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Towards Migrating from Monolithic-Based Web Application to Micro Service: A Case Study of ezScrum Product Backlog

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

The software ezScrum is a legacy web application that has been developed and maintained for more than ten years. With web technology constantly evolving, the ezScrum development team has found it increasingly difficult to keep up and many older technologies are still used. A consequence is the slowdown of release. Examining the issues, we have found the main cause to be the coupling of ezScrum modules since ezScrum is a monolith. Thus, effort has been taken to convert ezScrum into a set of microservices so that coupling is reduced. This thesis reports our work on extracting the product backlog from ezScrum. As demonstrated, the extracted product backlog microservice operates as an independent web application that collaborates with other extracted microservices from ezScrum including account management.

Keywords: Monolithic; microservice; migration; ezScrum; product backlog.

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1. INTRODUCTION

ezScrum since last year was in the phase of architectural transition from the old style of the monolithic to the microservice, this transition is due to the monolithic architecture that currently used by ezScrum is very dependent on specific technologies that have been used more than ten years since the first release ezScrum and the development of some of these technologies have even discontinued. In the implementation of the microservice architecture, large monolithic applications such as ezScrum are split into several modules each of which would become independent service and each service has its own technology coverage with its functionality and clear boundary [1].

ezScrum is a web application that facilitates system development through a scrum framework with several key functions such as product backlog, sprint planning, sprint backlog, taskboard, burndown chart, task management and et cetera. some of the above features have become the primary candidates that need to be decomposed into small bounded functionality. The product backlog is a list of everything to be accomplished in a project that is currently running. This list can be the addition of new features, enhancement running feature, or even fixing the issues. Usually, product backlog sorted by priority level. These priority levels are generated from several factors such as value added, cost and risk based on these criteria the product owner would be able to determine which user story that needs to be finished in the sprint backlog for the next sprint [2].

Scrum is one of the most popular method among the agile methods [3] , it has a few simple rules designed to help a team to organize, achieve high quality, high customer satisfaction and good developer experience. The open-source application ezScrum [4] is maintained around mature practices such as automated tests including user acceptance test cases for verifying the functional requirements and unit testing to test the individual classes and methods. The application is developed in Java, more specifically in Struts framework [5]. The 1.2.7 version of the Struts framework that is used to develop ezScrum became old and it is no longer supported by the community [6]. There are numbers of research studies and literatures that address issues on identifying and investigating possible methods and models to describe microservice, one of such is a Domain-Driven Design notion of Bounded Context [7]. It helps the development team gain a clear and shared understanding of what has to be consistent and what can be developed independently. Basically, it defines explicit boundaries of the service, which is essential in developing microservice. Fig. 1 is a sample diagram of a bounded context, as it shows how two unrelated concepts are separated into two services where they only share the common concepts Customer and Product [4-7].

However, getting service boundaries wrong would be costly and risky in the long run. Hence, the team has to be cautious when defining and modeling the loosely coupled and high cohesive services. Once the bounded context are determined and have the explicit public interface defined, it is then up to developers to develop the micro services around the business capabilities [9].

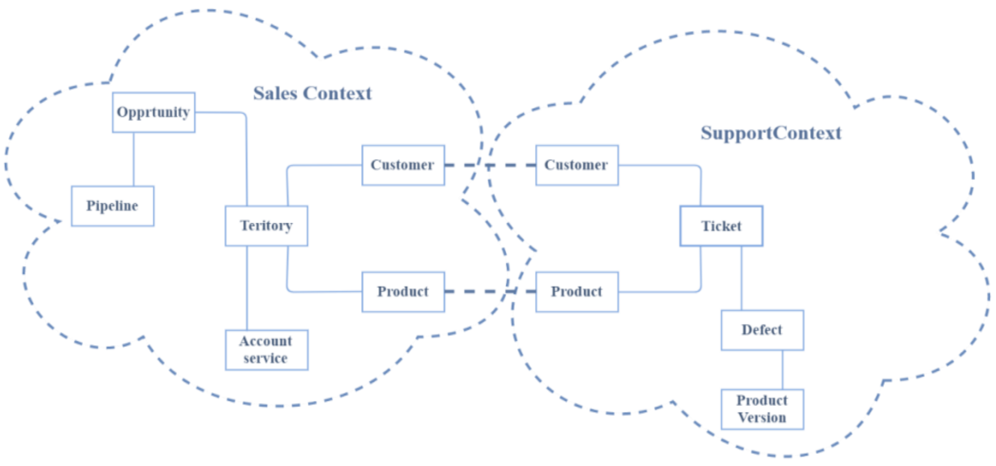


Fig. 1. Bounded context [8]

2. METHODOLOGY STARTING WITH MICROSERVICE

2.1 Preliminary Preparation

The first step that needs to be done is to identify the logical architecture of the ezScrum and find out in which cluster that business logic and domain model reside. This process is called isolating the domain [1]. This task including reading and organizing the existing source code and draw it into context diagram which is necessary to get the more profound understanding of the overall business process of ezScrum. The context diagram is also essential for mediating with domain professional to categorize the related domain into the defined business context and filter out the domains which not related to the product backlog microservice.

2.1.1 ezScrum package structure

In the legacy ezScrum java classes that have the similar functionality are grouped in the single package which is named into a meaningful name that is reflecting the concept and functionality for each class member. With this package naming and structure, providing the convenient way for locating the class that should be delegated to complete some specific task. For instance, AjaxAddStoryAction class and AjaxAddTaskAction class are providing the similar functionality, both classes primarily handling the client request and prepare the response data back to the client and these classes are grouped in the Package action. In Fig. 1a each package has its specific functionality that respectively describes as follows, *Package action* is responsible for coordinating the task that came from client and delegates work to *Package helper* for specific process with help from *Package* logic if there is any calculation involves then the process continues to *Package Mapper* which provides the higher level functionality to do a database query and maps this query to the underlying database query using *Package Dao* and return the output by creating an object from *Package data Object* [6].

2.1.2 Analyzing ezScrum architecture

ezScrum package naming structure above provides us with a convenient way to presume which package that contains the domain concept and also provides the excellent foundation for defining the specific architecture that is currently applied in ezScrum. This task is necessary to define the specific concern of each ezScrum package. This process also provides a reference for isolating the domain concept and decoupling it from the framework technology or other unrelated concepts that might be mixed with domain concept [3].

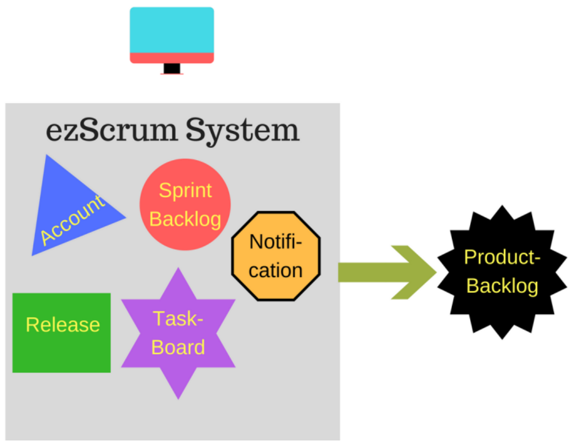


Fig. 1a. Splitting Illustration

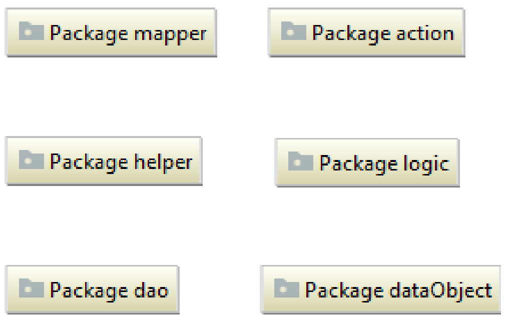


Fig. 1b. ezScrum packages

Follows is the sequence diagram that taken when new product backlog request occurs, which is notated using product backlog class and story class in ezScrum Fig. 1c.

Fig. 1c mildly illustrates the request action for creating a new story in ezScrum, the process that comes from HTTP request with body parameter firstly flows from *Ajax Addnew Story Action* class converts the HTTP request body to *Story Info* object and delegates the creation process to the *Product Backlog Helper* class which relies on *Product Backlog Logic* class for handling the conditional checking and *Story Object* for storing the story data to persistence database that facilitated by *Story Dao* class and when the process has been finished the delegated class notifies the caller class package by package.

