**STEP BY STEP WORKED EXAMPLE IN FUZZY TOPSIS**

The automated fuzzy tool was demonstrated and tested by software developers from the different software development companies who were part of the research using an online test site. The domain name was registered by the researcher. The website was hosted on a web server belonging a web application hosting company. The demonstration was validated and verified by showing the construction of all intermediate judgement matrices, distance measurement calculations and how final Closeness Coefficients (CCi) values were computed. The calculations were shown to stakeholders to prove the correctness of the results given by the tool at the time of the demonstration. These calculations took place programmatically at the backend of the automated fuzzy tool web application.

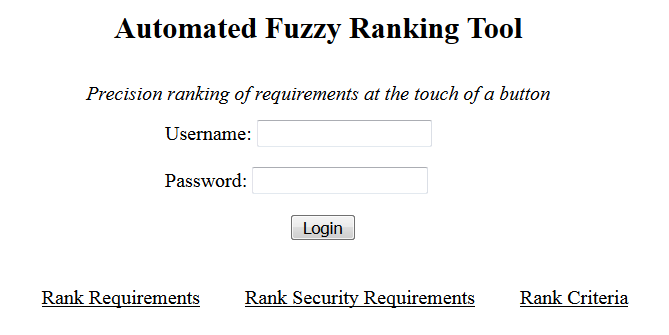
In this section, the demonstration is illustrated using requirements from a software development project at a study site and the actual values input by the various stakeholders.

The approach for this section therefore, is as follows:

1. Appropriate screen dumps of the automated fuzzy tool are depicted according to the steps of the fuzzy TOPSIS algorithm given in Appendix 2 of the research paper.
2. Brief explanations accompany the screen dumps.
3. Manual mathematical calculations using fuzzy TOPSIS equations are provided to show how the results of intermediate matrices and final Closeness Coefficients (CCi) values are computed. Detailed calculations are shown to validate the final output of the automated fuzzy tool using the input values given, when the tool was demonstrated.
4. The fully constructed fuzzy decision matrices and table of CCi values resulting from (iii) above is shown.

**Login screen**

Figure 1 depicts the login screen of the web application. A username and password is required to gain access to the system.

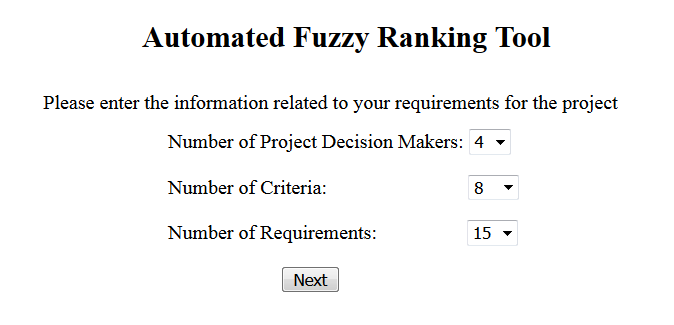


**Figure 1: Screen Dump of Login Screen**

In addition to ranking normal requirements the automated fuzzy tool allows decision makers to view ratio data on how they prioritised the evaluation criteria as the criteria is ranked as well.

**Set up parameters**

Figure 2 depicts screen for inputting project information namely, number of project decision makers, number of criteria and number of requirements of the automated fuzzy tool.

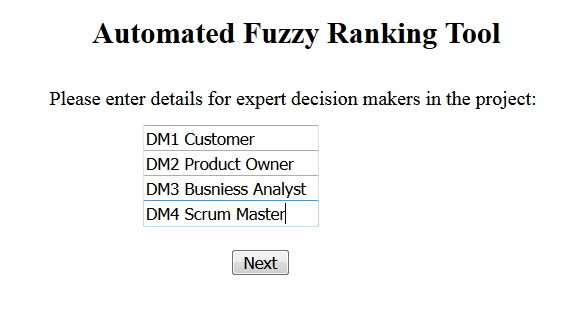


**Figure 2**: **Screen Dump of Set-up Parameter Screen**

The tool was demonstrated with 4 expert project decision makers, 8 project criteria and 15 requirements inclusive of non-functional requirements.

**Expert decision makers**

Figure 3 shows the ASD roles of the expert decision makers for the project.



**Figure 3: Screen Dump of Expert Decision Makers**

The expert decision makers who conducted the demonstration of the automated fuzzy tool were the customer (off-site), the product owner (on-site), the business analyst (team-member) and the scrum master (team leader) as shown in Figure 3.

**Input criteria for prioritisation**

Decision makers through consensus chose the following criteria by which user requirements were prioritised, namely:

C1 Right personnel are available to implement feature

C2 No dependencies: Dependent requirements get low priority

C3 Less mental effort required to implement

C4 Core: Core to system and must get high priority

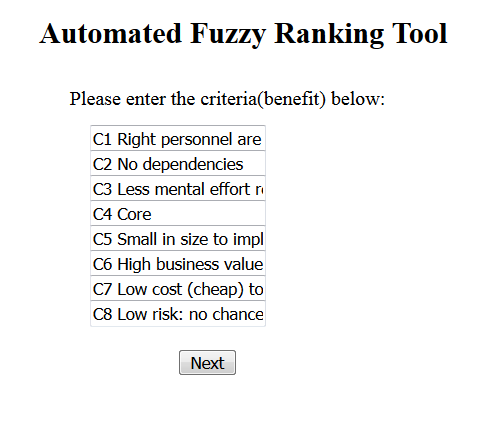
C5 Small in size to implement: generates only few user stories

C6 High business value

C7 Low cost (cheap) to implement

C8 Low risk: no chances of volatility/uncertainty

Figure 4 is a screen dump of the criteria entered in the criteria screen of the automated fuzzy tool. All criteria entered were benefit criteria.



**Figure 4**: **Screen Dump of Input Criteria**

**User requirements**

The Business Requirements Document (BRD) for an online book store specified roles for customers, an administrator, a stock manager and a dispatch clerk. The aim of the development was to deliver features in the form of several releases. The business requirements, that were drafted by the business analyst have been extrapolated and presented by the project manager in a kick off meeting, are listed below:

R1 Access control: Unauthorised Users, Registered Users and Privileged Users

R2 Login, Registration and Home Page

R3 Customizable reports for various roles: customer, administrator, dispatch clerk

R4 Courier costs per contracted vendor (transport companies)

R5 Product module: catalogue of products, services and promotions with terms and

conditions

R6 Encryption algorithms to scramble data into unreadable text

R7 Administrator module: add items to catalogue, delete items from catalogue, user accounts

R8 Delivery module: assign courier company, calculate cost of delivery for customer,

tracking

R9 Database backup and recovery of customers, shopping carts, orders, inventory, order transaction and delivery.

