MASTER OF TECHNOLOGY (INTELLIGENT SYSTEMS)

PROJECT REPORT

LOT DISPOSITION RECOMMENDATION

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EXECUTIVE SUMMARY

The safety of the transport sector especially in the automotive and aerospace industries relies on the reliability and integrity of integrated circuits (ICs) used in its systems. Any premature failure has grave catastrophic consequences and to mitigate such circumstances, the final quality checking of the ICs is essential to ensure that no defective ICs are shipped out.

Currently when a lot of ICs fail to meet quality and customer requirements, the process control will keep the lot on hold (LOH) to send for further testing for risk assessment to investigate and pinpoint the reasons for the deviation as attributed to the product or process-related. Based on a process of statistical checks, it is decided whether a lot has passed the test to be deployed for shipping or needs retesting or reassignment. This is known as the LOH disposition process.

In this project, our group has proposed a more integrated system that is able to bring in the individual aspects of the quality testing for a lot to reduce any bottlenecks by streamlining the processes. As it involves multiple quality inspectors who may not know the current status between the lots, this online system will improve efficiency by allow a user such as a quality inspector to go online to see the current status of a lot and take any necessary action such as checking on a lot allocated to him. This will free up resources to reduce any downtimes waiting for resource allocation.

Our team had an insightful time working on this project learning the affordances of the platform for jBPM(java Business Process Management), and share our insights with everyone with this report and our presentation.

1.0) PROBLEM DESCRIPTION

In the semiconductor manufacturing, the reliability and integrity of the integrated circuits (ICs) are especially critical to the automotive and aerospace industries whereby any premature failure will lead to catastrophic consequences. The test process is the last quality gate before the ICs are shipped to the customers, and thus it is most important process in the whole manufacturing chain to ensure that there are no defect being shipped out.

Many companies place high emphasis on quality management and achieving ‘zero defect’. In quality management, the 6-sigma process control is widely used to improve quality and eliminate defects. When the lot (batch of ICs) does not meet the quality and customer requirements, the process control will flag and stop the lot from proceeding on to the packing process and the lot will be on hold (LOH). The LOH will then be sent for further investigation to assess its risk and understand the cause of the deviation which may arise due to product or process-related problems.

During this LOH investigation, the domain expert will examine the violation that triggers the control limit and several statistical tests and checkpoints are performed to assess the risk and analyze the root cause (see Figure 1). After evaluation, the domain with decide to proceed to lot for shipping if the outcome is low risk, or re-testing for re-evaluation, or assign to other field domains for further investigation. This is also known as the LOH disposition process.

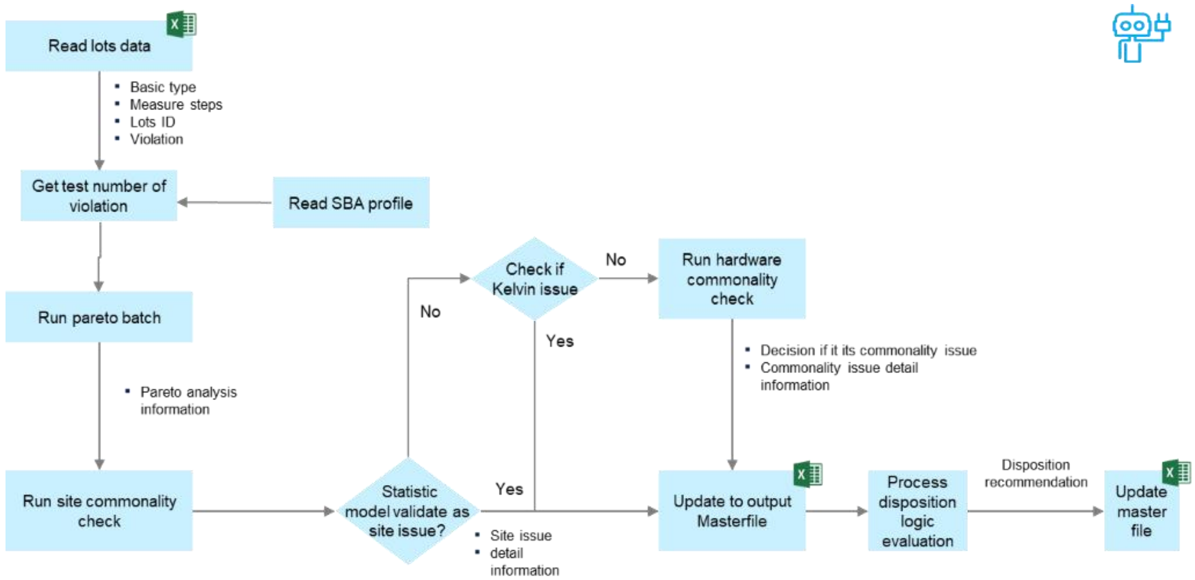

Figure 1: Lot on Hold (LOH) disposition decision-making process

As seen from the Figure 1, the LOH disposition decision-making process is a standardized, manual and demanding task. In a normal production line, ~ 15 % of the lots are placed on hold after the testing process. Today, the LOH disposition process requires ~ 50 % of the engineering resources. It is estimated that ~70 % of the LOH are processed and decided within 1 day. Therefore, it is necessary to employ a machine reasoning system to perform the evaluation, and help to facilitate and speed up the decision-making process so that resources can be freed up to handle highly complex and more value-adding tasks. In addition, with the machine reasoning system, it will also reduce human errors.

1.1) PROJECT OBJECTIVES

LOH disposition decision-making process system aims to assign the LOH responsibility to respective functional domains based on certain pre-defined rules. Firstly, the test measurement data is extracted and statistical tests are performed on the possible contributing factors (site-related, temperature-related, hardware-related or test program-related) to determine the cause of the low yield which trigger the LOH. The statistical tests performed indicate the significance of the factors contributing to the violation. Then, the test outcomes will decide the lot disposition assignment based on certain pre-defined production rules.

Finally, the engineering domain that is assigned for the LOH disposition will carry out further investigation to mitigate the problem, by assessing the risk and perform corrective action accordingly. The application is designed only for single product use with the assumption that the product tested are with sufficient production lot loading

1.2) PROJECT SCOPE

As the project is the first proof-of-concept, its scope addresses:

- LOH due to test set-up violations (non-product related)
- One product type (different products have different LOH rules and reasoning) with sufficient work in progress.

2.0) KNOWLEDGE MODELLING (ACQUISITION & REPRESENTATION)

The process of knowledge model development can be broken down into stages which are mainly: identification, specification and refinement.

i) Knowledge Identification

In the first step of the preparation phase for the knowledge modelling, a schematic diagram is constructed to illustrate the domain terms (see Fig. 2). During the test process, ICs will be loaded into a 'Tester' to be tested. In the 'Tester', it contains the 'Test Program' where all the necessary electrical test are configured. At the 'Loadboard', or otherwise commonly known as a circuit board, there are four test 'sites' (locations) where 'Socket' is attached to. During testing, the 'Handler' will load each IC into the individual 'Socket' where electrical testing takes place. These domain terms will later be used in the input test data which is utilized to perform the machine reasoning.

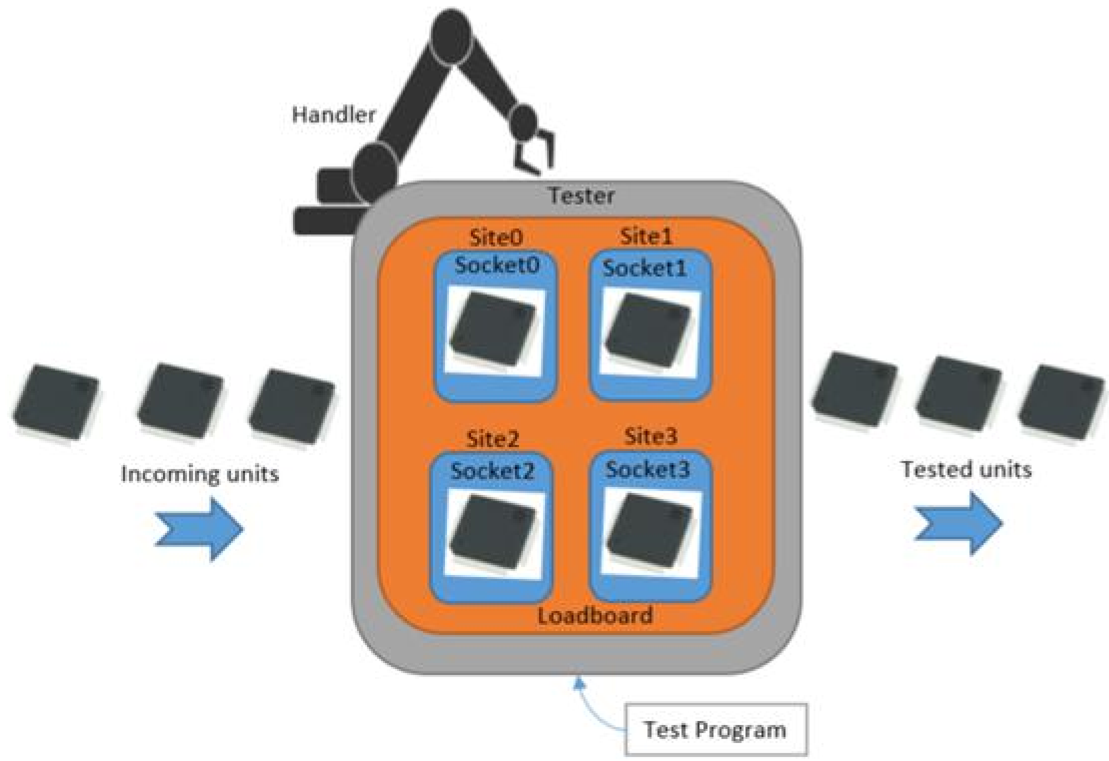

Figure 2: Schematic representation of the domain terms.