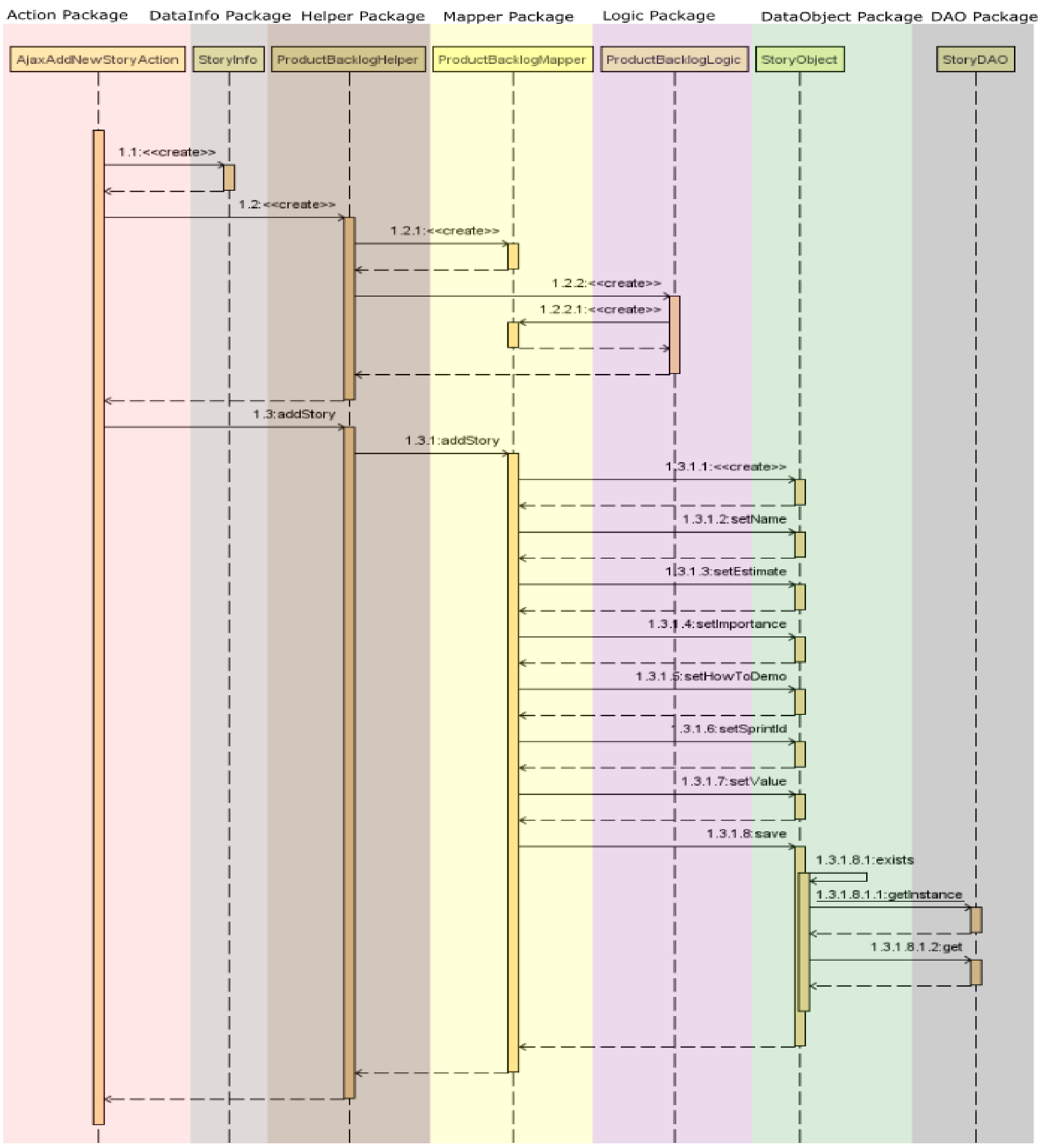


Fig. 1c. Sequence diagram of class call-stack in ezScrum

From above analysis it is straightforward to denote that ezScrum architecture is reflected with above figure which states that each layer is specialized in specific aspect of ezScrum process (Table 1).

2.1.3 ezScrum domain layer entities

Class diagram is used to express the situation and followed with the description for each class respectively. Two diagrams would be created the first diagram exhibits the list of the classes that were used by ezScrum and all the attributes that belongs to it respectively and the other one exhibits the interaction between these two classes.

2.1.4 ezScrum database entities

Having all the database entities listed in the report would help us to understand which table is currently being mapped from the domain entities to underlying database. Back to ezScrum database, we have identified 15 tables each of these tables representing the object model in ezScrum for storing the data in MySQL database, then in the splitting work. We will identify which entity that part of Product Backlog context and declare the relationship for each table based on the Table 2.

2.2 Splitting Work

2.2.1 Product backlog context boundary

To ensure our splitting processes would work in right path we implement one of DDD technique that called bounded context this approach states that each component and these context models are only used within their bounded scope and data arenot shared across the bounded contexts. We can explicitly defined the bounded context of product backlog with some general concept of product backlog:

> "*The product backlog is a list of product requirements to be accomplished in a project that is currently running. This list can be categorized into several category like the addition of new features, enhancement running feature, or even fixing the issues. Usually, product backlog sorted by priority level. These priority levels are generated from several factors such as value added, cost and risk based on these criteria" [8].*

From above product backlog concept we sorted out several important terms that would be important to be the list of sub-domain and explicitly compare these sub-domain into ezScrum related terms through a discussion session with domain expert.

Noticed that we ignored the product owner term because in ezScrum product owner is expressed by the user object that part of Account management context [5].

In the scrum, product requirement is a single item that needs to be accomplished to deliver a viable product. This item contains several attributes that defined with ranged value such as risk, business value, dependencies, size, and date needed. Similar with ezScrum product requirements and its attributes terms represented explicitly with story item that has the attributes with ranged value like a status, important, value and related tags that would categorize a story into the predefined category.

From above boundary we extracted several scenarios which involving the project, tags system, and story.Further we would analyze these scenario to confirm that we solve this boundary effectively.

2.2.2 Product backlog scenarios

Based on above analysis we extracted several product backlog related scenariosby running these scenarios in legacy ezScrum and track every class that apperars in callstack and express this scenario into call sequence using this phases intended to confirm that we solved the analysis effectively this phase would also help for structuring the microservice design and channeling for implementation as a reference.

Table 1. ezScrum layer description

Ezscrum presentation layer	In ezscrum, this layer is responsible for handling the user request that comes from a browser and returns the response whenever the related task is done. The classes that responsible for handling this task are grouped together in the package action.
Ezscrum application layer	In ezscrum, this layer which consisted with helper packages that are responsible for mediating a task comes from the action class for package naming, although the member classes are named with a related specific business process for example "productbackloghelper" this package is not involved with any business situation, only for delegating the task to the package in domain layer and tracks the progress of the currently running process to notify the package in an upper layer.
Ezscrum domain layer	In ezscrum this layer is consisted with the package that manages the business definition, for an instance the storyobject class member of the package object contains with variables that reflecting the states and attributes of the user story.
Ezscrum persistence layer	When the specific task that demands for storing data to persistence storage the domain layer invokes the mapper that maps the java storing procedure using the dao object to specific sql query which would be processed by underlying database system.

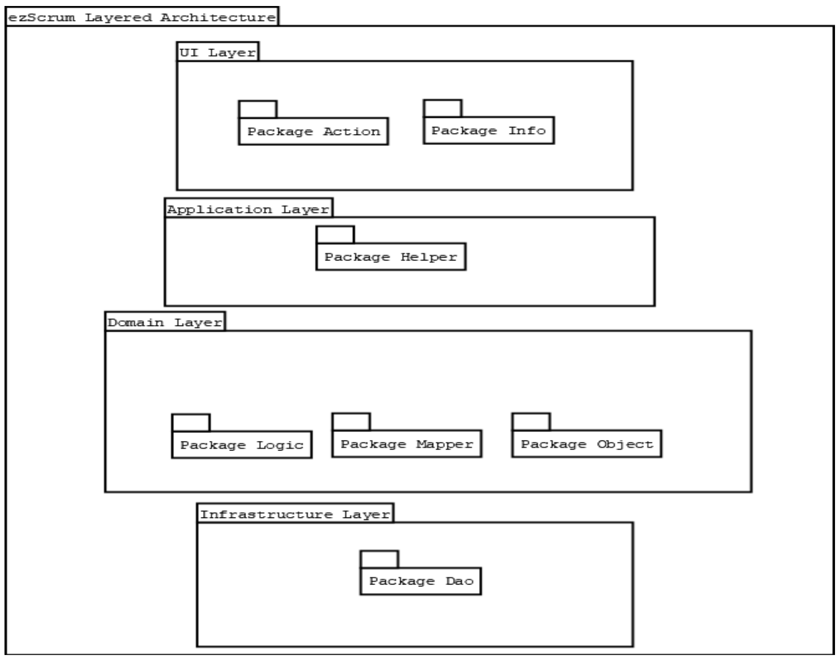
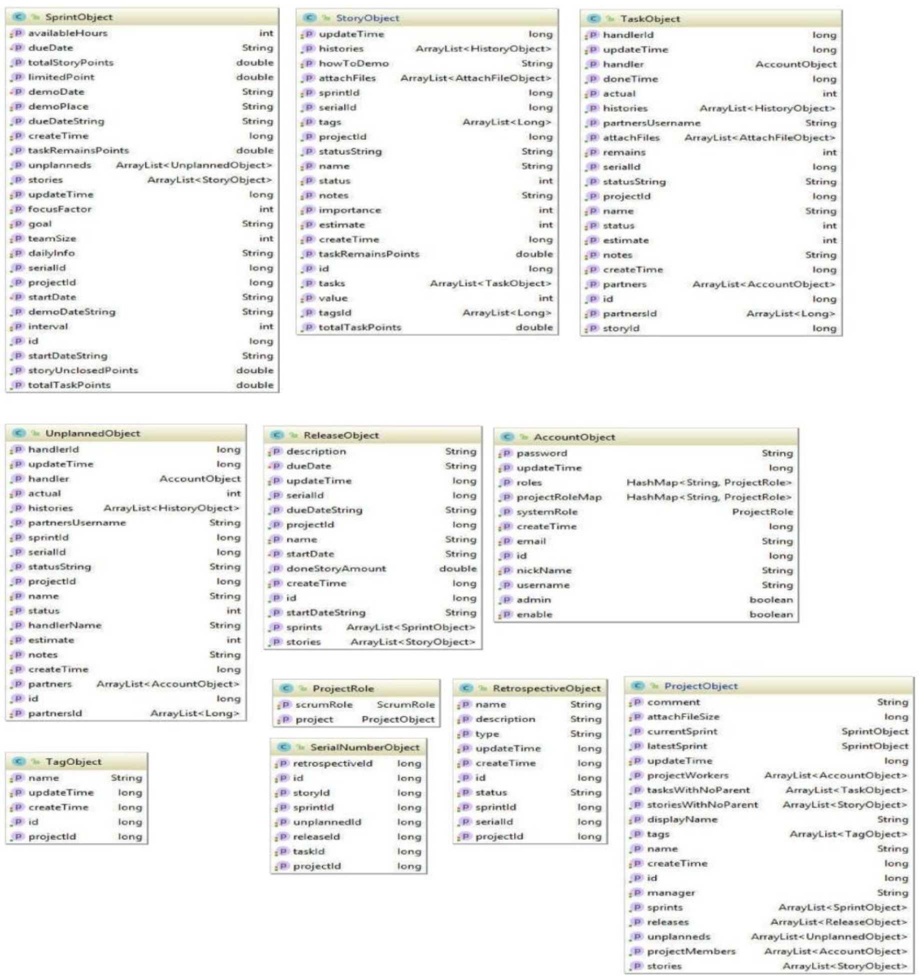