R10 Inventory module: view, add, delete, edit with automatic purchase and sales updates, alerts and re-order levels

R11 Checkout module: Order, cost of purchases in a shopping cart, process and record

payments

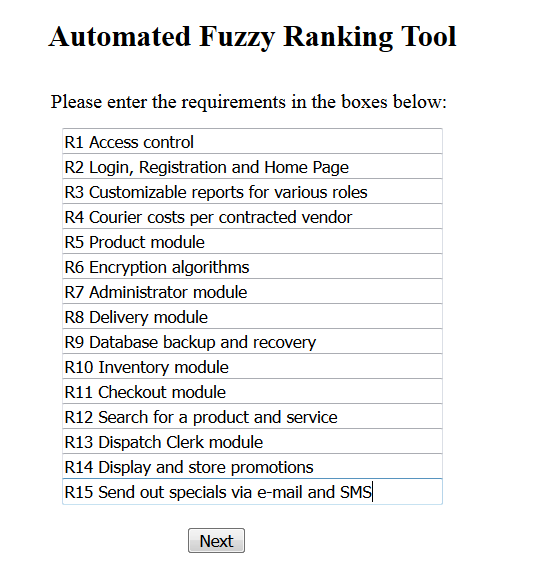
R12 Search for a product and service

R13 Dispatch Clerk module: manage customer orders

R14 Display and store promotions

R15 Send out specials and general information via e-mail and SMS.

A screen dump of the demonstration of the user requirements screen in the automated fuzzy tool is shown in Figure 5:



**Figure 5: Screen ump of User Requirement Screen**

**Decision makers rate criteria**

Table 1 shows linguistic ratings in column 1 and the corresponding fuzzy rating in column 2 for evaluation criteria. The fuzzy ratings are expressed as a triangular fuzzy number using a scale from 1 to 9. The fuzzy number chosen for a linguistic rating take into consideration the fuzziness of that linguistic rating, for example Medium (M) is represented as (3, 5, 7).

|  |  |
| --- | --- |
| **Linguistic term** | **Membership function** |
| Very Low (VL) | (1,1,3) |
| Low (L) | (1,3,5) |
| Medium (M) | (3,5,7) |
| High (H) | (5,7,9) |
| Very High (VH) | (7,9,9) |

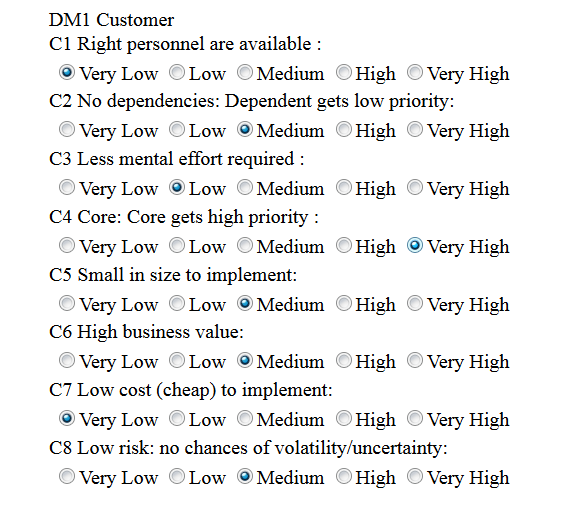
**Table 1: Fuzzy Numbers for Linguistic Ratings of Criteria**

Table 2 shows the linguistic weighting given to each criterion by the Customer (DM1), the Product Owner (DM2), the Business Analyst (DM3) and the Scrum Master (DM4).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Criteria** | **DM1** | **DM2** | **DM3** | **DM4** |
| **C1** | VL | L | M | M |
| **C2** | M | M | VL | L |
| **C3** | L | VL | M | M |
| **C4** | VH | VH | H | H |
| **C5** | M | L | L | VL |
| **C6** | M | L | L | H |
| **C7** | VL | L | M | VL |
| **C8** | M | H | H | H |

**Table 2: Linguistic Ratings for Criteria by Different Decision Makers**

Figure 6 below was extracted from the “rate criteria” screen by all decision makers. The screen dump indicates the choices made by first decision maker namely, the customer in terms of each criterion. The input in Figure 6 taken directly from the automated fuzzy tool corresponds with column 1 of the judgement matrix in Table 2 above. Similarly column 2 (DM1), column 3 (DM2), column 4 (DM3) and column 5 (DM4) of Table 3 was completed by the other expert decision makers namely, Product Owner, Business Analyst and Scrum Master using the automated fuzzy tool with a similar input interface shown in Figure 6.



**Figure 6: Screen Dump of Rate Criteria Screen**

Once all inputs were completed by decision makers a fuzzy judgement matrix was created using the fuzzy rating scale as shown in Table 3, for example DM3 on criteria 6 was low (L). The corresponding fuzzy rating for L is (1, 3, 5) as shown in Table 3 below. Similarly Table 3 was populated with all the other fuzzy weights for criteria.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Criteria** | **DM1** | | | **DM2** | | | **DM3** | | | **DM4** | | |
| **C1** | (1, | 1, | 3) | (1, | 3, | 5) | (3, | 5, | 7) | (3, | 5, | 7) |
| **C2** | (3, | 5, | 7) | (3, | 5, | 7) | (1, | 1, | 3) | (1, | 3, | 5) |
| **C3** | (1, | 3, | 5) | (1, | 1, | 3) | (3, | 5, | 7) | (3, | 5, | 7) |
| **C4** | (7, | 9, | 9) | (7, | 9, | 9) | (5, | 7, | 9) | (5, | 7, | 9) |
| **C5** | (3, | 5, | 7) | (1, | 3, | 5) | (1, | 3, | 5) | (1, | 1, | 3) |
| **C6** | (3, | 5, | 7) | (1, | 3, | 5) | (1, | 3, | 5) | (5, | 7, | 9) |
| **C7** | (1, | 1, | 3) | (1, | 3, | 5) | (3, | 5, | 7) | (1, | 1, | 3) |
| **C8** | (3, | 5, | 7) | (5, | 7, | 9) | (5, | 7, | 9) | (5, | 7, | 9 |

