

## Task 1: Defects and inconsistencies inspection forms

Defect #	Location	Defect type	Classification	Description	Status	Date corrected
1	Stakeholder Summary (3.1, Page 2)	Omission	Major	Not mentioned some major stakeholders for the system like Competitors, software testing team and management hierarchy of the whole project.		
2	Problem Statement (2.1, Page 1)	Ambiguity	Minor	Didn't mention if stores will be present in all over the country or just in a specific city or province		
3	Product Position Statement (2.2, Page 1)	Inadequacy	Minor	Can explain the product more clearly by a sentence or two.		
4	User Environment (3.3, Page 3)	Inadequacy	Minor	Need to elaborate more on User environment and make it more precise and technical. It should cover all questions mentioned in vision document.		
5	Assumptions and Dependencies (4.2, Page 4)	Unintelligibility	Major	"Customer should be more than 18 years old" is a requirement and it cannot be an assumption		
6	Product Features (5, Page 5 and 6)	Omission	Minor	Missing some product features like password recovery		
7	Other Product	Poor modifiability	Major	Tool is dependent on the database version. If the database needs to be		

	Requirements (Page 6)			updated, then PHP version needs to be updated accordingly.		
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#	Location	Inconsistency type	Classification	Description	Status	Date corrected
1	2.1 Problem Statement, Page 1 <b>S1</b>	Designation Clash	Weak	ETR makes different tools available to wide range of customers who maybe don't want to buy them because of budget and non-regular usage		
2	2.2 Problem Position Statement, Page 1 <b>S2</b>	Designation Clash	Weak	ETR helps people to rent tools and equipment they want according to availability and pricing		
3	2.2 Problem Position Statement, Page 1 <b>S3</b>	Designation Clash	Weak	Customers can make reservation, and pick up tools and equipment from stores which will be available at different locations		
4	2.2 Problem Position Statement, Page 1 <b>S4</b>	Designation Clash	Weak	ETR is a web application which allows customers to check availability of the tool online and make a reservation for renting a tool for a specific period		
5	5 Product Features, Page 5	Structure Clash	Weak	System Administrator can see the current inventory and		

	<b>S5</b>			add/remove the tools		
6	5 Product Features, Page 5 <b>S6</b>	Structure Clash	Weak	Branch Employee can see the current inventory and add/remove the tools		
7	6.1 Design/Architecture Requirements, Page 6 <b>S7</b>	Structure Clash	Weak	PHP MVC based project with MYSQL database structure.		

## Task 2: Documenting Conflicts

S1: ETR makes different tools available to wide range of customers who maybe don't want to buy them because of budget and non-regular usage

S2: ETR helps people to rent tools and equipment they want according to availability and pricing

S3: Customers can make reservation, and pick up tools and equipment from stores which will be available at different locations

S4: ETR is a web application which allows customers to check availability of the tool online and make a reservation for renting a tool for a specific period

S5: System Administrator can see the current inventory and add/remove the tools

S6: Branch Employee can see the current inventory and add/remove the tools

S7: PHP MVC based project with MYSQL database structure.

Statement	S1	S2	S3	S4	S5	S6	S7	Total
S1	0	1	0	1000	0	0	0	1001
S2	1	0	1	1	0	0	0	3
S3	0	1	0	1000	0	0	0	1001
S4	1000	1	1000	0	0	0	1000	3001
S5	0	0	0	0	0	1	0	1
S6	0	0	0	0	1	0	0	1
S7	0	0	0	1000	0	0	0	1000
Total	1001	3	1001	3001	1	1	1000	6008

$$= \frac{\text{The total number of non – conflicting overlaps and conflicts}}{1000}$$

$$= \frac{6008}{1000}$$

$$= 6.008$$

### Task 3: Conflict Resolution

1. Consider Divergence between S1 and S2. 'ETR makes different tools available to wide range of customers who maybe don't want to buy them because of budget and non-regular usage' and 'ETR helps people to rent tools and equipment they want according to availability and pricing'

S1 talks about making tools available (not specifying for renting) and discusses the problem of budget and usage whereas S2 specifies renting according to availability and pricing. Statements are conflicting on how availability and pricing is defined.