The input data required to perform this evaluation is summarized in Table 1. It is aggregated from the test log files and contains detailed information of every lot tested, for example, the test set-up, the tested quantity, the binning (Hbin) quantity and the transaction time (timestamp).

Table 1: Input data description for the machine reasoning process.

Data Attribute	Description	Type
Lot	Unique lot ID	string
EndTimestamp.datetime	Process end timestamp	string
Measstep	Test measurement step	string
TestprgName	Test Program Name	string
Tester	Hardware containing test program	string
Loadboard	Circuit board for testing	string
HandlerID	Hardware for pick & place of units	String
HBIN	Bins for hardware related failure except 1	Integer
SBIN	Bins for sub-failure	Integer
LBIN_P_NAME	Failed test name	string
SocketNumber	Site	Integer
N	Total Hbin count for per site	Integer
testedQtyBySocket	Total tested units per site	Integer
percentBySocket	N divided by tested quantity by socket	float
timestamp	Process end timestamp	date&time

In the second step of knowledge identification, the domain task workflow is mapped out. It is critical to understand the thinking and reasoning process of the domain so that the process can be transformed into a machine reasoning system. Interviews with several engineers are conducted and the thinking design is simplified and represented in the activity flowchart in Figure 3.

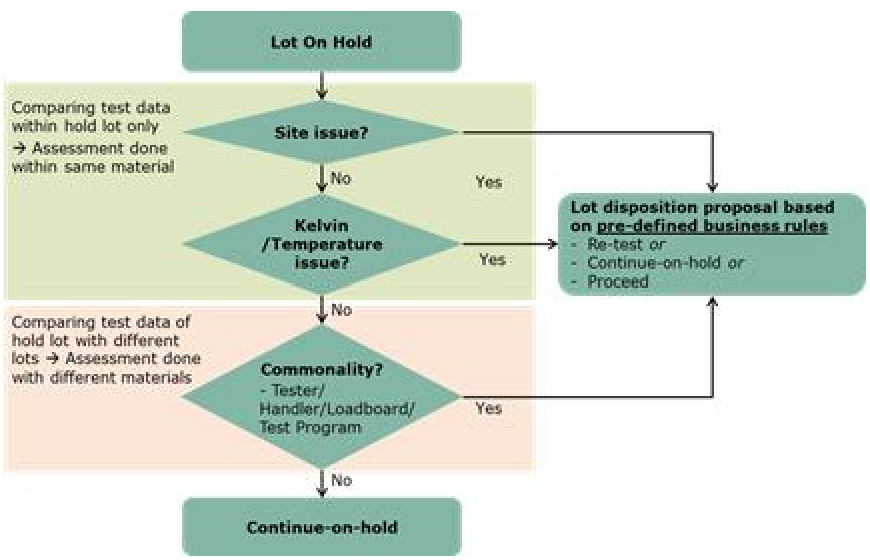

Figure 3:Thinking and reasoning process of the domain.

ii) Knowledge Specification

The lot disposition process is a goal-driven system where several tasks are performed to achieve a particular goal. The task decomposition is captured, conceptualized and represented in a dependency diagram as shown in Figure 4.

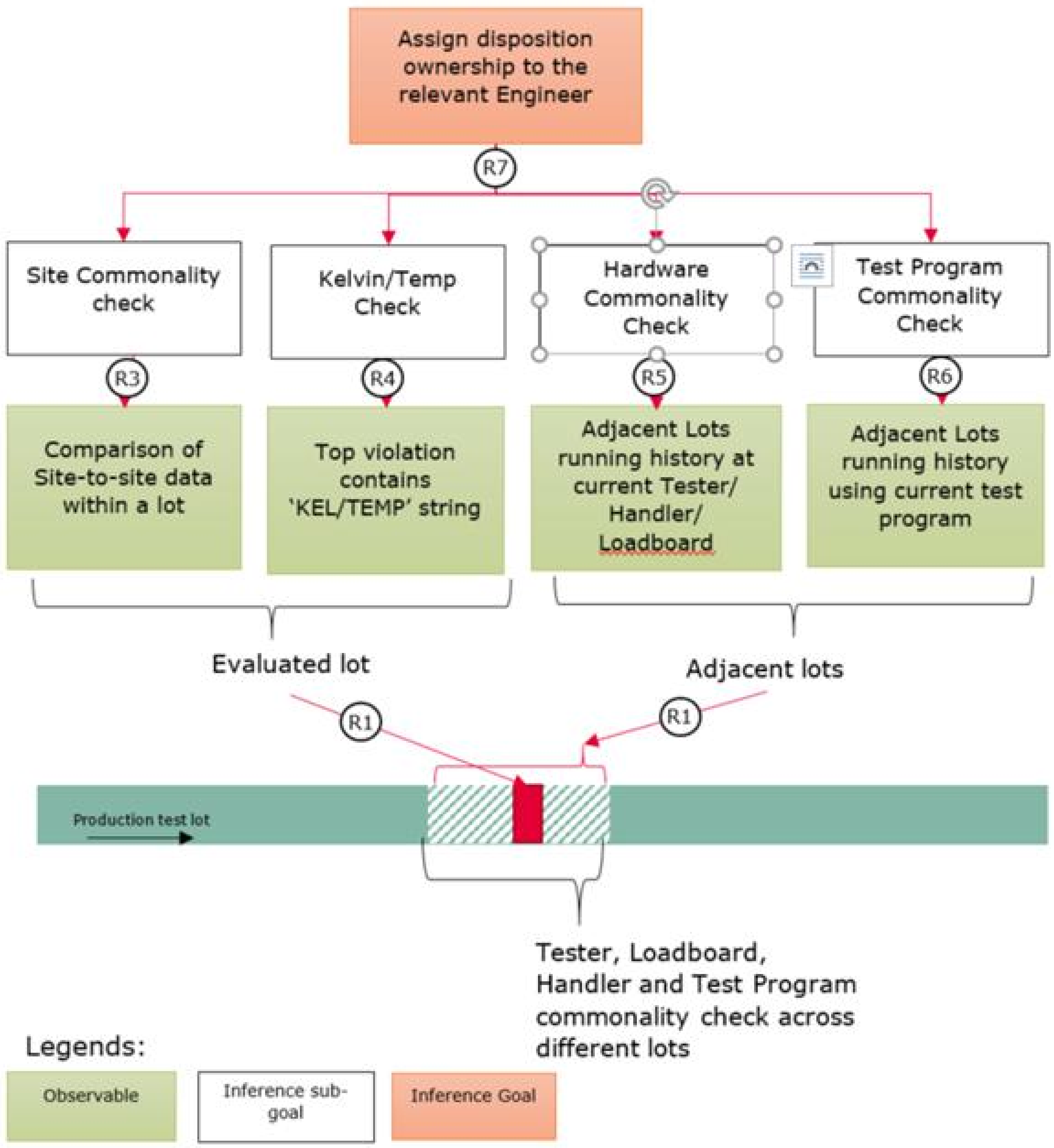

Figure 4: Dependency diagram of lot disposition process.

The main goal of the lot disposition process is to assign the LOH ownership to different domains based on the outcome of four different inference sub-goals. These sub-goals are achieved by applying rules and statistical tests to the observables which are representation of the product measurement data for the LOH and its adjacent lots. These rules are summarized in Table 2.

Table 2 : Rule summary for the lot disposition process.

Rule	Task	Level	Description
1	Select Lot Violation	Lot level	
2	Pareto	Violation level	For all violation, use test number as assessment, · Perform pareto analysis · Select top 10 failed test numbers
3	Site Commonality check	Violation level	Run Chi-square test for Pass/Fail at each site. When p-value < 0.05 then Site Commonality = ‘Y’.
4	Kelvin/Temperature Commonality Check	Violation level	When ‘LBIN_P_NAME’ contains ‘Kel’ or ‘Kelvin’ or ‘Temperature’ or ‘Temp’ then Kelvin/Temp Commonality = ‘Y’.
5	Hardware Commonality Check	Violation level	Run ANOVA test for each hardware (Tester/Handler/Loadboard/Test Program) for past 10 lots based on failed percentage of all test numbers. When $p<0.05$ then Commonality = ‘Y’
6	Test Program Commonality Check	Violation level	Run ANOVA test for different Test programs for past 10 lots based on failed percentage of all test numbers. When $p<0.05$ then Commonality = ‘Y’
7	LOH Disposition Assignment	Lot Level	Based on the outcome of the commonality tests, decision made on the lot disposition process follows the rules defined in decision table (see Figure 4).

For the 'Site Commonality check' sub-goal, the comparison of site-to-site performance (pass or fail) within a lot is performed via the Chi-Square statistical hypothesis homogeneity test. The test evaluates the significance of the failure distribution across the sites based on the failure occurrence at each sites for different test parameters. The null hypothesis indicates that the failure occurrence at all sites are identical while the alternative hypothesis states that the failure occurrences are different at each site for each test parameters. A p-value < 0.05 is used to reject the null hypothesis which indicates that the failure occurrence is different at the sites.

For the 'Kelvin/Temp' sub-goal, the LOH observables are assessed based on its association with the violated test parameter names containing strings of 'Kelvin' or 'Temperature'. The particular Kelvin/Temp test is designed to evaluate IC measurement condition and environment (contact resistance and temperature. Hence, Kelvin/Temp test violation is usually associated to equipment or hardware issues.

For the 'Hardware Commonality check' sub-goal, ANOVA test is performed on each hardware such as Tester, Loadboard and Handler. The statistical test involves extracting the past 10 lots that run on the different test set-up configuration at the same measurement step. Comparison is then made by observing the top failed test parameters (failure > 0.05 %) of the past lots and the evaluated LOH. The null hypothesis states that the mean failure rates of the different hardware are identical while the alternative hypothesis states that at least one of the hardware is different. Each hardware is evaluated separately. Similarly, p-value < 0.05 will result in the rejection of the null hypothesis, indicating that the hardware has an influence on the difference in testing results.