**Table 3: Fuzzy Weights of Criteria**

The fuzzy weights of each criteria were now aggregated to get the aggregated fuzzy weight ( of criterion using equation (1):

, (1)

Table 4 shows the aggregated fuzzy matrix for criteria. Taking C3, **Less mental effort required to implement**, as an example, we find from Table 4 that the aggregated fuzzy weight is shown as (1, 3.5, 7). It is noted from Table 3 above the rating for C3, **Less mental effort required to implement**, was (1, 3, 5) by the Customer represented as DM1; (1,1, 3) by the Product Owner represented as DM2; (3, 5, 7 ) by the Business Analyst represented as DM3 and (3, 5, 7) by the Scrum Master represented as DM4 in the system. Using equation (1) the lower bound value was obtained by finding the minimum of 1, 1, 3 and 3, the middle number was obtained as follows: (3 + 1 + 5 + 5)/4 = 3.5 and the upper bound was determined by finding the maximum of 5, 3, 7 and 7. Hence the aggregated fuzzy weight for C3, **Less mental effort required to implement** is (1, 3.5, 7) as shown in Table 4 below. Similarly aggregate fuzzy weights for C1, C2, C4, C5, C6, C7 and C8 were obtained.

|  |  |  |  |
| --- | --- | --- | --- |
| **Criteria** | **Aggregate** | | |
| **C1** | (1, | 3.5, | 7) |
| **C2** | (1, | 3.5, | 7) |
| **C3** | (1, | 3.5, | 7) |
| **C4** | (5, | 8, | 9) |
| **C5** | (1, | 3, | 7) |
| **C6** | (1, | 4.5, | 9) |
| **C7** | (1, | 2.5, | 7) |
| **C8** | (3, | 6.5, | 9) |

**Table 4: Aggregate fuzzy weights for criteria**

**Decision makers rate requirements based on each criterion**

Table 5 below shows linguistic ratings in column 1 and the corresponding fuzzy rating for the requirements (alternatives) in column 2. The fuzzy ratings are expressed as triangular fuzzy number using a scale from 1 to 9. The fuzzy number chosen for a linguistic rating takes into consideration the fuzziness of that linguistic rating, for example Very Poor (VP) is represented as (1, 1, 3) in Table 5.

|  |  |
| --- | --- |
| **Linguistic term** | **Membership function** |
| Very Poor (VP) | (1,1,3) |
| Poor (P) | (1,3,5) |
| Fair(F) | (3,5,7) |
| Good (G) | (5,7,9) |
| Very Good (VG) | (7,9,9) |

**Table 5: Fuzzy Numbers for Linguistic Ratings of Requirements**

Table 6 shows the population of the judgement matrix by the customer for each requirement based on criterion 1 to criterion 8, for example requirement 2 **(R2 Login, Registration and Home Page)** based on criterion 6 **(C6 High business value)** was rated VG by the customer.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** |
| **Customer** | **R1** | VW | VW | W | A | G | VG | A | G |
| **R2** | VG | G | W | A | G | VG | G | G |
| **R3** | VW | W | A | G | VG | VG | W | VW |
| **R4** | VW | VW | W | A | VW | A | A | VW |
| **R5** | VG | G | W | A | G | VG | G | G |
| **R6** | W | W | A | G | VG | G | W | VW |
| **R7** | VG | VG | W | A | G | W | A | G |
| **R8** | VG | A | A | A | G | VG | G | G |
| **R9** | VG | G | A | G | VG | A | W | VW |
| **R10** | W | VG | W | A | G | VG | A | G |
| **R11** | A | W | W | A | G | VG | G | G |
| **R12** | A | A | A | G | VG | VG | W | VW |
| **R13** | W | W | W | A | G | VG | G | G |
| **R14** | G | G | A | G | VG | VG | W | VW |
| **R15** | VG | VG | A | G | VG | A | W | VW |

**Table 6: Linguistic Rating for Requirements by Customer**

Table 7 shows the population of the judgement matrix by the Product Owner for each requirement based on criterion 1 to criterion 8, for example requirement 5 **(R5 Product module: catalogue of products, services and promotions with terms and conditions)** based on criterion 1 **(Right personnel are available to implement feature)** was rated W by the Product Owner.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** |
| **Product**  **Owner** | **R1** | **VG** | **VG** | **W** | **A** | **G** | **A** | **A** | **G** |
| **R2** | A | A | VG | A | G | VG | G | G |
| **R3** | A | W | VG | G | VG | VG | W | VW |
| **R4** | VG | VW | W | A | G | VG | A | G |
| **R5** | W | G | W | A | G | A | G | G |
| **R6** | VG | VG | A | G | A | G | W | VW |
| **R7** | W | A | VG | G | G | W | A | G |
| **R8** | G | W | A | A | G | VG | G | G |
| **R9** | G | VG | A | G | A | A | W | VW |
| **R10** | VG | W | W | VG | G | VG | A | G |
| **R11** | VG | A | G | A | G | VG | G | G |
| **R12** | G | G | VG | G | VG | VG | W | A |
| **R13** | VG | W | G | A | G | VG | G | G |
| **R14** | VG | G | W | G | VG | VG | W | VW |
| **R15** | W | VG | A | G | VG | G | W | VW |

**Table 7: Linguistic rating for requirements by Product Owner**

Table 8 shows the population of the judgement matrix by the Business Analyst for each requirement based on criterion 1 to criterion 8, for example requirement 8 (**Delivery module: assign courier company, calculate cost of delivery for customer, tracking)** based on criterion 7 **(Low cost to implement)** was rated G by the Business Analyst.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** |
| **Business**  **Analyst** | **R1** | G | VW | W | A | G | G | A | G |
| **R2** | VG | VG | W | A | VG | VG | G | G |
| **R3** | VW | A | A | G | VG | VG | A | VW |
| **R4** | VW | VG | W | A | G | W | A | G |
| **R5** | VG | G | VG | A | G | G | G | G |
| **R6** | VG | G | A | G | VG | G | W | VW |
| **R7** | VG | G | W | A | G | W | A | G |
| **R8** | VG | W | W | A | G | G | G | G |
| **R9** | G | VG | A | VG | VG | A | W | VW |
| **R10** | W | VG | W | A | VG | VG | A | G |
| **R11** | A | W | W | A | VG | VG | G | G |
| **R12** | A | A | A | VG | VG | VG | W | VW |
| **R13** | G | W | G | A | VG | VG | VG | VG |
| **R14** | G | G | A | VG | VG | VG | W | VW |
| **R15** | VG | VG | A | VG | VG | A | W | VW |

