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TOMCAT: An Obsolescence Management Capability Assessment Framework

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Abstract. As the UK Ministry of Defence (MoD) moves away from the traditional support contracts to contracting for availability/capability, it is essential that the MoD has confidence in Industry's capability to manage the risk of obsolescence. For this purpose, it was necessary to develop a set of metrics which will demonstrate Industry's ability to take on greater responsibility and ownership of the risk of obsolescence. These metrics will be utilised by the MoD to: incentivise Industry to develop a long-term capability in obsolescence management; ensure the risk of obsolescence resides in the right place; and ensure the risk to availability and impact on whole life costs is managed effectively.

The development of these metrics was carried out following a qualitative research approach. It enabled the development and validation of common terminologies regarding obsolescence management capability and a set of metrics to measure the capability of a contractor to manage obsolescence. The eight key elements considered are as follows: obsolescence management governance; supplier; design for obsolescence; risk assessment; obsolescence monitoring; communication; and obsolescence resolution process. Each element was assessed on its importance, impact and feasibility to establish a ranking, and was further broken down into major constituents. They formed the basis of the final 25 metrics, which were then ranked and weighted accordingly. These metrics are embedded into the Total Obsolescence Management Capability Assessment Tool (TOMCAT), which will provide a mean for contractors to perform a self assessment and a mean for the MoD to set obsolescence management capability improvement targets.

The TOMCAT tool was tailored to capture the capability of a contractor and the PT to manage obsolescence for a particular contract. It was also subjected to rigorous industry scrutiny through different means, including workshops and piloting sessions, which led to refining the TOMCAT tool and the way in which the metrics are formulated.

The tool has been developed on a software platform which enables its deployment as a standalone tool or as a web based application. The MoD is planning to standardise the usage of this tool by incorporating it to the obsolescence management policy for defence contracting.

1. Introduction

In long-lifecycle projects, obsolescence has become a major problem as it prevents the maintenance of the system. This is the reason why obsolescence management is now an essential part of the product support activities in sectors such as defence, aerospace, nuclear and railway; where systems need to be supported for several decades. In the defence sector, as the UK Ministry of Defence (MoD) is moving away from the traditional support contracts to contracting for availability/capability, it is essential that the MoD has confidence in industry's capability to manage the risk of obsolescence. For this purpose, it became necessary to develop a set of metrics which can demonstrate industry's ability to take on greater responsibility and ownership of the risk of obsolescence. These metrics will be utilised by the MoD to:

- Incentivise industry to develop a long-term capability in obsolescence management.
- Ensure the risk of obsolescence resides in the right place within the supply chain.
- Ensure the risk to availability and impact on whole life costs is managed effectively.

This paper begins by explaining the research methodology that has been followed. Thereafter, the TOMCAT framework and its metrics are described. Finally, the implementation of the TOMCAT into a software tool and its application methodology are explained.

The aim of this research is to develop a set of performance metrics for the MoD which will allow them to measure the current capability in obsolescence management of the contractors.

The objectives of the research covered by this paper are:
(1) Develop and validate metrics for total obsolescence management capability
(2) Develop an assessment tool to be used by both MoD and primes

2. Research Methodology

The development of the metrics to assess the capability for managing obsolescence was carried out in two phases. The first phase consisted of a qualitative research approach involving eight semi-structured interviews and one workshop. Twelve experts from prime contractors and Project Teams (PT) participated, and enabled the development and validation of common terminologies regarding obsolescence management capability and a set of metrics to measure the capability of a contractor to manage obsolescence. This task was carried out by a team of seven MSc students from Cranfield University. Each element was assessed on its importance, impact and feasibility to establish a ranking, and was further broken down into major constituents. They formed the basis of the final 25 metrics, which were then ranked and weighted accordingly. These metrics are embedded into the Total Obsolescence Management Capability Assessment Tool (TOMCAT), which will provide the means for contractors to perform a self assessment and the means by which the MoD can set obsolescence management capability improvement targets. The process followed in this phase of the research is outlined in Figure 1. As part of that process, the most suitable metrics were decided using the following criteria: importance, impact and feasibility, as described in Table 1.

