

Comparison of Requirement Management Software

by

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Abstract

The importance of gathering requirements that address a business need cannot be over emphasized. For IT projects to be successful, it is essential to gather and manage requirements until the project is satisfactorily delivered. This is where Requirement Management software come in and the essence of this research study.

The objective of this research is to compare requirement management software based on a set of selected criteria, and present findings from this comparison to be used as a starting point for organizations in their search for requirement management software. The study also contributes to the business analysis community by describing benefits and limitations of requirement management software. Lastly, the objective is to contribute to the body of knowledge in the area of evaluating different requirement management software.

The study identifies sixty-three requirement management software tools from articles and twenty-two from discussion forums (blogs), making a total of eighty-five. Based on the surveyed sources, a set of fifteen features has been selected to be used to compare this software. As a result, two groups of leading requirement management software tools have been recognized. The first group includes IBM Rational DOORS and Modern Requirements, while the second one is composed of IBM Rational Requisite, Caliber-RM and Cradle.

Key words: requirement management software; types of requirements; features for comparing requirement management software; and IBM Rational DOORS and Modern Requirements.

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Chapter 1: Introduction

1.1 Software Requirement

“A requirement is a usable representation of a need” (IIBA, 2015). It represents a stakeholder’s need to solve a problem or achieve an objective. There are four types of requirements including business, stakeholder, solution and transition.

Business requirements describe the reason for developing a system and/or initiating a change, and includes goals, objectives and outcomes.

Stakeholder requirements specify the need of stakeholders (including users) that must be met to achieve the objectives of the business requirements.

Solution requirements describe the features and functions of the solution to meet the stakeholder requirements. Solution requirements are further divided into functional, that is, the capabilities that the solution must have vis a vis capabilities and behaviour. Functional requirements are those things that the system can do. While non-functional requirements describe the quality characteristics of the solution, that is, conditions under which the solution remains effective.

Lastly, *transition requirements* are capabilities that the solution must have to facilitate a smooth transition from current state to the future state.

The importance of gathering requirements that addresses business needs cannot be over emphasized. This is further corroborated by the CHAOS Report of the Standish Group (The Standish Group, 2016). The Group has been publishing reports on factors leading to successful, challenged and failed projects since 1994, titled CHAOS Reports. The reports are updated annually, and classify project outcomes into: successful, challenged and failed. A successful project is a project that finishes on time, within budget and to scope. A challenged project is such that the project is NOT completed on time, within budget and to scope. Failed projects are those that are cancelled and never completed. Five factors that contribute to project success are: 1) user involvement; 2) executive management support; 3) clear statement of requirements; 4) proper planning; and 5) realistic expectations. The third factor is explicitly associated with requirements,

while other factors are linked with gathering stakeholder's requirements. On the flip side, the top five indicators for challenged projects are: 1) lack of users' input; 2) incomplete requirements & specifications; 3) changing requirements & specifications; 4) lack of executive support; and 5) technical incompetence. Again, two of these are associated with requirements.

Consequently, for IT projects to be successful, there is a need to gather and manage requirements until the project is satisfactorily delivered. This is where Requirement Management Software comes in. It is the topic of the research presented here. It focuses on reviewing publications, on-line forums (blogs) and other sources describing requirement management software, and on their comparing and ranking based on a set of established criteria.

1.2 Problem Statement

Despite the importance of managing the lifecycle of requirements for project success using a good requirement management tool, the basic limitations of existing surveys and reviews is comparison of requirement management software in order to address specific needs of an organization or to solve a particular problem. For example, Clark (2006) investigates requirement management best practices and relates them to the needs of Systems Engineering in shipbuilding industry.

The author also compares and analyzes two requirements management tools to determine if they are best suited for the shipbuilding industry. However, he fails to include other requirement management software, and his primary aim seems to be the validation of usefulness of the DOORS to shipbuilding industry.

Similarly, Kuutti (2019) compares the use of IBM Rational DOORS and HP ALM within the client company, but on different projects. Again, the analysis is limited in scope to two requirement management software tools, and the selection of software and the comparison criteria are not based on current body of literature.

Therefore, the previous research studies did not use the existing literature or blogs to justify the selection of requirement management software and the comparison criteria.

To address a need for a comprehensive comparison of software requirement management tools primarily based on literatures and online forums (blogs), this study aims to:

1. Identify a list of requirements management software based on published research papers, requirement management blogs, and other sources.
2. Select candidate requirement management software for comparison based on the existing literatures and blogs, and author's own experience in requirement management.
3. Establish a list of criteria used to evaluate requirement management software based on studied articles and blogs.
4. Determine criteria that will be used to compare selected requirement management software.
5. Compare the software based on our chosen criteria, and the adopted evaluation techniques.
6. Analyze findings and deduce conclusions.
7. Recommend top tier requirement management software for consideration by organizations with such need.
8. Discuss limitations and define opportunities for future research work.

1.3 Overview of Remaining Chapters

Overview information of the remaining chapters of this study is provided below.

Chapter 2: Literature Review

This chapter presents a review of selected literatures and online forums (blogs), and their relative contributions to the research study.

Chapter 3: Research Methodology

This chapter presents: research aims; data collection and analysis process; research process; and five research questions.

Chapter 4: Selected Software and Features

This chapter presents historical information on selected requirement management software, their features and limitations. The chapter also presents overview information about the selected features that would be used to compare the requirement management software.

Chapter 5: Comparison of Software

This chapter presents a comparison of requirement management software and our analysis of the result of the comparison.

Chapter 6: Conclusions and Future Work

This chapter presents conclusions from the research study and to what extent it addresses the research questions. It also provides limitation of this study and consideration for future work.

Chapter 2: Literature Review

2.1 Purpose of Literature Review

The purpose of this chapter is to present a review of shortlisted articles and online forums (blogs) regarding the research study: *comparison of requirement management software*.

The literatures and blogs were reviewed to determine their purpose, requirement management software compared, features used for the comparison, conclusions and any possible limitations.

Literatures or blogs published are grouped into three: 1) *those published before 2010*; 2) *those published between 2010 and 2015*; 3) *those published from 2015 to date*.

2.2 Category 1: Literatures and Blogs Published Before 2010

Four literatures were reviewed in this category and presented below.

1. “Requirements Management Tools: A Qualitative Assessment”, Sud and Arthur (2003)

Sud and Arthur (2003) studied the characteristics and capabilities of six popular requirements management tools including: Rational Suite AnalystStudio (Use Case Modeling); RDT 3.0, RTM Workshop 5.0, Telelogic DOORS, Omni Vista OnYourMark Pro and Starbase Caliber-RM.

The study made use of both empirical and survey technique to analyze the various management requirement tools.

Features used for assessment were: requirements traceability, requirements analysis, security and accessibility, portability and backend compatibility, configuration management communication/collaboration, change management, online publishing, usability requirements and specification/documentation.

Organizational factors including cost, operating expenses/licensing fees, and platform requirements were also used as assessment criteria.

Findings of the study revealed that some requirement management software had more enhanced features than others which made administration more effective.

The study recommended a list of features that should be contained in a requirement management tool including: ability to manage versions and changes; store requirements attributes; link requirements to other system elements; track status; view requirement subsets; control access; communicate with stakeholders; backend compatibility with editors; and publishable web interfaces.

The study however failed to provide some form of ranking or preference for the six-software surveyed.

2. “Analysis and Comparison Of Various Requirements Management Tools”, Clark (2006);

Clark (2006) analyzed and compared requirement management software for the ship building by investigating requirement management best practices and compared them with the needs of the systems development in the ship building industry.

The author also compared some requirement management software to see their fit for the ship building industry in vessel design. According to Clark (2006), it is impossible to compare every requirement management software and so he limited his comparison to: Analyst Pro 5.3, CORE 5.1, CRADLE 5.3 and DOORS based on INCOSE Requirements Management Tool Survey, and insufficient time as a constraint.

The study used the pros and cons with respect to requirement management lifecycle to compare the four tools based on the experience using three of the four tools and information obtained on Cradle as this could not be tried.

Clark concluded that Cradle tool came out on top for the Ship Building industry but however recommended that companies need not replace their existing tool as there would be some learning curve when changing tools. It however recommended DOORS for any organization that has no requirement management tool, as this could be the best starting point.

The study limited its comparison to a few requirement management software: Analyst Pro 5.3, CORE 5.1, CRADLE 5.3 and DOORS. It did not explore tools such as SLATE for lack of time. Future research could consider increasing the number of requirement management software compared.

3. “Requirements Management Tool Support for Software Engineering in Collaboration”, Heinonen (2006)

Heinonen (2006) investigated the requirements management tool support for software engineering collaboration.

Twelve requirement management software were initially selected for comparison including: Borland CaliberRM; Sophist Group CARE 3.2; Steeltrace Catalyze Enterprise; ViewSet PACE; Insoft Prosareq; IBM Rational RequisitePro; Igatech Systems RDT; RBC RMTrack; Serena RTM; SpeedDEV RM; Telelogic DOORS; and Teledyne Brown XTie-RT.

General features used for comparison include: 1) usability, simplicity and customization; 2) multi-platform support; 3) tool integration; 4) web access; 5) access control; 6) information sharing; and 7) simultaneous use. While specific features include: 1) requirements identification; 2) requirements classifying and viewing; 3) formats; 4) change management; 5) traceability; 6) document importing; 7) document generation; and 8) tailoring and extensibility.

After comparison, three requirement management tools were chosen for further analysis including: Borland CaliberRM, Rational RequisitePro and Telelogic DOORS were chosen for further evaluation.