Specialize conflict source or target	This conflict can be resolved by specializing the conflict source objects "availability", "budget" and "pricing". Specifying for example availability of tools in a store in a specific location.
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Restore conflict	Conflict can be resolved by amalgamation of both the statements. Parts of both statements added together can make a logically correct statement. Sample – ETR helps wide range of customers to rent different tools according to availability and pricing of the tool and keeping customer's budget and usage need in consideration
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2. Consider statements S2 'ETR helps people to rent tools and equipment they want according to availability and pricing' and S3 'Customers can make reservation and pick up tools and equipment from stores which will be available at different locations.'  
S2 talks about renting the tools according to availability and pricing which differs from S3 which talks about reservations.

Specialize conflict source or target	This conflict can be resolved by specializing the conflict source objects "availability" and "reservation". Specifying for example, availability of tools in a store in a specific location.
Restore conflict	This conflict can be resolved if we add all conditions together. Each scenario should be considered while using renting a tool.

3. Consider Divergence between S2 and S4. 'ETR helps people to rent tools and equipment they want according to availability and pricing' and 'ETR is a web application which allows customers to check availability of the tool online and make a reservation for renting a tool for a specific period'

Restore conflict	This conflict can be resolved if we add all conditions together. Everything should be considered while renting the tools like availability, amount of time or period, pricing and reservation.
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4. Consider statements S5 'System Administrator can see the current inventory and add/remove the tools' and S6 'Branch Employee can see the current inventory and add/remove the tools'

Avoid boundary condition	Avoid Boundary Condition by providing a separate inventory page and add/remove page for Admin and Branch employees.
Weak conflict	Weaken Conflicting statements by adding new requirement of different view/page of inventory and tools adding and removing for Admin and Branch employees. Also, can have some specific (or new tools) which need special Admin access

## Task 4: Conflict Evaluation

Using Weighted matrices for evaluating alternative options for the above documented conflicts.

$$totalScore(opt) = \sum_{crit} (Scores(opt, crit) \times Weight(crit))$$

1. Consider the divergence between the statements S1 'ETR makes different tools available to wide range of customers who maybe don't want to buy them because of budget and non-regular usage' and S2 'ETR helps people to rent tools and equipment they want according to availability and pricing'

Evaluation Criteria NFR	Significance Weighting	Option Score	
		ETR makes different tools available to wide range of customers who maybe don't want to buy them because of budget and non-regular usage	ETR helps people to rent tools and equipment they want according to availability and pricing
Availability	0.4	0.3	0.6
Scalability	0.3	0.5	0.7
Usability	0.3	0.7	0.8
Total	1.0	0.48	0.69

The option "ETR helps people to rent tools and equipment they want according to availability and pricing" is coming out be a better option according to the estimates.

2. Consider statements S2 'ETR helps people to rent tools and equipment they want according to availability and pricing' and S3 'Customers can make reservation and pick up tools and equipment from stores which will be available at different locations.'  
S2 talks about renting the tools according to availability and pricing which differs from S3 which talks about reservations.

Evaluation Criteria NFR	Significance Weighting	Option Score	
		ETR helps people to rent tools and equipment they want according to availability and pricing	Customers can make reservation and pick up tools and equipment from stores which will be available at different locations
Availability	0.3	0.6	0.4
Minimal Inconvenience	0.5	0.4	0.5

Usability	0.2	0.8	0.5
Total	1.0	0.54	0.59

The according to above estimates option “Customers can make reservation and pick up tools and equipment from stores which will be available at different locations” seems to be a better option.

3. Consider Divergence between S2 and S4. ‘ETR helps people to rent tools and equipment they want according to availability and pricing’ and ‘ETR is a web application which allows customers to check availability of the tool online and make a reservation for renting a tool for a specific period’

Evaluation Criteria NFR	Significance Weighting	Option Score	
		ETR helps people to rent tools and equipment they want according to availability and pricing	ETR is a web application which allows customers to check availability of the tool online and make a reservation for renting a tool for a specific period
Availability	0.3	0.6	0.6
Minimal Inconvenience	0.3	0.4	0.7
Distribution	0.4	0.3	0.7
Total	1.0	0.42	0.67

The option “ETR is a web application which allows customers to check availability of the tool online and make a reservation for renting a tool for a specific period” seems to be a better option according to above estimates.