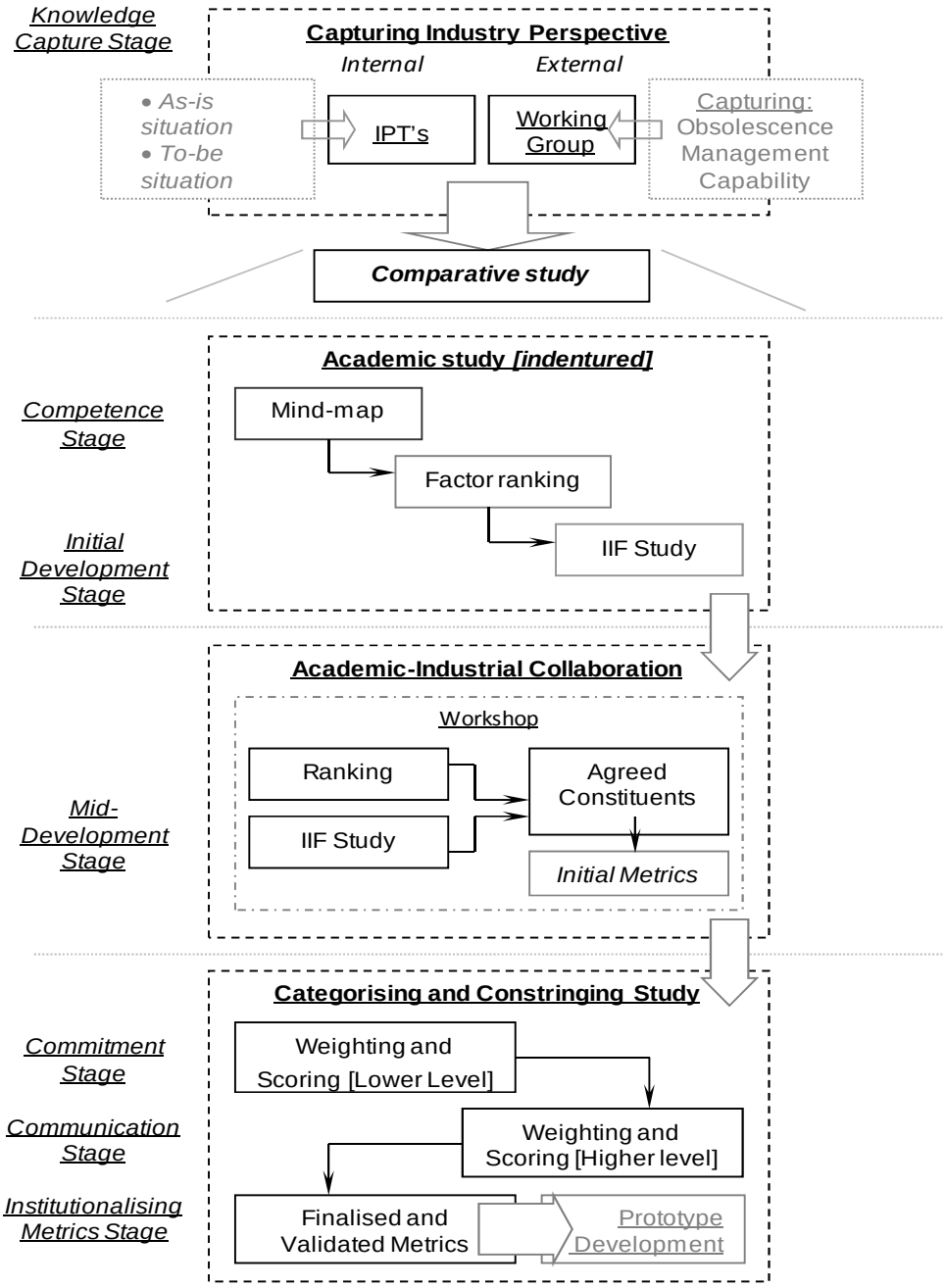


Figure 1. Research Methodology

In the second phase of the development, although the fundamental nature of the metrics remained unaltered, the TOMCAT tool was designed to capture the capability of a contractor and the Project Team (PT) to manage obsolescence for a particular contract. During this phase, the TOMCAT tool was subjected to rigorous industry scrutiny through different means: two workshops with obsolescence experts from prime contractors and PT; informal pilots with two prime contractors; and a formal pilot with the Eurofighter Radar project, involving the obsolescence managers from the PT, prime contractor and subcontractor. This led to the refinement of the TOMCAT tool and the way in which the metrics are formulated.