In conclusion, this three software had capabilities for integration and access control. DOORS had support for multiple platforms and offered the most features and so most expensive. CaliberRM and RequisitePro offered similar capabilities, had no major flaw except absence of multiplatform support (only runs on MS Windows), and because they had less features than DOORS, they were affordable. CaliberRM was also considered best in requirement identification.

4. “Evaluation of requirements management tools with support for traceability-based change impact analysis”, Abma (2009)

Abma (2009) examined four requirements management tools including: IBM’s RequisitePro, Borland’s CaliberRM, TopTeam’s Analyst and TeleLogic’s DOORS, to determine their support for assessing impact to changing requirements.

The study made use of previous literatures to identify criteria, metrics and impact analysis methods for evaluating the four selected software.

The study tested “information model support”; “options to import and export artifacts”; “integration with other tools used in the software life cycle”; “graphical representation of the artifacts and their relations”; “coverage and impact analysis” as amongst the criteria used for comparing the requirement management software.

The criteria were applied to four requirement management software, and there was no clear winner. All tools had poor impact analysis features, with most of the work still being done manually.

The differences between the tools appeared in their supporting features for the actual impact analysis process. DOORS offered the best basis for impact analysis through its extended information model support, providing custom link types and custom attributes for links.

2.3 Category 2: Literatures and Blogs Published Between 2010 and 2015

In this category, seven literatures were reviewed and presented below.

5. “A Comparative Study of Software Requirements Tools For Secure Software Development”, Mohammad Ubaidullah Bokhari and Shams Tabrez Siddiqui (2010)

Mohammad Ubaidullah Bokhari and Shams Tabrez Siddiqui (2010) provides a comparative study of requirement tools showing trends in the use of methodology for gathering, analyzing, specifying and validating the software requirements and the result presented in the tables will help the developer to develop an appropriate requirement tool.

The study compared twelve requirement management software using product and security features to arrive at its conclusions. Requirement management software compared include: RequisitePro; Case Complete; Analyst Pro; Optimal Trace; DOORS; GMARC; Objectiver; RDT; RDD-100; RTM; Reqtify; TcSE; Assure and IRqa.

The study concluded that DOORS is one of the best requirement tool satisfying the both functional and non-functional requirements, whereas for the security point of view CodeAssure is the best among all the tools.

Limitation to this study is that it did not compare the qualities and so unable to say that a particular software is good or bad. Second, the research work was based on things contained in the manufacturer’s website and so unable to judge overall quality of the tools.

6. “An Investigation of a Requirements Management Tool Elements”, Zainol and Mansoor (2011)

Zainol and Mansoor (2011) conducted an examination of requirement management tools in Malaysia including: Borland CaliberRM; Insoft Prosareq; IBM Rational RequisitePro; ViewSet PACE; Igatech Systems RDT; SpeeDEV RM; RBC RMTrack; Telelogic DOORS; Serena RTM; Teledyne Brown XTie-RT.

The study identified five general features for comparison including: 1) usability, simplicity and customization; 2) access control; 3) tailoring and extensibility; 4) free licensing and full version availability; and 5) database centric.

Specific features that were used include: 1) classifying and viewing; 2) requirements baselining; 3) change control; 4) version control; 5) status tracking; 6) requirement tracing; 7) use case; specification generation; 8) list of requirements generation; 9) requirements linking to system elements; 10) authentication procedure; 11) project definition; and 12) create user.

The study found that there was no specific requirement management tool that had all the five and twelve features defined above that fit the Malaysian software needs. The study recommended that it was important for organizations to develop requirement management tools that would aid practitioners to create software of quality standards.

7. “How to Evaluate and Select a Requirements Management Tool”, Beatty and Ferrari (2011)

Beatty and Ferrari (2011) started by building the case for a requirement management tool by identifying possible challenges that the tool was meant to address.

The challenges include: 1) the possibility of two or more people working concurrently on say v0.03, and each of them sending v0.04 that now need to be reconciled manually; 2) building features that were not required for the current scope of the project; 3) the dilemma caused by sending v0.05 to say ten stakeholders, and these people returned their feedback in several emails, some tracked their changes while others didn't; 4) not knowing the total number of people that have approved the requirement document without the need to manually count; 5) lastly not knowing what is approved and what is not until a manual count. These are examples of challenges that a good requirement management tool aim to address.

This study defines requirement management tools as those that support: 1) storing specified requirements and their related artifacts, such as models; 2) allowing links between requirements objects in the tool; 3) reviewing and tracking changes to requirements; and 4) importing and exporting requirements.

From this study it is evident that not one requirement management tool can meet the needs of every organization. In fact, it depends on the needs of the Business Analysts, the size of budget and their experience regarding which requirement management tool is best to meet their needs and budget.

The study started by creating a list of requirement management tools for comparison; and then the criteria that would be used to compare them; and used some filtering to reduce the number of requirement management tools to fifteen; published the results for industry review and then implement and evaluate top three on actual projects, prior to publishing the results of the three-requirement management tool on project-use.

Initial set of tools were created from past knowledge, INCOSE survey tools, internet search, suggestions from colleagues, tool vendors seen at conferences, and customers' existing requirements management tool selections. From these, and after further analysis, 125 tools were identified and then following new set of analysis, this was reduced to seventeen. The seventeen tools that were evaluated against 200 criteria were: 1) IBM Rational DOORS, 2) Siemens Teamcenter; 3) Blueprint Requirements Center; 4) eDevTECH inteGREAT / Requirement Studio / ModernRequirements4DevOps; 5) IBM Rational Composer; 6) 3SL Cradle; 7) Microsoft Team Foundation Server; 8) Jama Software Contour; 9) Polarion Requirements; 10) HP Quality Center; 11) Orcanos Qpack; 12) TraceCloud; 13) Sparx Systems Enterprise Architect; 14) Kovair Application Lifecycle Management; 15) TechnoSolutions TopTeam Analyst; 16) MKS Integrity; 17) Micro Focus CaliberRM.

These tools were evaluated against the full set of criteria using demo copies of the tool or having a vendor demo specific functionality. For each tool's evaluation, each of the criteria was given a score based on the following scale: 0) no support; 1) only slightly supported with major workarounds required or very minimal functionality; 2) supported but minor workarounds required or detailed functionality missing; 3) fully supported in the tool.

This study was the first whitepaper in the requirements management tool series by Seilevel for evaluating requirements management tools in an approach that produces results useful to the broader Business Analyst community. Other papers present the outcome of the comparison of the 17 tools, while the third paper presents the outcome of the three tools compared on actual projects.

8. “Seilevel’s Evaluations of Requirements Management Tools: Summaries and Scores”, Beatty et al (2011)

Beatty et al (2011) compared the seventeen requirement management tools in the first white paper and the following tools came out tops: eDevTECH inteGREAT Requirements Studio 5579; Blueprint Requirements Center 2010 5378; TechnoSolutions TopTeam Analyst 5314. Last three were: HP Application Lifecycle Management 4147; TraceCloud 4082; Microsoft Team Foundation Server 3438.

It should be noted that HP and Microsoft Team Foundation Server did not participate in the Self Evaluation study and so this affected their overall score.

Further analysis of criteria such as analysis, modelling, review & collaboration and ease of use had eDevTech InteGREAT coming within top three of these categories and MKS Integrity was top three in the following three criteria: requirements architecture; writing and review & collaboration. Others came tops in one or two of the criteria used.

9. “Assessment and Recommendation of Requirement Management Tool Based on User Needs”, Mohpal (2012).

Mohpal (2012) conducted a study on the assessment and recommendation of requirement management tool based on users’ needs and cost.

The study compared four requirement management tools in the market including: IBM Rational RequisitePro; HP Quality Center; Gatherspace and Contour.

The author identified 27 features to be used for comparison based on industry experience. Some of the features include: 1) requirement creation in tool; 2) import requirements from Word and Excel; 3) custom requirement attributes creation; 4) requirement status; 5) requirement impact; 6) date modified; etc. The 27 requirements were however grouped into 14 categories.

In conclusion, depending on the needs of users, the study recommended choosing requirement management software based on: 1) utility/score for each tool; 2) utility per unit cost; 3) total utility

vs. cost; with Contour (C: \$3,120, U:62); Gatherspace (C: \$3,540, U:47); Requisite Pro (C: \$5,020, U: 60); and HP Quality Center (C: \$5,400, U:90).

So, HP Quality Center leads the pack from a utility perspective, while Contour is preferred if the organization is budget conscious. Something in the middle may be considered such as Gatherspace or RequisitePro depending on the needs and budget of the organization and its users.

10. “Needs, Types and Benefits of Requirements Management Tools”, Siddiqui and Bokhari (2013)

Siddiqui and Bokhari (2013) evaluated the needs, types and benefits of requirement management tools in India using surveys.

The study compared the following tools: IBM Rational DOORS; IBM RequisitePro; Borland CaliberRM; Accompa; Jama; RMtoo; and LiteRM, using the following criteria: requirements analysis; links and traceability; change management; type of tools; tool integration; document generation and price \$ (year per user).

The comparison showed IBM Rational DOORS, IBM RequisitePro and Borland CaliberRM as heavyweight tool ranging from US\$2,000 to over US\$4,000 per user. Middleweight tools were Accompa and Jama; while lightweight tools were RMTToo and LiteRM.

The study recommended factors such as size of the project, budget and team members play a significant role in the choice and selection of a requirement management tool.

11. “Selecting Appropriate Requirements Management Tool for Developing Secure Enterprises Software”, Alhazzawi et al (2014)

Alhazzawi et al (2014) studied the significance of selecting right requirement management tool of four leading Requirements Management tools: Analyst Pro, CORE, Cradle and Caliber RM, with the focus of selecting the appropriate tool according to their capabilities and customers need.