**Table 8: Linguistic Rating for Requirements by Business Analyst**

Table 9 shows the population of the judgement matrix by the Scrum Master for each requirement based on criterion 1 to criterion 8, for example requirement 15 **(R15 Send out specials and general information via e-mail and SMS)** based on criterion 8 **(Low risk: no chances of volatility/uncertainty)** was rated VW by the Scrum Master.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** |
| **Scrum Master** | **R1** | G | W | VW | A | G | VG | A | G |
| **R2** | VG | A | VW | A | G | VG | G | G |
| **R3** | VW | W | A | G | VG | A | W | VW |
| **R4** | VW | VW | A | A | G | VG | A | G |
| **R5** | VG | A | VW | A | G | VG | G | G |
| **R6** | W | W | A | G | VG | A | W | VW |
| **R7** | VG | VG | A | A | G | W | A | G |
| **R8** | VG | A | A | A | G | VG | G | G |
| **R9** | VG | G | A | G | VG | A | VW | VW |
| **R10** | W | VG | VW | A | G | A | A | G |
| **R11** | A | W | VW | A | G | VG | G | G |
| **R12** | A | A | A | G | VG | VG | W | VW |
| **R13** | W | W | VW | A | G | VG | G | G |
| **R14** | G | G | A | G | VG | A | VW | VW |
| **R15** | VG | VG | A | G | A | A | VW | VW |

**Table 9: Linguistic Rating for Requirements by Scrum Master**

Decision makers ratings from Table 6, Table 7, Table 8 and Table 9 were then converted to a fuzzy decision matrix of requirements under each criterion. The table is now represented by fuzzy numbers, for example the rating by DM1, Customer for R2C6 was VW (1,1, 3), DM2, Product Owner for R5C1 was A (3, 5, 7), DM3, Business Analyst for R8C7 was VW (1, 1, 3) and DM 4, Scrum Master for R15C8 was VW (1,1, 3).

The fuzzy numbers are pooled together to get the aggregated fuzzy rating of requirement under criterion using equation (2):

, (2)

Table 10 shows the Aggregate fuzzy decision matrix for requirements.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | |  | | **C1** | |  | |  | | **C2** | |  | |  | | **C3** | |  | |  | | **C4** | |  | |  | | **C5** | |  | |  | | **C6** | |  | |  | | **C7** | |  | |  | | **C8** | |  | |  | |
| **R1** | (1, | | 6, | | 9) | | (1, | | 3.5, | | 9) | | (1, | | 2.5, | | 5) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | | (3, | | 7.5, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | |  | |
| **R2** | (3, | | 8, | | 9) | | (3, | | 6.5, | | 9) | | (1, | | 4, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7.5, | | 9) | | (7, | | 9, | | 9) | | (5, | | 7, | | 9) | | (5, | | 7, | | 9) | |  | |
| **R3** | (1, | | 2, | | 7) | | (1, | | 3.5, | | 7) | | (3, | | 6, | | 9) | | (5, | | 7, | | 9) | | (7, | | 9, | | 9) | | (3, | | 8, | | 9) | | (1, | | 3.5, | | 7) | | (1, | | 1, | | 3) | |  | |
| **R4** | (1, | | 3, | | 9) | | (1, | | 3, | | 9) | | (1, | | 3.5, | | 7) | | (3, | | 5, | | 7) | | (1, | | 5.5, | | 9) | | (1, | | 6.5, | | 9) | | (3, | | 5, | | 7) | | (1, | | 5.5, | | 9) | |  | |
| **R5** | (1, | | 7.5, | | 9) | | (3, | | 6.5, | | 9) | | (1, | | 4, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | | (3, | | 7.5, | | 9) | | (5, | | 7, | | 9) | | (5, | | 7, | | 9) | |  | |
| **R6** | (1, | | 6, | | 9) | | (1, | | 5.5, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | | (3, | | 8, | | 9) | | (3, | | 6.5, | | 9) | | (1, | | 3, | | 5) | | (1, | | 1, | | 3) | |  | |
| **R7** | (1, | | 7.5, | | 9) | | (3, | | 7.5, | | 9) | | (1, | | 5, | | 9) | | (3, | | 5.5, | | 9) | | (5, | | 7, | | 9) | | (1, | | 3, | | 5) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | |  | |
| **R8** | (5, | | 8.5, | | 9) | | (1, | | 4, | | 7) | | (1, | | 4.5, | | 7) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | | (5, | | 8.5, | | 9) | | (5, | | 7, | | 9) | | (5, | | 7, | | 9) | |  | |
| **R9** | (5, | | 8, | | 9) | | (5, | | 8, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7.5, | | 9) | | (3, | | 8, | | 9) | | (3, | | 5, | | 7) | | (1, | | 2.5, | | 5) | | (1, | | 1, | | 3) | |  | |
| **R10** | (1, | | 4.5, | | 9) | | (1, | | 7.5, | | 9) | | (1, | | 2.5, | | 5) | | (3, | | 6, | | 9) | | (5, | | 7.5, | | 9) | | (3, | | 8, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7, | | 9) | |  | |
| **R11** | (3, | | 6, | | 9) | | (1, | | 3.5, | | 7) | | (1, | | 3.5, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7.5, | | 9) | | (7, | | 9, | | 9) | | (5, | | 7, | | 9) | | (5, | | 7, | | 9) | |  | |
| **R12** | (3, | | 5.5, | | 9) | | (3, | | 5.5, | | 9) | | (3, | | 6, | | 9) | | (5, | | 7.5, | | 9) | | (7, | | 9, | | 9) | | (7, | | 9, | | 9) | | (1, | | 3, | | 5) | | (1, | | 2, | | 7) | |  | |
| **R13** | (1, | | 5.5, | | 9) | | (1, | | 3, | | 5) | | (1, | | 4.5, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7.5, | | 9) | | (7, | | 9, | | 9) | | (5, | | 7.5, | | 9) | | (5, | | 7.5, | | 9) | |  | |
| **R14** | (5, | | 7.5, | | 9) | | (5, | | 7, | | 9) | | (3, | | 4.5, | | 7) | | (5, | | 7.5, | | 9) | | (7, | | 9, | | 9) | | (3, | | 8, | | 9) | | (1, | | 2.5, | | 5) | | (1, | | 1, | | 3) | |  | |
| **R15** | (1, | | 7.5, | | 9) | | (7, | | 9, | | 9) | | (3, | | 5, | | 7) | | (5, | | 7.5, | | 9) | | (3, | | 8, | | 9) | | (3, | | 5.5, | | 9) | | (1, | | 2.5, | | 5) | | (1, | | 1, | | 3) | |  | |
|  | | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |

**Table 10: Aggregate Fuzzy Decision Matrix for Requirements**

Using requirement 3 **(R3 Customizable reports for various roles: customer, administrator, dispatch clerk)** and Criterion 1 **(C1 Right personnel are available to implement feature)** as an example it can be illustrated how Table 10 was constructed. The rating by DM 1, the customer was VW (1,1, 3), DM2, the Product Owner was A (3, 5, 7), DM3, the Business Analyst was VW (1, 1, 3) and DM4, Scrum Master was VW (1,1, 3) as shown in Table 6, 7, 8 and 9 respectively. The aggregated triple was calculated as follows: lower bound = min 1, 3, 1, and 1, middle number = (1+5+1+1)/4= 2 and upper bound = max 3, 7, 3 and 3. Hence an aggregate rating of (1, 2, 7) was obtained for R3 C1 as shown in Table 10.

All other values in Table 10 were populated similarly.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **C1** | |  | |  | | **C2** | |  | |  | | **C3** | |  | |  | | **C4** | |  | |  | | **C5** | |  | |  | | **C6** | |  | |  | | **C7** | |  | |  | | **C8** | |  | |
| **R1** | (0.11, | | 0.67, | | 1) | | (0.11, | | 0.39, | | 1) | | (0.11, | | 0.28, | | 0.56) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | | (0.33, | | 0.83, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | |
| **R2** | (0.33, | | 0.89, | | 1) | | (0.33, | | 0.72, | | 1) | | (0.11, | | 0.44, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.83, | | 1) | | (0.78, | | 1, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.56, | | 0.78, | | 1) | |
| **R3** | (0.11, | | 0.22, | | 0.78) | | (0.11, | | 0.39, | | 0.78) | | (0.33, | | 0.67, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.78, | | 1, | | 1) | | (0.33, | | 0.89, | | 1) | | (0.11, | | 0.39, | | 0.78) | | (0.11, | | 0.11, | | 0.33) | |
| **R4** | (0.11, | | 0.33, | | 1) | | (0.11, | | 0.33, | | 1) | | (0.11, | | 0.39, | | 0.78) | | (0.33, | | 0.56, | | 0.78) | | (0.11, | | 0.61, | | 1) | | (0.11, | | 0.72, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.11, | | 0.61, | | 1) | |
| **R5** | (0.11, | | 0.83, | | 1) | | (0.33, | | 0.72, | | 1) | | (0.11, | | 0.44, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | | (0.33, | | 0.83, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.56, | | 0.78, | | 1) | |
| **R6** | (0.11, | | 0.67, | | 1) | | (0.11, | | 0.61, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | | (0.33, | | 0.89, | | 1) | | (0.33, | | 0.72, | | 1) | | (0.11, | | 0.33, | | 0.56) | | (0.11, | | 0.11, | | 0.33) | |
| **R7** | (0.11, | | 0.83, | | 1) | | (0.33, | | 0.83, | | 1) | | (0.11, | | 0.56, | | 1) | | (0.33, | | 0.61, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.11, | | 0.33, | | 0.56) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | |
| **R8** | (0.56, | | 0.94, | | 1) | | (0.11, | | 0.44, | | 0.78) | | (0.11, | | 0.5, | | 0.78) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | | (0.56, | | 0.94, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.56, | | 0.78, | | 1) | |
| **R9** | (0.56, | | 0.89, | | 1) | | (0.56, | | 0.89, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.83, | | 1) | | (0.33, | | 0.89, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.11, | | 0.28, | | 0.56) | | (0.11, | | 0.11, | | 0.33) | |
| **R10** | (0.11, | | 0.5, | | 1) | | (0.11, | | 0.83, | | 1) | | (0.11, | | 0.28, | | 0.56) | | (0.33, | | 0.67, | | 1) | | (0.56, | | 0.83, | | 1) | | (0.33, | | 0.89, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.78, | | 1) | |
| **R11** | (0.33, | | 0.67, | | 1) | | (0.11, | | 0.39, | | 0.78) | | (0.11, | | 0.39, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.83, | | 1) | | (0.78, | | 1, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.56, | | 0.78, | | 1) | |
| **R12** | (0.33, | | 0.61, | | 1) | | (0.33, | | 0.61, | | 1) | | (0.33, | | 0.67, | | 1) | | (0.56, | | 0.83, | | 1) | | (0.78, | | 1, | | 1) | | (0.78, | | 1, | | 1) | | (0.11, | | 0.33, | | 0.56) | | (0.11, | | 0.22, | | 0.78) | |
| **R13** | (0.11, | | 0.61, | | 1) | | (0.11, | | 0.33, | | 0.56) | | (0.11, | | 0.5, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.83, | | 1) | | (0.78, | | 1, | | 1) | | (0.56, | | 0.83, | | 1) | | (0.56, | | 0.83, | | 1) | |
| **R14** | (0.56, | | 0.83, | | 1) | | (0.56, | | 0.78, | | 1) | | (0.33, | | 0.5, | | 0.78) | | (0.56, | | 0.83, | | 1) | | (0.78, | | 1, | | 1) | | (0.33, | | 0.89, | | 1) | | (0.11, | | 0.28, | | 0.56) | | (0.11, | | 0.11, | | 0.33) | |
| **R15** | (0.11, | | 0.83, | | 1) | | (0.78, | | 1, | | 1) | | (0.33, | | 0.56, | | 0.78) | | (0.56, | | 0.83, | | 1) | | (0.33, | | 0.89, | | 1) | | (0.33, | | 0.61, | | 1) | | (0.11, | | 0.28, | | 0.56) | | (0.11, | | 0.11, | | 0.33) | |