Fig. 1d. ezScrum layered architecture



SprintObject	
availableHours	int
dueDate	String
totalStoryPoints	double
limitedPoint	double
demoDate	String
demoPlace	String
dueDateString	String
createTime	long
taskRemainsPoints	double
unplanneds	ArrayList<UnplannedObject>
stories	ArrayList<StoryObject>
updateTime	long
focusFactor	int
goal	String
teamSize	int
dailyInfo	String
serialId	long
projectId	long
startDate	String
demoDateString	String
interval	int
id	long
startDateString	String
storyUnclosedPoints	double
totalTaskPoints	double

StoryObject	
updateTime	long
histories	ArrayList<HistoryObject>
howToDemo	String
attachFiles	ArrayList<AttachFileObject>
sprintId	long
serialId	long
tags	ArrayList<Long>
projectId	long
statusString	String
name	String
status	int
notes	String
importance	int
estimate	int
createTime	long
taskRemainsPoints	double
id	long
tasks	ArrayList<TaskObject>
value	int
tagsId	ArrayList<Long>
totalTaskPoints	double

TaskObject	
handlerId	long
updateTime	long
handler	AccountObject
doneTime	long
actual	int
histories	ArrayList<HistoryObject>
partnersUsername	String
attachFiles	ArrayList<AttachFileObject>
remains	int
serialId	long
statusString	String
projectId	long
name	String
status	int
estimate	int
notes	String
createTime	long
partners	ArrayList<AccountObject>
id	long
partnersId	ArrayList<Long>
storyId	long

UnplannedObject	
handlerId	long
updateTime	long
handler	AccountObject
actual	int
histories	ArrayList<HistoryObject>
partnersUsername	String
sprintId	long
serialId	long
statusString	String
projectId	long
name	String
status	int
handlerName	String
estimate	int
notes	String
createTime	long
partners	ArrayList<AccountObject>
id	long
partnersId	ArrayList<Long>

ReleaseObject	
description	String
dueDate	String
updateTime	long
serialId	long
dueDateString	String
projectId	long
name	String
startDate	String
doneStoryAmount	double
createTime	long
id	long
startDateString	String
sprints	ArrayList<SprintObject>
stories	ArrayList<StoryObject>

AccountObject	
password	String
updateTime	long
roles	HashMap<String, ProjectRole>
projectRoleMap	HashMap<String, ProjectRole>
systemRole	ProjectRole
createTime	long
email	String
id	long
nickName	String
username	String
admin	boolean
enable	boolean

ProjectRole	
scrumRole	ScrumRole
project	ProjectObject

RetrospectiveObject	
name	String
description	String
type	String
updateTime	long
createTime	long
id	long
status	String
sprintId	long
serialId	long
projectId	long

ProjectObject	
comment	String
attachFileSize	long
currentSprint	SprintObject
latestSprint	SprintObject
updateTime	long
projectWorkers	ArrayList<AccountObject>
tasksWithNoParent	ArrayList<TaskObject>
storiesWithNoParent	ArrayList<StoryObject>
displayName	String
tags	ArrayList<TagObject>
name	String
createTime	long
id	long
manager	String
sprints	ArrayList<SprintObject>
releases	ArrayList<ReleaseObject>
unplanneds	ArrayList<UnplannedObject>
projectMembers	ArrayList<AccountObject>
stories	ArrayList<StoryObject>

TagObject	
name	String
updateTime	long
createTime	long
id	long
projectId	long

SerialNumberObject	
retrospectiveId	long
id	long
storyId	long
sprintId	long
unplannedId	long
releaseId	long
taskId	long
projectId	long

Fig. 1e. ezScrum object entities

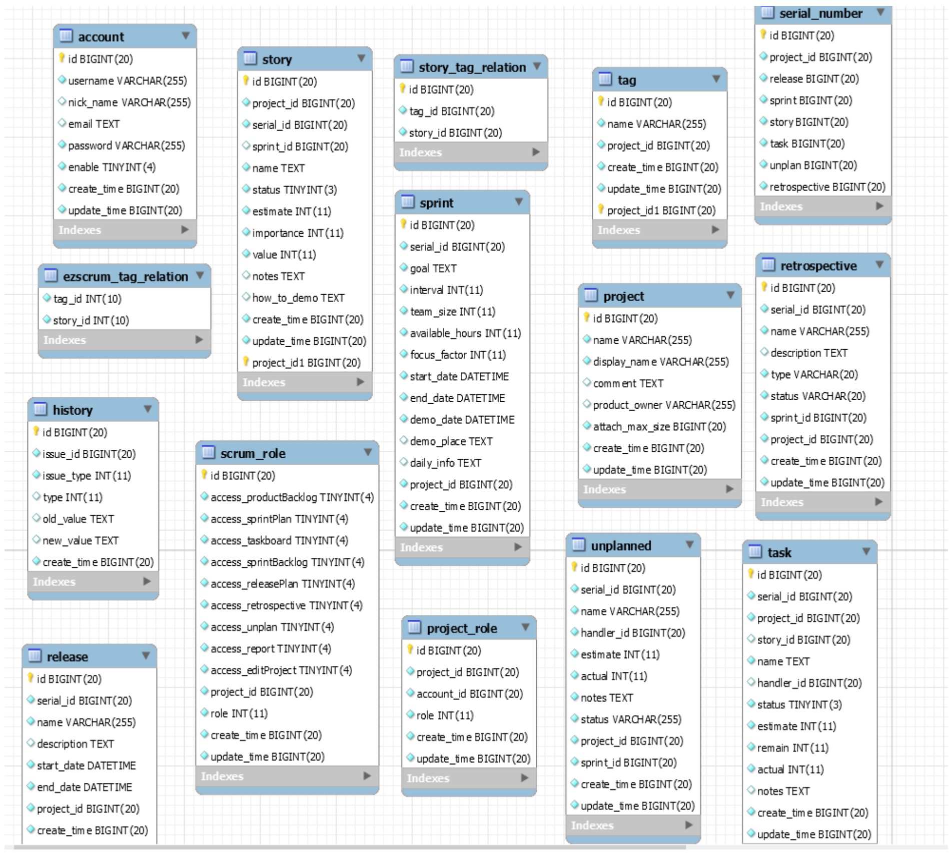


Fig. 1f. ezScrum database entities

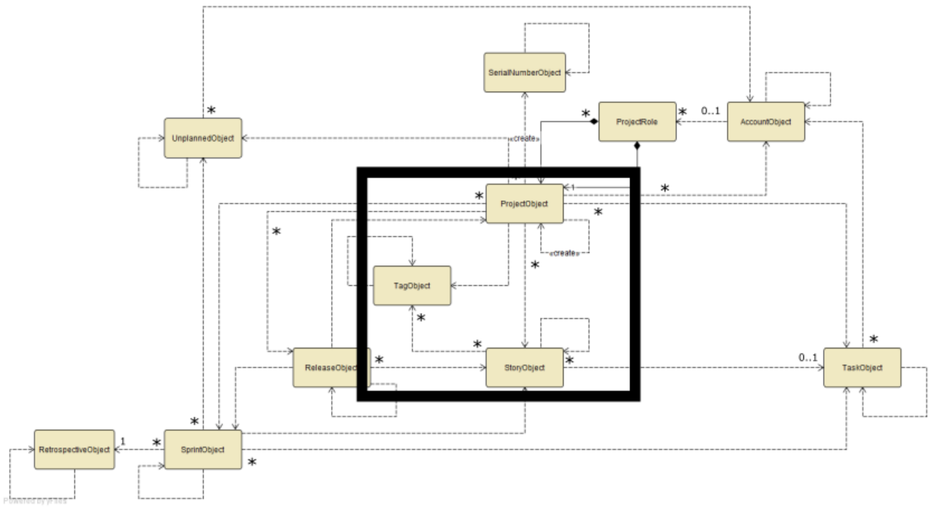


Fig. 1g. Product Backlog context boundary

Table 2. Product backlog sub-domain list

Subdomain	Description	In ezScrum
Product requirements	The items that has to be done.	Story
Category	A predefined categories that allow the PO to categorize the story.	Tagging system
Project	Aplanned work that need to be finished in the range of time.	Project

2.2.2.1 Scenario 1: The story and project scenario

Whenever the request comes from the user, the process would first pass through the action class Ajax Addnew Story Action which stand in the user interface layer, the raw requested parameters that contain the Story Info are mapped into the Story Object in the domain layer data. Product Backlog Helper in the application layer that responsible for tracking the progress status.