Lastly, the ‘Test Program Commonality check’ sub-goal is similar to that of the ‘Hardware Commonality check’ sub-goal with Test Program as the subject of evaluation. The outcome of sub-goals will be in the form of Boolean and will be used to determine the lot disposition assignment based on the decision rule set shown in Figure 5.

Commonality Check

SocketNumber	Loadboard	Tester	Handler	TestProgram	Kelvintemp	User Task Assign to
$IsSocket	$IsLoadboard	$IsTester	$IsHandler	$IsTestProgram	$IsKelvinTemp	
Y	Y	Y	Y	Y	N	Equipment Engineer
Y	Y	Y	Y	N	N	Equipment Engineer
Y	Y	Y	N	Y	N	Equipment Engineer
Y	Y	Y	N	N	N	Equipment Engineer
Y	Y	N	Y	Y	N	Equipment Engineer
Y	Y	N	Y	N	N	Equipment Engineer
Y	Y	N	N	Y	N	Equipment Engineer
Y	Y	N	N	N	N	Equipment Engineer
Y	N	Y	Y	Y	N	Equipment Engineer
Y	N	Y	Y	N	N	Equipment Engineer
Y	N	Y	N	Y	N	Equipment Engineer
Y	N	Y	N	N	N	Equipment Engineer
Y	N	N	Y	Y	N	Equipment Engineer
Y	N	N	Y	N	N	Equipment Engineer
Y	N	N	N	Y	N	Equipment Engineer
Y	N	N	N	N	N	Equipment Engineer
N	Y	Y	Y	Y	N	Product Engineer
N	Y	Y	Y	N	N	Process Engineer
N	Y	Y	N	Y	N	Product Engineer
N	Y	Y	N	N	N	Process Engineer
N	Y	N	Y	Y	N	Product Engineer
N	Y	N	Y	N	N	Process Engineer
N	Y	N	N	Y	N	Product Engineer
N	Y	N	N	N	N	Process Engineer
N	N	Y	Y	Y	N	Product Engineer
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N	N	N	Y	Y	N	Product Engineer
N	N	N	Y	N	N	Process Engineer
N	N	N	N	Y	N	Product Engineer
N	N	N	N	N	N	Product Engineer
Y	Y	Y	Y	Y	Y	Equipment Engineer
Y	Y	Y	Y	N	Y	Equipment Engineer
Y	Y	Y	N	Y	Y	Equipment Engineer
Y	Y	Y	N	N	Y	Equipment Engineer
Y	Y	N	Y	Y	Y	Equipment Engineer
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N	N	Y	Y	Y	Y	Process Engineer
N	N	Y	Y	N	Y	Process Engineer
N	N	Y	N	Y	Y	Process Engineer
N	N	Y	N	N	Y	Process Engineer
N	N	N	Y	Y	Y	Process Engineer
N	N	N	Y	N	Y	Process Engineer
N	N	N	N	Y	Y	Product Engineer
N	N	N	N	N	Y	Product Engineer

Figure 5 : Decision table for lot disposition assignment

Generally, when the site-to-site commonality check is true or ‘Y’, then the problem is associated with the test site, and thus the LOH should be taken care of by the equipment engineering domain. Next, as the Test Program are well-tested before operationalization, and if Test Program commonality check is found to be true or ‘Y’ and the Kelvin/Temp check and Hardware Commonality check are found to be ‘N’ then the product engineering domain should re-review the Test Program. Similarly, once it is detected that there is no hardware commonality then the LOH also goes to product engineering to trace the upstream processes to determine the cause of the violation. However, regardless of the outcome of other sub-goals, once hardware commonality is detected, then LOH falls in the domain of the process engineering to localize the hardware that caused the deviation or violation.

i) Knowledge Refinement

In the production, the equipment technician will first attend to the triggered LOH and conduct visual inspection for apparent defect or abnormality. Subsequently, the technician will scan the LOH identification number (ID) into the reasoning system to execute the tasks created in the model. Finally, the LOH is assigned to the respective engineering domains depending on the risk and issue involved. However, in the proof-of-concept application, a user task form is created for the technician to input in the LOT ID and its respective measurement step. In the final stage of knowledge modelling, a known data set containing a list of LOHs (see Table 3) is input into the model and three scenarios are evaluated for validation and verification.

Table 3 : Known data set of LOH

lot	Tester	Measstep	Handler ID	Loadboard	EndTimestamp .datetime	Fail Percent	Lot Qty
lot12	tester4	B2	Handler2	Loadboard4	1/11/2019 14:21	38.1128	8404
lot13	tester3	B2	Handler2	Loadboard7	1/29/2019 5:25	32.45625	7943
lot33	tester4	B2	Handler2	Loadboard5	1/5/2019 11:10	30.69498	2072
lot9	tester4	B2	Handler2	Loadboard5	1/4/2019 12:00	27.90179	3584
lot38	tester5	B2	Handler3	Loadboard3	1/26/2019 15:55	25.82687	4898
lot37	tester4	B2	Handler2	Loadboard4	1/7/2019 9:58	21.51317	8697
lot5	tester1	B3	Handler1	Loadboard4	1/3/2019 20:48	21.35417	960
lot6	tester4	B2	Handler2	Loadboard5	1/1/2019 13:36	18.19611	8903
lot26	tester4	B2	Handler2	Loadboard4	1/10/2019 8:03	15.92096	8806
lot5	tester4	B2	Handler2	Loadboard4	1/7/2019 22:21	15.27094	9135
lot9	tester4	B1	Handler2	Loadboard5	1/2/2019 13:26	14.10273	7963
lot35	tester4	B2	Handler2	Loadboard4	1/6/2019 22:42	13.86781	9093
lot13	tester3	B1	Handler1	Loadboard2	1/25/2019 1:57	13.31955	8221
lot40	tester3	B3	Handler1	Loadboard2	1/25/2019 10:49	12.45791	891
lot43	tester3	B1	Handler1	Loadboard2	1/24/2019 1:58	11.95243	8492
lot36	tester4	B2	Handler2	Loadboard4	1/10/2019 15:16	10.89089	4894

lot40	tester5	B2	Handler3	Loadboard3	1/27/2019 11:12	10.60867	8116
lot43	tester5	B2	Handler3	Loadboard3	1/26/2019 7:53	10.18256	7395
lot10	tester4	B3	Handler3	Loadboard3	12/27/2018 2:55	9.93622	5958
lot40	tester3	B1	Handler1	Loadboard2	1/24/2019 9:58	9.647761	8375
lot18	tester4	B3	Handler3	Loadboard3	12/17/2018 7:03	9.509202	8802
lot14	tester3	B1	Handler1	Loadboard1	1/26/2019 7:38	9.083293	8356
lot41	tester3	B1	Handler1	Loadboard1	1/26/2019 21:29	9.063893	2692

In the first scenario, LOH lot 6 and its measurement step B2 are selected by the task user and the specific tasks are performed as designed and the sub-goal results are shown in Table 4. The results indicate that there is a significant difference in the site-to-site commonality check, which implies that it might be a site-related problem. In addition, Kelvin/Temperature check also turns out to be positive. For validation, a matrix table is created to illustrate the failure occurrence in the Kelvin/Temperature tests at the different sites, as seen in Table 5. It is observed that there are high failure at Site 0 and 1 due to ‘KELVINRES_CLK_2’ and ‘KELVINRES_CSQ_2’ tests, respectively, and thus the modelling can be validated to be accurate. As these two test parameters are associated with electromechanical contact-related problem, the LOH is assigned to the equipment engineering domain for risk assessment, deeper failure analysis and then mitigation.

Table 4:
The Boolean outcomes of the sub-goals for the first scenario with LOH Lot 6 at measurement step B2.

Test	Result
SocketNumber (sites)	Y
Tester	N
Loadboard	N
Handler	N
Test Program	N
Kelvin/Temp	Y

Table 5:
A failure occurrence matrix of Kelvin/Temperature tests at each site for LOH lot 6.

	SITES			
LBIN_P_NAME (Test Parameters)	0	1	2	3
KELVINRES_CLK	11	0	0	2
KELVINRES_CLK_2	63	0	0	0
KELVINRES_CSQ	0	0	0	2
KELVINRES_CSQ_2	0	38	0	1
KELVINRES_DAT	0	0	0	2
KELVINRES_DAT_2	1	0	1	0
KELVINRES_GND	0	1	0	0
KELVINRES_IFA_2	3	0	0	0
KELVINRES_SCK	2	0	0	1
KELVINRES_VDD_2	0	0	2	0

For the second scenario, the LOH lot 26 and its measurement step B1 is selected and the model outcomes of the sub-goals show that the Site-to-site Commonality sub-goal is negative while the Hardware, Kelvin/Temp and Test Programs sub-goals are positive (see Table 6). For validation, the ANOVA tests are performed separately and the results are displayed in Table 7. The p-values are observed to be <0.05 for the tester, loadboard and test program. The results imply that the hardware and test programs have significant influence on the failure rate and are coherent to the model outcomes. Hence, even though the LOH shows test program-related problem (domain of Product Engineering), it also have problems relating to the Kelvin/Temp test and hardware. Based on the human reasoning rules used by the production (represented in Fig. 5), the combination of Kelvin/Temp and hardware-related problems is associated with the production environmental state, and thus the LOH will be assigned to the domain of Process Engineering.

In the last scenario, LOH lot 19 and its measurement step B3 is chosen and the results of sub-goals are shown in Table 8. It is observed there is only negative outcome from the Kelvin/Temp check and the model has assigned the LOH to the Product Engineering domain. Based on production rule reasoning and domain knowledge (see Fig. 5), as there is no hardware commonality, it is highly probable that the violation may be due to product-related issue caused by upstream processes. Therefore, the outcomes of these scenarios have shown that the model is capable of capturing the required problem-solving behaviors and assigning the LOH to the right domains.

