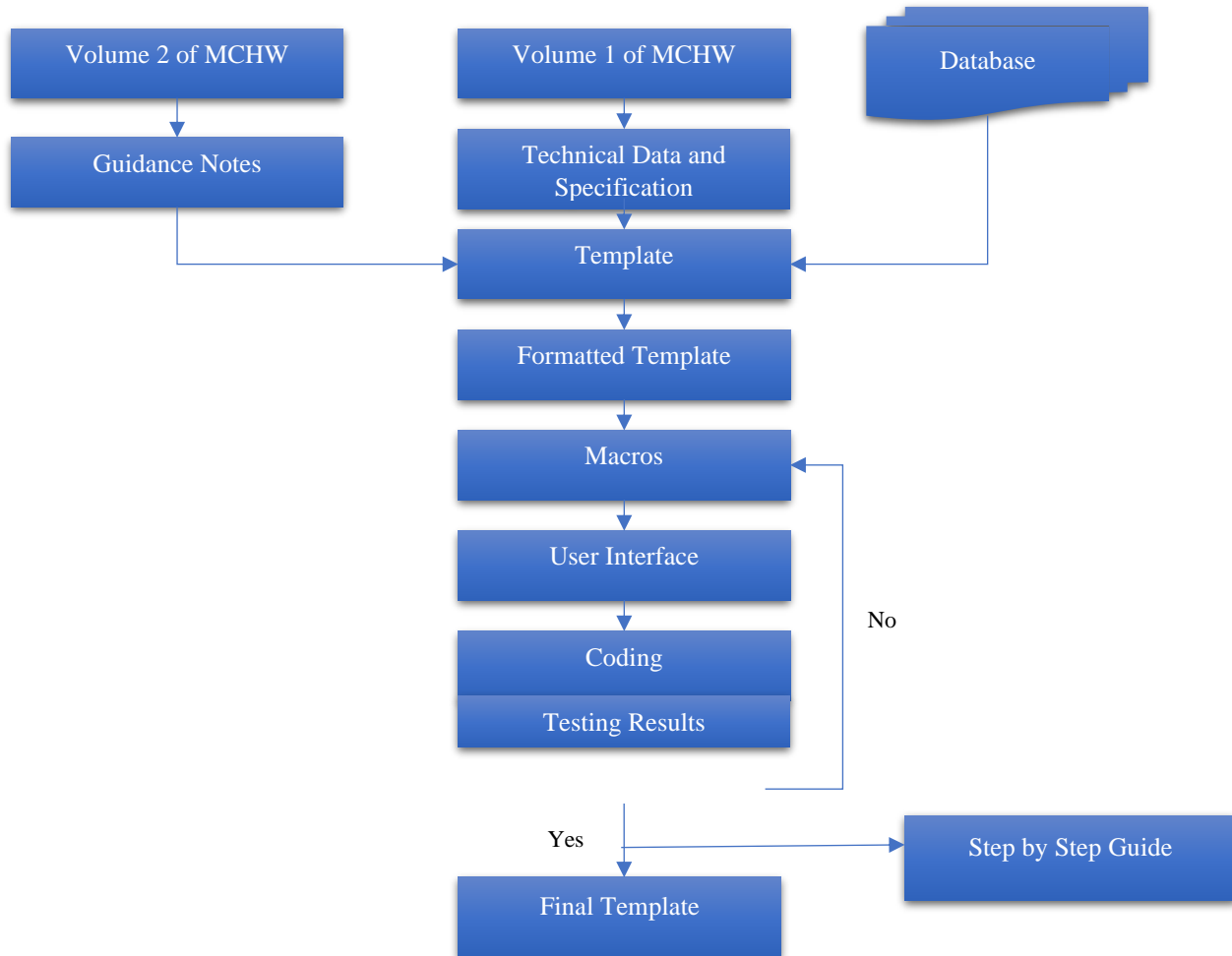


Figure 1: Flow diagram of methodology steps for the specification template

The final part of the tool to be completed was the coding. This was accomplished by using the Macros and ensuring that, when the user interfaces were filled in, the information was then inputted into the correct places. An example of the coding used for the variable words can be seen in Figure 2.

The Appendices were also added to the specification, in the correct order and with the correct formatting. The specification was then tested on a project where works were to be completed, to ensure accuracy. After testing the coding, any errors were corrected. The document was finally modified into a template so that original cannot be modified. A step by step guide was created for anyone wishing to use the tool. The specification was then tested by other users, within the Company, who confirmed that the guide and tool were easy to use and accurate.



```
'Updating the Project Title in the document.  
Project_Title = Me.TextBox1.Value  
For Each CC In ActiveDocument.ContentControls  
    If CC.Title = "TX_Title" Then  
        CC.Range.Text = Project_Title  
    End If  
Next CC  
For i = 1 To ActiveDocument.Sections.Count  
    For Each CC In doc.Sections(i).Headers(wdHeaderFooterPrimary).Range.ContentControls  
        If CC.Title = "TX_Title" Then  
            CC.Range.Text = Project_Title  
        End If  
    Next CC  
    For Each CC In doc.Sections(i).Footers(wdHeaderFooterPrimary).Range.ContentControls  
        If CC.Title = "TX_Title" Then  
            CC.Range.Text = Project_Title  
        End If  
    Next CC  
Next i
```

Figure 2: Coding used to set up the tool with the variable words

3 RESULTS AND DISCUSSION

Figure 3 shows the results of the tool and demonstrates the process for using the tool.