The specific work here occurs in Product Backlog Logic which responsible for maintaining the new story creation state and initializes the Product Backlog Mapper for mapping the Story Object to StoryDao for storing the data in the underlying database. Noticed that the id of Project Object is needed for basic parameter to instantiate Story Object, the relationship detail would be covered later.

The state diagram above exhibits the state of ezScrum and story creation process, state starting from the request that comes until appending the response back. From above analysis we noticed that StoryObject and ProjectObject are classes that residing in domain layer.

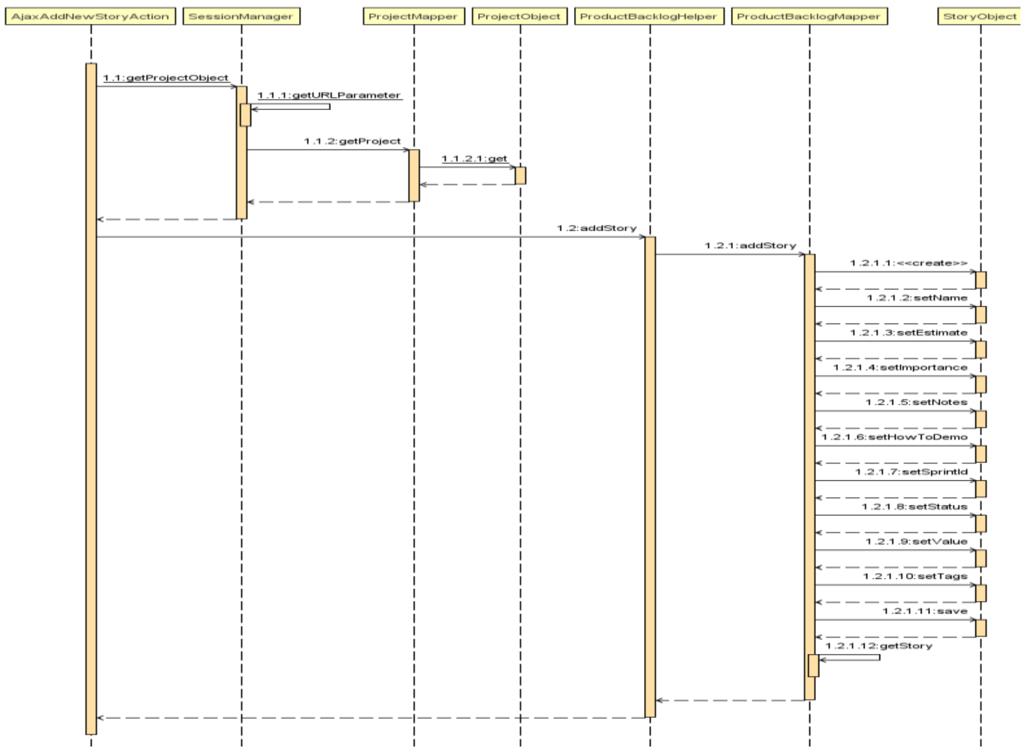
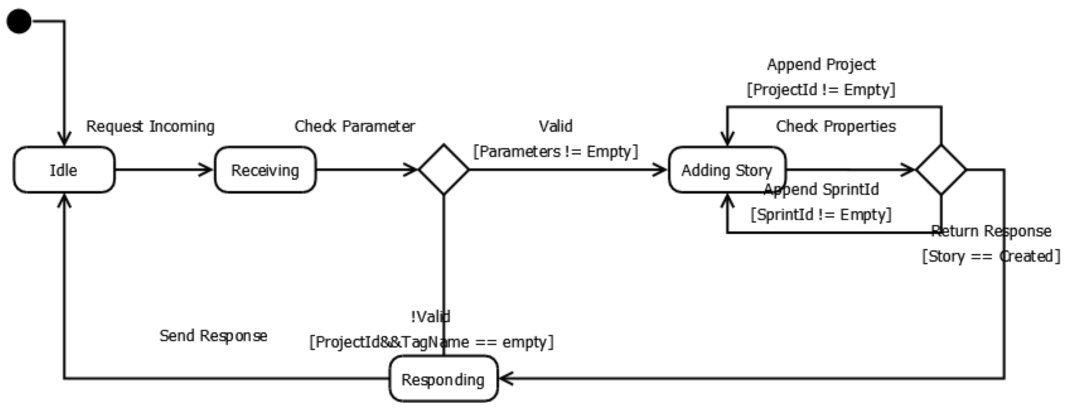


Fig. 1h. Sequence diagram for story creation scenario



Flow Chart 1. The state of ezScrum and story creation process

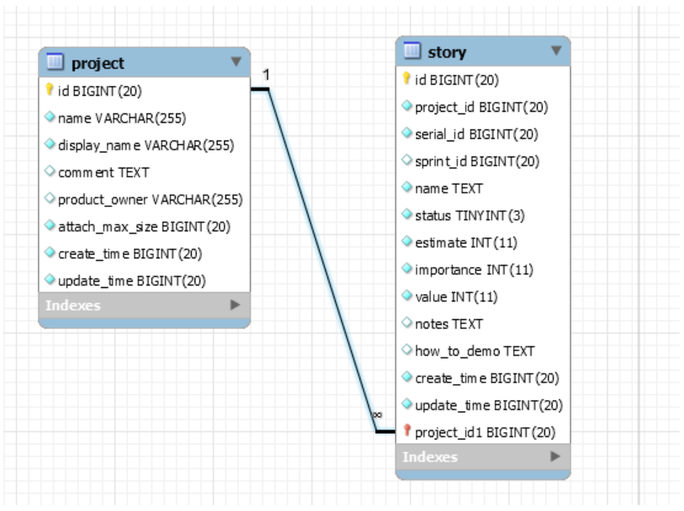


Fig. 1i. Project and story relationship

Fig. 1i describing the relationship between project and story which has one-to-many cardinality type. This type states that one project can contains with many story and many story can only belongs to one project and based on above analysis we extract these requirements as noted in the Table 3.

2.2.2.2 Scenario 2: The tag scenario

Fig. 2a describes the process for tag creation in legacy ezScrum, the request that forwarded to AjaxAddNewTagAction class, before the creation process, the system ensures that only one tag data with the similar name that exist in the current running project.

With the ProductBacklogHelper class delegates the checking task to ProductBacklogMapper class for looking up the database entry,if the new tag does not exist, the system can leap to creation process by delegating the process to TagDao class for storing it with defined SQL-query.

The state diagram above exhibits the state of ezScrum and for tag creation process state, the request must come with valid parameters that contains the tag data which would be stored in database if the tag does not exist and return the status back.

From the tag sequence diagram we noticed a sentence for ensuring that only one tag with similar tag_name exists in current running project, this sentence expressing the relationship between tag and project which one tag can only belongs to one project, whereas one project can have many tags as expressed in the following image.

From the tag creation scenario analysis, it demands two object that should be involved in from domain layer Tag Object and Project Object and extracts two following requirements in Table 4.

Table 3. Project based analysis

R1	As a developer I want to develop api that serve for story creation, so that the client can store the story data in the microservice.
R2	As a developer I want to develop api for project creation, so that the project data can be appended in my new story data.
R3	As a developer I want to develop api for updating and removing the story, so that client can alter their story data.
R4	As a developer I want to develop api for modifying the project attributes, so that client can alter their project data.
R5	As a developer I want to develop api for retrieving a list of story based on parent project, so that the client can manage the detailed story in current running project