Table 6:
The model Boolean outcomes of the sub-goals for the second scenario with LOH Lot 26 at measurement step B1.

Test	Result
SocketNumber (sites)	N
Tester	Y
Loadboard	Y
Handler	N
Test Program	Y
Kelvin/Temp	Y

Table 7:
Results from ANOVA tests performed on Hardware Commonality check.

currentTest	Tester	HandlerID	Loadboard	Measstep	Violation	P	parameter
Tester	tester4	Handler2	Loadboard4	B1	HBIN6	0.004305042	Response KELVINRES_DAT
TestprgName	tester4	Handler2	Loadboard4	B1	HBIN6	0.006987219	Response KELVINRES_DAT
Loadboard	tester4	Handler2	Loadboard4	B1	HBIN6	0.008762208	Response KELVINRES_DAT
TestprgName	tester4	Handler2	Loadboard4	B1	HBIN6	0.019056963	Response KELVINRES_IFB_2

Table 8:
The model Boolean outcomes of the sub-goals for the third scenario with LOH Lot 19 at measurement step B3.

Test	Result
SocketNumber (sites)	N
Tester	N
Loadboard	N
Handler	N
Test Program	N
Kelvin/Temp	Y

3.0) BUSINESS SOLUTION

The development of a knowledge model in section 3 enables the structuring of a rule-base which specifies the knowledge and reasoning requirements to evaluate the quality of IC chips by lots to determine if they pass(zero-defect) or need further testing when found to be defective. It also provides the function on assign issues to engineers in charge. The business process diagram (Figure 6) will show the design of the strategy.

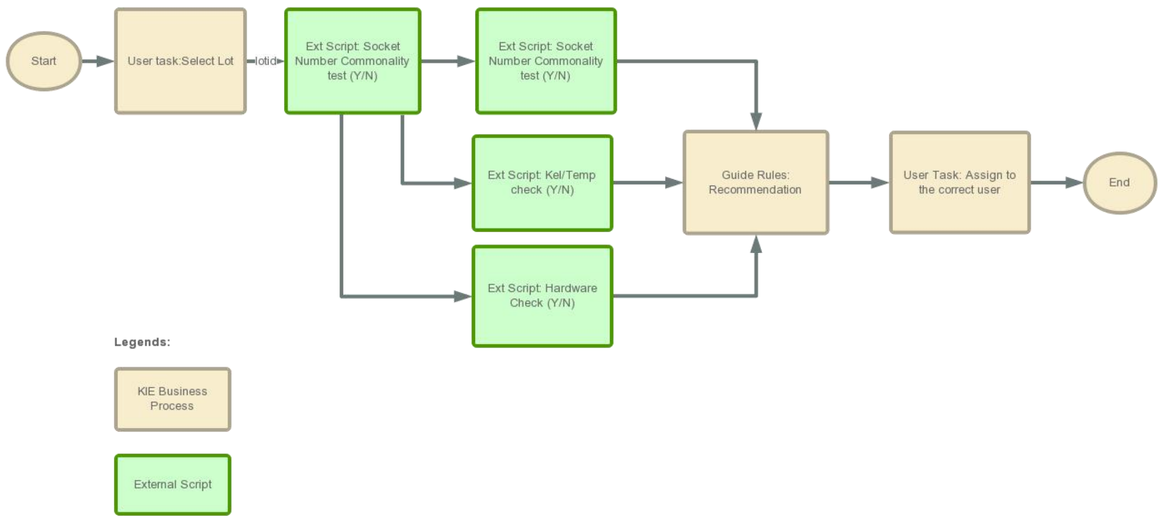
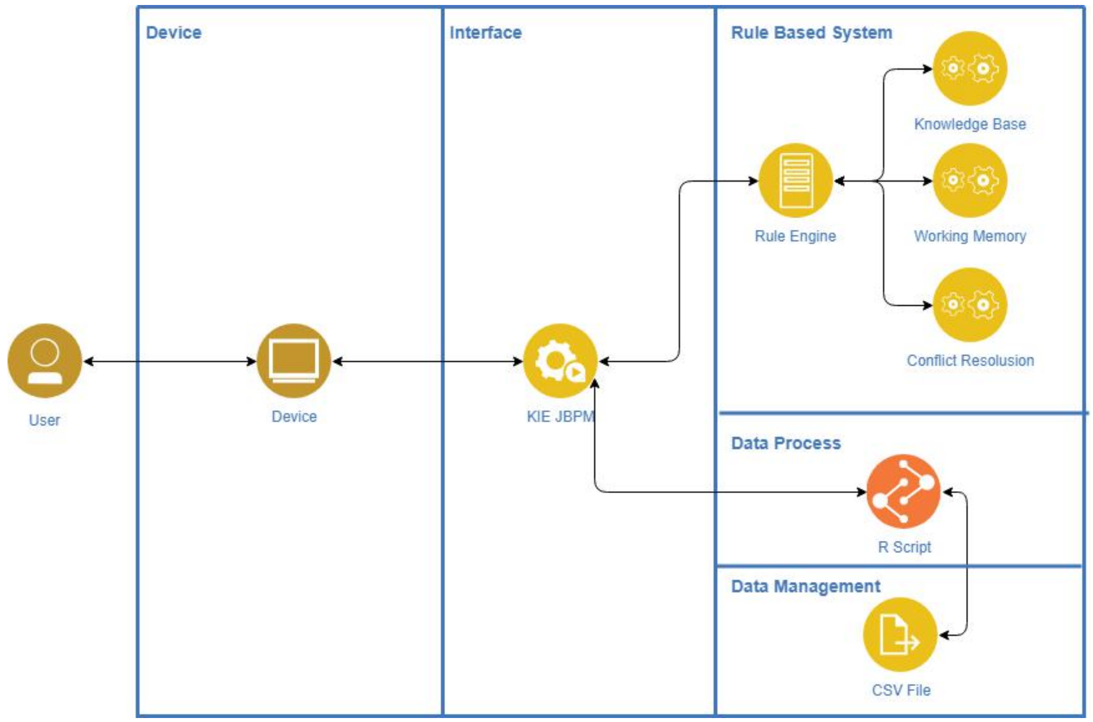


Fig 6 : Business Process Diagram

3.1) SYSTEM ARCHITECTURE

Our strategy is based on KIE jbpm, which provide the rule engine and user interface, and R, which supported all the data process. For user's continence on data importing and management, data source comes from .csv file. The system architecture diagram (Figure 7) will show how the application has been interfaced with the back-end rule based system and data source

Fig 7 System Architecture Diagram



3.2) SYSTEM'S FEATURES

In a day-to-day scenario these defects would have to be manually sorted by a data analyst, and this project aims to ease their efforts by classifying a portion of defects based on known features which are related to the defects. Therefore, certain aspects of this projects are well-thought of with the objective to assist and increase efficiency of the task assignment process.

USER FRIENDLY INTERFACE AND PROCESS TRACEABILITY

Natively using the interface provided by JBPM, this project inherits the user-friendly interface JBPM is built upon with an easy to navigate workbench and dashboard. Users are also able to access this easily from a local intranet system, and even globally through internet if hosted on an internet domain.

For archival purposes of historical records of lots processed, this system also serves as a repository that can allow the user to back trace any lots that were assigned should the need arise. For every process completed, any process auditor can access the decision of the process by ticking the "completed instance" to view.

RULE-BASED INTELLIGENCE AND THIRD PARTY TOOL INTEGRATION

Using tools developed by JBoss/RedHat, mainly JBPM, this project utilizes a rule engine that is able to take in an array of variables and process it into useful decisions, to be made in place of a real human. Currently we are only using it to determine which engineer to assign defective lots for fixing, but potentially, we can implement some intelligence and reasoning to deal with more difficult scenarios.

Because JBoss tools are coded with java, we are able to integrate java functions within the system. We can also call third party tools with the java console command, such as in this project's case, we utilise R to do the heavy-duty analysis and processing while taking variables returned from it. This makes for a powerful and robust system and will make implementation easier.

3.3) LIMITATIONS

Although the lot disposition recommender is able to assist the data analyst in classifying defects, it is not fully able to replace the operation yet. At this moment it is only using a few vital parameters of the test product to make certain judgement, and is not able to handle new type of defects not defined by those parameters.

4) CONCLUSION

The lot disposition recommender system is one example of a semi-automatic solution that will be very useful not just in the semi-conductor industry, but in multiple others as well. In this world where mass production is common, especially for consumer products, these types of systems can potentially help contain defects so humans can be tasked to do more complex analysis while simple rule-based logic be taken over by these types of system. Of course, with the advancement of Artificial Intelligence, the system can be enhanced to take over even more complex operations.

