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CAPSTONE PROJECT

Test Guidelines

Contents

- Concepts
  - Testing Concepts
  - How to do Unit Test (UT)?
  - How to do Integration/System Test?
- Issues
- Case Studies

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Testing Concepts 1/2

- Test Type
  - Functional test/Black-box test
  - White-box test/Structural Test/Glass-Box Test/Transparent Test
  - Non-functional test
    - Security Test
    - Performance test, Usability Test
    - ….Installation Test, Backup Test
  - Changes-related test
- Test Level/Test Stages
  - Unit Test/Component Test
  - Integration Test (Component/System integration test)
  - System Test
  - Acceptance test

Testing Concepts 2/4

Test Techniques

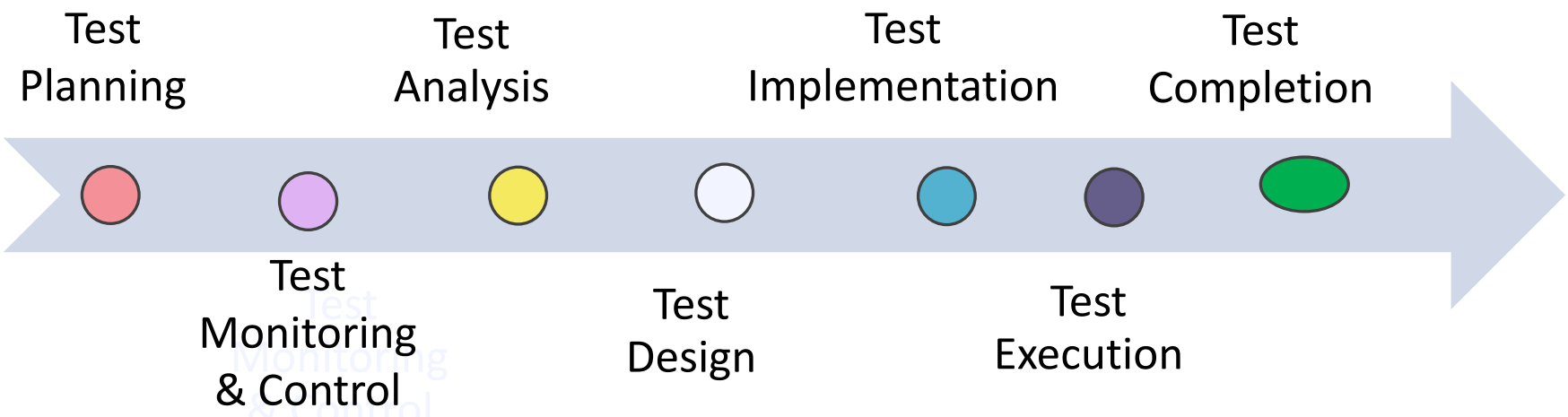
- Purpose:to identify test conditions, test cases, and test data.
- White-box testing techniques
  - Statement testing
  - Branch/Decision Testing
- Black-box/Functional Testing Techniques
  - Equivalent Partitioning testing
  - Boundary Analysis testing
  - Decision table testing
  - State transition testing

Testing Concepts 3/4

- Complete criteria
  - Define for each testing stage/level
- Test Coverage

$$\text{Coverage} = \frac{Number\ of\ coverage\ items\ excercised}{Total\ number\ of\ coverage\ items} * 100\%$$

- Test Process Activities



Testing Concepts 4/4

Test Scope

- Target of test
  - Features/Functions/Non-requirements to be tested
  - Features/Functions/Non-requirements not to be tested
- Test Level/test stage
  - What levels of test will be done in the project?
  - Brief of *in-charge, inputs/time, focuses, acceptance criteria*
- Assumptions, Constraints

How to do Unit Test?

- Focus on testing GUIs and components
- Component Testing Techniques
  - Statement testing
  - Decision/branch testing
- How to develop UT test cases, UT script?
- UT Frameworks

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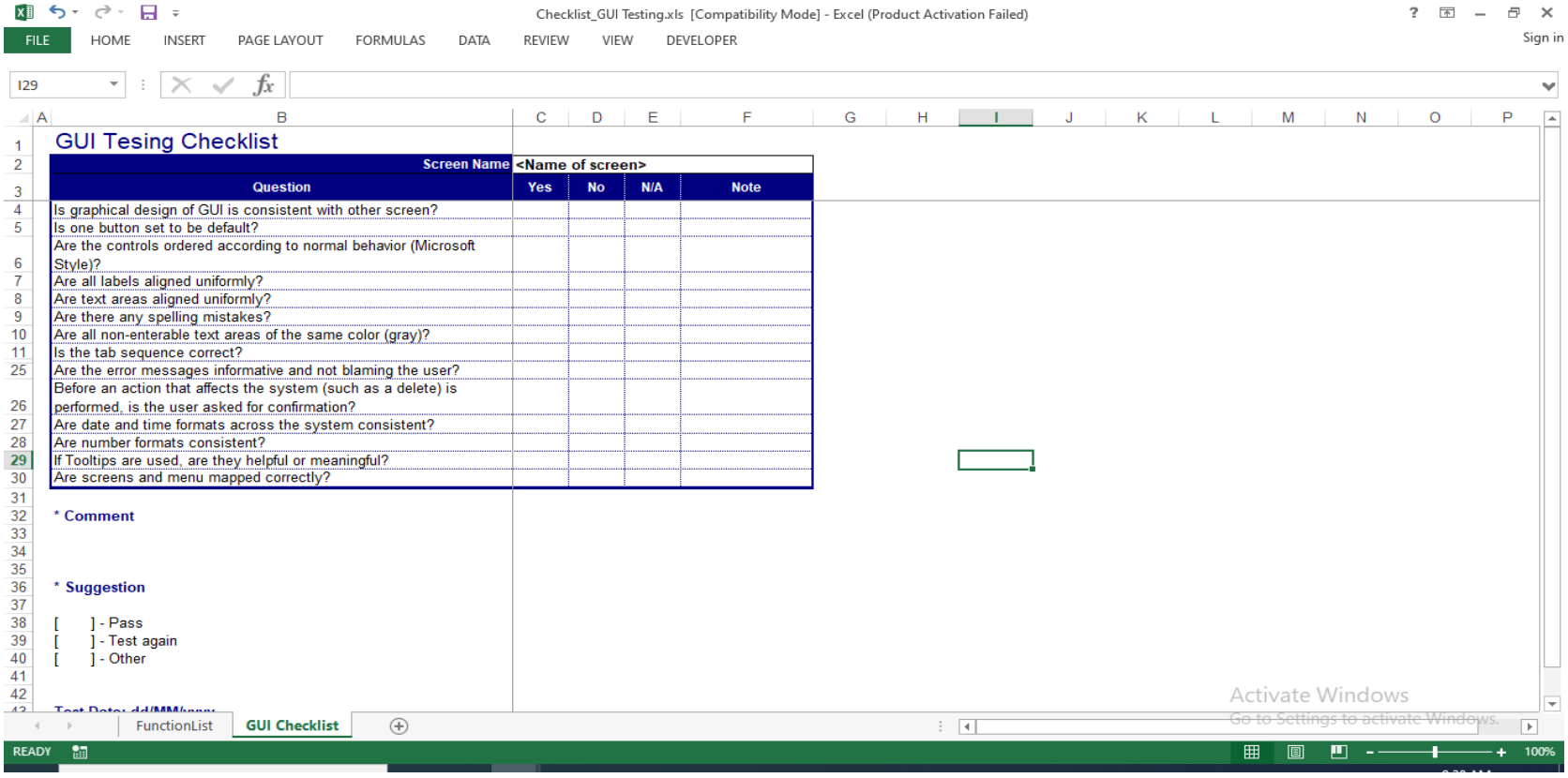
Graphical User Interface Test

- Focus on human user interface – text alignment, screen layout, font size, field size, color…
- Should use Check-list-based testing



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Component Testing- Techniques 1/2

- Statement testing: Complete criteria is statement coverage

Percentage of executable statements exercised by a test suite

$$\text{Statement coverage} = \frac{number\ of\ statements\ exercised}{total\ number\ of\ statements} * 100\%$$

Example:

- Program has 100 statements
- Tests exercise 87 statements
- Statement coverage = 87%

Statement coverage is normally measured by a software tool.