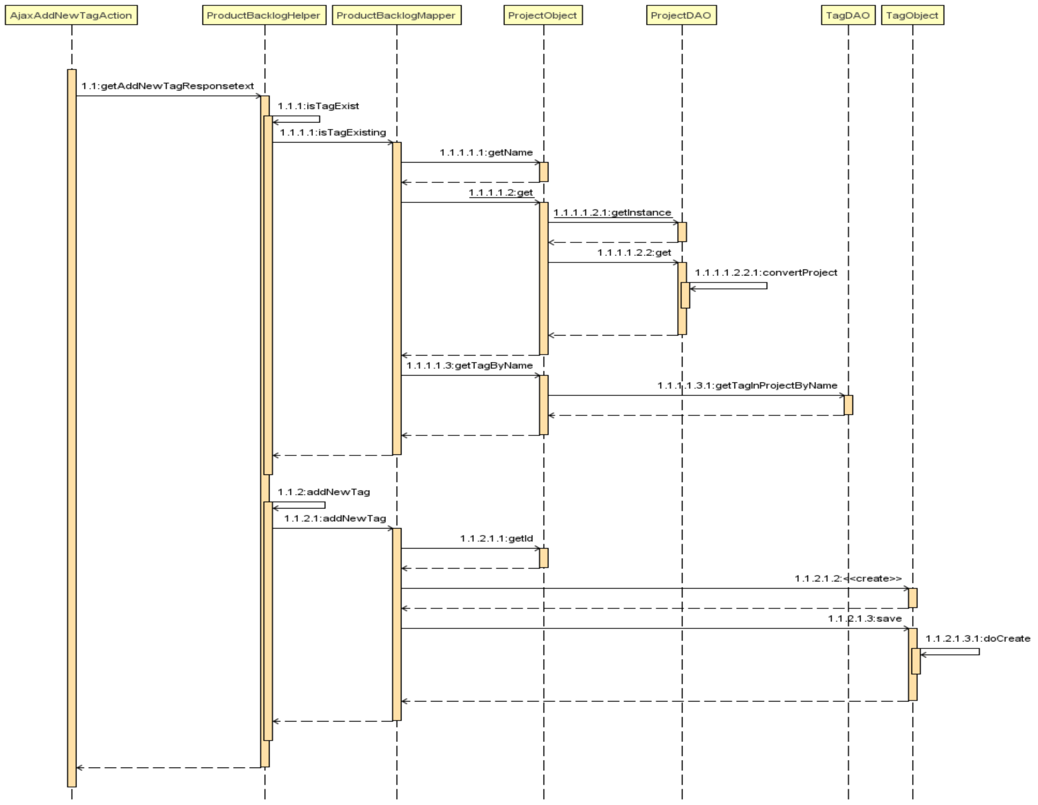


Fig. 2a. The process for tag creation in legacy ezScrum

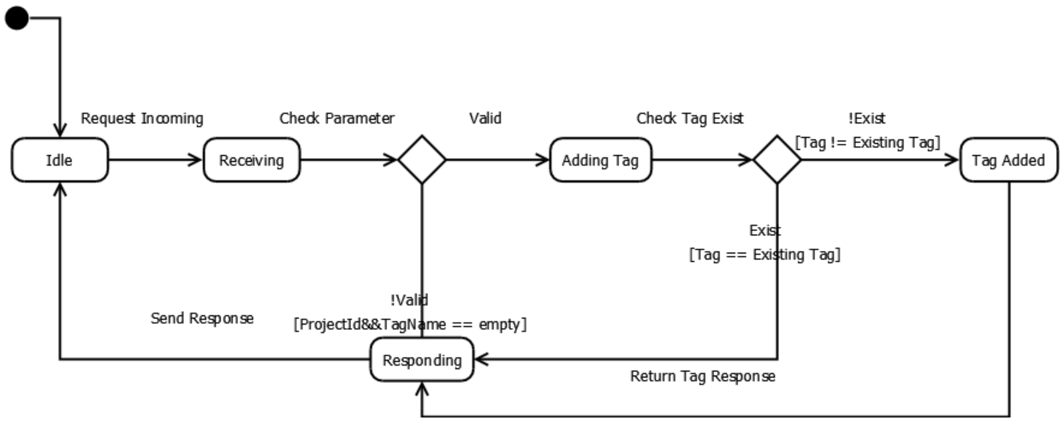


Fig. 2b. State of ezScrum and for tag creation process

2.2.2.3 Scenario 3: Story and tag relationship

The valid requests for attaching story to tag job are fistly forwarded through Ajax Add Story Tag Action class, the ProductBacklogHelper class then delegating the job to the ProductBacklogMapper for retrieving the story and tag data from database and attach these two data by creating the new record in pivot table in mysql database.

In ezScrum story and tag can be attached together by storing the story_id value and tag_id value in story_tag_relation table, this table acts as a pivot table for mediating the many-to-many relationship between tag and story which has the bidirectional relationship type, states that either story or tag can be the aggregate point for retrieving the relationship between the story and tag job which would be detailed in the requirement list in this section.

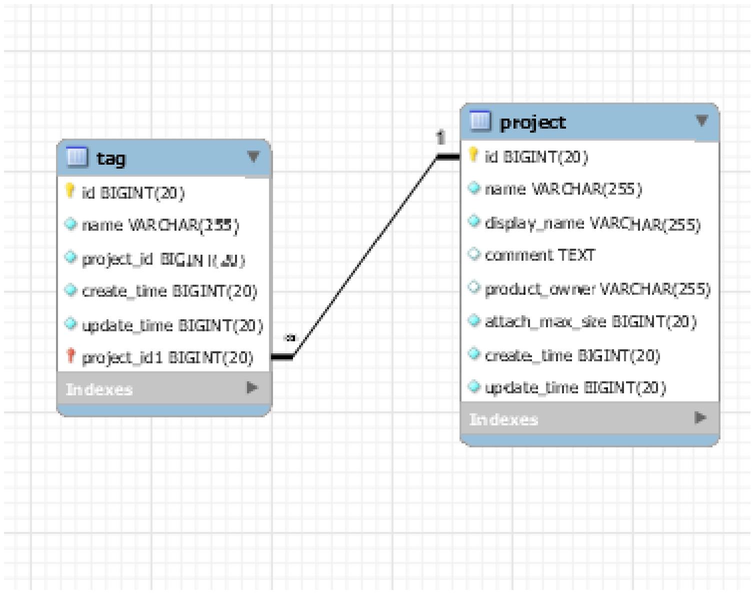


Fig. 3. Project tags

Table 4. Domain layer tag object

R1	As a developer I want to developapi tag for a tag creation, so that the client can manage their story with defined tag.
R2	As a developer I want to develop api for tag checking, so that the client can ensure only one tag exist in current running project.
R3	As a developer I want to develop api for updating and removing the tag, so that client can alter their tag.

Table 5. From above analysis we extracted the requirements as following

R1	As a developer I want to develop api for attaching defined tags to story, so that the client can organize the user story based on tag
R2	As a developer I want to develop api for removing attached tags from story, so that the client can change it whenever incorrect tagging.
R3	As a developer I want to develop api retrieving a list of story based on certain tag, so that the client can organize the story with tag

2.3 Put All Pieces Together

As we have mentioned before that we have analyzed the splitting monolith application through a gradual process which has produced pieces of separate requirements and entity description based on the sub-domain. In this phase, we aim to bring all these pieces into one completed requirements list and compose all the extracted database entity into one relationship details as expressed in the following Fig. 6.

2.4 Product Backlog Microservice

Our product backlog microservice basically a small instance of service that should serve functionality which we have defined before in splitting works, however in the implementation phase microservice should also have a clear data exchange format, and communication channel, which will be consumed regardless of underlying technology is being applied by the client. Which we would discuss in this chapter including the architecture, communication mechanism, and microservice framework.

2.4.1 The architecture

Fig. 7 describes the purposed architecture of our microservice. We split the purposed architecture into three tiers, the first tier is called user interface tier and the second tier is a legacy ezScrum which mainly communicate via web browser client through HTTP protocol, but in our project we did not touch the first tier since there are residing legacy services which are still not decomposed yet and need to be orchestrated by the legacy ezScrum in order to work, such as Sprint Backlog service, Taskboard service, and et cetera. Ideally when all these services have been established the API gateway will take over the orchestration job so that the client in the first tier would leap to the third tier without needing to communicate to legacy ezScrum anymore.

In the third tier, the legacy ezScrum would communicate with Product Backlog Microservice using the API endpoints that are publicly published. This endpoint and detail will be discussed later.