The study identified the mistake organizations make by selecting requirement management tools based on a laundry list of features instead of what their organizations really needed.

The study used qualitative and descriptive method of comparing the four requirement management tools and features used for comparison were baseline, links and traceability, security, Microsoft support, workflow, and document, database or design centric.

The studied concluded, after in-depth evaluation and subsequent objective trade-off analysis of each tool that CaliberRM ranks topmost, while Cradle and AnalystPro were next in line. CaliberRM combines the capabilities of requirement definition and requirement management and is best for secure software development with database protection capability. AnalystPro may also be considered after considerations for including security functions that is current deficient.

Category 3: Literatures and Blogs Published Beyond 2015

12. “Requirements Management Tool Evaluation Report”, Beatty et al (2016);

Beatty et al (2016), in this phase of requirement management tool evaluation started with 175 tools, and eliminated 130, and then put 45 through the Minimum Viable Product (MVP) criteria. The top 21 tools from phase 1 were put through the full evaluation in phase 2 with the following topmost five tools: TopTeam Analyst 1506.50; Modern Requirement Tool Suite 1462.50; Blueprint 1454; Jama 1399.50; and Visure 1393. Last five were: Innovator 1109; Jira 1105; Aha! 1027; Workspace.com 922; Innoslate 914.

A major limitation to this study and several similar studies is the subjectivity in scoring as each organization may award scores based on what is most important to them. This limitation was greatly reduced by allowing each Analyst spend six hours on each tool and actually use them prior to ranking them based on the analyst’s experience from the use of the trial or demo software.

13. “Comparing Requirements Management Tools – IBM Rational DOORS & HP ALM”, Kuutti (2019)

Kuutti, (2019) conducted a study on how users felt when using IBM Rational DOORS and HP ALM. The study was to also determine the features they liked and those they disliked and whether there were some ways of improving the usability.

The features used for comparing DOORS with HP ALM were: “can be used via a Browser”; “defect management”; “testing”; “add functionality to UI with scripting”; “supports ReqIF”; “task tracking & agile planning”; and “marks related tests if requirement has been changed”.

The study revealed that users preferred DOORS to HP ALM and they liked traceability and customizability features but disliked connection issues, slowness, and DOORS tables.

The study recommended that companies should increase the usability of the DOOR to enhance the continuous use of the requirements management tool by addressing smaller fixes found from

DOORS documentation, which could provide some boost for performance, and for the connection issues, by relocating the server to the local site.

This study was limited to two requirement management tools that were in use at the research organization. So, the comparison was not extended to other requirement management software for this reason.

Chapter 3: Research Methodology

3.1 Research Aims

This research study aims to **explore** and compare requirement management software presented and described in the current literature, online forums (blogs) and other sources, and present findings in the form of a ranking of the selected requirement management software. The features used for comparison would also be described.

3.2 Data Collection and Analysis

The data for this study would be obtained from literatures and online forums (blogs), and analyzed using author's own experience and those sought from literatures and blogs determine choices for: literatures, online forums, requirement management software and features/criteria for comparison. The data were mostly captured in excel worksheets and manipulated as appropriate to obtain the information needed to progress the research work.

It was also essential to this study to obtain data from literatures and from other sources especially because of the nature of the thesis – requirement management software comparison and because of limited literatures on the subject matter. Other data sources for this study were online forums and books.

Lastly, as the outcome of this study contributes into the business analysis profession, we created a manageable list of features to be used for comparison, and validated them with features used in surveyed literatures.

3.3 Research Process

The research process is presented and discussed below.

Step 1: Search, Download and Shortlist Articles

The purpose of this step was to search, download and shortlist articles. Using the search “comparison of requirement management software” on University of Alberta Library Articles and EBSCO ebooks, generated 2,401 articles.

The first five articles are: 1) *Comparison of Requirement Items Based on the Requirements Change Management System of QONE* (Lu and Yuan, 2010); 2) *Comparison of Requirements and Capabilities of Major Multipurpose Software Packages* (Elston et al, 2011); 3) *A Comparison of a Campus Cluster and Open Science Grid Platforms for Protein-Guided Assembly Using Pegasus Workflow Management System* (Pavlovikj et al, 2014); 4) *A Comparison of the Structural Contingency and Risk-Based Perspectives on Coordination in Software-Development Projects* (Nidumolu, 1996); and 5) *An investigation of skill requirements for business and data analytics positions: A content analysis of job advertisements*. (Verma et al, 2019). These five articles and many of the other 2,401 articles had nothing in common with the subject of this study.

The search “comparison of requirement software” was filtered using the “AB Abstract” on the same University of Alberta platform and this generated 568 articles. Again, the first five and several others had nothing in common with the research study.

The search was then carried out with “comparison of requirement management tool” and this generated 3,096 articles, and when filtered with “AB Abstract” returned 852 articles. With “TI Title” filter on the same University of Alberta platform, it generated 10 articles. Article, “*Analysis and comparison of various requirements management tools for use in the shipbuilding industry*” (Clark, 2006) came out eight times, while “*Tools for Requirements Management: A Comparison of Telelogic DOORS and the HiVe*” (Cant et al, 2006-07).

A search on Google Scholar of “comparison of requirement management software” generated 843,000 results. Filtering using date range of 2015 – 2020 gave 74,000 results and with date range of 2017 – 2020, gave 41,900 results.

To increase the chances of getting articles related to the research study, we used the following search criteria: comparison of requirement management software; requirement management tools review; business requirement management tools; requirements management software comparison; requirements management tool comparison; requirements management tool comparison; and requirements management software evaluation; on Google, Google Scholar, Research Gate, RefSeek, and Virtual LRC.

After removing duplicates, 41 articles were downloaded and presented in Appendix 1. The 41 articles were assessed for relevance to the research study and 13 articles were shortlisted for further in-depth review as contained in the table 1 below.

#	Articles	When	Name	Relevance (Y/N)
1	Analysis And Comparison Of Various Requirements Management Tools For Use In The Shipbuilding Industry	2006-09-01	Eric D. Clark	Y
2	Comparing Requirements Management Tools – IBM Rational DOORS & HP	2019-11-20	Tuomas Kuutti	Y
3	Requirements Management Tools A Qualitative Assessment	2003-01-00	1. Rajat R. Sud 2. James D Arthur	Y
4	Selecting Appropriate Requirements Management Tool for Developing Secure Enterprises Software	2014-03-00	1. Daniyal M Alghazzawi 2. Shams Tabrez 3. Siddiqui Mohammad 4. Ubaidullah Bokhari	Y
5	Evaluation of requirements management tools with support for traceability-based change impact analysis	2009-09-10	B.J.M. Abma	Y
6	How to Evaluate and Select a Requirements Management Tool	2011-00-00	Joy Beatty and Remo Ferrari	Y
7	Needs, Types and Benefits of Requirements Management Tools	2013-00-00	1. Shams Tabrez Siddiqui 2. M.U. Bokhari	y
8	Seilevel's Evaluations of Requirements Management Tools: Summaries and Scores	2011-08-30	Joy Beatty et al	Y
9	Requirements Management Tool Evaluation Report	2016-00-00	1. Joy Beatty 2. Amanda Cardenas 3. Jonathan Bartlett 4. David Reinhardt 5. Megan Jackson Stowe	Y
10	A Comparative Study of Software Requirements Tools For Secure Software Development	2010-04-00	1. Mohammad Ubaidullah Bokhari 2. Shams Tabrez Siddiqui	Y
11	An Investigation of a Requirements Management Tool elements	2011-09-25	Azida Zainol	Y
12	Requirements Management Tool Support For Software Engineering in Collaboration	2006-00-00	Heinonen S.	Y
13	Assessment and Recommendation of Requirement Management Tool Based on User Needs	2012-11-00	Aditi Mohpal	Y

Table 1: Shortlisted articles on comparison of requirement management software

Step 2: Search and Shortlist Online Forums (Blogs)

The aim of this step was to identify blogs that would be used to identify requirement management software for comparison. Using a google search with similar search criteria as in articles, 13 online requirement management forums were identified, and these were further reviewed for relevance and three blogs were shortlisted for further in-depth review.

Appendix 2 contains a list of the 13 blogs while table 2 contains the three shortlisted blogs.

#	Blog Name	Author	Blog Address
1	Capterra	Capterra	https://www.capterra.com/sem-compare/requirements-management-software?utm_source=bing&utm_medium=cpc
2	Software Testing Help	Software Testing Help	https://www.softwaretestinghelp.com/requirements-management-tools/
3	The Digital Project Manager	Ben Aston	https://thedigitalprojectmanager.com/requirements-management-tools/

Table 2: Requirement management software blogs

Step 3: Shortlist Requirement Management Software

In this step, 13 shortlisted articles were reviewed to identify 63 requirement management software for comparison. To determine the relative importance of each of this 63 requirement management software, we reviewed the literatures to see the number of times each software appeared in the 13 shortlisted literatures. Similarly, the three blogs were reviewed to identify 22 requirement management software, and the blogs were further reviewed to identify the number of times each appeared in blogs.

The frequencies from both articles and blogs were summed up and we limited the number of requirement management software for further comparison to those with three or more appearances in both articles and blogs, primarily because of time constraint, and as suggested by Clark (2006) that it was impossible to compare too many software. So we limited the number to nine. The nine requirement management software for comparison is presented in table 3 below.