Component Testing- Techniques 2/2

- Decision/Branch testing: Complete criteria is branch coverage

Percentage of decision outcomes exercised by a test suite

$$Branch\ coverage\ = \frac{number\ of\ decision\ outcomes\ exercised}{total\ number\ of\ decision\ outcomes} * 100\%$$

Example:

- Program has 4 branches
- Tests exercise 2 branches
- Branch coverage = 50%

Decision coverage is normally measured by a software tool.

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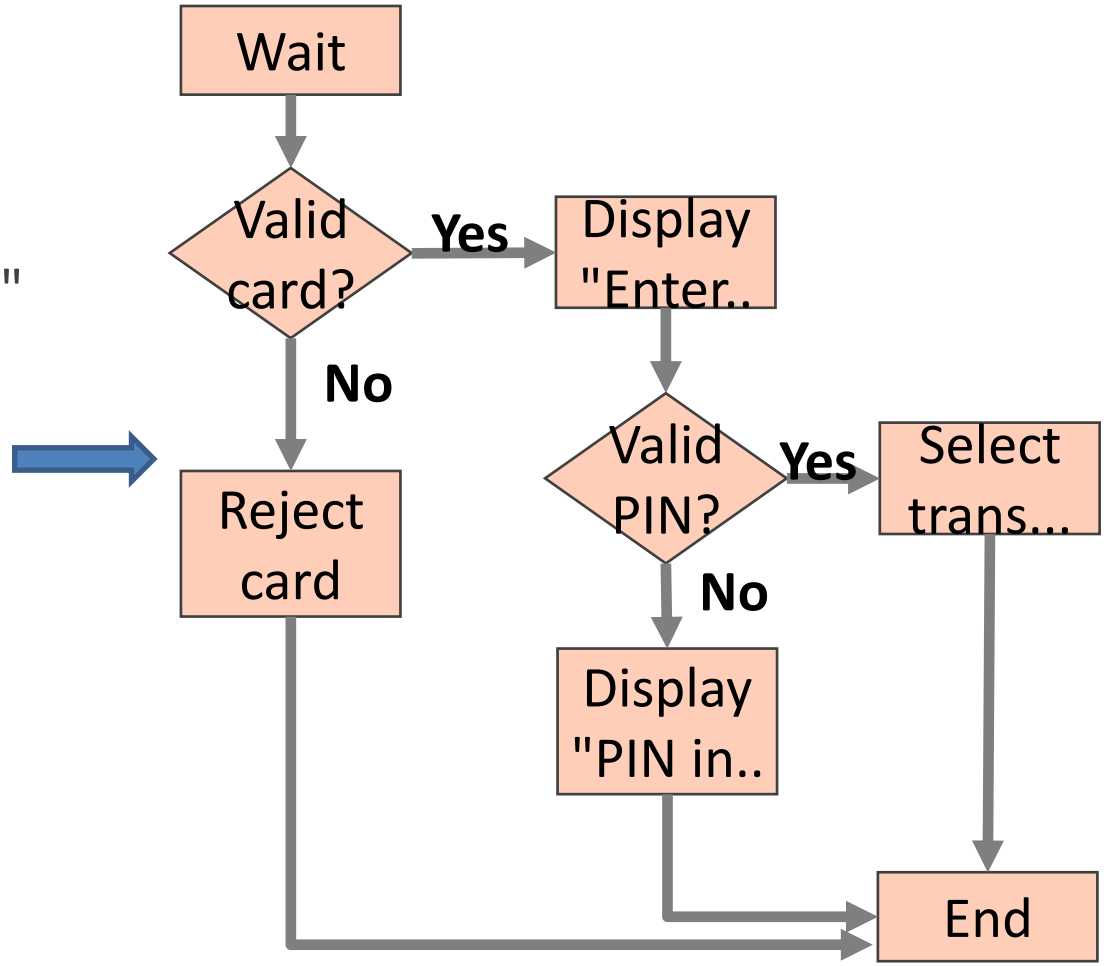
Develop Component Testing 1/5

- Step 1: Do code analysis & build control chart to identify test conditions and test cases

Example 1

Wait for card to be inserted
IF card is a valid card THEN
  display "Enter PIN number"
  IF PIN is valid THEN
    select transaction
  ELSE (otherwise)
    display “PIN invalid”
ELSE (otherwise)
  reject card
End



Develop Component Testing 2/5

❑Step 2: Put test cases into template

Code Module	RegisterUser	Method	validateDOB			
Created By	Nguyen Van Hoang	Executed By				
Test requirement	Test to ensure that all statements and branches in this method executed at leastone time.					
Passed	Failed	Untested	N/A	B		Total Test Cases
0	0	4	11	3	1	4

		UTCID01	UTCID02	UTCID03	UTCID04										
Condition	Precondition														
	N/A														
	Date														
	29	O	O												
	30														
	Month														
	2	O													
	3		O												
	Year														
	2000	O													
	2009		O												
Confirm	Return														
	TRUE	O	O												
	FALSE														
	Exception														
	Log message														
	"success"														
	"input1 is null"														
Result	Type(N : Normal, A : Abnormal, B : Boundary)	A	N	N	N	N	B	A	N	N	N	N	N	A	N	N
	Passed/Failed														
	Executed Date														
	Defect ID														

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Develop Component Testing 3/5

- Step 3: Develop script test in UT framework
  - Should comment test case for each test method
  - Test method name should include method name/component name + test case ID
- Example in Junit

```java
@Test
void authenticate() {
    // Arrange
    AuthenticationLoginDto loginRequest = new AuthenticationLoginDto();
    loginRequest.setEmail("test@example.com");
    loginRequest.setPassword("password");

    UserAccount user = new UserAccount();
    user.setEmail("test@example.com");
    when(userAccountRepository.findByEmail(anyString())).thenReturn(Optional.of(user));
    when(authenticationManager.authenticate(any())).thenReturn( t: null);
    when(jwtService.generateToken(any())).thenReturn( t: "accessToken");
    when(jwtService.generateRefreshToken(any())).thenReturn( t: "refreshToken");
    when(tokenRepository.findByUserAccountAndExpiredAndRevoked(any(), anyBoolean(), anyBoolean())).thenReturn( t: Optional.empty());
    when(tokenRepository.save(any())).thenReturn(new Token());

    // Act
    AuthenticationDto authenticationDto = authenticationService.authenticate(loginRequest);

    // Assert
    assertNotNull(authenticationDto);
    assertEquals( expected: "accessToken", authenticationDto.getAccessToken());
    // Add more assertions if needed
}
```

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Develop Component Testing 4/5

- Java
  - Junit, TestNG
  - Mockito
  - Jmockit
  - JaCoCo (coverage tool)
  - OpenClover (coverage tool)
- .NET & ASP.NET
  - NUnit
  - Unit Test framework includes in .NET MVC framework
  - Visual Studio, Coverlet (coverage tool)
- NodeJS
  - Mocha (https://mochajs.org/) & Chai (https://www.chaijs.com/)
  - **Jest** (https://jestjs.io/)

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Develop Component Testing 5/5

- React JS & React native
  - Jest (support code coverage measurement)
  - React Testing Library
- Angular
  - karma-jasmine (https://www.npmjs.com/package/karma-jasmine)
  - Istanbul (coverage tool)
- Android
  - Junit