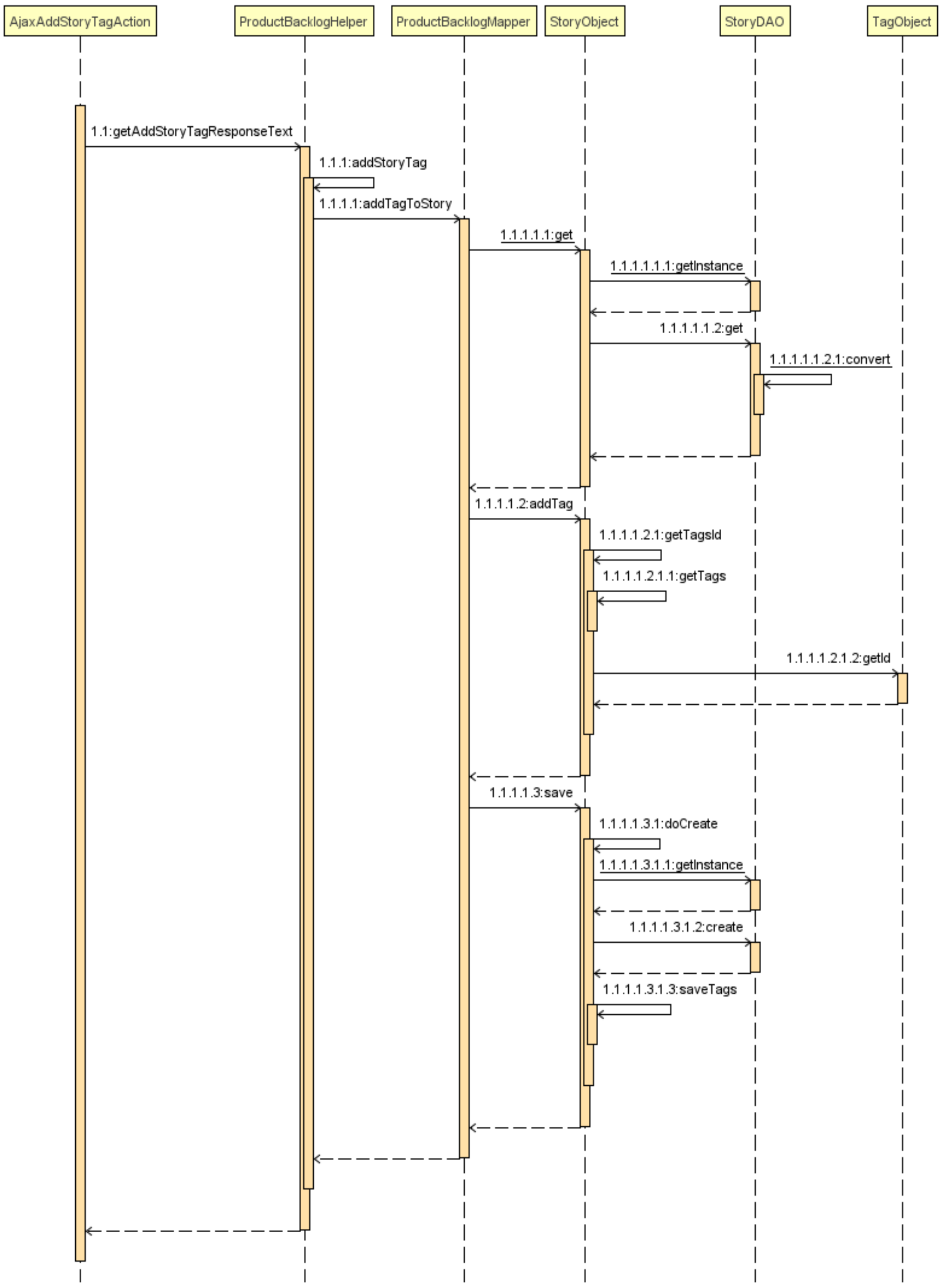


Fig. 4. Story and tag relationship

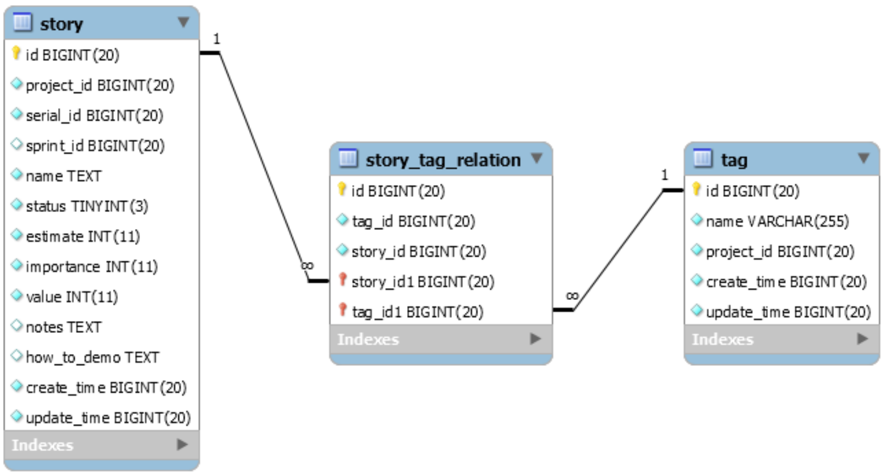


Fig. 5. Story and tag data from database

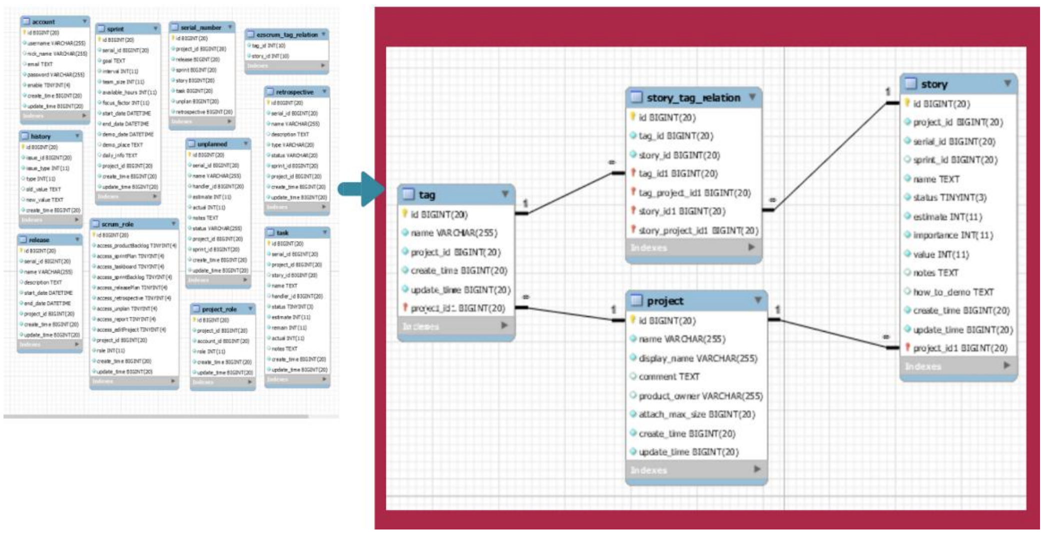


Fig. 6. Extracted database entity into one relationship details

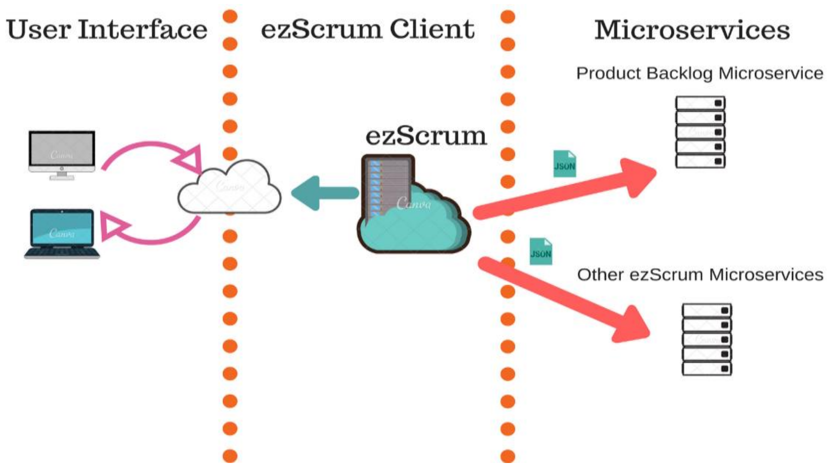


Fig. 7. Architecture of our microservice

Table 6. Sub-domain

R1	As a developer I want to develop api that serve for story creation, so that the client can store the story data in the microservice.
R2	As a developer I want to develop api for project creation, so that the project data can be appended in my new story data.
R3	As a developer I want to develop api for updating and removing the story, so that client can alter their story data.
R4	As a developer I want to develop api for modifying the project attributes, so that client can alter their project data.
R5	As a developer I want to develop api tag for a tag creation, so that the client can manage their story with defined tag.
R6	As a developer I want to develop api for tag checking, so that the client can ensure only one tag exist in current running project.
R7	As a developer I want to develop api for updating and removing the tag, so that client can alter their tag.
R8	As a developer I want to develop api for attaching defined tags to story, so that the client can organize the user story based on tag
R9	As a developer I want to develop api for removing attached tags from story, so that the client can change it whenever incorrect tagging.
R10	As a developer I want to develop api retrieving a list of story based on certain tag, so that the client can organize the story with tag
R11	As a developer I want to develop api for retrieving a list of story based on parent project, so that the client can manage the detailed story in current running project

2.4.2 Connect with product backlog microservice

When our product backlog microservice has been deployed properly, we need to expose the service to the client with common communication mechanism. Restful API with HTTP protocol is chosen to expose our microservice mainly because this concept encourages the developer to address the resource inside the service using the URL pattern which has been used widely over the world for exposing the resource. Our microservice resource would have an endpoint interface using the URL pattern as follows:

http://host:port/product_backlog/{resource_name_path}/{identifier}/{child_resource}

Since we are implementing the HTTP protocol the URL pattern would be started with http:// term follows by our microservice hostname and port. The product_backlog path is representing the context of our microservice followed by resource_name path in our service it could be a story, tag, project with identifier path that is required when the client need specific single resource and child_resource path for retrieving the related resource that belongs to the parent.

2.4.3 Microservice framework

Spring boot is chosen as a microservice framework in implementation part, since it provides a production ready code with minimum configuration thus make the application up and running as fast as possible, spring also comes with embedded application server (Tomcat by default) so we don’t need to build and deploy our application into WAR file. These two advantages align with our project goal, since we need to deliver our application for every sprint or iteration.

3. PRODUCT BACKLOG MICROSERVICE

So far we have extracted the ezScrum parts that related to product backlog context, started from isolating the layer contains the business domain, analyzing the database schema that which belonged to product backlog and capturing the product backlog business requirements. Further, we would develop the product backlog microservice by using the spring boot framework as an environment and properly up and running the microservice to ensure the extraction will not affect the operation of legacy ezScrum.