Table 1 Importance, Impact and Feasibility (IIF) criteria definitions

Criterion	Definition
Importance	Factors that contain authoritative and relevant influence in regards to the capability of Obsolescence Management.
Impact	Factors that contain a strong effect and enforce a forceful consequence in regards to the capability of Obsolescence Management
Feasibility	Factors that possess the quality of being achievable with means at hand and circumstances as they are in regards to the capability of Obsolescence Management.

The next section provides a more detailed description of the metrics, explaining how they are used in the TOMCAT tool.

3. TOMCAT Metrics

There are certain activities required to implement a successful proactive Obsolescence Management (OM) strategy as documented in the International standard IEC 62402:2007 Obsolescence Management – Application Guide [1]. Currently the TOMCAT process involves seven activities, which are as follows:

- Obsolescence Management Governance
- Supplier
- Design for Obsolescence
- Risk Assessment
- Obsolescence Monitoring
- Communication
- Obsolescence Resolution Process

These activities are further broken down into their major constituents, which form the basis of the 25 metrics. The following table describes the distribution of the number of metrics within each activity (Table 2).

Table 2 Number of Metrics per Activity

Activities	Number of metrics
OM Governance	3
Supplier	3
Design for Obsolescence	4
Risk Assessment	5
Obsolescence Monitoring	3
Communication	4
Obsolescence Resolution Process	3
Total	**25**

Two examples of metrics from different activities, namely “OM Governance” and “Design for Obsolescence”, are presented as follows.

- Activity OM Governance

Metric ***How has the MOD defined the appropriate requirements / contractual conditions in order to proactively manage the obsolescence risk?***

Definition This metric is to evaluate how well the responsibility for managing the obsolescence risk has been defined contractually or within requirements documentation prior to contract award.

Regulatory Compliance	JSP 886 Volume 7 Part 8.13 Obsolescence Management and / or the Commercial Policy Statement [2]
Recommended Evidence	Contract, Requirement Document
Weighting	60%

- Activity Design for Obsolescence

Metric	***How has obsolescence risk been incorporated within design procedures and processes?***
Definition	The purpose of this metric is to assess the importance of managing obsolescence risk in the design stage. It investigates whether this issue is incorporated within design.
Regulatory Compliance	BS EN 62402:2007, paragraph 7.4.1 – Design Considerations and paragraph 7.4.2 – Technology transparency [1]
Recommended Evidence	Obsolescence Management Plan (OMP) / procedures and processes, design review checklist, minutes from review meetings
Weighting	40%

Metric supplementary questions

To further help the assessor benchmark the evidence against each metric, so-called supplementary questions have been introduced and given a specific weighting. The following are examples of supplementary questions from the metrics presented above. Metrics within a single activity can have either "Project Team Supplementary Questions" or "Contractor Supplementary Questions". Both of the following examples constitute part of contractor supplementary questions.

An example of a supplementary question for the first metric above is as follows: "Is there an OMP developed for this project?". For the second metric above, an example of a supplementary question would be: "Show me an example of how Design considerations are embedded in Design Engineers documentation".

Metric Weights

Depending on its importance (High, Medium, Low) within each activity, the metric is given a weight represented as a percentage. At the same time, the activities may have different weights, depending on its relative importance.

Metric Scoring

The metric scoring mechanism is based on the European Foundation for Quality Management (EFQM) methodology [3]. The score for each metric depends on the evidence provided. A 100% mark would mean the user has scored equal to the weight given to the metric. Depending on the evidence available the user can give each metric a score by using the following scale as shown in Figure 2.