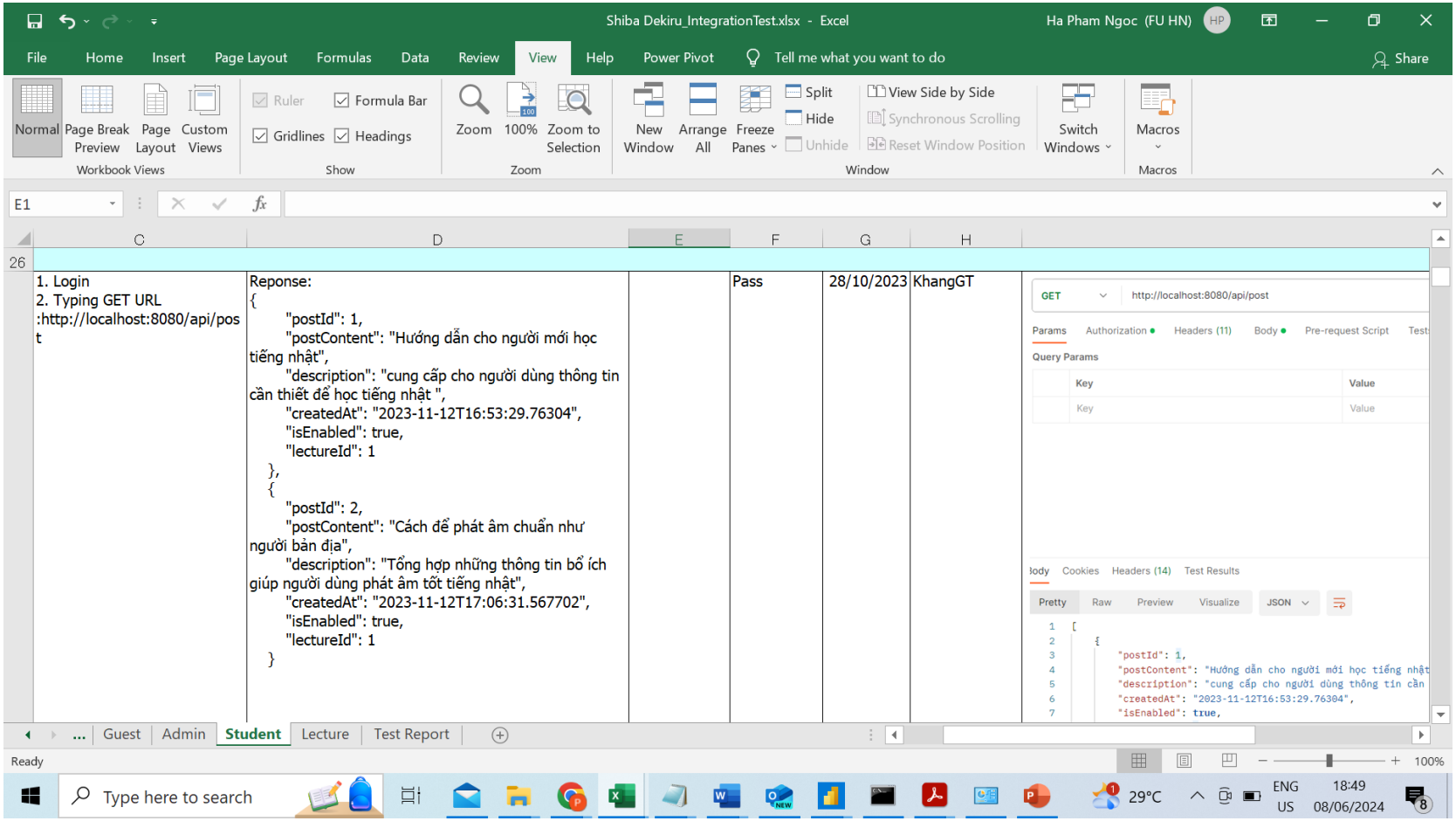
Integration Test 1/2

- Concept
  - This testing ensures that the integrated modules/components work properly.
  - Integration testing can start once the modules to be tested are available. This does not require another module to be completed for testing to be done, as Stubs and Drivers can be used for the same.
  - It detects errors related to the interface.
- Techniques
  - White-box and Black-box Test Techniques
- Frameworks
  - API Testing
    - Tool : Postman
  - Functional Integration Testing
    - Use same frameworks/tools with system testing

Integration Test 2/2

White-box: Develop test case for API Testing

- Format should be changed to be suitable with test case



System Test 1/4

- End to end testing
- Techniques
  - Black-box test techniques
    - Business Process-based Testing
    - Use-case based testing
- Tools & Frameworks?
  - Functional Test –same with IT
  - Performance: Jmeter (Opensource), Apidog (OpenSource), Load Runner (paid), **Gatling** (opensource)

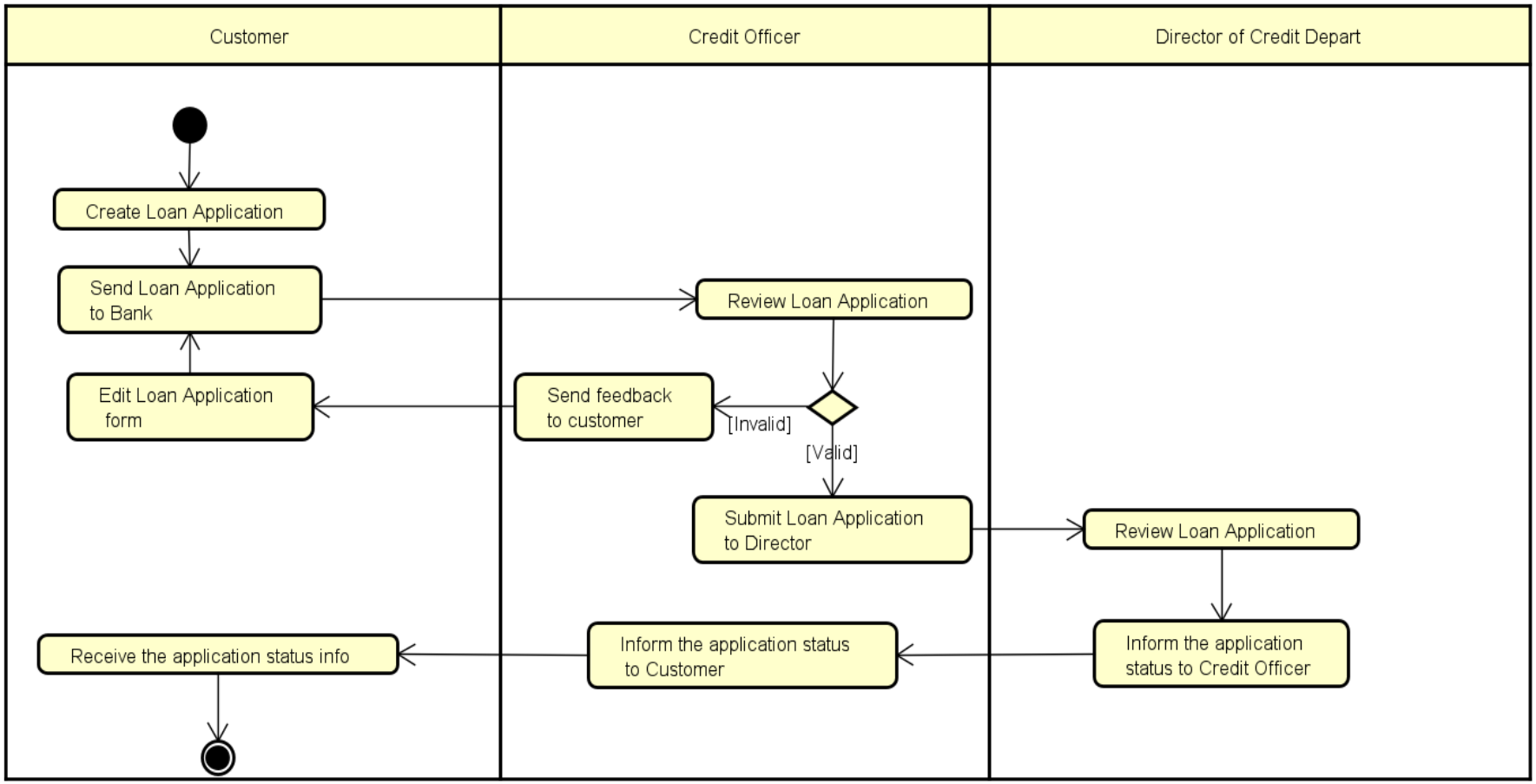
System Test 2/4

- How to develop test cases?
  - Study business processes (develop if not have)
  - Identify functions involve in business processes
  - Develop test case to verify flows in business process
  - Identify test cases of each function in the business process
  - Develop test procedure

System Test 3/4

Business Process Sample

- Loan Application process : Involve software functions
  - Create Loan Application, Display Loan Application List, Send for Approval, Approve…



System Test 4/4

Frameworks

- Web App
  - Selenium (open source)
  - Katalon
- Mobile App
  - Katalon (free for small team)
  - TestGorilla (free for essential features)