Appendix

- Appendix A: User Guide
- Appendix B: Sample System input and output

Appendix A: User Guide

REQUIREMENTS

RECOMMENDED BROWSERS

Supports the following Web Browsers:

- Microsoft Edge 39 and above
- Firefox 53 and 52 ESR and above
- Google Chrome Version 59 and above

SYSTEM OVERVIEW

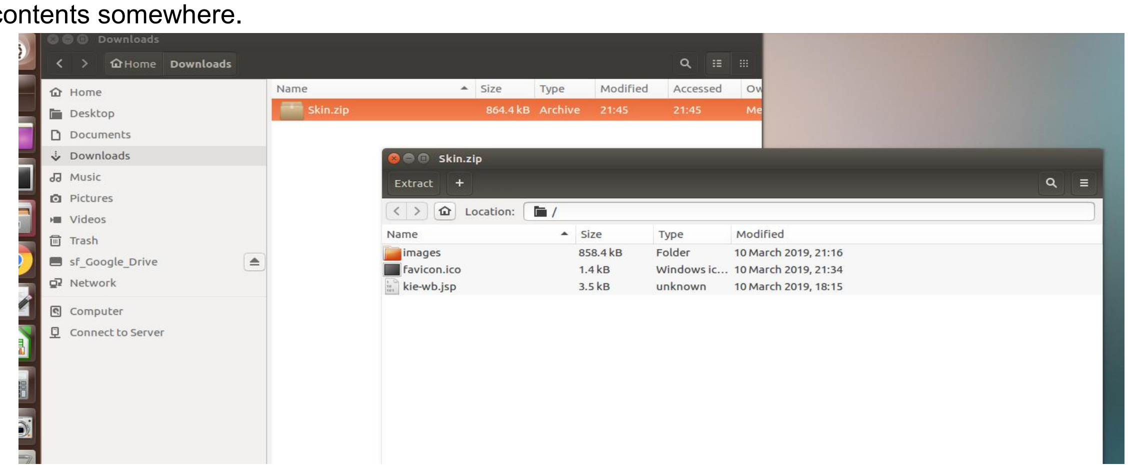
LOT disposition recommendation system aims to assign the LOH responsibility to respective functional domains based on certain pre-defined rules. Firstly, the test measurement data is extracted and statistical tests are performed on the possible contributing factors (site-related, temperature-related, hardware-related or test program-related) to determine the cause of the low yield which trigger the LOH. The statistical tests performed indicate the significance of the factors contributing to the violation. Then, the test outcomes will decide the lot disposition assignment based on certain pre-defined production rules.

Finally, the engineering domain that is assigned for the LOH disposition will carry out further investigation to mitigate the problem, by assessing the risk and perform corrective action accordingly.

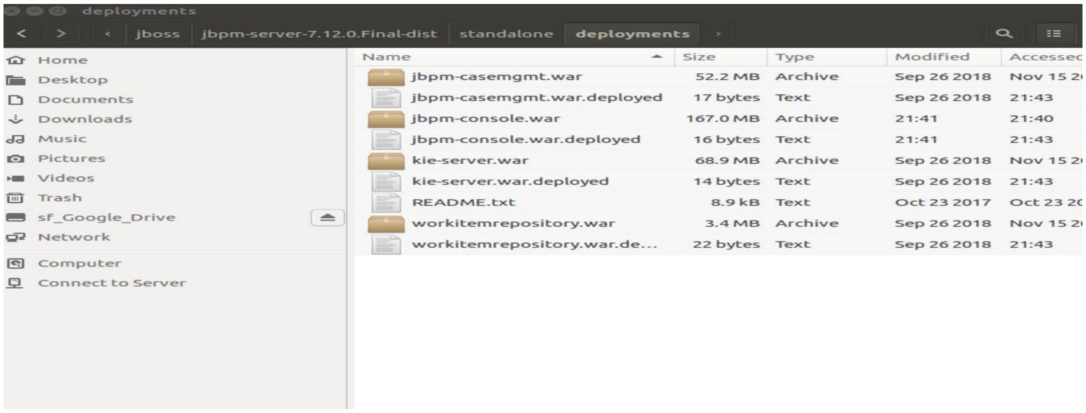
USER INTERFACE

Our user interface base on KIE Workbench. Once users input the information, the data will be get by R script and rule engine, which will help to assign the issues to different engineer.

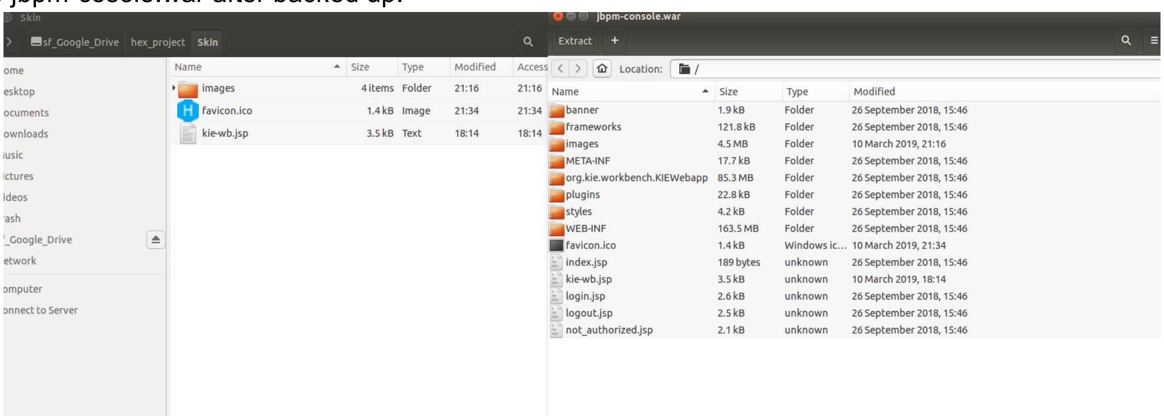
To use our HEX skin for this project, please download "Skin.zip" from the Misc Folder. Extract its contents somewhere.



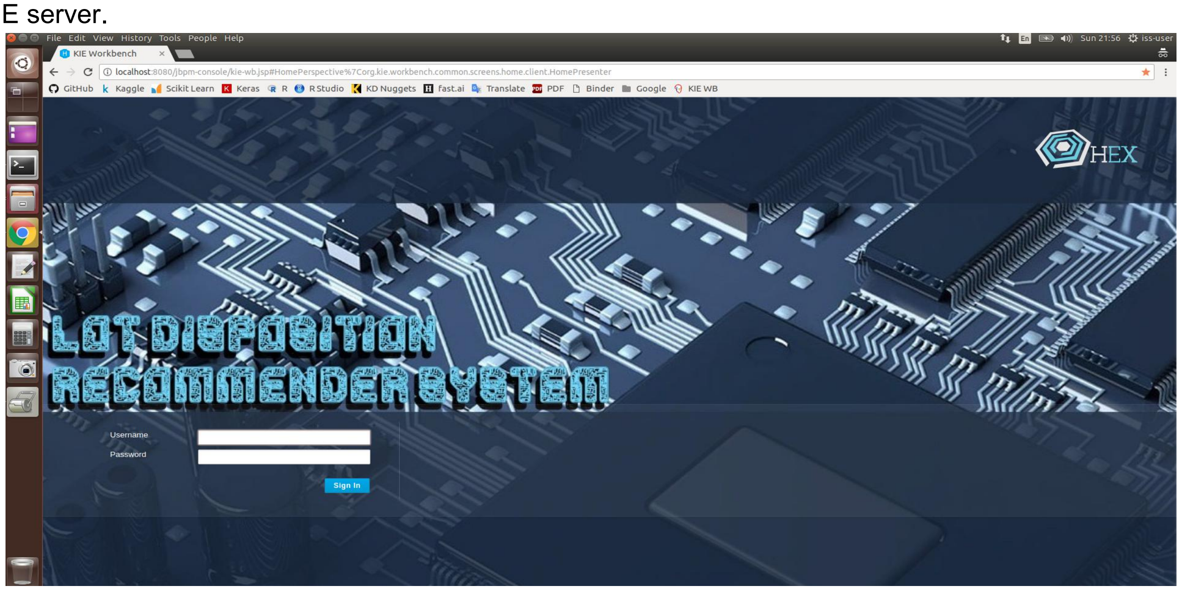
Next, navigate to the directory of JBPM (In the VM, /iss-vm-program/is-intelligent-reasoning-systems/jboss/jbpm-server-7.12.0.Final-dist/standalone/deployments).

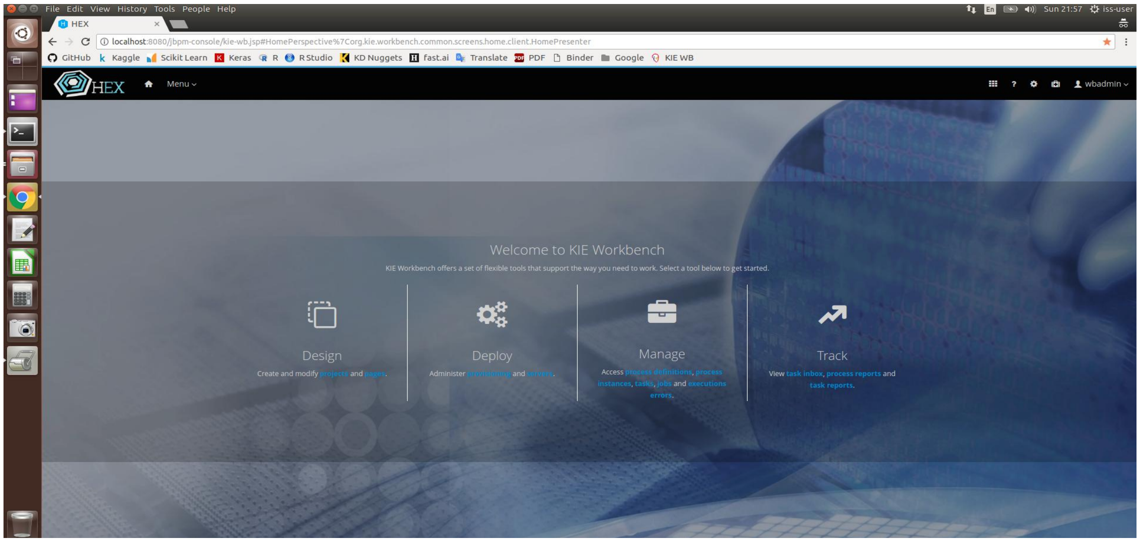


Back up jbpm-console.war in another folder. Make sure jbpm server is not started (important!). Open up jbpm-cosole.war after backed up.



Drag all of the skin's contents into jbpm-console.war. After that, it's done. You can proceed to start up KIE server.