#	Requirement Management Software	Frequency
1	IBM Rational DOORS	12
2	CaliberRM	10
3	Modern Requirements Suite of Tools (including InteGREAT	7
4	Cradle	6
5	IBM Rational RequisitePro	4
6	CORE	3
7	Team AnalystPro	3
8	Jama Software Contour	3
9	Serena RTM	3

Table 3: Requirement management software (articles & blogs).

Appendix 3 contains a list of requirement management software and its frequencies from articles, and Appendix 4 contains a list of requirement management software and its frequencies from blogs.

Step 4: Shortlist Features for Requirement Management Software Comparison

The intention of this step was to create a list of features that would be used to compare the nine requirement management software.

69 features were found from all the researched articles, five from Blogs, and 13 found in Books. After removing duplicates, a total of 56 master features could be used to compare our selected nine requirement management software. This is presented in Appendix 5.

With this high number of features, we used our experience to identify 15 set of features that would be used to compare the requirement management software but validated them with the 56 master features found in articles, blogs and books to determine the relative importance of each feature.

Step 5: Comparison of Software

We compared the selected nine requirement management software using the 15 features.

Firstly, we determined the relative importance of each feature based on the number of times such a feature appeared in articles, blogs and books as depicted in the table 4 on the next page.

Secondly, based on the contents of table 4, we defined three weights: *high*, a feature that could be linked to between ten and twenty of the 56 features identified from articles, blogs and books; *medium*, a feature that could be linked to five to nine of the master features; and *low*, a feature that could be linked to less than five features. This is shown in table 5 on the next page.

Thirdly, we established a scoring system which allowed us to assess the degree to which each requirement management software satisfies a given feature, in accordance with: 3, the feature is fully supported in the requirement management software with more detailed information available; 2, the feature is supported in the requirement management software, but with slightly detailed functionality missing; 1, the feature slight supports the requirement management software with very minimal information provided; and 0, no support. A similar approach was applied in Beatty and Ferrari, 2011. This is depicted in table 6.

#	Requirements Features/Criteria (from Author's Experience and Articles/Blogs)	Matching with Master Features	Frequency
Functional Requirement			
1	Ability to elicit requirements	1, 17,27, 36,	4
2	Ability to analyze requirements	9, 18, 29,31,44,49,53	7
3	Ability to document requirements	1,3, 6,13,23,24,28,32,41,42,43	11
4	Ability to verify and validate requirements	54,55	2
5	Ability to manage requirements	5,9,15,16,19,20,22,26,28,32,33, 34,35,41,42,43,45,46,47,48,52	21
6	Ability to allow collaboration on requirements	16	1
7	Ability to uniquely identify requirements	17,39, 40	3
8	Ability to trace requirements - products and to product objectives	4,14,20,21,55,	5
Non-Functional Requirement			
9	Allows for flexible pricing including free trials	1	1
10	Support and maintenance	3,4,5,7,8,9	6
11	Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows	8	1
12	Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa	2, 3, 9, 23, 29, 36	6
13	Ability to integrate into other tools including import and export of requirements	7, 38, 39	3
14	Ability to search requirements	14,20,21, 17,54,55	6
15	Allows for impaired users		

Table 4: Features and frequency

Frequency	Weight
11- 25	High (3)
6 - 10	Medium(2)
0 - 5	Low(1)

Table 5: Frequency and weight

Score	Meaning
3	Fully supported, as it appeared many times in literatures/blogs
2	Supported, as it appeared in some literatures/blogs
1	Slightly, supported as it appeared in a few literatures/blogs
0	No support, as it was not seen in literatures/blogs

Table 6: Score and meaning

The fourth task was to score and rank the nine-requirement management software using the sum of the scores from the fifteen features. The extent to which each software fulfils a given feature was rated as θ , no support, meaning that literatures and blogs did not say that the feature is supported by the software. However, a score of 3 would mean that many literatures and blogs made that assertion. The score was then multiplied by the weight of that feature to arrive at a total score for the software under consideration.

The final task was to analyze the result of comparison, determined similarities and differences, and most importantly state how the result would help organizations in search of a requirement management software and the business analysis community.

Step 6: Conclusions and Future Work

The aim of this step was to draw conclusions, provide specific recommendations, discuss limitations of the study and opportunities for future work.

3.4 Research Questions

Following from above and the goals for this study presented in Chapter 1, the following research questions would be addressed by this study:

RQ1: *What research has been conducted on comparison of requirement management software? Which requirement management software have been compared in literatures and blogs?*

RQ2: *Which requirement management software would be selected for comparison and why?*

RQ3: *Which features would be selected for the comparison of the requirement management software and why?*

RQ4: *What is the relative ranking of requirement management software after comparison? What is the conclusion of this comparison?*

RQ5: *What are the limitations to this study? What is possible future research work?*

Chapter 4: Selected Software and Features

This chapter presents high-level information on requirement management software to be compared and the criteria used for the comparison.

4.1 Overview of Selected Requirement Management Software

Basic website information is provided on the nine selected software, while additional information is included on the top four requirement management software as per comparison result in Chapter 5. Additional information provided include: 1) overview or historical information; 2) features and/or strengths; and 3) limitations or known weaknesses. Detail information about the nine software can be found on the websites of the software companies, Table 7.

#	Requirement Management Software	Frequency	Website
1	IBM Rational DOORS	12	www.ibm.com
2	CaliberRM	10	www.microfocus.com
3	Modern Requirements Suite of Tools (including InteGREAT	7	www.modernrequirements.com
4	Cradle	6	www.threesl.com
5	IBM Rational RequisitePro	4	www.ibm.com
6	CORE	3	www.vitechcorp.com
7	Team AnalystPro	3	www.technosolutions.com
8	Jama Software Contour	3	www.jamasoftware.com
9	Serena RTM	3	www.microfocus.com

Table 7: Selected requirement management software and associated websites

The four leading requirement management software from comparison result in Chapter 5 are: Modern Requirements, IBM Rational DOORS, IBM Rational RequisitePro; and CaliberRM. Each of this is presented below.

1. Modern Requirement (previously inteGREAT)

eDev Technologies, now trading as Modern Requirements, developed inteGREAT, as its first requirement management software in 2006. Today, inteGREAT has been renamed as Modern Requirements, a requirement management software that manages the complete lifecycle of requirement definition and management, for a more efficient and cost-effective projects.

Modern Requirements was built on Microsoft's Application Lifecycle Management platforms, with robust data security and privacy compliance. The tool can be deployed on premise or on the cloud using Microsoft Azure DevOps.

The software has the following features: 1) requirements definition and requirement management including elicitation, documentation, analysis, reviews and validation, traceability, audit trail of changes, import and export of requirements; report generation; etc; 2) management of project scope and objectives; 3) visually map requirements using any of the standard templates based on client needs; 4) simulations, use cases and scenarios; 5) impact analyzer; 6) Alice artificial intelligence for allowing users another way of gathering requirements.

inteGREAT (Modern Requirements) came first using Seilevel's priorities and weightings with a score of 5579 out of 5757 as the tool met most of the criteria used for comparison. The tool's topmost strength is its support for process flow modeling integrating directly with MS Visio. (Beatty et al, 2011)

However, Modern Requirements has its own limitations including: 1) absence of features in every module; 2) basic review feature when compared with other leading tools; lack of is without; 3) creating templates in Microsoft word could be confusing; 4) reverting to baseline is a challenge; 4) lastly, system performance may be slow as one performs high resource task such as running large traceability report.

2. IBM Rational DOORS

DOORS was developed in 1991 by Quality Systems and Software Ltd (QSS), acquired by Telelogic in 2000 and by IBM in 2008, and renamed the software as IBM Rational DOORS. In April 2019, IBM renamed its portfolio of products and IBM Rational DOORS became IBM Engineering Requirements Management DOORS.

DOORS is a client-server application and users have to connect through a Citrix server to use the application. One of the advantages this brings is the fact that everyone is using the same version of the software and so resolving difficulties associated with upgrades.

DOORS is one of the leading requirement management software and has the following features including: 1) ability to elicit, document, analyze, trace, import and export from tools such as MS Word, MS Excel, MS PowerPoint, MS Outlook, and Adobe FrameMaker; 2) ability to establish association between requirements, test procedures and test results; 3) ability to keep an audit trail of changes.

DOORS is particularly good at managing requirements and is also able to automatically load source documents allowing for easy analysis of requirements using an interface that close resembles MS Excel. As DOORS is from a family of requirement management suites of software, allows users the flexibility of switching between modules.

With the addition of DOORS/Analyst, users are able to augment requirements with diagrams, pictures and models. This allows for visualization and improves requirements capture, traceability, communication, verification and collaboration.

DOORS has its limitations and a few of them are: 1) it could slow, maybe due to size of a particular module or resources consumed or due to connectivity issues between the client and the server; 2) unable to easily manipulate information generated seamlessly; 3) lacks the ability to search and populate document templates based on a set of defined criteria; 4) basic use case modelling as the tool does not enforce use case rules; 5) unable to support offline work.

Finally, DOORS is suitable for enterprise IT projects with large volume of requirements and several project users working together. Regulatory or compliant based industries including health services, aerospace, defense, etc., would benefit most from DOORS (Clark, 2006), (Kuutti, 2019).

3. IBM Rational RequisitePro

IBM Rational RequisitePro is one IBM's requirements management tools acquired from Rational. The tool is developed for multi-user environments, integrating MS Word and requirement multi-user database to allow project teams and users to organize, elicit, document, prioritize and tracing requirements to products and tracking changes to authorized requirements. The tool also allows customers to specify requirements that would make them consider the project successful.