**Table 11: Normalised Aggregate Fuzzy Decision Matrix**

Table 11 shows the constructed normalized fuzzy decision matrix. This matrix is constructed with equation (3)

and = maxi  (benefit criteria)

Therefore = maxi  (9,9,9)

Consider R3C1 (1, 2, 7) and R15C5 (3, 8, 9) from Table 10 as examples. The normalized values were obtained from Table 10 as follows (1/9,2/9,7/9) and (3/9, 8/9, 9/9) to obtain (0.111,0.222,0.778) and (0.111, 0.889, 1) respectively, as shown in Table 11 above. Similarly other normalized values in Table 11 were obtained using values from the Aggregate fuzzy decision matrix for requirements in Table 10.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **C1** |  |  | **C2** |  |  | **C3** |  |  | **C4** |  |  | **C5** |  |  | **C6** |  |  | **C7** |  |  | **C8** |  |
| **R1** | (0.11, | 2.33, | 7) | (0.11, | 1.36, | 7) | (0.11, | 0.97, | 3.89) | (1.67, | 4.44, | 7) | (0.56, | 2.33, | 7) | (0.33, | 3.75, | 9) | (0.33, | 1.39, | 5.44) | (1.67, | 5.06, | 9) |
| **R2** | (0.33, | 3.11, | 7 | (0.33, | 2.53, | 7) | (0.11, | 1.56, | 7) | (1.67, | 4.44, | 7) | (0.56, | 2.5, | 7) | (0.78, | 4.5, | 9) | (0.56, | 1.94, | 7) | (1.67, | 5.06, | 9) |
| **R3** | (0.11, | 0.78, | 5.44) | (0.11, | 1.36, | 5.44) | (0.33, | 2.33, | 7) | (2.78, | 6.22, | 9) | (0.78, | 3, | 7) | (0.33, | 4, | 9) | (0.11, | 0.97, | 5.44) | (0.33, | 0.72, | 3) |
| **R4** | (0.11, | 1.17, | 7) | (0.11, | 1.17, | 7) | (0.11, | 1.36, | 5.44) | (1.67, | 4.44, | 7) | (0.11, | 1.83, | 7) | (0.11, | 3.25, | 9) | (0.33, | 1.39, | 5.44) | (0.33, | 3.97, | 9) |
| **R5** | (0.11, | 2.92, | 7) | (0.33, | 2.53, | 7) | (0.11, | 1.56, | 7) | (1.67, | 4.44, | 7) | (0.56, | 2.33, | 7) | (0.33, | 3.75, | 9) | (0.56, | 1.94, | 7) | (1.67, | 5.06, | 9) |
| **R6** | (0.11, | 2.33, | 7) | (0.11, | 2.14, | 7) | (0.33, | 1.94, | 5.44) | (2.78, | 6.22, | 9) | (0.33, | 2.67, | 7) | (0.33, | 3.25, | 9) | (0.11, | 0.83, | 3.89) | (0.33, | 0.72, | 3) |
| **R7** | (0.11, | 2.92, | 7) | (0.33, | 2.92, | 7) | (0.11, | 1.94, | 7) | (1.67, | 4.89, | 9) | (0.56, | 2.33, | 7) | (0.11, | 1.5, | 5) | (0.33, | 1.39, | 5.44) | (1.67, | 5.06, | 9) |
| **R8** | (0.56, | 3.31, | 7) | (0.11, | 1.56, | 5.44) | (0.11, | 1.75, | 5.44) | (1.67, | 4.44, | 7) | (0.56, | 2.33, | 7) | (0.56, | 4.25, | 9) | (0.56, | 1.94, | 7) | (1.67, | 5.06, | 9) |
| **R9** | (0.56, | 3.11, | 7) | (0.56, | 3.11, | 7) | (0.33, | 1.94, | 5.44) | (2.78, | 6.67, | 9) | (0.33, | 2.67, | 7) | (0.33, | 2.5, | 7) | (0.11, | 0.69, | 3.89) | (0.33, | 0.72, | 3) |
| **R10** | (0.11, | 1.75, | 7) | (0.11, | 2.92, | 7) | (0.11, | 0.97, | 3.89) | (1.67, | 5.33, | 9) | (0.56, | 2.5, | 7) | (0.33, | 4, | 9) | (0.33, | 1.39, | 5.44) | (1.67, | 5.06, | 9) |
| **R11** | (0.33, | 2.33, | 7) | (0.11, | 1.36, | 5.44) | (0.11, | 1.36, | 7) | (1.67, | 4.44, | 7) | (0.56, | 2.5, | 7) | (0.78, | 4.5, | 9) | (0.56, | 1.94, | 7) | (1.67, | 5.06, | 9) |
| **R12** | (0.33, | 2.14, | 7) | (0.33, | 2.14, | 7) | (0.33, | 2.33, | 7) | (2.78, | 6.67, | 9) | (0.78, | 3, | 7) | (0.78, | 4.5, | 9) | (0.11, | 0.83, | 3.89) | (0.33, | 1.44, | 7) |
| **R13** | (0.11, | 2.14, | 7) | (0.11, | 1.17, | 3.89) | (0.11, | 1.75, | 7) | (1.67, | 4.44, | 7) | (0.56, | 2.5, | 7) | (0.78, | 4.5, | 9) | (0.56, | 2.08, | 7) | (1.67, | 5.42, | 9) |
| **R14** | (0.56, | 2.92, | 7) | (0.56, | 2.72, | 7) | (0.33, | 1.75, | 5.44) | (2.78, | 6.67, | 9) | (0.78, | 3, | 7) | (0.33, | 4, | 9) | (0.11, | 0.69, | 3.89) | (0.33, | 0.72, | 3) |
| **R15** | (0.11, | 2.92, | 7) | (0.78, | 3.5, | 7) | (0.33, | 1.94, | 5.44) | (2.78, | 6.67, | 9) | (0.33, | 2.67, | 7) | (0.33, | 2.75, | 9) | (0.11, | 0.69, | 3.89) | (0.33, | 0.72, | 3) |