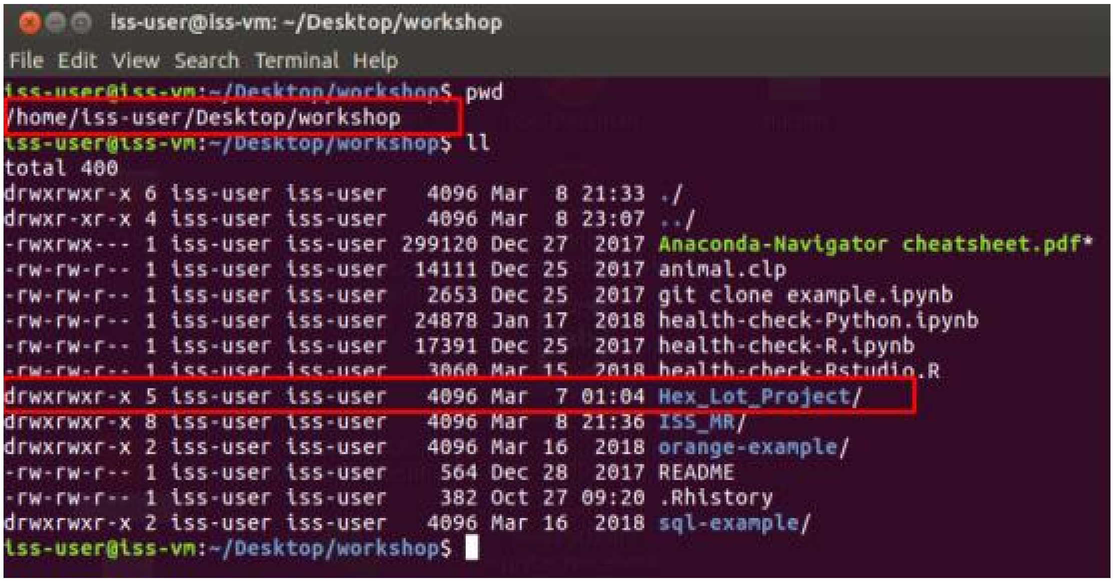
DEPLOYMENT

Our system is deployed by KIE Drools and R script. In order to run the system, you will need to install:

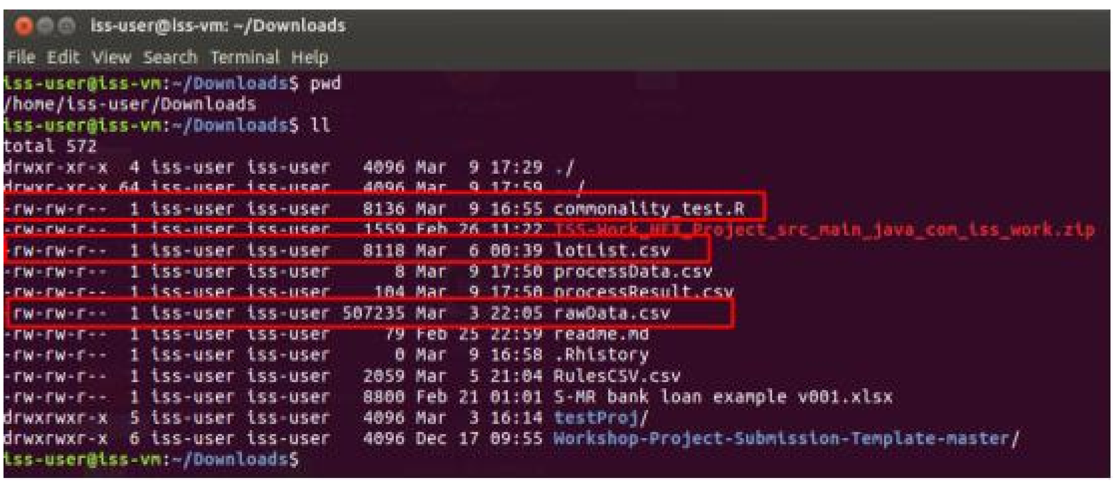
- Java (1.8.0_191 and above)
- R (3.4.3 and above)
- KIE Workbench (7.12 and above)

IMPORT PROJECT

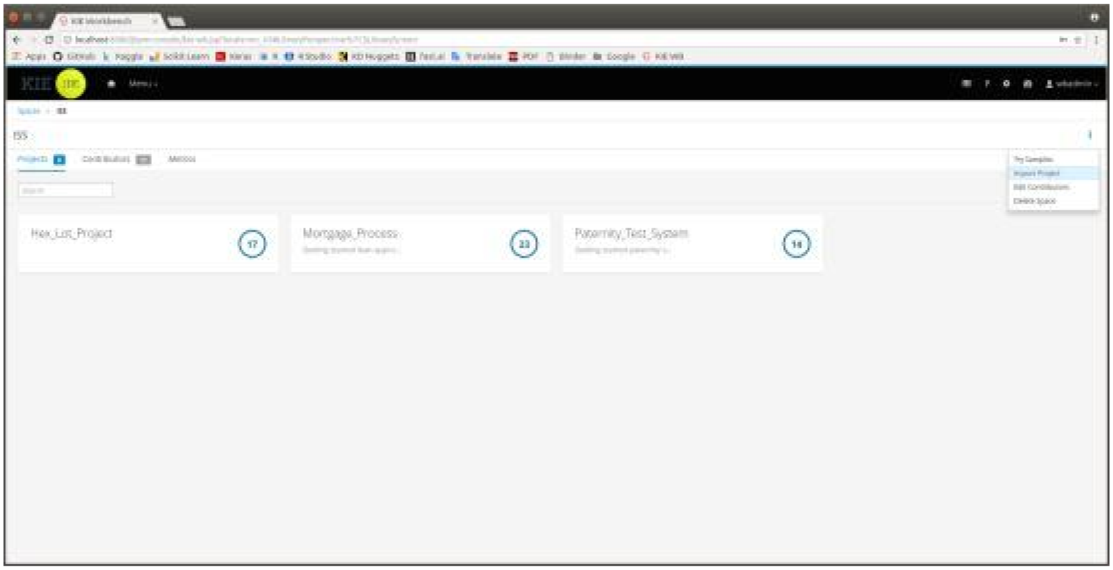
1. Download and unzip the project under path /home/iss-user/Desktop/workshop

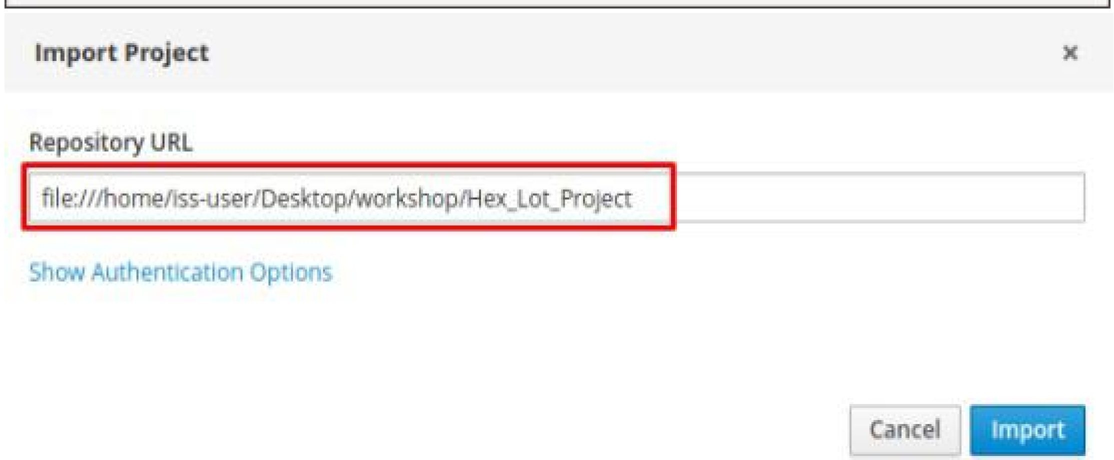


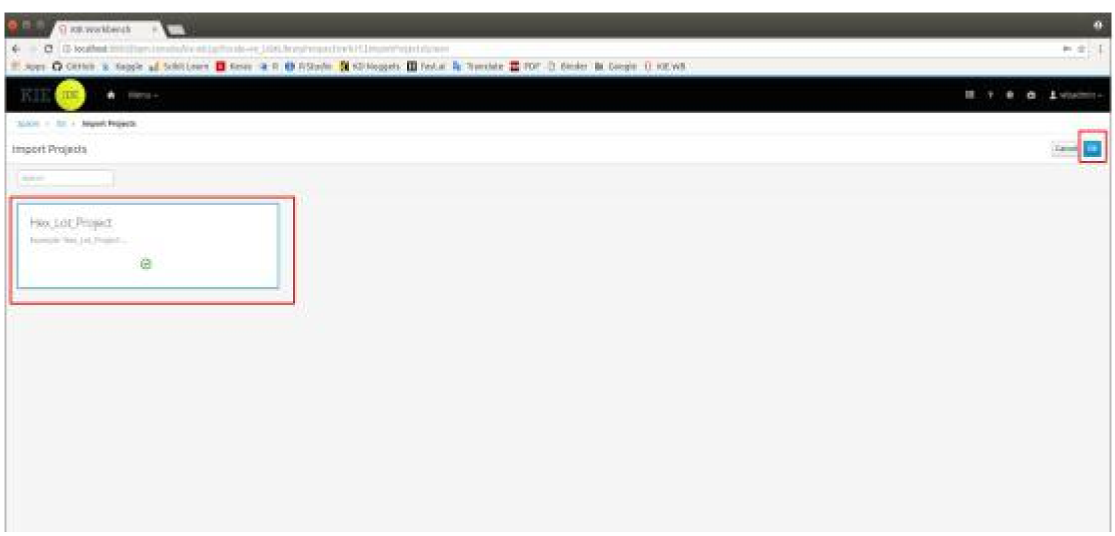
2. Put the required R script and csv file from Miscellaneous folder and put them under the /home/iss-user/Downloads (Should be exactly the same path).