In addition, IBM Rational RequisitePro has the following features: 1) ability to dynamically link word documents with the information stored in the requirement database; 2) ability to customize and filter attributes; 3) ability to trace requirements to use case models; 4) ability to compare multiple projects; 5) ability to integrate multiple tools and teams for improved communication and accessibility.

So, the benefits of IBM Rational RequisitePro are that it enables users to achieve project goals, foster collaboration ways of working, increase quality of applications and reduces project risk.

Despite the strengths and benefits of IBM Relational RequisitePro, here are some of its limitations: 1) performance issues associated with inaccurate estimates for server specifications; 2) Requires an expert for setup to increase the chances of getting the most value from the tool; 3) reducing variability between thick client and web-based version; 4) may be considered insecure; 5) some requirements might be missed because of the absence of a checklist; 6) not scalable to different project sizes; 6) no online glossary that allows better understanding of industry terms, project preferences, and organization's own language.

4. CaliberRM

CaliberRM (formerly Borland Caliber) is a web-based tool by Micro Focus, with features that allow for elicitation, documentation, prioritization, and validation of requirements.

CaliberRM allows large and small product development teams improve quality of their software using features such as document management, budgeting, stakeholder defined attributes, collaboration, traceability and reporting.

CaliberRM also has features for capturing and communicating changes across application development lifecycle useful for designers, testers, analysts, and other project stakeholders.

CaliberRM came fourth (tied with MKS Integrity) out of 17 tools in Seilevel's priorities and weightings, with a score of 5171 out of 5757. CaliberRM supports both waterfall and agile methodologies and very good capabilities for mockups, simulations and visual modeling (Beatty et al, 2011).

The limitations of CaliberRM include: 1) inability to track issue within the tool; 2) Dated UI makes usability a problem; 3) limited capability for import and export from excel.

4.2 Overview of Features for Comparison

In this section, we provide overview information about each of the fifteen features used for comparing the nine-requirement management software based on our experience.

We decided to come up with the 15 features for comparison, instead of using the 56 master features collated from all the literatures in support of the suggestion from Alghazzawi et al (2014) that organizations should be concerned with their needs instead of the numerous features that a tool has.

Consequently, we are not claiming that a software with the highest score would be best suited for most organization as it would depend on the needs of such a business. Similarly, a software with the lowest score does not imply that it is bad for most organizations to consider. Alghazzawi et al (2014)

The 15 features for comparison are presented below.

1. Ability to elicit requirements.

This purpose of this feature is to allow for the elicitation of requirements using different techniques. There are several techniques for eliciting requirements including: interviewing; document analysis; questionnaires and surveys; workshops; focus groups; interface analysis; prototyping and observation.

Every requirement management software should support this feature for the software to be relevant in this ever-changing business environment.

2. Ability to analyze requirements.

The purpose of this feature is to validate whether requirements are valid, clear, concise, unambiguous, complete, and not conflicting with other requirements.

Without this feature, users and stakeholder needs for the system may be incomplete and thus lead to project failure.

3. Ability to document requirements.

There are several techniques for documenting requirements including use case diagram; use cases and scenarios; flowchart; context diagram; SIPOC, BPMN, spaghetti diagram; activity diagram; state diagrams; data models; etc.

The more technique a requirement management software supports the more beneficial it would be for the users of the software.

4. Ability to verify and validate requirements.

The feature “verify requirements” is about confirming that a product matches the specific needs of the users and stakeholders for which the system is established. Requirement validation on the other hand entails confirming that a system can achieve the objectives for which the system was created.

The ability for a requirement management software to verify and validate requirements is extremely important and its absence may lead to project failures.

5. Ability to manage requirements.

This feature allows for updates to Requirement Document and for the tracking of changes to requirements and provision of audit trail.

This will also include managing version control of Requirement Documents.

6. Ability to allow collaboration on requirements.

Requirement collaboration allows different stakeholders the ability to update Requirement Document concurrently with appropriate audit trail.

Absence of this feature would mean updating documents in sequence and would prolong requirement gathering timeline and may also lead to project delays.

7. Ability to uniquely identify requirements.

This feature allows each requirement to be given a reference which becomes the unique identifier for the requirement throughout the requirement gathering and management lifecycle.

8. Ability to trace requirements – to products and to product objectives.

Traceability is one of the most important features of any requirement management software as its absence would prevent the verification that the requirements have been implemented in the product, and would also allow tracing the product to project objectives.

9. Allows for flexible pricing including free trials

It is now the norm that most software including requirement management software allow for some free trials, typically 30 days before an organization can fully commit to the purchase of the software. This is also the case for requirement management software.

It is also important to allow for flexible pricing. There are two pricing models: subscription and perpetual licenses. Subscription based license offer the software at a Unit price per month or per annum, and usually written off onto the company's income statement. Perpetual license is such that the software is sold for one huge price and this is typically capitalized over the useful life of the software. The company then pays annual maintenance price for upgrades and maintenance, between 15 and 25%, that are typically written off to income statement in the month or year of acquisition.

There are also other dimensions to this. There could per user license, where the subscription or perpetual is per user or for a concurrent number of users.

10. Offers support and maintenance.

This feature can be linked with feature 9. For subscription-based license, support and maintenance is assumed. However, for perpetual based license, support and maintenance come at a charge between 15 and 25% for most requirement management software companies.

11. Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows.

Omni channels is now becoming an important feature for most organizations and so it is essential for requirement management software to operate in multiple devices and channels.

12. Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa.

This is one of the features that set requirement management software apart. The ability of a software to take in activities in text form and convert it into flowcharts and vice versa.

13. Ability to integrate into other tools including import and export of requirements.

The ability to take data from other systems such as excel and bring it into the requirement management software and vice versa is an extremely useful feature especially for enterprise requirement management software.

14. Ability to search requirements.

The search feature is a feature that allows one to find whatever one is looking for quite easily. Without this feature, it will be extremely cumbersome looking for the occurrence of a word in a requirement management software containing 25,000 requirements for example.

15. Allows for impaired users.

This feature will allow for anyone with seeing disability to be able to read documented requirements in formats that is applicable to them.

Many requirement management software do not have this feature and so will set any company apart if this feature is included in the software.

Chapter 5: Comparison of Software

This chapter includes description of the process of comparing nine selected requirement management software using the previously presented methodology (Chapter 3). We present the obtained results including details related to similarities and differences between the software.

5.1 Details of Scoring Process

Let us provide summary of the tasks of the Step 5, Chapter 3:

1. Determine the relative importance of features used for comparison based on the number of times they appeared in surveyed literature.
2. Represent importance of features as weights: *high*, *medium* and *low*
3. Establish a system for scoring software based on their support of individual features: from 0 – no support, to 3 – full support.
4. Score and rank the nine selected requirement management software based on the scores representing degrees to which the software supports the features – all fifteen of them.
5. Analyze the result of comparison.

The outcome of the first three tasks is presented below. Table 8 contains the list of selected features together with their weights, while Table 9, the repeated Table 6, provides a detailed explanation of the applied score system.

In table 8, we grouped features based on their importance. The most important features – once again, based on analyzed literature – are: “Ability to manage requirements” and “Ability to document requirements”. We can say that they are considered the ‘*essential*’ features of a requirement management software. Any software that supports them should certainly have an advantage over those that do not have them. Yes, in some such special circumstances, a lack of these features may not be considered as a disadvantage.

The next set of features – the one we can call ‘*anticipated*’ – includes: “Ability to analyze requirements”; “Ability to trace requirements - products and to product objectives”; “Support and

maintenance”; “Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa”; and “Ability to search requirements”. As we can see these features can be considered as ones that allow users to better navigate via and work with collected and stored requirements. It means they allow to search for specific requirements, analyze them and convert between different representation formats.

The third, and it seems the most populated, group of features is composed of “Ability to trace requirements - products and to product objectives”; “Ability to elicit requirements”; “Ability to uniquely identify requirements”; “Ability to integrate into other tools including import and export of requirements”; “Ability to verify and validate requirements”; “Ability to allow collaboration on requirements”; “Allows for flexible pricing including free trials”; “Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows”; “Allows for impaired users”.

We call this group – ‘*good to have*’. These features provide support for eliciting and validating specific requirements, as well as focus on collaborating processes and multi-platform deployment.

#	Requirements Features/Criteria (from Author's Experience and Articles/Blogs)	Matching with Master Features	Frequency	Weight
1	Ability to manage requirements	5,9,15,16,19,20,22,26,28,32,33,34,35,41,42,43,45,46,47,48,52	21	3
2	Ability to document requirements	1,3, 6,13,23,24,28,32,41,42,43	11	3
3	Ability to analyze requirements	9, 18, 29,31,44,49,53	7	2
4	Support and maintenance	3,4,5,7,8,9	6	2
5	Allows for requirements modelling including converting requirements into use	2, 3, 9, 23, 29, 36	6	2
6	Ability to search requirements	14,20,21, 17,54,55	6	2
7	Ability to trace requirements - products and to product objectives	4,14,20,21,55,	5	1
8	Ability to elicit requirements	1, 17,27, 36,	4	1
9	Ability to uniquely identify requirements	17,39, 40	3	1
10	Ability to integrate into other tools including import and export of requirements	7, 38, 39	3	1
11	Ability to verify and validate requirements	54,55	2	1
12	Ability to allow collaboration on requirements	16	1	1
13	Allows for flexible pricing including free trials	1	1	1
14	Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows	8	1	1
15	Allows for impaired users			1

Table 8: Selected features and weight

We now provide some clarification and justification of our approach to define scores representing difference degrees to which software supports a given feature. In order to score, for example, IBM Rational DOORS's ability to support a feature such as "Ability to elicit requirements", we start by searching for the feature in any of the literatures that compared IBM Rational DOORS. Specifically, we looked for the feature in "Analysis And Comparison Of Various Requirements Management Tools For Use In The Shipbuilding Industry, Clark 2006" and found it several times within this literature.