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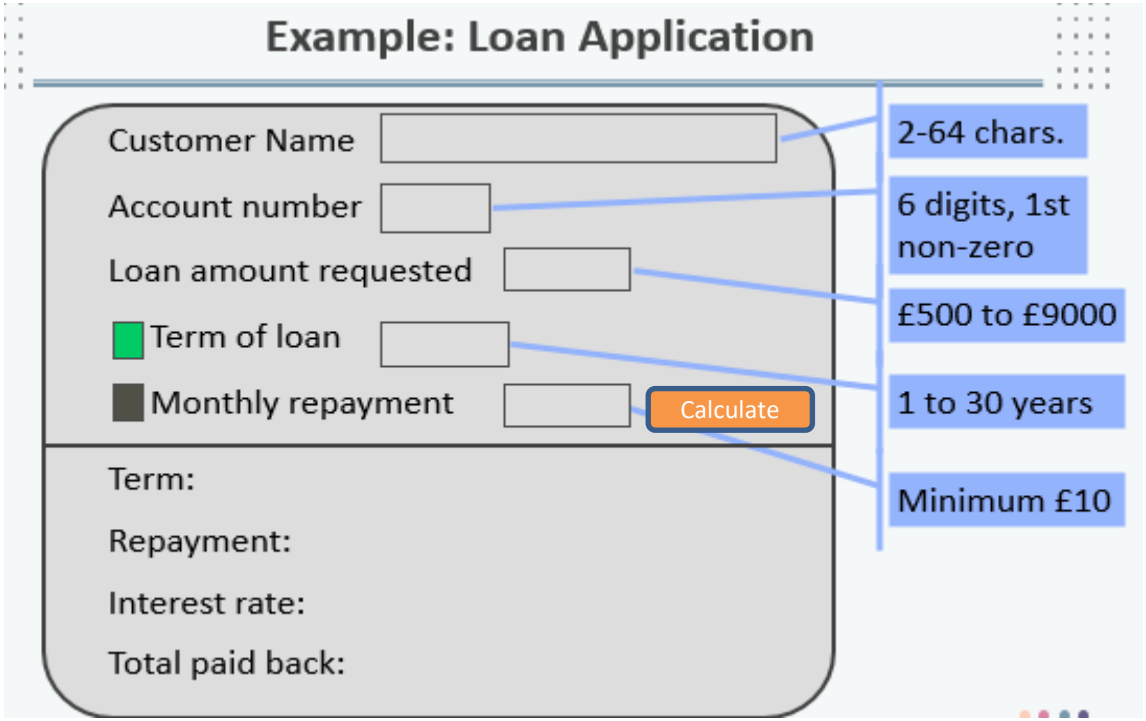
How to develop Black-box Test cases?

Step 1: Identify Test Condition

- **Step 1:** Identify, study, analyze test basis (e.g. Functional specification, AD, Interface Spec…)
  - to identify test conditions
  - and put into a condition table
- E.g. Conditions table for Loan Application



Condition	Valid Partitions	Invalid Partitions	Valid Boundaries	Invalid Boundaries
Customer name				
Account number				
Loan amount				

How to develop Black-box Test cases?

Step 2: Condition Analysis

❑ Step 2: Condition Analysis

- Use techniques to develop condition analysis to identify test cases
- E.g. Customer name condition

Number of characters:

Valid characters: _, A-Z a-z *space*

Any other

Conditions	Valid Partitions	Invalid Partitions	Valid Boundaries	Invalid Boundaries
Customer name	2 to 64 chars	< 2 chars	2 chars	1 char
		> 64 chars	64 chars	65 chars
	valid chars	invalid chars		0 char

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How to develop IT Test cases?

Step 2: Condition Analysis

❑ E.g. Conditions Analysis Sheet after analysis complete

Condition	Valid Partitions	Tag	Invalid Partitions	Tag	Valid Boundaries	Tag	Invalid Boundaries	Tag
Customer name	2 – 64 chars	VP1	< 2 chars	IP1	2 chars	VB1	1 char	IB1
	valid chars	VP2	> 64 chars	IP2	64 chars	VB2	65 chars	IB2
			invalid chars	IP3			0 char	IB3
Account number	6 digits	VP3	< 6 digits	IP4	100000	VB3	99999	IB4
	1st non-zero	VP4	> 6 digits	IP5	999999	VB4	1000000	IB5
			1st digit = 0	IP6			_ (0 digit)	IB6
			non-digit	IP7				
Loan amount	500 – 9000	VP5	< 500	IP8	500	VB5	499	IB7
			> 9000	IP9	9000	VB6	9001	IB8
			0	IP10				
			non-integer	IP11				
			null	IP12				

How to develop Black-box Test cases?

Step 3: Design test case

❑ Step 3: Design Test cases

- Define test cases with datatest based on test objectives

Test Case	Description	Expected Outcome	New Tag Covered
1	Name: John Smith Acc. No: 123456 Loan: 2500 Term: 3 years	Term: 3 years Repayment: 79.86 Interest rate: 10% Total paid: 2874.96	V1, V2, V3, V4, V5,…
2	Name: AB Acc. No: 100000 Loan: 500 Term: 1 year	Term: 1 year Repayment: 44.80 Interest rate: 7.5% Total paid: 537.60	B1, B3, B5…

How to develop Black-box Test cases?

Step 4: Develop test case

- **Step 4**: Implement/Develop Test case
  - Develop Test Data
  - Develop Test Procedures (if test GUI functions)
  - Develop message lists (Use requirements & design documents)
  - Put into Test Cases template
    - Use UT Test Case Template for API Test (**Report5.1_Unit Test.xls**)
    - Use Functional Test Case Template for GUI Function Test (**Report5.2_Integration Test.xlsx**)

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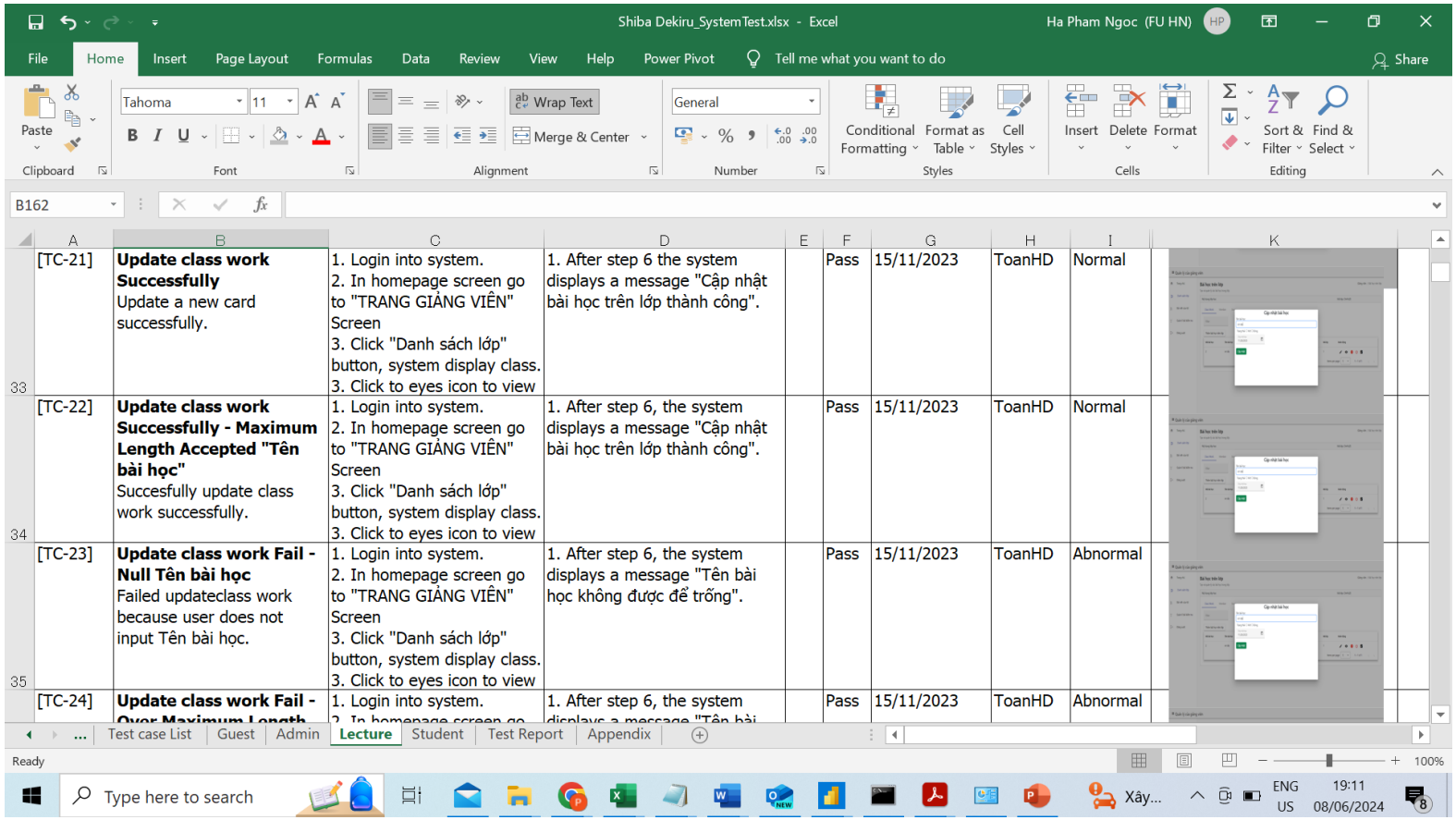
How to develop Black-box Test cases?