Not Defined				Partially Defined						Defined						Clearly Defined				Comprehensively Defined		
0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100		

Figure 2. Scoring Scale for Metrics

The knowledge and expertise of the assessor is vital in understanding if the obsolescence management activity of the metric is relevant for the complexity of the project being assessed. In light of relevance, the assessor can choose whether the metric is applicable or not depending on his or her judgement. If the metric is not applicable, the overall weighting of all other metrics within the activity are recalculated.

As mentioned above, each metric has a set of supplementary questions to get a more accurate score for that metric. Each supplementary question has been allocated a specific weighting, and by successfully demonstrating the evidences required for each supplementary question, it will contribute to the increase in the score for that metric. The user/assessor can either select "Yes" or "No" for each supplementary question to calculate the metric score automatically or use the scale to give a score, as shown in Figure 3. The overall score is calculated by adding the scores of all activities.

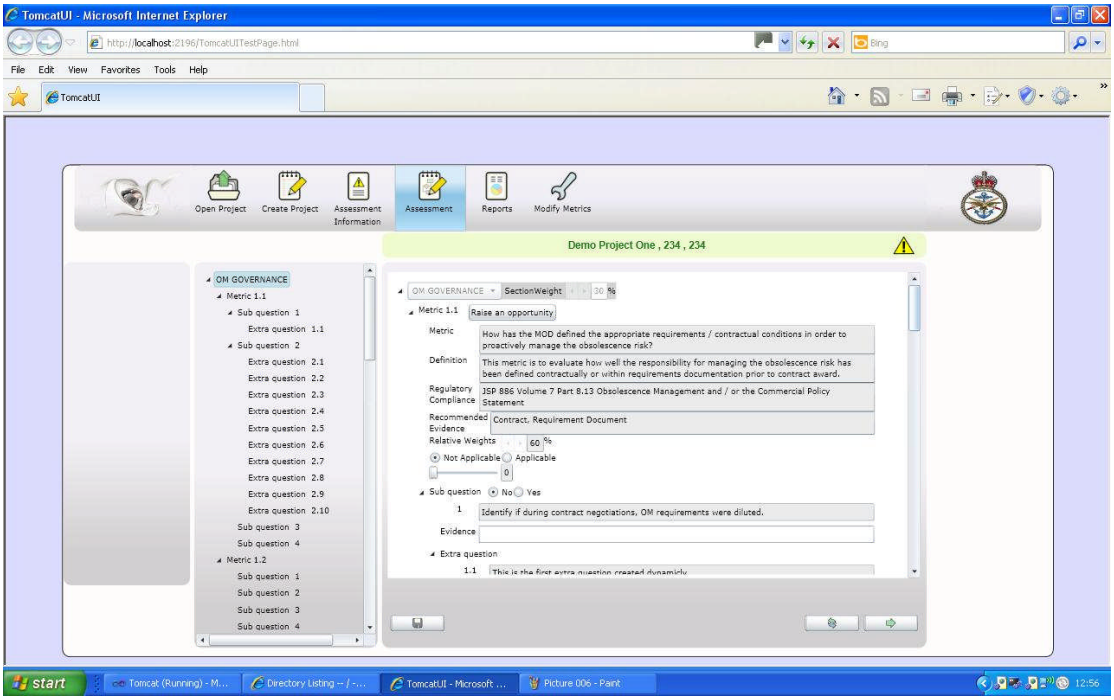


Figure 3. Snapshot of Metrics Assessment in TOMCAT

By adopting the ISO 9001 philosophy of continuous improvement, the functionality of the tool will be enhanced to enable the assessor to record and monitor an "Opportunity for Improvement" against a specific metric. This will enable the assessor to identify any areas of the Obsolescence Management strategy that do not align with OM policy. The "Recommended Corrective Action" will enable the Contractor to concentrate their efforts implementing the appropriate action to improve future capability.

4. TOMCAT Implementation

TOMCAT software is owned by the MoD and has been developed in collaboration with Cranfield University. This software can be used to self-assess Obsolescence Management (OM) capability within an organisation or used by an external assessor for evaluating the OM capability of all the stakeholder of a particular project.