3.1 Product Backlog DB Entity Details

3.1.1 Entity relationship diagram

From the product backlog sub-domain analysis phase we have extracted the following entities in our development database, noted that some of the field are required by spring framework and not related to the product backlog context, which will be explained later in field description part.

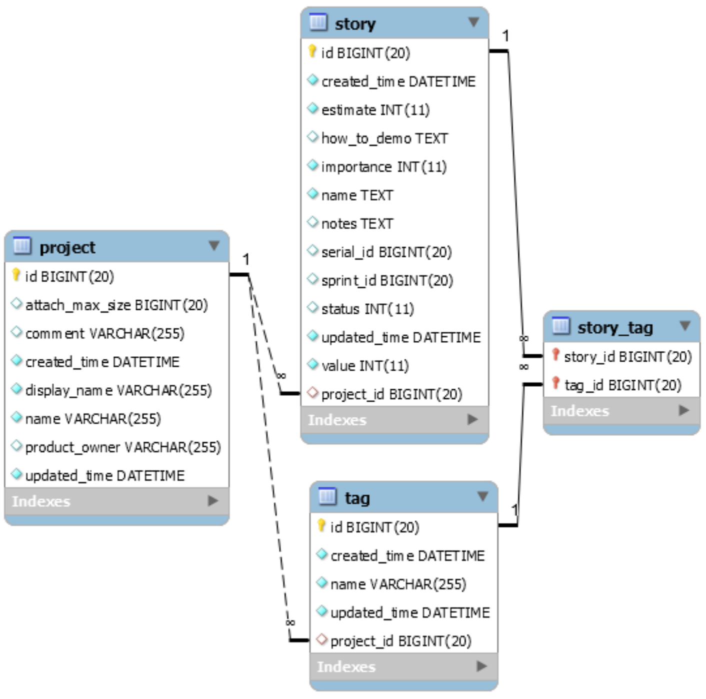


Fig. 8. Entity relationship diagram of product backlog microservice table

We have noticed between from Fig. 8 each entity is circularly connected, states that each entity could be an aggregate point for retrieving the entity which belongs to it. In our case for an instance we could retrieve the list of story or list of tag by picking up one single project and traverse the relationship to point out the story or tag that belongs to it; thus the relation between project and story or project and tag would be a one-to-many with condition that each project has 0 or more story and tag. Or we could also say each story and tag should only exist in one single project.

From the scenario analysis part, state that we could attach the story to tag or attach the tag to the story. Hence the relation between these entities would be many-to-many which states one tag could have zero or more story and one story could have zero or more tag. Because of the complexity of the relationship, we could not connect these two tables directly; thus we need the story_tag table as a pivot table that stores the relationship between them.

3.1.2 Entity field descriptions

Entity field descriptions presented in Table 7.

3.2 Product Backlog API Contracts

Our API endpoint pattern would be like the following with the orange colored text path represent the context prefix and black colored text path represent the resource:

http://host:port/product_backlog/{resource_name_path}/{identifier}/{child_resource}

From the product backlog requirements, we have developed a list of API endpoint contracts with the pattern like as Table 11.

3.3 Class Diagram

The product backlog microservice has three controllers which contain all the microservice API endpoints that we have explained in chapter 9. The classes are the slim class with responsibility for handling the incoming HTTP request, and the request further delegated to service package.

The service package has three class packages which are responsible for maintaining the state of the request progress and delegates more complicated job, business rules and computation in the logic layer which for now only has one class.

The Repositories is Java Persistence API the class implementing the repository enterprise architecture, and this implementation is needed for mediating the access between the domain and data mapping layer in spring boot technology [7].

Table 7. Project table field descriptions

Field name	Data type	Description
Id	BIGINT	The unique identified for project, maximum 20 character
Comment	VARCHAR	Additional details for the project, maximum 255 character, can be null
Display_name	VARCHAR	The displayed project name in client, maximum 255, not null
Name	VARCHAR	The project name, maximum 255 character and not null
Product_owner	VARCHAR	The product owner name, maximum 255 character, not null
Attach_max_size	BIGINT	A configurable maximum size of the attached file in MB, default 2
Created_time	DATETIME	Storing the date and time for the row creation in datetime format
Updated_time	DATETIME	Storing the date and time for the last update row, in datetime format

Table 8. Story table field descriptions

Field name	Data type	Description
Id	BIGINT	The unique identified for story, maximum 20 character
Notes	TEXT	Additional details for the story
Status	INTEGER	Story status, new : 1, assigned : 2, closed : 3
Name	VARCHAR	The story name, maximum 255 character and not null
Importance	INTEGER	Importance level for the story, maximum 11 character, required
Value	INTEGER	A value level for the story, maximum 11 character, required
Estimate	INTEGER	An estimation value for the story, maximum 11 character, required
How_to_demo	TEXT	Demo description
Project_id	INTEGER	Reference to the project table, not null
Serial_id	INTEGER	Reference to the serial, not null
Sprint_id	INTEGER	Reference to the sprint id
Created_time	DATETIME	Storing the date and time for the row creation in datetime format
Updated_time	DATETIME	Storing the date and time for the last update row, in datetime format

Table 9. Tag table field descriptions

Field name	Data type	Description
Id	BIGINT	The unique identified for tag, maximum 20 character
Name	VARCHAR	The tag name, maximum 255 character and not null
Project_id	BIGINT	A reference value to the project
Created_time	DATETIME	Storing the date and time for the row creation in datetime format
Updated_time	DATETIME	Storing the date and time for the last update row, in datetime format

Table 10. Story tag pivot table, field descriptions

Field name	Data type	Description
Story_id	BIGINT	A reference value for the story
Tag_id	BIGINT	A reference value for the tag

Table 11. Product backlog API endpoint list

Resource	Method	Description
/project/projects	GET	Retrieving all the project in microservice.
/project/get/{id}	GET	Retrieving single project data with appended id {id}.
/project/get_by_name/{name}	GET	Retrieving single project data with appended project name {name}.
/project/check_by_name/{name}	GET	Provides the Boolean data for checking the project existence.
/project/create	POST	Create single project with appended project data in request body.
/project/update/{id}	PUT	Update the project with id {id} and appended project data in request body.
/project/delete/{id}	DELETE	Remove single project data with id {id}.
/project/{id}/stories/{filterType}	GET	Retrieving the stories that belongs to project id {id} with optional filter type {filter type} ALL, BACKLOG, DONE, DETAIL.
/project/{id}/tags	GET	Retrieving the tags that belongs to project with id {id} .
/story/stories/{filterType}	GET	Retrieving the stories with optional filter type {filter type} ALL, BACKLOG, DONE, DETAIL.
/story/get/{id}	GET	Retrieving single story data with appended id {id}.
/story/get_by_project_serial/{project_id}/{serial_id}	GET	Retrieving single story data with appended project id {project_id} and serial id {serial_id}.
/story/{id}/project	GET	Retrieving project that belongs to story with id {id}
/story/{id}/tags	GET	Retrieving tags that attached to story with id {id}
/story/{id}/attach_tag/{tag_id}	GET	Attach story with id {id} to the tag with id {tag_id}
/story/{id}/un_attach_tag/{tag_id}	GET	Unattached story with id {id} to the tag with id {tag_id}
/story/create	POST	Create single project with appended story data in request body.
/story/update/{id}	PUT	Update the story with id {id} and appended story data in request body.
/story/delete/{id}	DELETE	Remove single story data with id {id}.
/tag/create	POST	Create single tag with the appended tag data in request body
/tag/update/{id}	PUT	Update single tag data with id {id} and appended tag data in request body.
/tag/delete/{id}	DELETE	Delete single tag data with id {id}
/tag/{id}/project	GET	Retrieving project data that has the tag id {id}
/tag/{id}/stories	GET	Retrieving the stories data that has the tag id {id}