Test case sample

- This TC related to Create Loan Application, Display Loan App List, Approve…



	A	B	C	D	E	F	G	H	I	K
33	[TC-21]	**Update class work Successfully** Update a new card successfully.	1. Login into system. 2. In homepage screen go to "TRANG GIẢNG VIÊN" Screen 3. Click "Danh sách lớp" button, system display class. 3. Click to eyes icon to view	1. After step 6 the system displays a message "Cập nhật bài học trên lớp thành công".		Pass	15/11/2023	ToanHD	Normal	
34	[TC-22]	**Update class work Successfully - Maximum Length Accepted "Tên bài học"** Succesfully update class work successfully.	1. Login into system. 2. In homepage screen go to "TRANG GIẢNG VIÊN" Screen 3. Click "Danh sách lớp" button, system display class. 3. Click to eyes icon to view	1. After step 6, the system displays a message "Cập nhật bài học trên lớp thành công".		Pass	15/11/2023	ToanHD	Normal	
35	[TC-23]	**Update class work Fail - Null Tên bài học** Failed updateclass work because user does not input Tên bài học.	1. Login into system. 2. In homepage screen go to "TRANG GIẢNG VIÊN" Screen 3. Click "Danh sách lớp" button, system display class. 3. Click to eyes icon to view	1. After step 6, the system displays a message "Tên bài học không được để trống".		Pass	15/11/2023	ToanHD	Abnormal	
	[TC-24]	**Update class work Fail - Over Maximum Length**	1. Login into system. 2. In homepage screen go	1. After step 6, the system displays a message "Tên bài		Pass	15/11/2023	ToanHD	Abnormal	

Test Report

- Individual Test Case Report
  - Test case filled test result
- Test Summary Reports : A test report prepared at the end of a test activity / a test level.
  - UT Report
  - IT Report
  - ST Report
  - AT Report
- Defect Reports

Issue

- Not Execute Test
  - Have not UT
  - Test case filled test result with-out execute test
- Test not follow process
  - Only write test case not have evidence
  - Not execute IT different with ST
  - Test report filled test result with only “Pass”
  - Have not user but fill AT Report
- Have not Defect Reports

Case Studies

- Not Execute Test
- Test not follow enough process
- Test with right process of real project.

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Case Study – Not Execute

- Developer not execute UT and IT
- Tester not execute ST because coding not finish on-time
- Developer and Tester not log bug
  - don’t know how to log Bug (concept/process/tool).
  - Not enough time to log Bug

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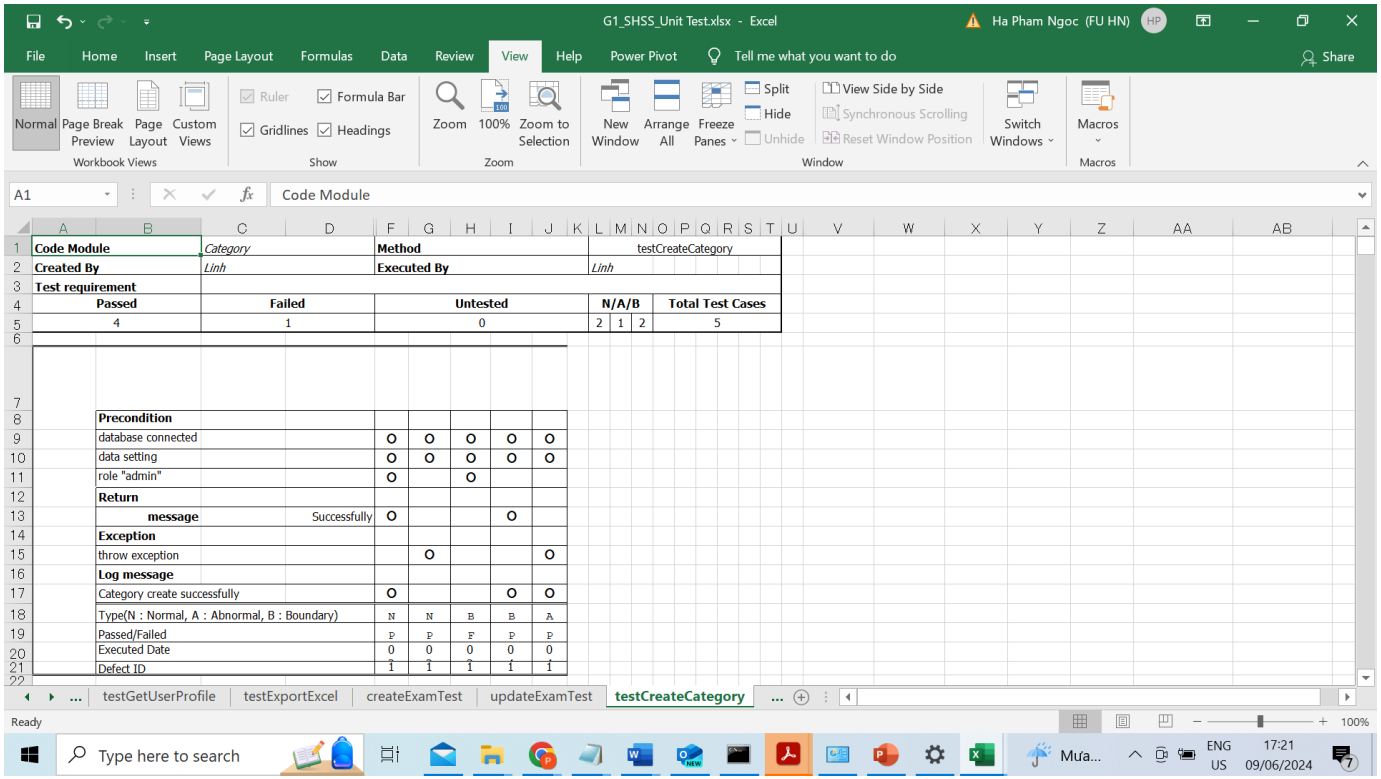
Case Study – Not Enough 1/4

- Test not enough for right process of real project.
  - UT report : G1_SHSS_Unit Test
    - Only write UT test case with-out evidence