We then searched other literatures such “Requirement Management Tool Evaluation Report, Beatty et al, 2016”, and again found that IBM Rational DOORS supports the feature. Based on these findings, we gave a score of 3 to IBM Rational DOORS for supporting “Ability to elicit requirements”.

For “Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows” for the same IBM Rational DOORS, again we found it a few times in Clark, 2006 and in “Requirements Management Tools A Qualitative Assessment, Sud and Arthur (2003)”, and qualify as category 2 - supported.

For the feature “Allowed for impaired users”, this was not found in literatures and blogs, and so gave it a score of zero.

To score Modern Requirement software, as we were only able to find this in one literature “Requirement Management Tool Evaluation Report, Beatty et al (2016)”, our score was only based on this literature. We found that Modern Requirement software supports all the fifteen features in detail, with the exception of “Ability to integrate into other tools including import and export of requirements”. While Modern Requirement supports integration into primarily MS Office, we used this to give it a score of 1.

So, we have updated Table 6 to include some of the above reasons as rationale for our score. This is presented in table 9 below.

Score	Feature Support	Examples
3	Fully supported, as it appeared many times in literatures/blogs	"Analysis And Comparison Of Various Requirements Management Tools For Use In The Shipbuilding Industry, Clark 2006" validates that IBM Rational DOORS supports "Ability to analyze requirements" and "Ability to document requirements"
2	Supported, as it appeared in some literatures/blogs	"Analysis And Comparison Of Various Requirements Management Tools For Use In The Shipbuilding Industry, Clark 2006" had some information about IBM Rational DOORS support for "Ability to verify and validate requirements" and "Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows".
1	Slightly, supported as it appeared a few literatures/blogs	"Requirements Management Tool Evaluation Report, Beatty et al (2016)" had little information about Modern Requirement's ability to support "Ability to integrate into other tools including import and export of requirements" except for MS Office products
0	No support, as it was not seen in literatures/blogs	Not contained in literatures surveyed

Table 9: Scoring with examples

As we can see, the scoring process is fully based on the descriptions of software found during our literature survey.

In the subsequent tables, we present the comparison scores. Table 10 contains scores for IBM Rational DOORS, Caliber RM, and Modern Requirements. Besides the ‘Score’ column (values from Table 9), there is the column ‘Total Score’ that represents a degree to which software supports a given feature multiplied by the feature’s importance. The **Summary Score** row at the bottom is a sum of ‘Total Score’s and illustrates the software ‘goodness’, i.e., represents how well features of different importance are supported by the evaluated software.

Evaluation of another three software: Cradle, IBM Rational RequisitePro and CORE, is presented in table 11. Finally, the scores for the remaining software, i.e., TeamAnalyst Pro, Jama Software Contour and Serena RTM, are shown in Table 12.

		IBM Rational DOORS		Caliber -RM		Modern Requirements	
Weight	Feature	Score	Total Score	Score	Total Score	Score	Total Score
3	Ability to document requirements	3	9	3	9	3	9
3	Ability to manage requirements	3	9	3	9	3	9
2	Ability to analyze requirements	3	6	2	4	3	6
2	Ability to trace requirements - products and to product	3	6	2	4	3	6
2	Support and maintenance	3	6	1	2	3	6
2	Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa	3	6	2	4	3	6
2	Ability to search requirements	3	6	2	4	3	6
1	Ability to elicit requirements	3	3	2	2	3	3
1	Ability to verify and validate requirements	2	2		0	3	3
1	Ability to allow collaboration on requirements	3	3	2	2	3	3
1	Ability to uniquely identify requirements	3	3	3	3	3	3
1	Allows for flexible pricing including free trials	2	2	2	2	3	3
1	Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows	2	2	2	2	3	3
1	Ability to integrate into other tools including import and export of requirements	3	3	3	3	1	1
0	Allows for impaired users	0	0			0	0
Summary Score			66		50		67

Table 10: Scores for IBM Rational DOORS, Caliber RM, and Modern Requirements.

Weight	Feature	Cradle		IBM Rational Requisite		CORE	
		Score	Total Score	Score	Total Score	Score	Total Score
3	Ability to document requirements	2	6	2	6	2	6
3	Ability to manage requirements	2	6	3	9	3	9
2	Ability to analyze requirements	2	4	2	4	1	2
2	Ability to trace requirements - products and to product	3	6	3	6	1	2
2	Support and maintenance	2	4	2	4	1	2
2	Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa	2	4	2	4	1	2
2	Ability to search requirements	1	2	2	4	1	2
1	Ability to elicit requirements	2	2	2	2	1	1
1	Ability to verify and validate requirements	2	2	3	3	2	2
1	Ability to allow collaboration on requirements	2	2	2	2	3	3
1	Ability to uniquely identify requirements	3	3	2	2	1	1
1	Allows for flexible pricing including free trials	2	2	1	1	1	1
1	Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows	1	1	2	2	2	2
1	Ability to integrate into other tools including import and export of requirements	2	2	2	2	2	2
0	Allows for impaired users	0	0	0	0	0	0
Summary Score			46		51		37

Table 11: Scores for Cradle, IBM Rational RequisitePro and CORE

Weight	Feature	Team Analyst Pro		Jama Software Contour		Serena RTM	
		Score	Total Score	Score	Total Score	Score	Total Score
3	Ability to document requirements	1	3	2	6	1	3
3	Ability to manage requirements	3	9	3	9	1	3
2	Ability to analyze requirements	2	4	1	2	2	4
2	Ability to trace requirements - products and to product	3	6	1	2		0
2	Support and maintenance	1	2	1	2	2	4
2	Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa	1	2	1	2	1	2
2	Ability to search requirements	1	2	1	2	2	4
1	Ability to elicit requirements	2	2	1	1	3	3
1	Ability to verify and validate requirements	1	1	2	2	2	2
1	Ability to allow collaboration on requirements	3	3	3	3	1	1
1	Ability to uniquely identify requirements	2	2	1	1	1	1
1	Allows for flexible pricing including free trials	2	2	1	1	2	2
1	Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows	1	1	1	1	2	2
1	Ability to integrate into other tools including import and export of requirements	0	0	1	1	1	1
0	Allows for impaired users	0	0	0	0	0	0
Summary Score			39		35		32

Table 12: Scores for TeamAnalyst Pro, Jama Software Contour and Serena RTM.

5.2 Analysis

In this section, we provide our analysis of the software based on the obtained scores. To simplify a process of comparing different software we include a bar-based visualization of **Summary Scores** obtained by each software, Figure 1.

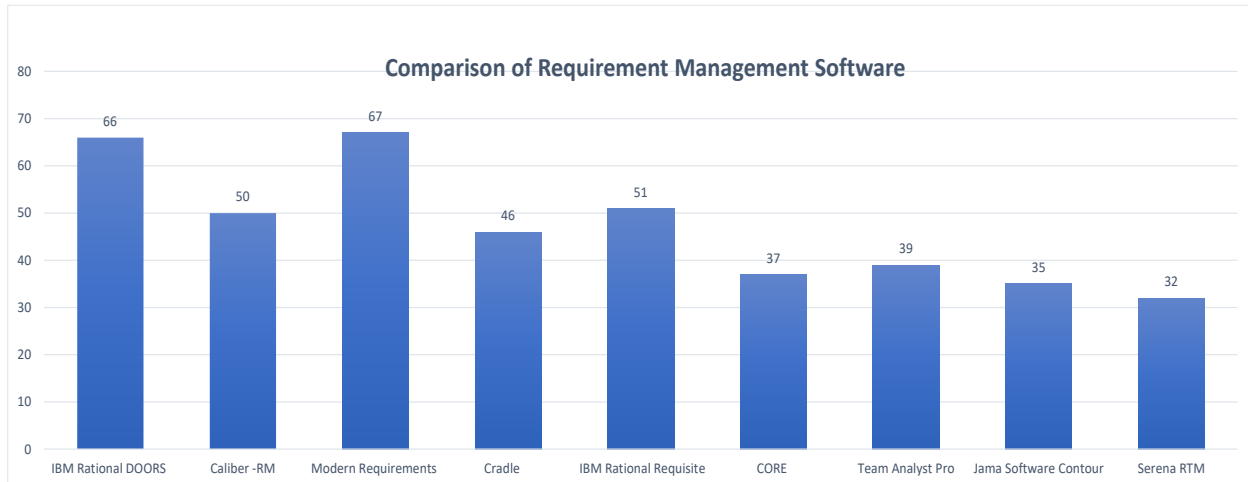


Figure 1: Comparison of requirement management software

It seems obvious, that there are two software that stand above the rest. They have very similar scores of 66 and 67. Then we have a few in the range of the score of 50, and the rest obtained the summary score from 30 to 40.

Based on that, we have grouped the software into three categories: 1) Category 1: scores above 60; 2) Category 2: scores between 45 and 60; 3) Category 3: scores below 45. These categories are described below.

Category 1: Above 60

Modern Requirements and **IBM Rational DOORS** obtained the highest scores of 67 and 66 respectively. Both software support all but one feature a requirement management software should have. A very positive assessment of **Modern Requirement** confirms high praises the software achieved in other studies dedicated to evaluation of requirement management software, Beatty et al (2016). The evaluation of software presented in Kuuti (2019) showed a preference of **IBM**

Rational DOORS when compared with **HP ALM**. It should be noted that **Modern Requirement** was not included in this comparison of software.