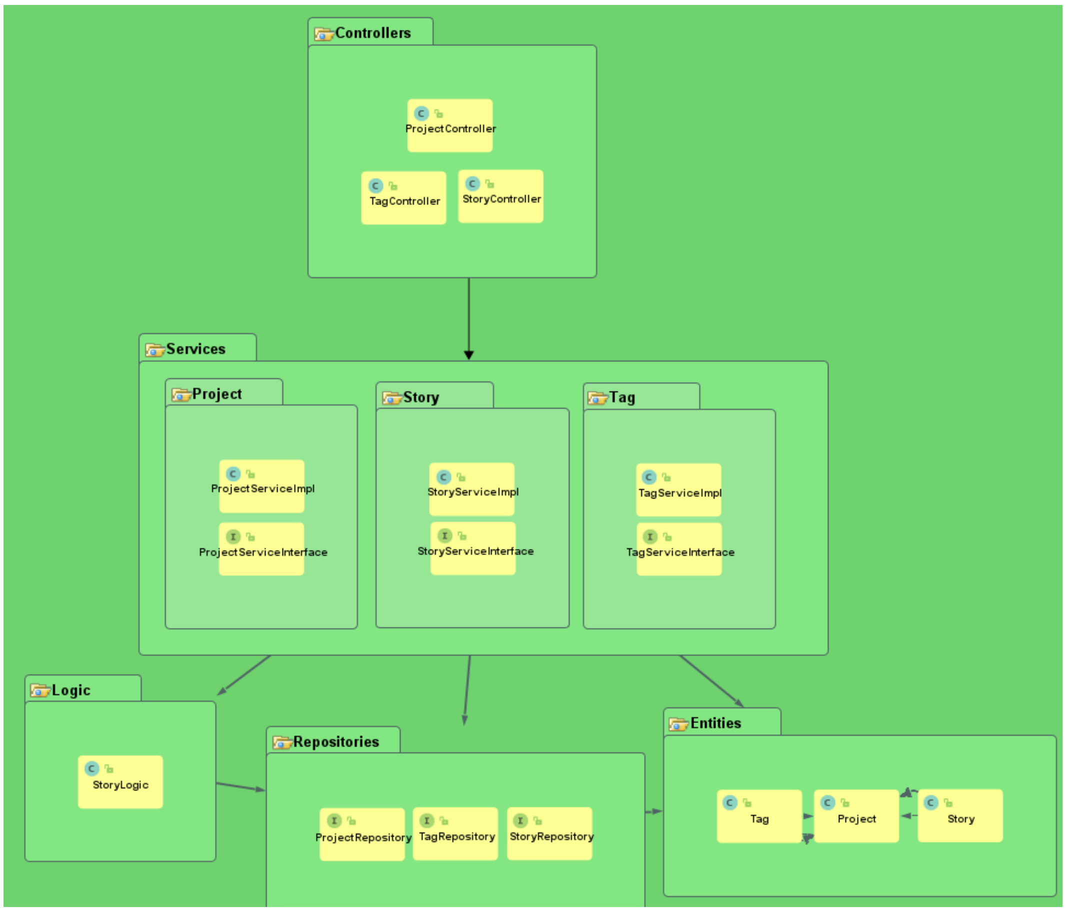


Fig. 9. Class diagram of the product backlog microservice

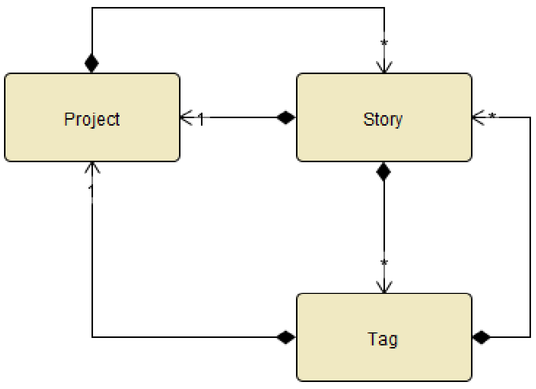
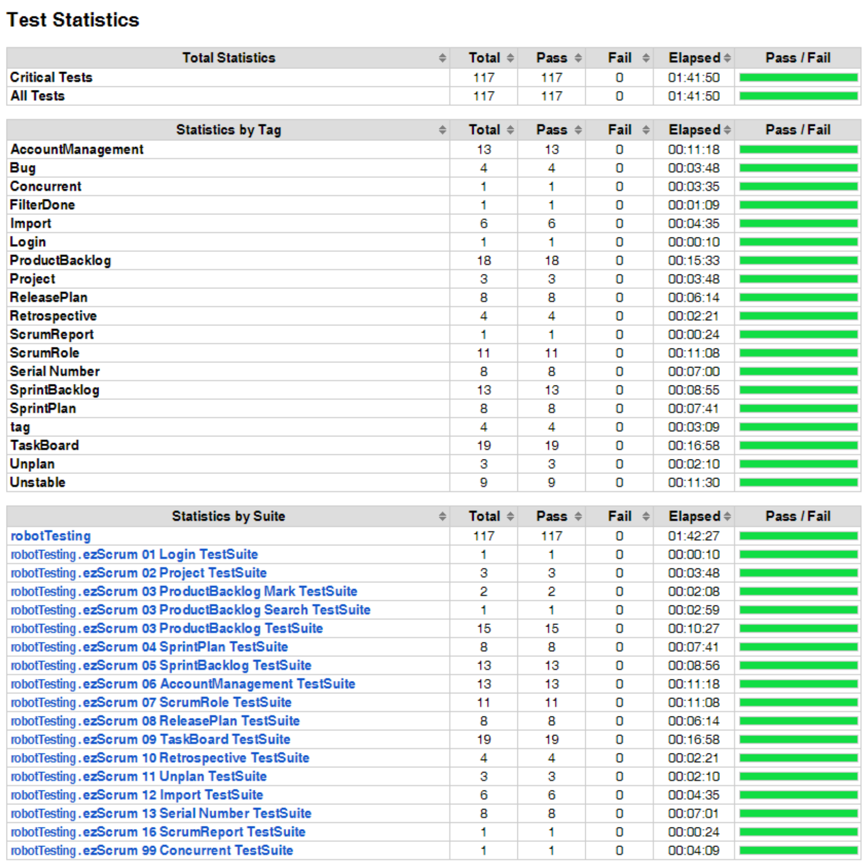


Fig. 10. Product backlog microservice entity relationship diagram

3.4 The Integration

We have picked up several AT test case scenario which related to the product backlog requirements with additional test case scenario that might potential having a share data with product backlog context. This phase intended to ensure our product backlog microservice has been appropriately implemented in the legacy ezScrum and covered all the requirements that are needed by the client to run the application without any defecting the existing functionality of our legacy ezScrum.


Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	117	117	0	01:41:50	🟩
All Tests	117	117	0	01:41:50	🟩

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
AccountManagement	13	13	0	00:11:18	🟩
Bug	4	4	0	00:03:48	🟩
Concurrent	1	1	0	00:03:35	🟩
FilterDone	1	1	0	00:01:09	🟩
Import	6	6	0	00:04:35	🟩
Login	1	1	0	00:00:10	🟩
ProductBacklog	18	18	0	00:15:33	🟩
Project	3	3	0	00:03:48	🟩
ReleasePlan	8	8	0	00:06:14	🟩
Retrospective	4	4	0	00:02:21	🟩
ScrumReport	1	1	0	00:00:24	🟩
ScrumRole	11	11	0	00:11:08	🟩
Serial Number	8	8	0	00:07:00	🟩
SprintBacklog	13	13	0	00:08:55	🟩
SprintPlan	8	8	0	00:07:41	🟩
tag	4	4	0	00:03:09	🟩
TaskBoard	19	19	0	00:16:58	🟩
Unplan	3	3	0	00:02:10	🟩
Unstable	9	9	0	00:11:30	🟩

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
robotTesting	117	117	0	01:42:27	🟩
robotTesting.ezScrum 01 Login TestSuite	1	1	0	00:00:10	🟩
robotTesting.ezScrum 02 Project TestSuite	3	3	0	00:03:48	🟩
robotTesting.ezScrum 03 ProductBacklog Mark TestSuite	2	2	0	00:02:08	🟩
robotTesting.ezScrum 03 ProductBacklog Search TestSuite	1	1	0	00:02:59	🟩
robotTesting.ezScrum 03 ProductBacklog TestSuite	15	15	0	00:10:27	🟩
robotTesting.ezScrum 04 SprintPlan TestSuite	8	8	0	00:07:41	🟩
robotTesting.ezScrum 05 SprintBacklog TestSuite	13	13	0	00:08:56	🟩
robotTesting.ezScrum 06 AccountManagement TestSuite	13	13	0	00:11:18	🟩
robotTesting.ezScrum 07 ScrumRole TestSuite	11	11	0	00:11:08	🟩
robotTesting.ezScrum 08 ReleasePlan TestSuite	8	8	0	00:06:14	🟩
robotTesting.ezScrum 09 TaskBoard TestSuite	19	19	0	00:16:58	🟩
robotTesting.ezScrum 10 Retrospective TestSuite	4	4	0	00:02:21	🟩
robotTesting.ezScrum 11 Unplan TestSuite	3	3	0	00:02:10	🟩
robotTesting.ezScrum 12 Import TestSuite	6	6	0	00:04:35	🟩
robotTesting.ezScrum 13 Serial Number TestSuite	8	8	0	00:07:01	🟩
robotTesting.ezScrum 16 ScrumReport TestSuite	1	1	0	00:00:24	🟩
robotTesting.ezScrum 99 Concurrent TestSuite	1	1	0	00:04:09	🟩

Fig. 11. Automatic testing result

4. CONCLUSION

As we have accomplished so far, we have reached our primary goal to split the product backlog context from ezScrum application, our work progress has extracted 11 requirements which we have converted into single product backlog microservice that serves with 24 API endpoints, in the splitting process we first came through for understanding our problem which is the context of our product backlog, we have identified the boundary of this context by using the general concept of product backlog because we did believe that each component or sub-domain is firmly connected and would share the data in frequent time within this context. This DDD concept was became our firm guidelines for splitting the product backlog related from ezScrum.

Then based on the sub-domains which we obtained above, we extracted several business scenarios which aligned within the product backlog context and pointed out the java class and database entities that representing the data model by running these scenarios in the legacy ezScrum. Then we generated the requirement list based on the scenarios and its specification based on the data model.

Further, we developed the product backlog micro service which serving 24 API endpoint that satisfied the requirement list. Although we have established a well prepared a product backlog micro service but still there are some aspect that we would seize this opportunity in the future such as: how we coordinate and arrange since we will have more micro service eventually, how do we ensure our micro service will keep serving whenever exception appears so that our micro service will not be a single point of failure, and the last but not least how our micro service will be more tenacious from external interference since our micro service directly facing the public and we need to have a mechanism to hide the actual implementation to filter out the malicious request is addressing to it.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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