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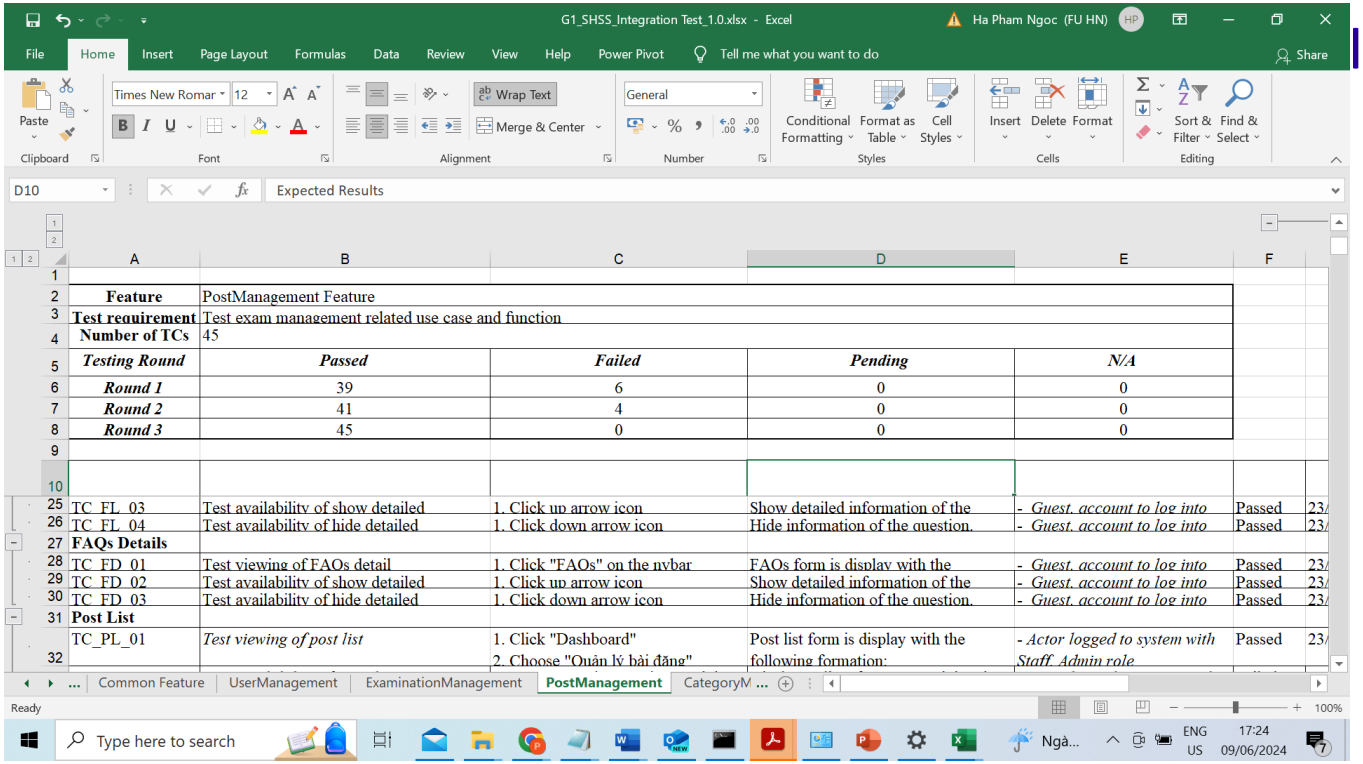
Case Study – Not Enough 2/4

- Test not enough for right process of real project.
  - IT report: G1_SHSS_Integration Test_1.0
    - Only plan testing screen flow with-out evidence



	A	B	C	D	E	F
1						
2	**Feature**	PostManagement Feature				
3	**Test requirement**	Test exam management related use case and function				
4	**Number of TCs**	45				
5	***Testing Round***	***Passed***	***Failed***	***Pending***	***N/A***	
6	***Round 1***	39	6	0	0	
7	***Round 2***	41	4	0	0	
8	***Round 3***	45	0	0	0	
9						
10						
25	TC_FL_03	Test availability of show detailed	1. Click up arrow icon	Show detailed information of the	- *Guest, account to log into*	Passed
26	TC_FL_04	Test availability of hide detailed	1. Click down arrow icon	Hide information of the question.	- *Guest, account to log into*	Passed
27	**FAQs Details**					
28	TC_FD_01	Test viewing of FAQs detail	1. Click "FAQs" on the nybar	FAQs form is display with the	- *Guest, account to log into*	Passed
29	TC_FD_02	Test availability of show detailed	1. Click up arrow icon	Show detailed information of the	- *Guest, account to log into*	Passed
30	TC_FD_03	Test availability of hide detailed	1. Click down arrow icon	Hide information of the question.	- *Guest, account to log into*	Passed
31	**Post List**					
32	TC_PL_01	*Test viewing of post list*	1. Click "Dashboard" 2. Choose "Quản lý bài đăng"	Post list form is display with the following formation:	- *Actor logged to system with Staff, Admin role*	Passed

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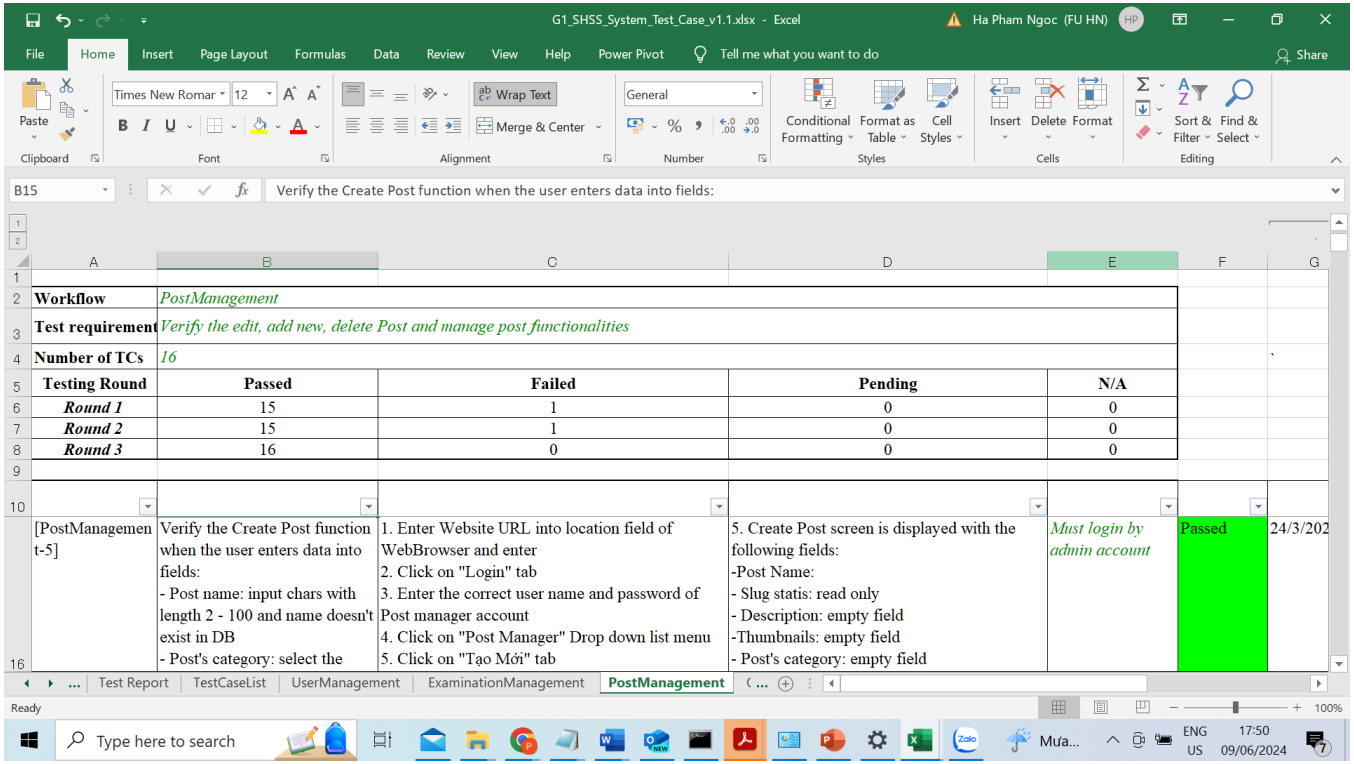
Case Study – Right Process 3/4

- Test not enough for right process of real project.
  - ST report: G1_SHSS_System_Test_Case_v1.1
    - Not fill data test



G1_SHSS_System_Test_Case_v1.1.xlsx - Excel

B15: Verify the Create Post function when the user enters data into fields:

Workflow	*PostManagement*				
Test requirement	*Verify the edit, add new, delete Post and manage post functionalities*				
Number of TCs	*16*				
Testing Round	**Passed**	**Failed**	**Pending**	**N/A**	
Round 1	15	1	0	0	
Round 2	15	1	0	0	
Round 3	16	0	0	0	
[PostManagement-5]	Verify the Create Post function when the user enters data into fields: - Post name: input chars with length 2 - 100 and name doesn't exist in DB - Post's category: select the	1. Enter Website URL into location field of WebBrowser and enter 2. Click on "Login" tab 3. Enter the correct user name and password of Post manager account 4. Click on "Post Manager" Drop down list menu 5. Click on "Tạo Mới" tab	5. Create Post screen is displayed with the following fields: -Post Name: - Slug statis: read only - Description: empty field -Thumbnails: empty field - Post's category: empty field	*Must login by admin account*	Passed	24/3/202