**Table 12: Weighted Normalized Fuzzy Decision Matrix**

Now the weighted normalized fuzzy decision matrix was constructed as shown in Table 12. The values were computed by multiplying the weights of evaluation criteria (vector) with the normalized fuzzy decision matrix using the equation . Still taking R3C1 and R15C5 as examples, it is shown how the values for Table 12 were computed. In Table 11 it was shown that the normalized values for R3C1 was (0.111, 0.222, 0.778) and R15C5 was (0.333, 0.889, 1). Using values from Table 4 the weight for C1 was (1, 3.5, 7) and C5 was (1, 3 , 7). Therefore using equation (10) R3C1 was obtained as follows: lower bound = 0.111 x 1, middle = 0.2222 x 3.5, upper bound = 0.778 x 7 and R15C5 was obtained as follows: lower bound = 0.33x1, middle =0.89x3, upper= 1x7. Hence the values for R3C1 is (0.111, 0.778, 5.44) and R15C5 is (0.33, 2.67, 7) as shown in Table 12 were obtained. Similarly, other values were computed and Table 12 shows the values after these computations were completed.

Now the Fuzzy Negative-Ideal Solution (FNIS) and Fuzzy Positive-Ideal Solution (FPIS) are calculated. The Fuzzy Positive Ideal Solution (FPIS, A+) and the Fuzzy Negative Ideal Solution (FNIS, A-) are defined according to the following equations:

A+ = (8)

A- = (9)

Where = (1, 1, 1) and = (0, 0, 0)

Table 13 shows the FNIS(A-) and FNIS(A+) values. These values are obtained by looking for the maximum and minimum values under each criterion in Table 12.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Criteria** | **FNIS(A-)** | | | **FNIS(A+)** | | |
| **C1** | 0.111 | 0.111 | 0.111 | 7.000 | 7.000 | 7.000 |
| **C2** | 0.111 | 0.111 | 0.111 | 7.000 | 7.000 | 7.000 |
| **C3** | 0.111 | 0.111 | 0.111 | 7.000 | 7.000 | 7.000 |
| **C4** | 0.111 | 0.111 | 0.111 | 9.000 | 9.000 | 9.000 |
| **C5** | 0.111 | 0.111 | 0.111 | 7.000 | 7.000 | 7.000 |
| **C6** | 0.111 | 0.111 | 0.111 | 9.000 | 9.000 | 9.000 |
| **C7** | 0.111 | 0.111 | 0.111 | 7.000 | 7.000 | 7.000 |
| **C8** | 0.333 | 0.333 | 0.333 | 9.000 | 9.000 | 9.000 |

**Table 13: FNIS(A-) and FNIS(A+)**

The distance *d* which represents the distance between two triangular fuzzy numbers, namely the weighted normalized triple (l1,m1, u1) and FNIS or FPIS (l2,m2,u2) are calculated using equation (12) below.

d( = (12)

Table 14 and Table 15 shows distance values from FPIS and FNIS respectively. For example in order to find the distance between R5 C8 (1.67, 5.06, 9) and A+ (9, 9, 9) the following calculation was completed:

D(R5,A+) = = 4.80, as shown in Table 14 below.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** |  | **d+** |
| **d(R1,A+)** | 4.804 | 5.14 | 5.582 | 5.116 | 4.594 | 5.85 | 5.11 | 4.808 |  | 41 |
| **d(R2,A+)** | 4.456 | 4.635 | 5.069 | 5.116 | 4.538 | 5.412 | 4.729 | 4.808 |  | 38.76 |
| **d(R3,A+)** | 5.434 | 5.218 | 4.698 | 3.934 | 4.271 | 5.777 | 5.361 | 7.738 |  | 42.43 |
| **d(R4,A+)** | 5.212 | 5.212 | 5.218 | 5.116 | 4.972 | 6.112 | 5.11 | 5.785 |  | 42.74 |
| **d(R5,A+)** | 4.624 | 4.635 | 5.069 | 5.116 | 4.594 | 5.85 | 4.729 | 4.808 |  | 39.42 |
| **d(R6,A+)** | 4.804 | 4.868 | 4.913 | 3.934 | 4.591 | 6.005 | 5.632 | 7.738 |  | 42.48 |
| **d(R7,A+)** | 4.624 | 4.514 | 4.933 | 4.854 | 4.594 | 7.101 | 5.11 | 4.808 |  | 40.54 |
| **d(R8,A+)** | 4.289 | 5.148 | 5.081 | 5.116 | 4.594 | 5.594 | 4.729 | 4.808 |  | 39.36 |
| **d(R9,A+)** | 4.346 | 4.346 | 4.913 | 3.837 | 4.591 | 6.36 | 5.683 | 7.738 |  | 41.81 |
| **d(R10,A+)** | 5.001 | 4.624 | 5.582 | 4.734 | 4.538 | 5.777 | 5.11 | 4.808 |  | 40.17 |
| **d(R11,A+)** | 4.698 | 5.218 | 5.14 | 5.116 | 4.538 | 5.412 | 4.729 | 4.808 |  | 39.66 |
| **d(R12,A+)** | 4.764 | 4.764 | 4.698 | 3.837 | 4.271 | 5.412 | 5.632 | 6.738 |  | 40.11 |
| **d(R13,A+)** | 4.868 | 5.513 | 5.001 | 5.116 | 4.538 | 5.412 | 4.68 | 4.712 |  | 39.84 |
| **d(R14,A+)** | 4.405 | 4.466 | 4.981 | 3.837 | 4.271 | 5.777 | 5.683 | 7.738 |  | 41.16 |
| **d(R15,A+)** | 4.624 | 4.122 | 4.913 | 3.837 | 4.591 | 6.169 | 5.683 | 7.738 |  | 41.68 |

**Table 14: Distance from FPIS (A+)**

The distances as shown in Table 14 and as shown in Table 15 of each alternative is computed from respectively and according to equations (10) and (11).