TOMCAT assessment, as shown in Figure 4, is a two-part process where the assessor first gathers required information from the stakeholders (i.e. project teams and contractors) by sending them a project team assessment form and the contractor assessment form. These can be downloaded from the software's report section. The assessor then gathers further evidence by visiting each site location and assessing the information available against the forms sent. If required, the assessor may ask for more data at this point.

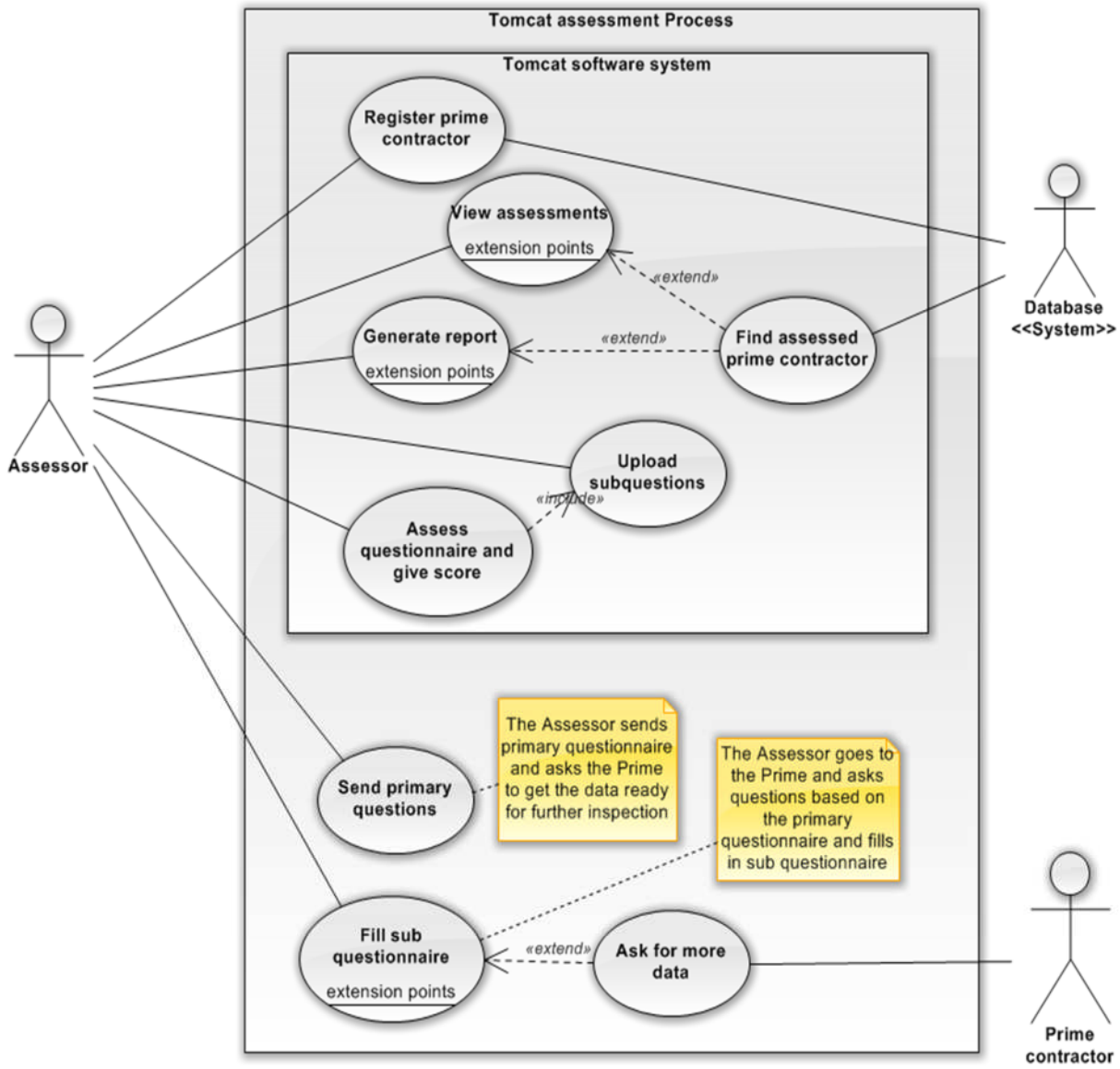


Figure 4. Unified Modelling Language (UML) Diagram of TOMCAT Process

After the data gathering process is complete, the assessor creates an assessment as shown in Figure 5 and fills in the data gathered from the visit, as shown in Figure 6; and finally fills the TOMCAT assessment in the assessment section of the software as shown in Figure 3. This is done by going through each supplementary question and ticking either yes or no depending upon the findings from the assessment forms. The software then calculates the score and presents it in a report, as shown in Figure 7. This report can be downloaded from the report section of the software.