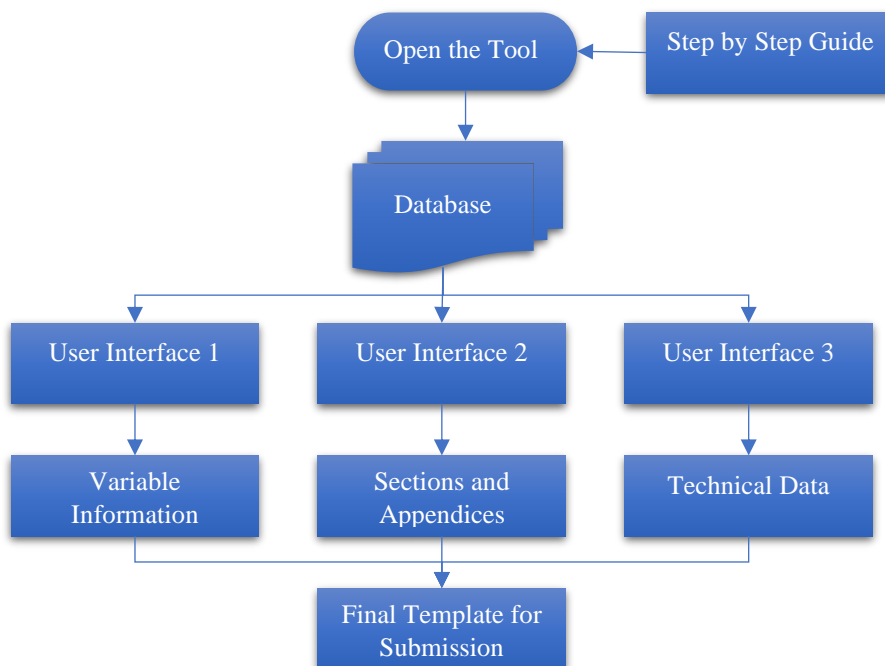


Figure3: Flow diagram demonstrating how the tool is used

Figure 4 shows the first user interface where variable information, including the area and project title, would need to be inputted.



Project Information

Project Information

Area:

Project Title:

Date:

Project Ref:

Project No:

Update Finish

Figure 4: User interface 1 of the tool for the Specification of Highways Works

The tool allows only the data to be input into the interface and then, because the specification is formatted, the information is kept constant, helping to improve the overall quality of the specifications. The data only needs to be entered once; the tool then inputs the variable information into the correct places within the specification.

User interface 2 is shown in Figure 5 and allows users to tick which Appendices are appropriate for the works to be completed.

Inserting Appendix

General Appendix | Expansion Joint Appendix | Bearing Appendix | Waterproofing | Concrete Repairs

Expansion Joint Appendix

- Appendix 5/1: Drainage Requirements
- Appendix 7/1: Permitted Pavement Options
- Appendix 7/2: Excavation, Trimming and Reinstatement of Existing Surfaces
- Appendix 7/4: Bond Coat, Track Coats and Other Bitumous Sprays
- Appendix 7/9: Cold Milling (Planing) of Bitumous Bound Flexible Pavements
- Appendix 11/1: Kerbs, Footwats and Paved Areas
- Appendix 12/3: Traffic Signs, Road Markings and Studs
- Appendix 17/1: Concrete - Classification of Mixes
- Appendix 17/4: Concrete - General
- Appendix 17/73: Concrete Condition Survey
- Appendix 17/74: Concrete and Mortar Repair Areas
- Appendix 23/1: Bridge Deck Expansion Joints Schedule

Figure 5: User interface 2 of the tool for the Specification of Highways Works

Figure 5 demonstrates the different tabs that contain the specific Appendices relating to the works. This is beneficial as it ensures that all the technical and non-technical information is considered and readily available to input at the same



location. This helps to ensure that no parts of the specification could be missed, which could result in rejection of the whole specification by the Client.

Figure 6 shows user interface 3 where the technical data for the Appendices and sections are inputted.

Figure 6: User interface 3 of the tool for the Specification of Highways Works

Similar to the other interfaces, all the variable information for the specification can be input in the same area and the tool will ensure it is positioned into the correct place. This helps to significantly reduce the time, by up to 50%; it usually takes a week to complete a specification without the tool, therefore, the tool aids efficiency on time and consequently helps to save money on projects.

Finally, after testing the tool on an additional project, it was concluded that, with the step-by-step guide, the tool is user friendly and easy to use. This again helped to save time when completing the specification and resulted in the preparation of a good quality document.

Currently, the tool is limited to a few clauses from the specification which are, the concrete repair, joint replacement and resurfacing. However, it is possible to add further clauses to the specification, when needed, as the template has now been prepared.

4 CONCLUSION AND RECOMMENDATIONS

The development of a user-friendly tool for the Specification for Highways Works has been represented in this paper. The following conclusions have been drawn:

- The development of the tool helps to significantly save time when completing specifications as all the information is input into the same place once only. This can help projects to save money as it saves time.
- The quality of the documents are improved as the tool ensures there is consistent formatting throughout.
- As the information needed to be input into the document is located in the tool, it helps to ensure that none is missing from the specification, which could lead to it being rejected.
- Finally, it has been demonstrated that using the tool and the step-by-step guide helps to make the MCHW user friendly and simple to use.

Based on the developed and tested tool, the following recommendations are made:

- A similar tool needs to be implemented for other construction elements and new designs in a future study.
- The tool needs to be developed in a future study to work out the actual time and cost savings in a project.



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