Sheets: Test Report | TestCaseList | UserManagement | ExaminationManagement | PostManagement

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Case Study – Right Process 1/4

- Test not enough for right process of real project.
  - Bug Tracking: Have not bug tracking evidence

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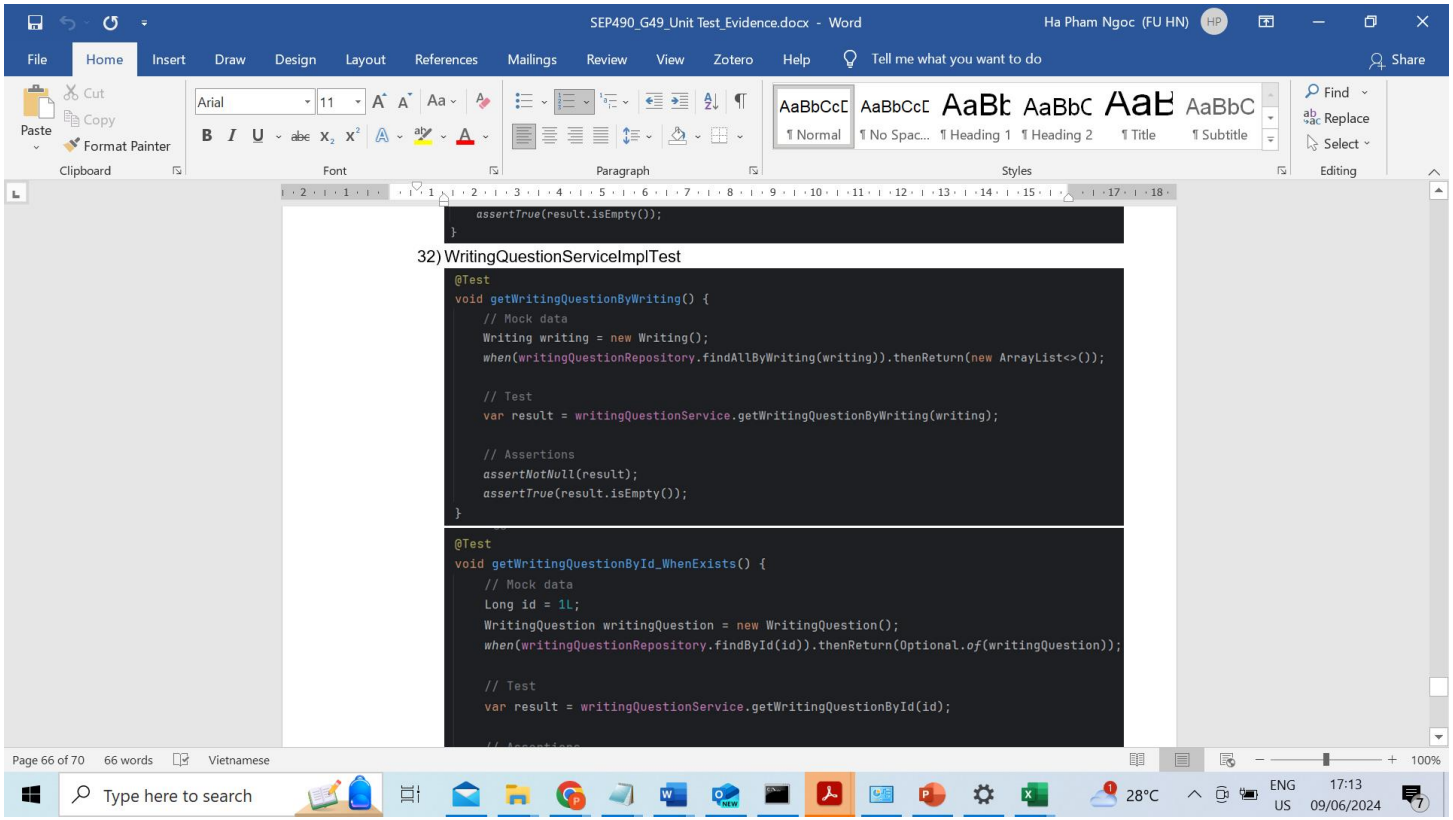
Case Study – Right Process 1/4

- Test with right process of real project.
  - UT report: SEP490_G49_Unit Test_Evidence



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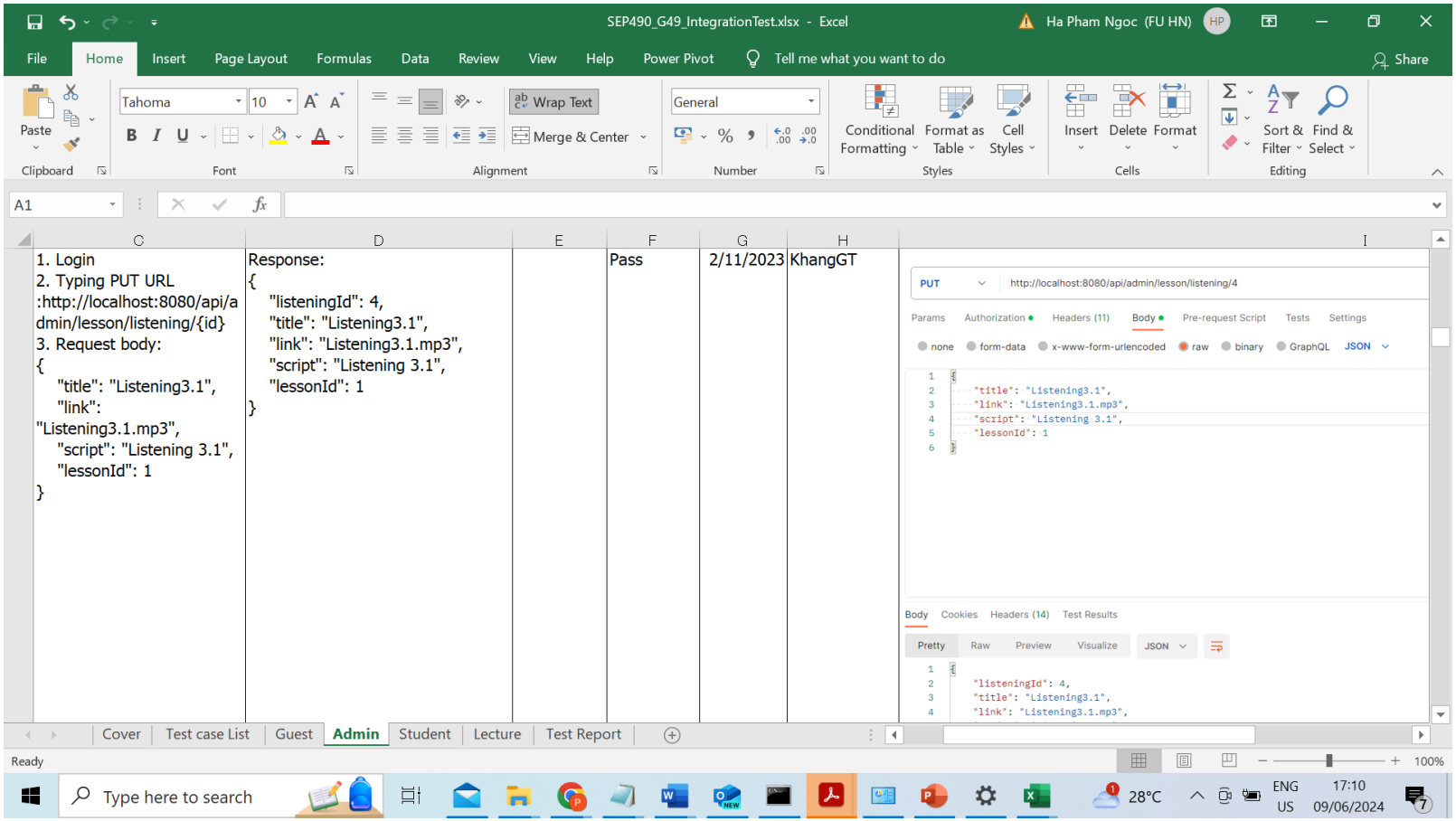
Case Study – Right Process 2/4