Let us analyze differences in scores obtained by the software. The features differently supported are:

- 1) *Ability to verify and validate requirements*: **IBM Rational DOORS** had a score of 2, while **Modern Requirements** had a score of 3; Our rationale for this comes from page 57 in the comparison of software presented in Clark, (2006), where we could not see many instances that confirms support for this feature by IBM Rational DOORS. However, the comparison presented by Beatty et al (2016) showed strong support for this feature by Modern Requirements.
- 2) *Allows for flexible pricing including free trials*. **IBM Rational DOORS** had a score of 2, while **Modern Requirements** had a score of 3; Again, our rationale for this is similar to the one above.
- 3) *Ability to operate in different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows*. **IBM Rational DOORS** had a score of 2, while **Modern Requirements** had a score of 3. Rationale for this is also similar to the one presented above.
- 4) *Ability to integrate into other tools including import and export of requirements*. **IBM Rational DOORS** had a score of 3, while **Modern Requirements** had a score of 1. For this, IBM Rational DOORS had extensive support for this feature as presented by Clark (2006) and Beatty et al (2016), while Modern Requirements primarily supports MS Office.

As the difference between **Modern Requirements** and **IBM Rational DOORS** is minimal – just one point, we can say that both Modern Requirement and IBM Rational DOORS are leading requirement management software. Further, we would state that any organization may/should consider these software, especially if the fifteen features used to evaluate the software are most important to them.

Category 2: Above between 45 and 60

Three requirement management tools fit the score range of this category. These are: **IBM Rational RequisitePro** with a score of 51; **CaliberRM** with a score of 50, and **Cradle** with a score of 46. Again, as the difference between their scores is small with a maximum of five, any of this software could be considered as the 'second choice'. All three are quite unique as their scores differ in several features.

With a difference of only one point, **IBM Rational RequisitePro** (51) and **CaliberRM** (50), both software are equally commendable and it is difficult to determine superiority of any of it. We state that this study does not distinguish between them.

Organizations that look for a tool able to *Verify and validate requirements* and has *Ability to trace requirements – to products and product objectives* may choose **IBM Rational RequisitePro**, while an organization that is interested in *Ability to uniquely identify requirements* and *Allows for flexible pricing including free trials* (feature 9) may select **CaliberRM**.

Category 3: Below 45

Four requirement management software belong to the third category with the scores of 32, 35, 37 and 39. These include **Serena RTM**, **Jamal**, **CORE** and **Team Analyst Pro**. While an organization may choose any of this software, such a choice should be based on the specific features that they are interested in. For example, if feature: *Ability to elicit requirements* is the most important for an organization, then they should consider **Serena RTM** or **Team Analyst Pro**. But if feature – *Ability to trace requirements – to products and to product objectives* – is most important for the organization, then **Team Analyst Pro** should be investigated further by the organization.

Chapter 6: Conclusion and Future Work

A requirement management software offers a tremendous opportunity for an organization to elicit, document, analyze, trace, review, validate business, stakeholder, solution and transition requirements. And by doing so, reduces the risk of project failure but may not necessarily increase chances of project success (The Standish Group, 2016).

Overall, we recommend that organizations use requirement management software to support their project lifecycle for the following reasons: 1) ensuring that requirements are not missed; 2) increasing time to market; 3) improving software quality; 4) reducing project cost; and 5) increasing customer satisfaction.

6.1 Obtained Outcomes

We identified sixty-three requirement management software from articles and twenty-two from blogs, making a total of eighty-five. We created an approach (Chapter 3) for reducing this number to nine for further comparison.

We also identified, based on examined articles and blogs, fifty-six features that were commonly used to describe and evaluate requirement management software. We analyzed them and based on their rate of occurrence and our business analysis and requirement management experience, we created a set of fifteen features that were applied to compare the selected nine requirement management software.

The comparison identified two leading requirement management software that every organization should consider in their search for requirement management tool: IBM Rational DOORS with a score of 66, and Modern Requirements (MR) with a score of 67. These two had many similarities based on the fifteen features used for evaluation. They differ in four areas:

- 1) Ability to verify and validate requirements: MR scored a bit higher than IBM Rational DOORS;

- 2) Ability to operate on different devices - desktop, laptop, tablets, phones etc and operating systems - Mac and Windows; MR scored higher;
- 3) Ability to integrate into other tools including import and export of requirements; here IBM Rational DOORS scored noticeably higher than MR;
- 4) Allows for flexible pricing including free trials: again, MR scored a bit higher.

The presented study also revealed three other candidate requirement management software for consideration: CaliberRM (50), IBM Rational RequisitePro (51) and Cradle (46).

The last category of software from our comparison are: CORE (37), Team Analyst Pro (39), Jamal (35) and Serena RTM (32). The fact that they have been selected from a set of eight-five initially identified software indicate they are important and should be considered. So, using a different set of features for comparison would make these four software attractive.

As for criteria or features used for the comparison, this study could not use all fifty-six features identified in the literature. We came up with fifteen features from our business analysis experience and validated them against the master features contained in Appendix 5 to affirm their importance.

The following features should be used by organizations wanting to select a requirement management software including: “Ability to document requirements”; “Ability to manage requirements”; and “Ability to analyze requirements”; “Ability to trace requirements - products and to product objectives”; “Support and maintenance”; and “Allows for requirements modelling including converting requirements into use cases, flowcharts, and other models and vice versa”; and “ability to search requirements”.

6.2 Future Work

This study was not without its own limitations. Timing was the greatest hinderance. The author would have liked to further validate the data used in this research by talking with the makers of this nine selected requirement management software and their users. This would help to establish the most important features that should be used for the comparison.

Also, a first-hand experience in utilization of the software could alter some outcomes. We would have liked to survey the business analysis community regarding the top candidate software and features that should be used for comparison.

Further research could be done in the following areas:

1. To further validate assumptions, made for the comparison purposes, based on interactions with the makers of the requirement management software systems, and their users.
2. To investigate which of the eighty-five requirement management software would be better suited for different industries including financial services, telecommunication, oil and gas, energy, retail, information technology and communication, and government.
3. To discuss and consult with users of requirement management software and the business analysts which of the selected fifteen requirement features should organizations consider the most and which ones the least when making decisions regarding purchase and usage of requirement management software.

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Appendix 1: Articles Downloaded

#	Articles	When	Authors
1	Analysis And Comparison Of Various Requirements Management Tools For Use In The Shipbuilding Industry	2006-09-00	Eric D. Clark
2	Comparing Requirements Management Tools – IBM Rational DOORS & HP ALM	2019-11-20	Tuomas Kuutti
3	Change Requirement Management Issues for a Large Software Development Projects	2013-01-00	1. Hassan Osman Ali 2. Mohd Zaidi Abd Rozan 3. Abdullahi Mohamud Sharif
4	Requirements Management Tools A Qualitative Assessment	2003-01-00	1. Rajat R. Sud 2. Arthur James D.
5	Selecting Appropriate Requirements Management Tool for Developing Secure Enterprises Software	2014-03-00	1. Daniyal M Alghazzawi 2. Shams Tabrez 3. Siddiqui Mohammad 4. Ubaidullah Bokhari
6	Commonalities and Differences between Requirements Engineering Tools: A Quantitative Approach	2015-02-11	1. Joaquín Nicolas 2. Juan M. Carrillo de Gea 3. Jose L. Fern 4. ez-Alem 5. Ambrosio Toval Christof Eber 6. Aurora Vizca
7	Evaluation of requirements management tools with support for traceability-based change impact analysis	2009-09-10	B.J.M. Abma
8	An integrated approach to support the Requirement Management (RM) tool customization for a collaborative scenario	2015-03-05	1. Maria Grazia Violante 2. Enrico Vezzetti 3. Marco Alemanni
9	How to Evaluate and Select a Requirements Management Tool	2016-00-00	Joy Beatty, et al
10	Requirements Definition & Management Processes and Tools	0000-00-00	Dr. Jean-Claude Franchitti
11	Needs, Types and Benefits of Requirements Management Tools	2013-00-00	1. Shams Tabrez Siddiqui 2. M.U. Bokhari
12	Considerations When Choosing a Requirements Management Tool	2013-00-00	John Parker

#	Articles	When	Authors
13	Agile Requirements Management Tool	2018-01-00	1. Vandana Gaikwad 2. Prasanna Joeg 3. Shashank Joshi
14	Seilevel's Evaluations of Requirements Management Tools: Summaries and Scores	2011-01-01	Joy Beatty R Ferrari B Vijayan S Godugula.
15	Requirements Management Tool Evaluation Report	2016-00-00	1.Joy Beatty 2.Amanda Cardenas 3.Jonathan Bartlett 4.David Reinhardt Amanda 5.Megan Jackson Stowe
16	Evaluating and selecting software packages	2008-10-30	1. Anil S. Jadhav 2. Rajendra M. 3. Sonar b
17	Tool Support for Requirements Management Quality from a User Perspective	2016-03-22	1. Anders Larsson 2. Sogeti Sverige AB
18	An Empirical Comparison of Dependency Network Evolution in Seven Software Packaging Ecosystems	2017-10-03	1.Alexandre Decan 2.Tom Mens 3.Philippe
19	Selecting Appropriate Requirements Management Tool for Developing Secure Enterprises Software	2014/03/00	1. Daniyal M Alghazzawi 2. Shams Tabrez Siddiqui 3. Mohammad Ubaidullah Bokhari
20	A Comparative Study of Software Requirements Tools For Secure Software Development	2010-04-00	1.Mohammad Ubaidullah Bokhari 2.Shams Tabrez Siddiqui
21	Evaluation of Software Requirements Management Practices in Some Nigerian Software Companies	2019-12-01	1. Moses Kehinde Aregbesola 2. Opeoluwa Babatunde Akinkunni
22	Software tools for requirements management in an ERP system context	2016-10-24	Jeddah
23	Software Requirements Management	2015-00-00	Ali Altalbe
24	A Review of the Most Relevant Features of Agile Tools Supporting Requirements Management	2016-10-01	1.Irum Inayat Siti 2.Salwah Salim