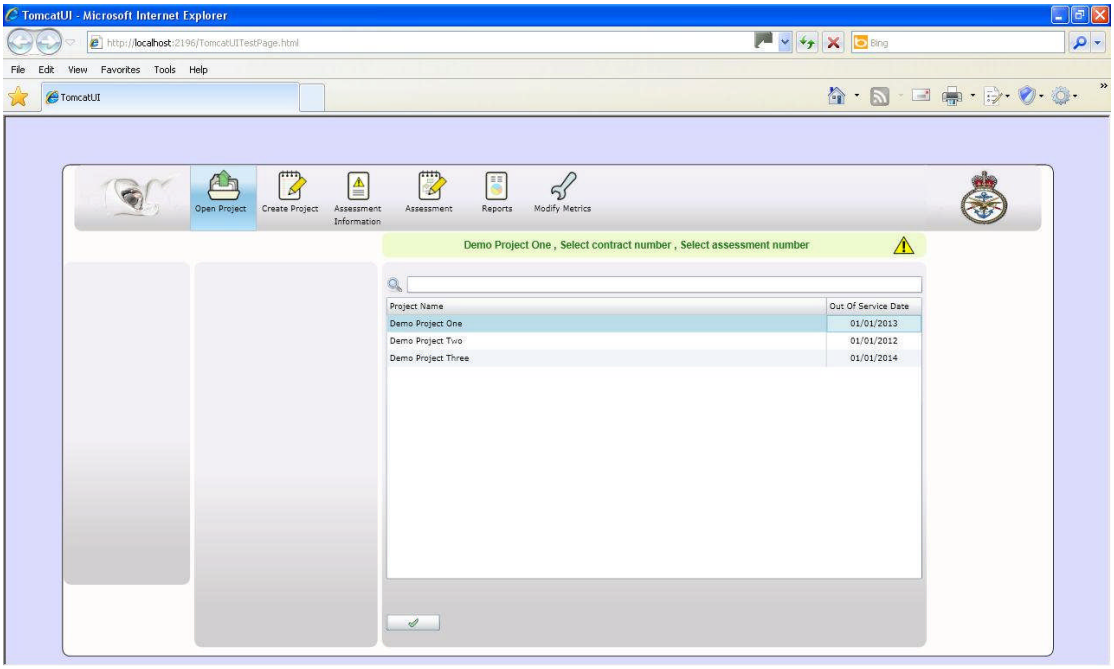


Figure 5. Snapshot of Assessment Creation in TOMCAT

The user starts by selecting an existing project or creating one, the screen in Figure 5Figure 5 is an example of this process. The user has the ability to create a contract and then an assessment within a contract. Once done, the software takes the user through a set of data inputs by following the 'next' button on the screen. After all the data has been input, the user can complete the assessment as follows. A report is generated with the overall score and that of each individual metric. This report can be emailed back to the assessor for further scrutiny.