=( (10)

=( (11)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** |  | **d-** |
| **d(R1,A-)** | 4.179 | 4.042 | 2.237 | 3.472 | 4.187 | 5.547 | 3.169 | 5.75 |  | 32.58 |
| **d(R2,A-)** | 4.34 | 4.217 | 4.064 | 3.472 | 4.217 | 5.736 | 4.124 | 5.75 |  | 35.92 |
| **d(R3,A-)** | 3.103 | 3.163 | 4.181 | 5.025 | 4.33 | 5.603 | 3.119 | 1.556 |  | 30.08 |
| **d(R4,A-)** | 4.024 | 4.024 | 3.163 | 3.472 | 4.1 | 5.443 | 3.169 | 5.427 |  | 32.82 |
| **d(R5,A-)** | 4.294 | 4.217 | 4.064 | 3.472 | 4.187 | 5.547 | 4.124 | 5.75 |  | 35.65 |
| **d(R6,A-)** | 4.179 | 4.146 | 3.259 | 5.025 | 4.244 | 5.444 | 2.221 | 1.556 |  | 30.07 |
| **d(R7,A-)** | 4.294 | 4.296 | 4.116 | 4.625 | 4.187 | 2.934 | 3.169 | 5.75 |  | 33.37 |
| **d(R8,A-)** | 4.392 | 3.19 | 3.221 | 3.472 | 4.187 | 5.667 | 4.124 | 5.75 |  | 34 |
| **d(R9,A-)** | 4.346 | 4.346 | 3.259 | 5.164 | 4.244 | 4.212 | 2.207 | 1.556 |  | 29.33 |
| **d(R10,A-)** | 4.088 | 4.294 | 2.237 | 4.734 | 4.217 | 5.603 | 3.169 | 5.75 |  | 34.09 |
| **d(R11,A-)** | 4.181 | 3.163 | 4.042 | 3.472 | 4.217 | 5.736 | 4.124 | 5.75 |  | 34.69 |
| **d(R12,A-)** | 4.148 | 4.148 | 4.181 | 5.164 | 4.33 | 5.736 | 2.221 | 3.902 |  | 33.83 |
| **d(R13,A-)** | 4.146 | 2.265 | 4.088 | 3.472 | 4.217 | 5.736 | 4.145 | 5.852 |  | 33.92 |
| **d(R14,A-)** | 4.302 | 4.261 | 3.224 | 5.164 | 4.33 | 5.603 | 2.207 | 1.556 |  | 30.65 |
| **d(R15,A-)** | 4.294 | 4.449 | 3.259 | 5.164 | 4.244 | 5.355 | 2.207 | 1.556 |  | 30.53 |

**Table 15: Distance from FNIS (A-)**

For example the d- value for R3 is computed as 3.103 + 3.163 + 4.181 + 5.025 + 4.33 + 5.603 + 3.119 + 1.556 = 30.08 as shown in Table 15.

**The defuzzified 0utput**

The closeness coefficient (CCi) is computed according to equation (13).

CCi =

The alternative with the highest closeness coefficient represents the best alternatives and is closest to the FPIS and farthest from FNIS. For example, the CCi value for R3 can be calculated using equation (13) above is as follows: CCi = 30.08/(30.08+42.43) = 0.41484. Similarly all other CCi values were calculated as shown in Table 16.

|  |  |  |
| --- | --- | --- |
| **Requirement** | **CCi** | **Ranking** |
| **R2** | 0.48097 | 1 |
| **R5** | 0.47489 | 2 |
| **R11** | 0.46656 | 3 |
| **R8** | 0.4635 | 4 |
| **R13** | 0.45989 | 5 |
| **R10** | 0.45907 | 6 |
| **R12** | 0.45751 | 7 |
| **R7** | 0.45153 | 8 |
| **R1** | 0.44278 | 9 |
| **R4** | 0.43438 | 10 |
| **R14** | 0.42682 | 11 |
| **R15** | 0.4228 | 12 |
| **R3** | 0.41484 | 13 |
| **R6** | 0.41448 | 14 |
| **R9** | 0.41229 | 15 |

**Table 16: Closeness Coeffiecients and Ranking of Requirements**

Defuzzification of the Best Non fuzzy Performance value (BNP) for a criteria weighting j, is calculated using the following equation (Safari et al. 2012):

for example, the aggregated fuzzy value for criteria 1 is (1, 3.5, 7). The calculation for the BNP of criteria 1 is as follows:

BNP = [(7-1) + (3.5-1)]/3 + 1

BNP = 3.83333

Similarly other BNP values were calculated.

Figure 6 shows the output of the automated fuzzy ranking tool. The values of Table 16 are identical to Figure 6 proving the correctness of the demonstration and the accuracy of the automated fuzzy tool.

**Automated Fuzzy Ranking Tool**

**(Defuzzified Output)**

**Backlog: Closeness Coefficients (CCi) and Ranking:**

R2 Login, Registration and Home Page CCi: 0,481  
R5 Product module CCi: 0,4749  
R11Checkout module CCi: 0,4666  
R8 Delivery module CCi: 0,4635  
R13 Dispatch Clerk module CCi: 0,4599  
R10 Inventory module CCi: 0,4591  
R12 Search for a product and service CCi: 0,4575  
R7 Administrator module CCi: 0,4515  
R1 Access control CCi: 0,4428  
R4 Courier costs per contracted vendor CCi: 0,4344  
R14 Display and store promotions CCi: 0,4262  
R15 Send out specials via e-mail and SMS CCi: 0,4228  
R3 Customizable reports for various roles CCi: 0,4148  
R6 Encryption algorithms CCi: 0,4145  
R9 Database backup and recovery CCi: 0,4123

**Ranked Criteria: Best Non Fuzzy Performance (BNP):**

C4 Core: Core to system and must get high priority BNP: 7,3333  
C8 Low risk: no chances of volatility/uncertainty BNP: 6,1667  
C6 High business value BNP: 4,8333  
C1 Right personnel are available to implement feature BNP: 3,8333  
C2 No dependencies: Dependent requirements get low priority BNP: 3,8333  
C3 Less mental effort required to implement BNP: 3,8333  
C5 Small in size to implement: generates only few user stories BNP: 3,6667  
C7 Low cost (cheap) to implement BNP: 3,5

**Figure 6: Output of Automated Fuzzy Tool**

The results of the tool were verified and shown to be valid.