3. Run the KIE Workbench and import the project





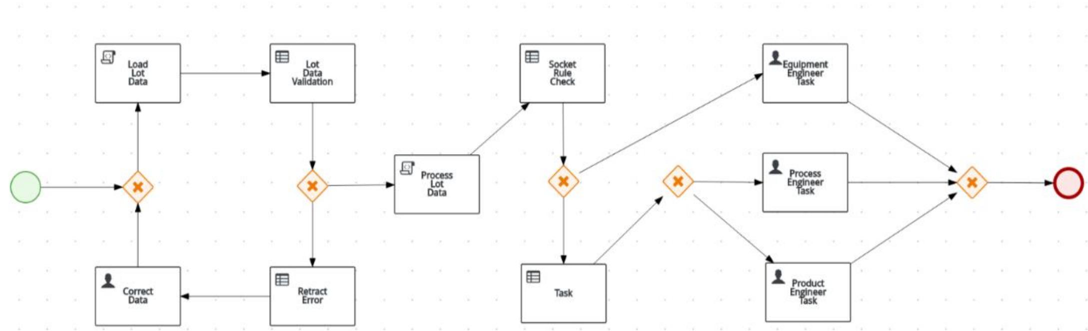


4. Create user:

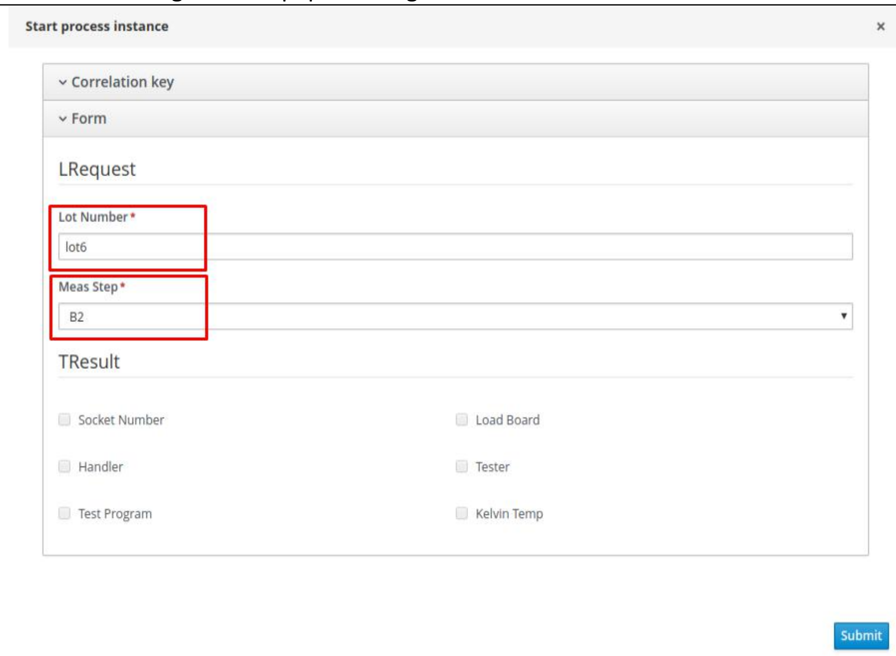
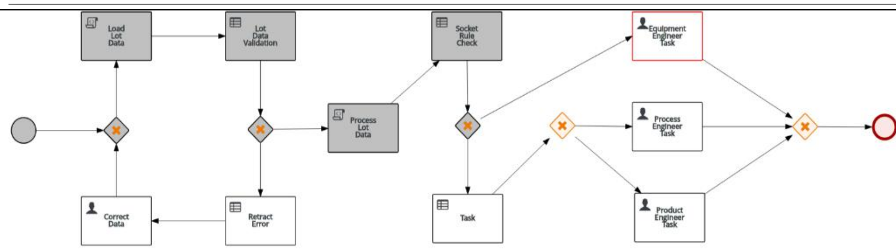
Role	Group	User
user	kie-server	Technician
user	kie-server	EquipmentEngineer
user	kie-server	ProcessEngineer
user	kie-server	ProductEngineer

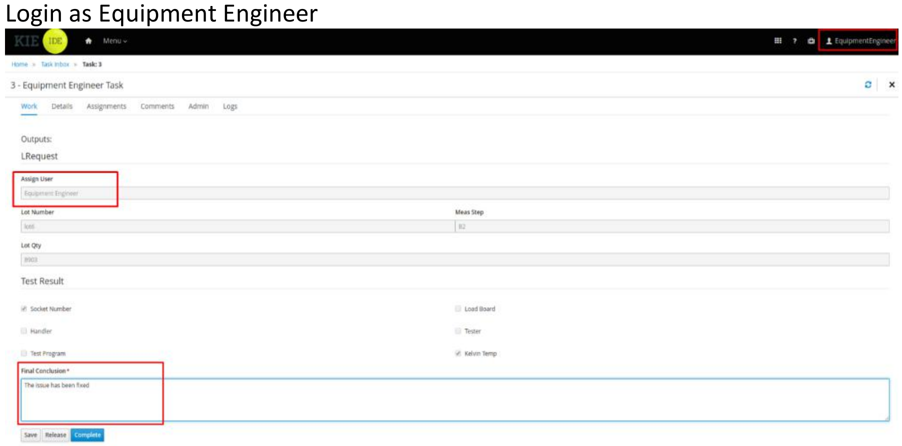
APPENDIX B: Sample system input and output

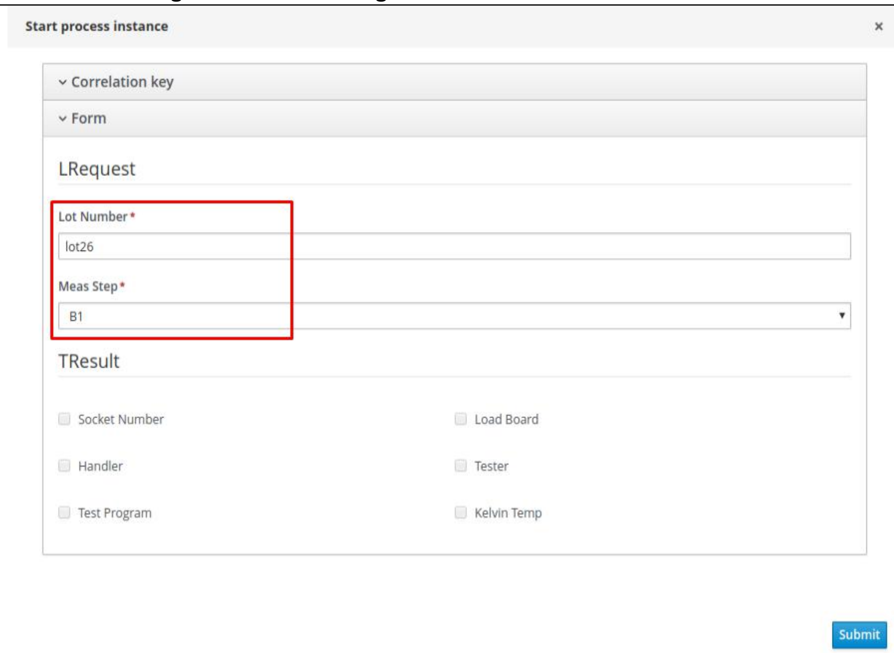
BUSINESS PROCESS MODEL

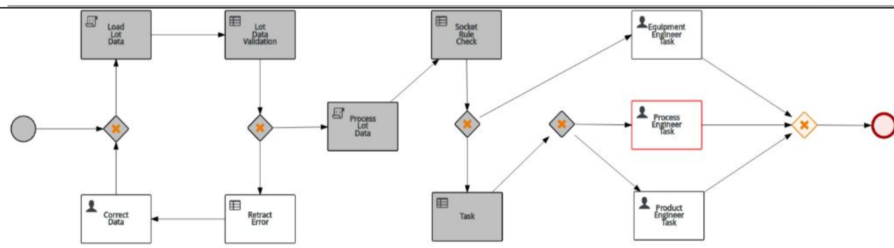


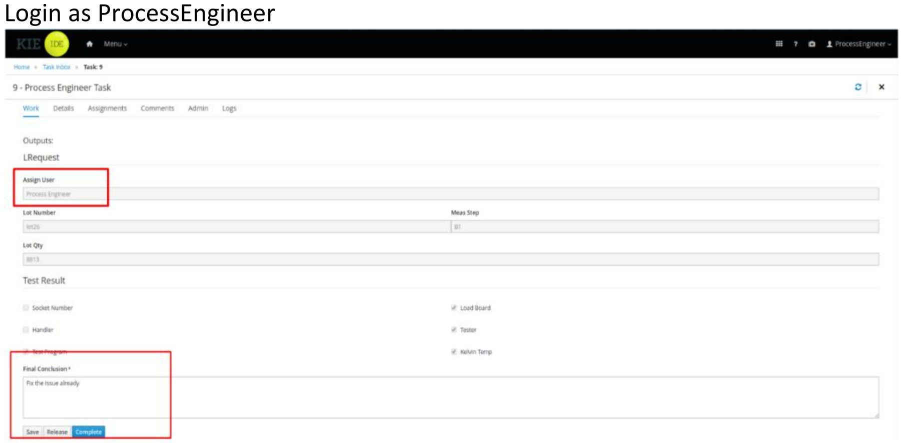
TEST SCENARIO

<table>
<tr><td>Test Case 1</td><td>Login as Technician
Lot Number : lot6
Meas Step : B2
The Task is assigned to EquipmentEngineer</td></tr>
<tr><td>User Input</td><td>
</td></tr>
<tr><td>System out put</td><td>