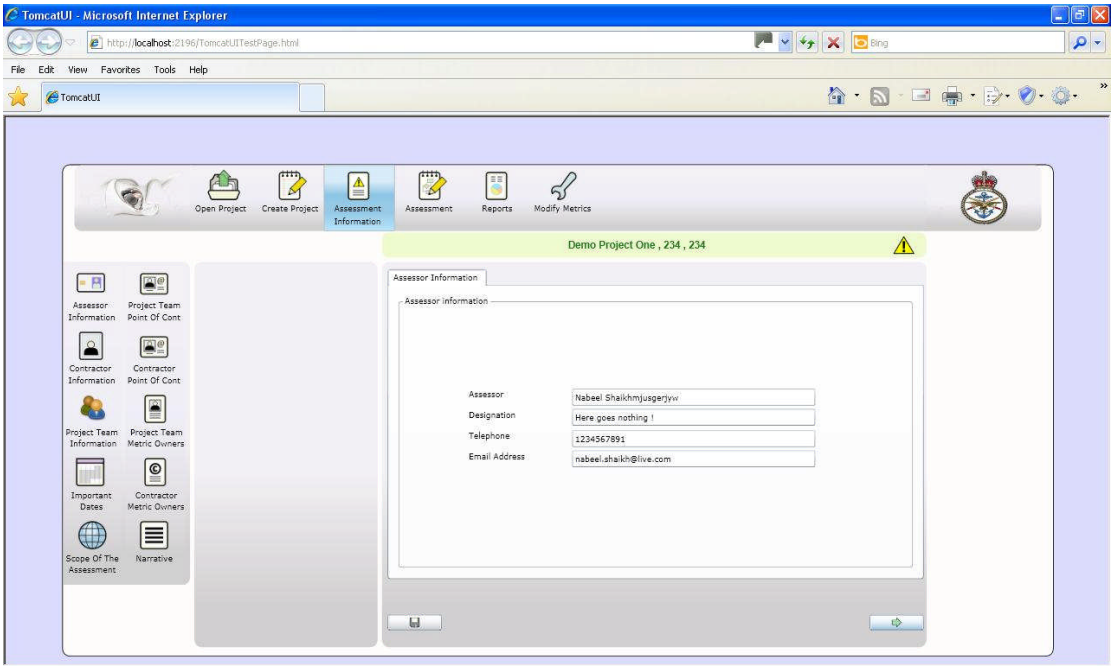


Figure 6. Snapshot of Assessment data input in TOMCAT

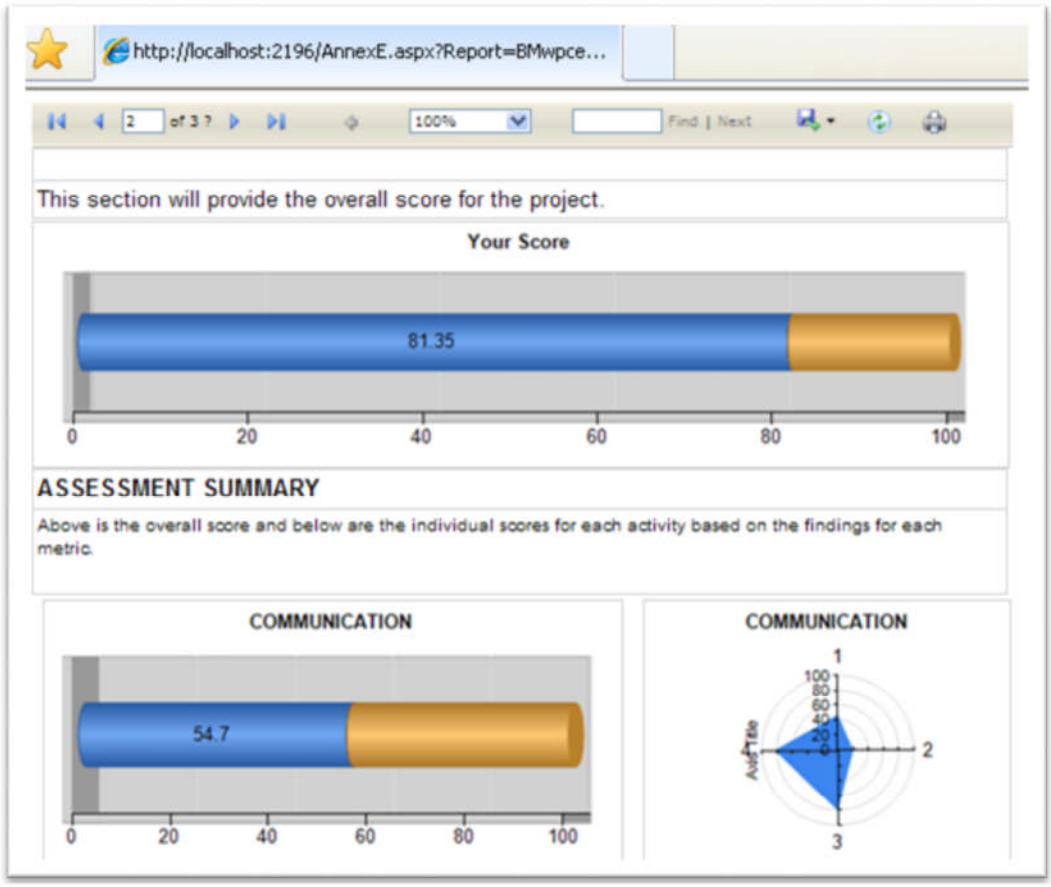


Figure 7. Snapshot of Assessment Report in TOMCAT

5. Discussion and Conclusions

Obsolescence Management is a significant part of Product Service Systems research (Cranfield Innovative Manufacturing Research Centre, EP/E001874/1) appropriate for application in the context of capability and availability contracts. In particular it is apparent that if companies are not pro-active about obsolescence management then the costs and lead times in managing obsolescence are so much greater than if a pro-active stance is not taken. Therefore a tool to encourage such pro-active capability in organisations is a key strategic enabler.

Defining cost engineering aspects of obsolescence management is important and also potentially difficult ([4], [5]). For example costs avoided through obsolescence management can be potentially interpreted as costs saved. This is an important distinction and debate in obsolescence management.

Without TOMCAT one of the significant cost drivers for the full life cycle cost would not be addressed or managed leading to potential opportunities for cost avoidance being lost ([5], [6]). Current research at Cranfield University is also focussing on the potential link between obsolescence and availability and how to quantify a trade-off in investing in obsolescence mitigation strategies and in payoffs relating to availability targets.

TOMCAT was initially developed as an Excel based tool which was useable by the MoD but still not fully at commercial software standard. A research grant from the Engineering Physical Sciences Research Council (EPSRC) called KT Box has allowed the further development to professional level of the tool and its interface. Part of the improvements from prototype to commercial level of the TOMCAT as a software tool is the flexibility in defining new metrics in the future.

TOMCAT provides a tool developed with a reasonably robust research methodology that allows a consistent and repeatable form of measurement of obsolescence management capability. The strength of the research is in identifying a set of metrics with industry supplier and customer as defined by the research methodology in Section 2.