4. Consider the divergence between the statements (S5 and S6) “Login Page for System Administrator prompts for username & Password.” And “Login Page for Branch Employee also prompts for username & Password.”

Evaluation Criteria NFR	Significance Weighting	Option Score	
		Adding different features for Admin and Branch employees on same pages. Using access limitation to solve the issue.	Introducing the new requirement of adding a different inventory and add/remove pages for Admin and Branch employees
Usability	0.3	0.6	0.4
Confidentiality	0.4	0.4	0.7
Minimal Inconvenience	0.3	0.7	0.6

Total	1.0	0.55	0.58
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The option “Introducing the new requirement of adding a different inventory and add/remove pages for Admin and Branch employees” seems to be a better option according to above estimates.

## Task 5: Risk Management

### 1. Risk Identification

#### a. Component Inspection

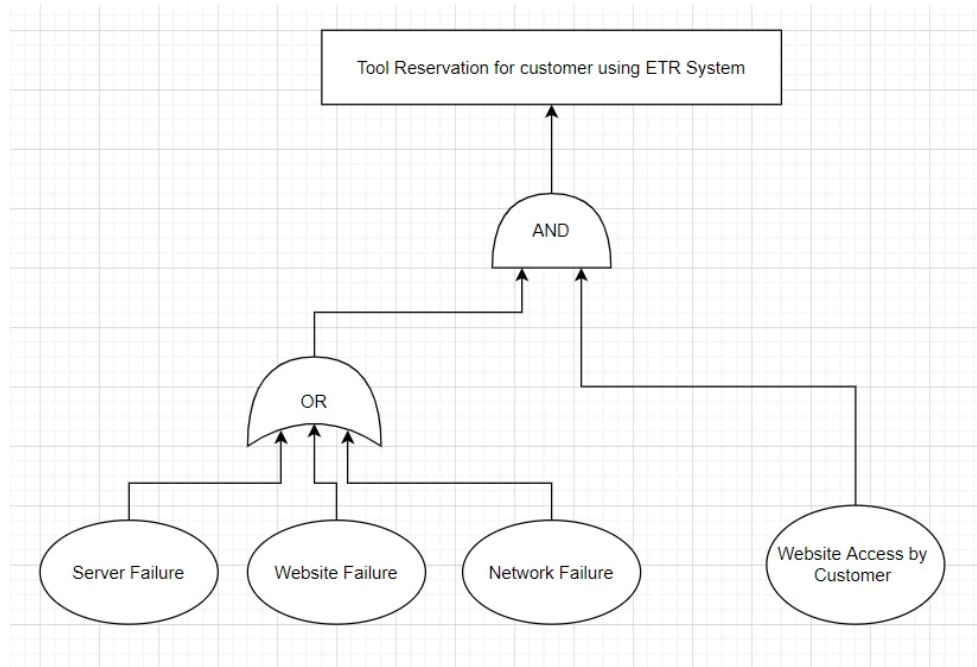
- i. Server Failure: Server can fail due to different issues like too many requests (heavy load).
- ii. Website Failure: A bug in the site can result to website going down
- iii. Network Failure: Network (provided by a telecom) used where the server lies can go down, resulting in whole web application going down. Also, the users should have a good connection.

#### b. Risk Checklist

- i. Performance Risk: This system is using php framework which not the fastest and many photos across the site which may slow down the website. (Can use <https://pagespeed.web.dev/> to check the performance)
- ii. Reliability Risk: This system is relying on entries made by employees for the tools which might not be as reliable as machine generated data.
- iii. Security Risk: System needs to be using https (SSL/TLS) and encryption for passwords.



### c. Risk Tree



Thus, from this risk tree, and with the help of cut-set, the possible risks identified are Server Failure, Website Failure and Network Failure.