#	Articles	When	Authors
25	A Review of the Most Relevant Features of Agile Tools Supporting Requirements Management	2015-08-01	1. Faisal Adnan 2. Imran Haider Naqvi
26	A case study of requirements management: Toward transparency in requirements management tools	2013-01-01	1. Markus Kelanti 2. Jarkko Hyysalo 3. Pasi Kuvaja 4. Markku Oivo
27	How to Select a Requirements Management Tool: Initial Steps	2009-10-01	1. Orlena Gotel 2. Patrick Mader
28	An assessment of published evaluations of requirements management tools	2009-04-01	1. Austen Rainera 2. Sarah Beechamb 3. Cei Sandersona
29	Requirements for Requirements Management Tools	2004-00-00	1. Matthias Hoffmann 2. Nikolaus Kühn 3. Matthias Weber
30	An Investigation of a Requirements Management Tool elements	2011-09- 25	Azida Zainol
31	Selecting Appropriate Requirements Management Tool for Developing Secure Enterprises Software	2014-03-01	1. Daniyal M Alghazzawi 2. Shams Tabrez Siddiqui 3. Mohammad Ubaidullah Bokhari 4. Hatem S Abu Hamatta
32	The future of requirements management tools	2000-05-01	1. Anthony Finkelstein 2. Wolfgang Emmerich
33	How to Assure that Requirements for Requirements Management Tools Are Adequate	2015-06-23	Michael E. Krueger
34	Evaluation framework for analyzing the applicability of criteria lists for the selection of requirements management tools supporting distributed collaboration and software product line requirements management	2016-01-08	1. Maria Florencia Santillan 2. Timo Käkölä
35	Software tools for requirements management in an ERP system context	2010-03-00	Björn Johansson
36	A Survey Identifying Trends on Use of Software Development Tools in Different Indian SMES	2012-09-01	Nomi Baruah Ashima
37	A hierarchical requirements modeling scheme to support engineering innovation	2007-08-01	1. Jonathan R.A. Maier 2. Thulasiram Ezhilan 3. Georges M. Fadel 4. Joshua D. Summers 5. Gregory Mocko
38	Requirements Prioritization and using Iteration Model for Successful Implementation of Requirements	2019-00-00	1. Muhammad Yaseen 2. Noraini Ibrahim 3. Aida Mustapha
39	Introduction to Requirements Management	2009-00-00	Gunter Mussbacher
40	Requirements Management Tool Support For Software Engerineering in Collaboration	2006-00-00	Heinonen S.
41	Assessment and Recommendation of Requirement Management Tool Based on User Needs	2012-11-00	Aditi Mohpal

Appendix 2: List of Online Forums (Blogs)

1	Requirements Management Software	Capterra	Capterra	https://www.capterra.com/sem-compare/requirements-management-software?utm_source=bing&utm_medium=cpc
2		Get App	Get App	https://www.getapp.com/project-management-planning-software/requirements-management/
3		TestLodge	Jake Bartlett	https://blog.testlodge.com/requirements-management-tools-list/
4	Top 20+ Best Requirements Management Tools (The Complete List)	Software Testing Help	Software Testing Help	https://www.softwaretestinghelp.com/requirements-management-tools/
5		Req Test	Ulf Eriksson	https://reqtest.com/requirements-blog/requirements-management-tools/
6		Guru 99	Guru 99	https://www.guru99.com/requirement-management-tools.html
7	The Best Requirements Management Tools Of 2020	The Digital Project Manager	Ben Aston	https://thedigitalprojectmanager.com/requirements-management-tools/
8		Trustradius	Trustradius	https://www.trustradius.com/requirements-management
9		kovair	Vikram Gupta	https://www.kovair.com/blog/5-solutions-for-better-requirements-management/
10		Software Suggest	Software Suggest	https://www.softwaresuggest.com/blog/best-requirements-management-tools-and-how-to-adapt-it/
11	Free and Open Source Software Requirements Management Tools	Martinig & Associates		https://www.requirementsmanagementtools.com/opensource.php
12		Business Analyst Learnings	Business Analyst Learnings	https://businessanalystlearnings.com/technology-matters/2017/7/4/a-list-of-free-requirements-management-rm-software
13		Rmblog.accompa	Michael Shrivathsan	http://rmblog.accompa.com/2012/04/free-open-source-requirements-management-tool/

Appendix 3: List of Requirement Management Software and Frequencies (Articles)

#	Requirement Management Software from Shortlisted Articles	Frequency
1	IBM Rational DOORS	9
2	Caliber -RM	8
3	Cradle	6
4	Modern Requirements Suite of Tools (including InteGREAT)	4
5	IBM Rational Requisite	4
6	Team Analyst Pro	3
7	CORE	3
8	Serena RTM	3
9	Jama Software Contour	2
10	TraceCloud	2
11	Team Foundation Server/Visual Studio Team Services, Microsoft	2
12	Sparx Systems Enterprise Architect	2
13	iRise integrated with JIRA	2
14	IBM Rational Composer	2
15	Insoft Prosareq	2
16	Teledyne Brown XTie-RT	2
17	RBC RMTrack	2
18	SpeeDEV RM	2
19	HP Quality Center	2
20	P+B24:B67olarion Requirements	1
21	TestTrack, Seapine Software	1
22	Visure Solutions Requirment	1
23	in-STEP RED, microTool	1
24	Innoslate, SPEC Innovations	1
25	Innovator for Business Analysts, MID Gmbh	1
26	Optimal Trace	1
27	GMARC	1
28	Objectiver	1
29	RDD	1
30	RTM	1

#	Requirement Management Software from Shortlisted Articles	Frequency
31	Reqtify	1
32	TcSE	1
33	Code Assu	1
34	ViewSet PACE	1
35	Igatech Systems RDT	1
36	RTMWorkshop 5.0	1
37	Omni Vista OnYourMark Pro	1
38	SLATE (SDRC)	1
39	CELADON TOOL	1
40	HiVe (Hierarchical Verification Environment)	1
41	Kovair Application Lifecycle Management	1
42	TechnoSolutions	1
43	Polarion Requirements	1
44	HP Quality Center	1
45	Orcanos Qpack	1
46	Siemens Teamcenter Blueprint Requirements	1
47	LiteRM	1
48	Blueprint® Requirements Center 2010	1
49	HP Application Lifecycle Management	1
50	Kovair Global Lifecycle/ALM solution, Kovair Software	1
51	MKS Integrity	1
52	Rmtoo	1
53	Aha!, Aha! Labs	1
54	Cockpit, Cognition	1
55	TestTrack, Seapine Software	1
56	GenSpec (Hydro-Quebec)	1
57	TWiki	1
58	Sophist Group CARE 3.2	1
59	Steeltrace Catalyze Enterprise	1
60	ViewSet PACE	1
61	Igatech Systems RDT	1
62	Gatherspace	1
63	Contour	1

Appendix 4: List of Requirement Management Software and Frequencies (Blogs)

#	Requirement Management Software from Blogs	Frequency
1	Modern Requirements4DevOps	3
2	IBM Rational	2
3	ReQtest	2
4	ReqSuite	2
5	Accompa	2
6	IRIS Business Architect	2
7	CaseComplete	2
8	Caliber	2
9	Visure requirement	2
10	Xebrio	1
11	Process Street	1
12	Orcanos	1
13	Pearls	1
14	Confluence	1
15	ReqView	1
16	Conclusion	1
17	Matrix Requirements Medical	1
18	Jama Software	1
19	Spiral Team	1
20	Perfomance Helix	1
21	Atlassian JIRA	1
22	Aligned Elements	1

Appendix 5: Summary Features from Articles, Blogs & Books

#	Feature
1	Capturing and classifying requirements
2	Capturing system element structure
3	Requirements flowdown
4	Traceability analysis
5	Configuration Management
6	Documents and other output media
7	Interfaces to other tools
8	Licensing
9	User Interfaces
10	Standards--which ones do you comply with
11	Support and maintenance
12	Training
13	Store requirements attributes
14	View requirement subsets
15	Control access
16	Communicate with stakeholders
17	Requirements identification
18	Requirements classifying and viewing
19	Requirements baselining
20	Change control
21	Version control
22	Status tracking
23	Use case specification generation
24	List of requirements generation
25	Requirements linking to system elements
26	Authentication procedure
27	Elicitation(Record Notes)
28	Prototyping
29	Modeling
30	Store requirements attributes

#	Feature
31	Identify missing and extraneous requirements
32	Reuse requirements
33	Track issue status
34	Generate tailored subsets
35	Track requirements status
36	Requirement Creation in tool
37	Import Requirements from Word
38	Import Requirements from Excel:
39	Custom Requirement Attributes Creation: Requirements can be managed using different attributes such as status/priority
40	Requirement
41	History of Requirement Text Change
42	Requirement Modified By
43	Requirement modified date
44	Impact Analysis
45	Requirement-Level Security
46	Package-Level Security
47	Project-Level Security
48	Static Report
49	Trend Analysis Report
50	Thick Client
51	Web Client
52	Typo Spelling Error
53	Duplicate Requirements
54	Requirement Query Based on Attribute
55	Requirement Query Based on Traceability
56	Pricing/Cost