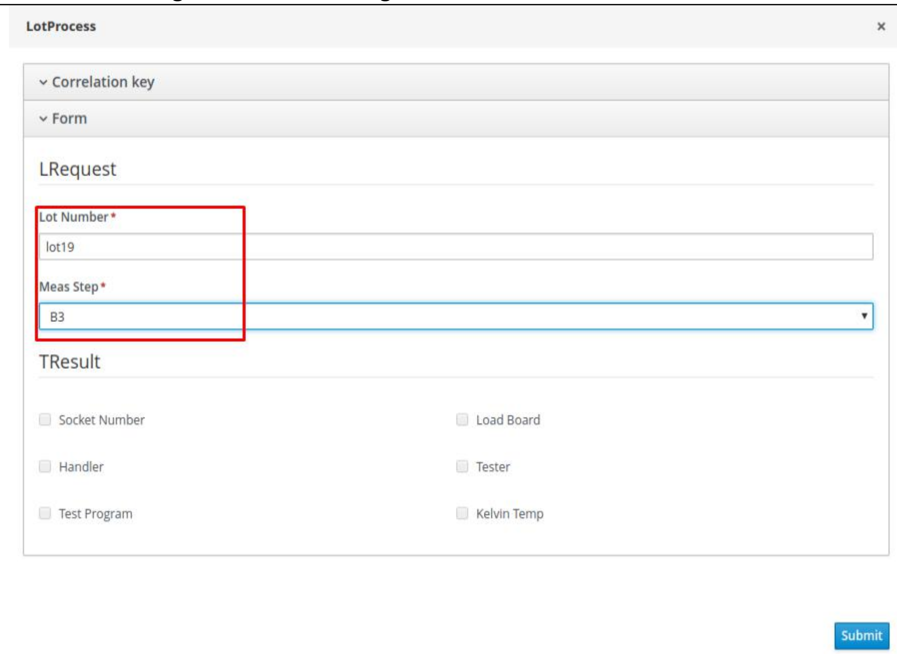
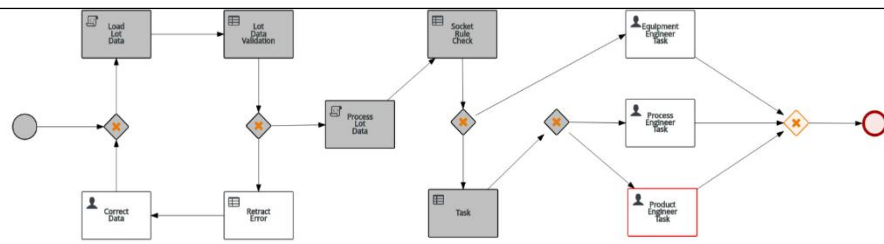
Login as Equipment Engineer

</td></tr>
</table>

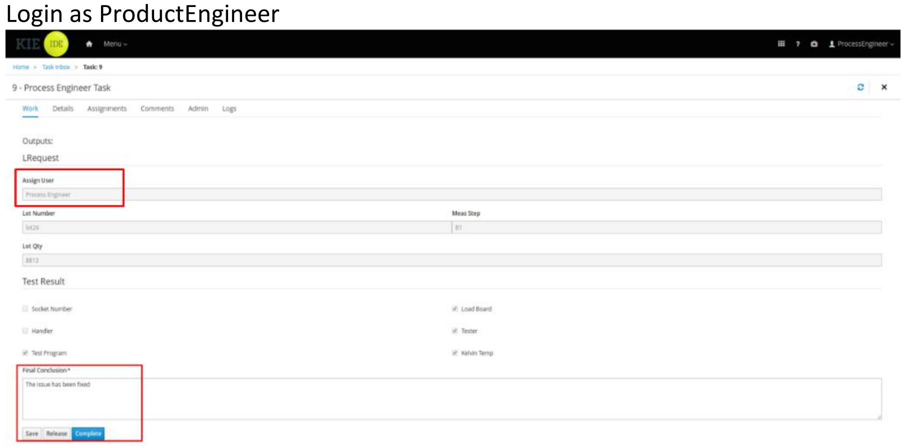
<table>
<tr><td>Test Case 2</td><td>Login as Technician
Lot Number : lot26
Meas Step : B1
The Task is assigned to Process Engineer</td></tr>
<tr><td>User Input</td><td>


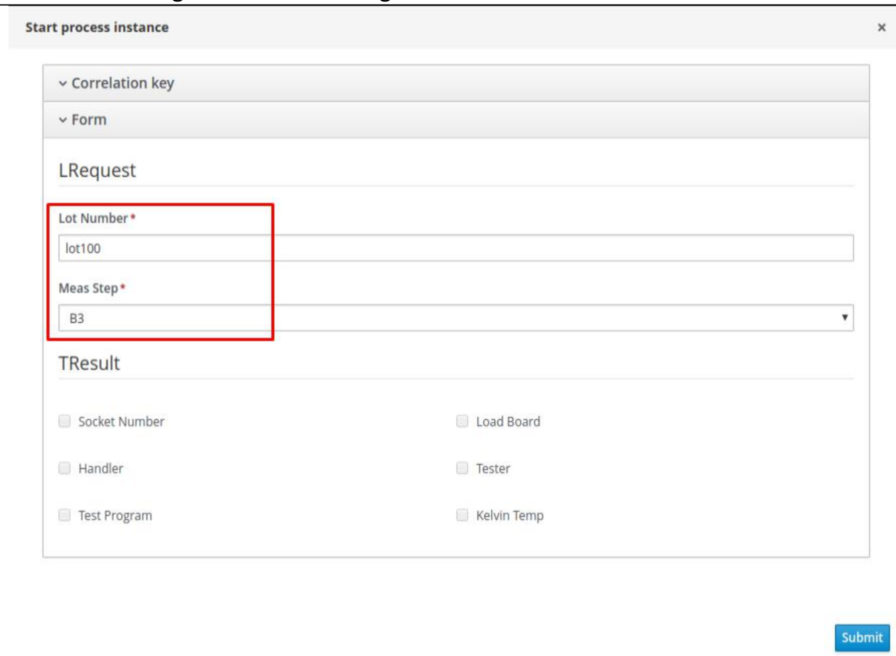
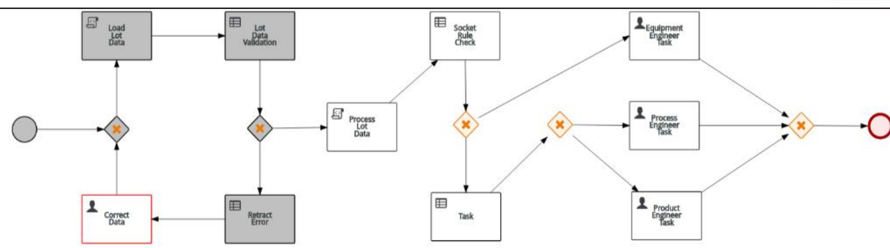
</td></tr>
<tr><td>System out put</td><td>


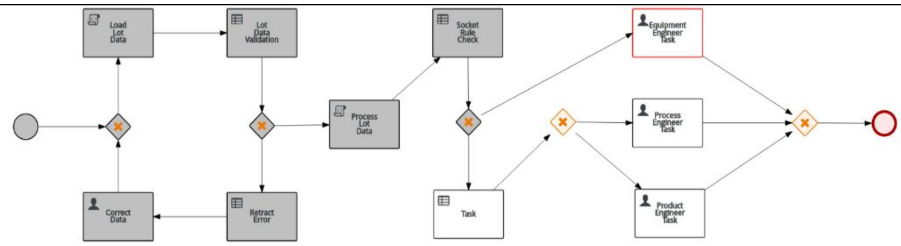
Login as ProcessEngineer


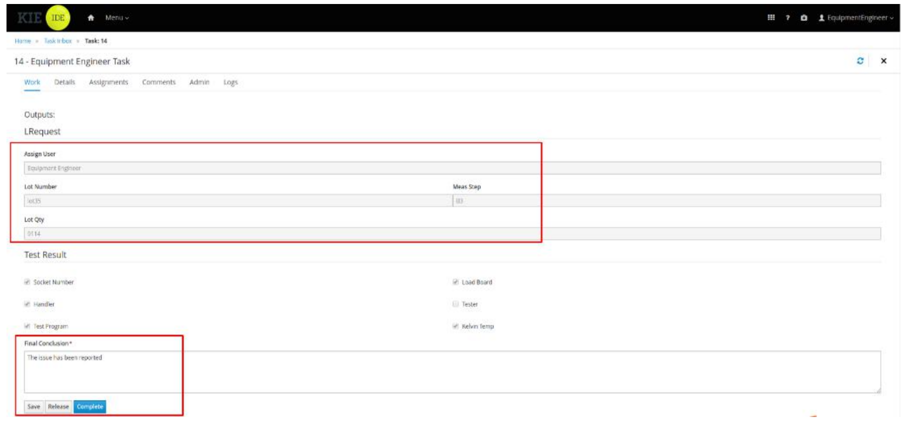
</td></tr>
</table>

<table>
<tr><td>Test Case 3</td><td>Login as Technician
Lot Number : lot19
Meas Step : B3
The Task is assigned to Product Engineer</td></tr>
<tr><td>User Input</td><td>
</td></tr>
<tr><td>System out put</td><td>

Login as ProductEngineer

</td></tr>
</table>

Test Case 4 (Negative)	Login as Technician Lot Number : lot100 (lot doesn't exist) Meas Step : B3 The Task is assigned to Product Engineer
User Input	
System out put	 Login as Technician Correct the data  Login as EquipmentEngineer


Load Lot Data
Lot Data Validation
Socket Rule Check
Equipment Engineer Task
Process Lot Data
Process Engineer Task
Correct Data
Retract Error
Task
Product Engineer Task


KIE IDE
Menu
14 - Equipment Engineer Task
Work
Details
Assignments
Comments
Admin
Logs
Outputs:
LRequest
Assign User
Lot Number
Meas Step
Lot Qty
Test Result
Socket Number
Load Board
Handler
Tester
Test Program
Kelvin Temp
Final Conclusion *
The issue has been reported
Save
Release
Complete