The significance of this research lies also with the participation and sponsorship of the MoD. The MoD and seven companies took part in the research involving 50 hours of interviews and workshops with leading experts in obsolescence. The research methodology involved a narrowing down of metrics from an initial identification of about 60 metrics to about 20 metrics. Hence the value in the research has been in the process of selecting the metrics and in the significance of the organisations in the UK who took part in this process.

The TOMCAT tool facilitates the move to risk sharing with the customer and supplier. The metric scales are defined using clear qualitative statements agreed through the research methodology in Section 2. Accuracy of the metric scores are thus reflected in this way. Usability and understanding are two issues important for the MoD to impart to its suppliers. In view of this there is clear visualisation of the results through radar charts and bar charts.

In summary benefits to the MoD of using TOMCAT are:

- Ensuring obsolescence risk is placed with the right partner
- Joint development of metrics for obsolescence management with industry
- The support of contractors to improve their capability
- Better understanding of contractor's capability

The benefits to industry are:

- Better understanding of the priorities of the MoD
- Improved communication with the MoD in terms of obsolescence issues
- Using good practice to improve obsolescence management capability

The tool has been developed on a software platform which enables its deployment as a standalone tool or as a web based application. This is important for the purposes of version control for the MoD.
So therefore in conclusion:

- This research has developed metrics for obsolescence management capability assessment.
- Initial prototype software has been developed which has subsequently been developed into full professional software used in the assessment of obsolescence management capability of suppliers by the MoD and also self assessment by the supplier.
- The metrics to assess capability in obsolescence management have a strong basis from a research methodology conducted with UK industry and the MoD.
- The tool continues to be used by the MoD and has capability to have obsolescence management capability metrics re-defined and added to and then delivered as a software tool which is application based or web based.

6. References

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