- Test with right process of real project.
  - IT report: SEP490_G49_IntegrationTest



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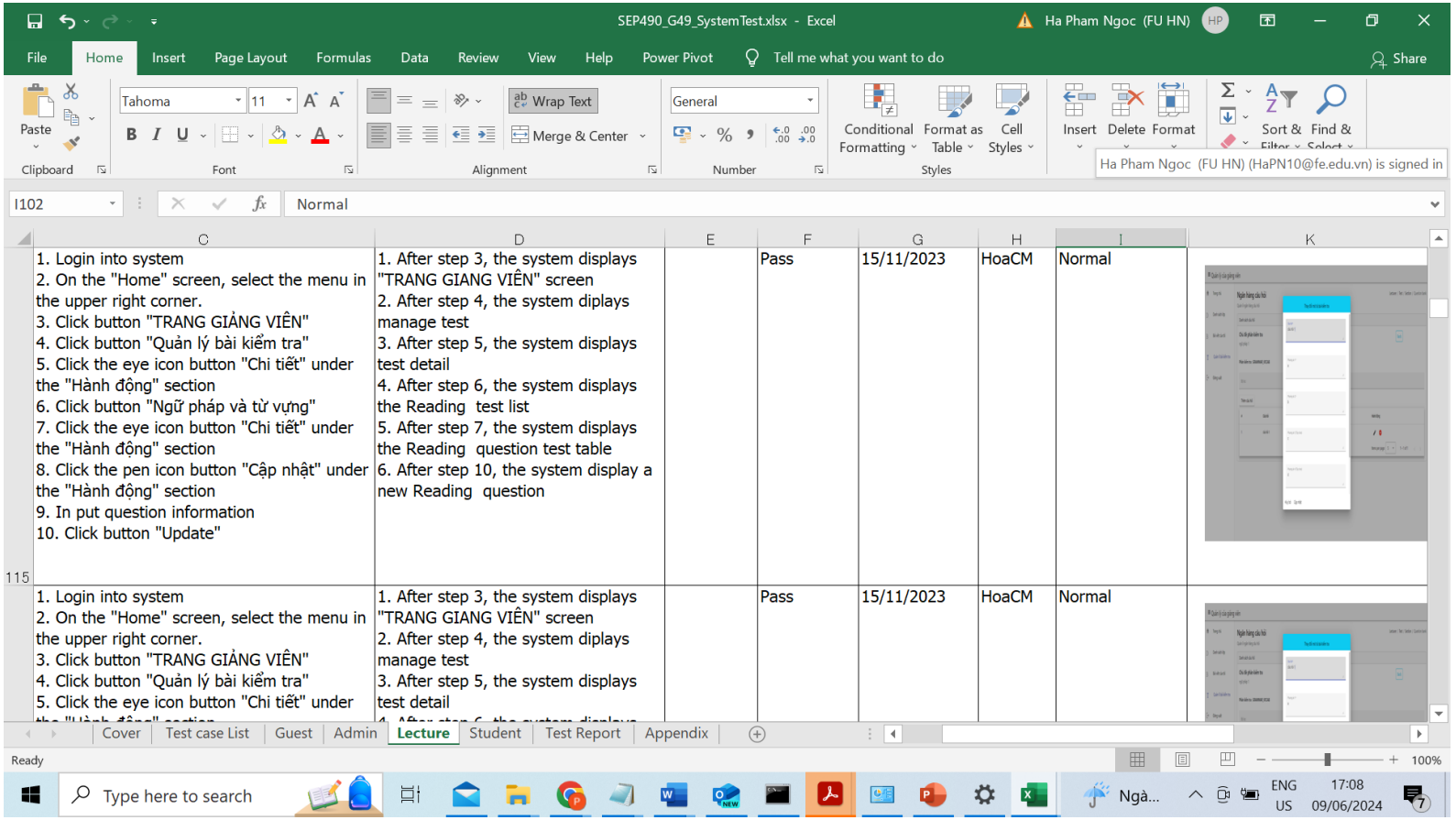
Case Study – Right Process 3/4

- Test with right process of real project.
  - ST report: SEP490_G49_SystemTest



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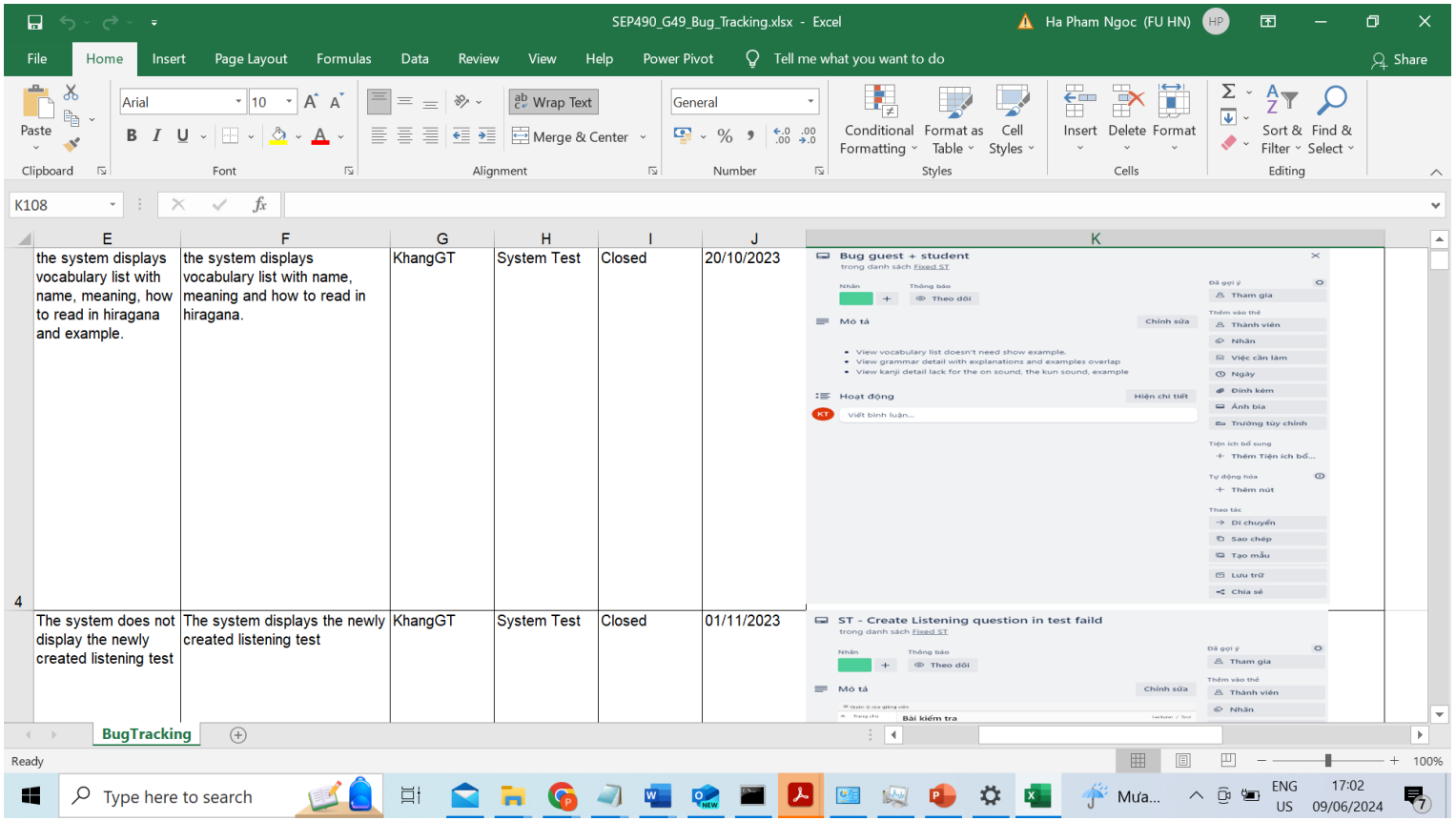
Case Study – Right Process 4/4

- Test with right process of real project.
  - Bug Tracking: SEP490_G49_Bug_Tracking



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