## 2. Risk Quantitative Assessment

Risk	Likelihood	Severity (1-10)	Risk Exposure = Likelihood * Severity
Server Failure Risk	26%	7	1.82
Network Failure Risk	19%	8	1.52
Website Failure Risk	29%	8	2.32
Reliability Risk	27%	6	1.62
Security Risk	33%	7	2.31
Performance Risk	31%	5	1.55

### 3. Risk Control

We will be using Risk Reduction Leverage (RRL) to calculate the better countermeasure for a particular risk.

$$\text{Risk reduction leverage (RRL)} = \frac{RE_{\text{before}} - RE_{\text{after}}}{\text{Cost of risk reduction}}$$

**Some Short Notations of Full Words used in below tables:**

Likelihood → LH

Severity → SR

Risk Exposure →  $RE_{\text{after}}$

Cost of Risk Reduction → CRR

Risk Reduce Leverage → RRL

#### a. Server Failure Risk

Risk Exposure<sub>before</sub> = 1.82

Risk Reduction Tactic: **Reduce Risk Likelihood**

Alternative Option	Description	LH (0-1)	SR (1-10)	$RE_{\text{after}}$	CRR (1-10)	RRL
1	Add monitoring tools like Alerta, uptime, etc. Also, can add data management and logging system like Splunk	0.2	1	0.25	3	0.52
2	Add a backup server and do load balancing	0.23	2	0.4	1	1.42

Since  $RRL_1 < RRL_2$  which indicates cost effective risk reduction measure. **The second** alternative is the better option.

#### b. Network Failure Risk

Risk Exposure<sub>before</sub> = 1.52

Risk Reduction Tactic: **Reduce Risk Likelihood**

Alternative Option	Description	LH (0-1)	SR (1-10)	$RE_{\text{after}}$	CRR (1-10)	RRL
1	Servers must have an internet speed, bandwidth and use a trusted ISP	0.18	1	0.3	1	1.22
2	Backup internet connection	0.21	2	0.2	2	0.66

Since  $RRL_1 > RRL_2$  which indicates cost effective risk reduction measure. **The first** alternative is the better option.

### c. Website Failure Risk

Risk Exposure<sub>before</sub> = 2.32

Risk Reduction Tactic: **Reduce Risk Likelihood**

Alternative Option	Description	LH (0-1)	SR (1-10)	RE <sub>after</sub>	CRR (1-10)	RRL
1	Use automated automation testing tools	0.16	5	0.75	2	0.785
2	Perform good automation testing through third party	0.28	4	0.80	1	1.52

Since  $RRL_1 < RRL_2$  which indicates cost effective risk reduction measure. **The second** alternative is the better option.

### d. Reliability Risk

Risk Exposure<sub>before</sub> = 1.62

Risk Reduction Tactic: **Avoid Risk**

Alternative Option	Description	LH (0-1)	SR (1-10)	RE <sub>after</sub>	CRR (1-10)	RRL
1	Assign a person to check the entries made the employees	0.44	3	1.05	2	0.285
2	Use QR based scanning to identify the tools and automatically entering the data	0.8	3	0.5	1	1.12

Since  $RRL_1 < RRL_2$  which indicates cost effective risk reduction measure. **The second** alternative is the better option.

### e. Security Risk

Risk Exposure<sub>before</sub> = 2.31

Risk Reduction Tactic: **Reduce Risk Likelihood**

Alternative Option	Description	LH (0-1)	SR (1-10)	RE <sub>after</sub>	CRR (1-10)	RRL
1	Use automated scanning tools to find the vulnerabilities	0.3	3	0.8	2	0.755

<b>2</b>	Get security pen-testing done by third party and use SSL/TLS	0.6	2	0.25	2	1.03
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Since  $RRL1 < RRL2$  which indicates cost effective risk reduction measure. **The second** alternative is the better option.

#### f. Performance Risk

Risk Exposure<sub>before</sub> = 1.55

Risk Reduction Tactic: **Reduce Risk Likelihood**

Alternative Option	Description	LH (0-1)	SR (1-10)	RE <sub>after</sub>	CRR (1-10)	RRL
<b>1</b>	Optimize images, minimize code and use CDN	0.4	3	0.42	1	1.13
<b>2</b>	Use premium caching and optimization plugins	0.4	3	0.6	1	0.95

Since  $RRL1 > RRL2$  which indicates cost effective risk reduction measure. **The first** alternative is the better option.

## Appendix

Task	Description	Duration
Task 1	Defects and inconsistencies inspection forms	2.5 hours
Task 2	Documenting conflicts	2 hours
Task 3	Conflict resolution	3 hours
Task 4	Conflict evaluation	3 hours
Task 5	Risk Management	3.5 hours