



CS 415 - Software Product Line Engineering

TERM PROJECT

FINAL REPORT

Group Vitamin

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Available at: <http://sple2-vitaminmanagement.azurewebsites.net/Home>

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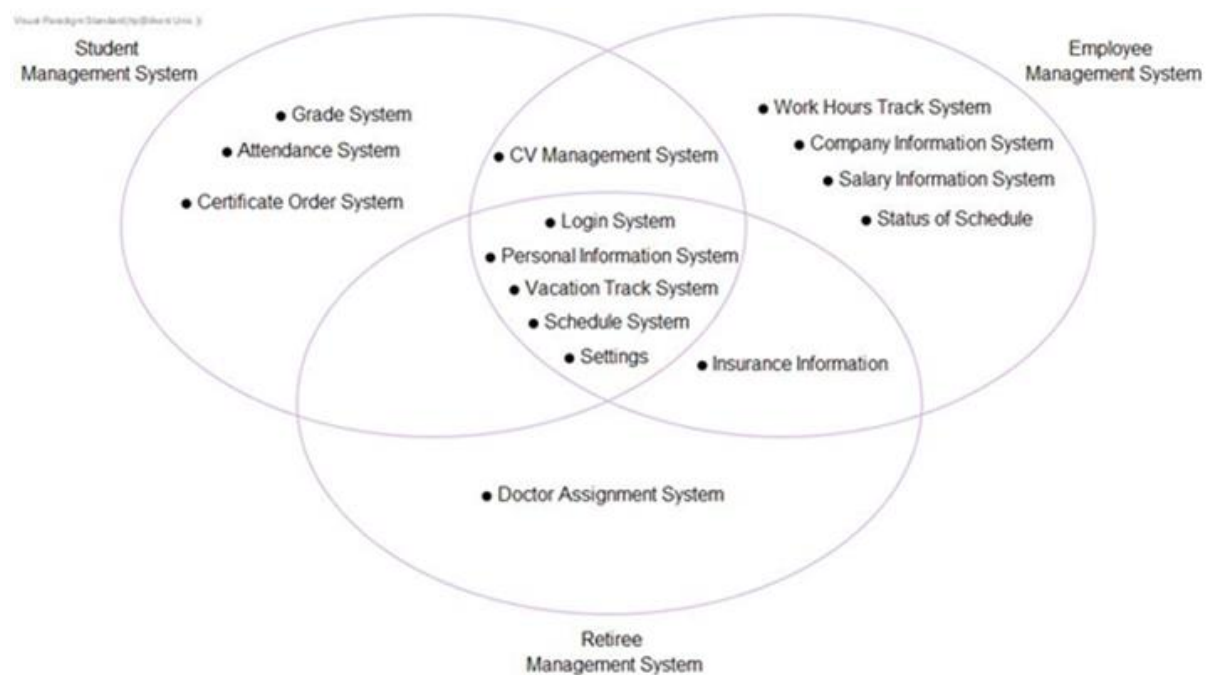
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1. DISCUSSION OF THE FIRST SPLE EFFORT

This section is dedicated to evaluate the team's first effort for a Software Product Line.

Both in phase-0 and phase-1 report, we stated that we are planning to design a general management system to collect users personal and domain related information. Tweaking the general system according to needs of different domains will create individual system variants. Said variants will result in a product line. Each application of this family aims to enhance the customer's (Schools, companies and the government) routine workflow. The planned system variants are the student management system, the employee management system and the retiree management system.

The proposed system's cluster representation is provided below:



However, it turns out that the proposed system did not have enough commonality. That is, in order to come up with an efficient software product line, 60% of features should be common; but in our case, we couldn't satisfy this condition. The below paragraphs will try to explain the situation better.

There are certain conditions for a successful product family and until these conditions are met, one would not be able to benefit from a product line. The first condition in order to benefit from SPL is a decent number of variants. There is no certain amount of required variants, the number of variants one needs to benefit from the SPL approach

depends on how and how much the products vary. In our case the team started out with tree variants.

The second condition is that these variants should have a high percent of commonality between them. This allows domain assets to cover a large portion of a product therefore decrease the amount of effort required to develop a single product. With three variants the required amount of commonality between products is calculated to be %60. As an example for a product with 10 modules, 6 of the modules should come from the domain assets which are shared among variants. Of course the example assumes that all of the modules require the same amount of effort.

The evaluation of our first SPL effort regarding the conditions explained above showed that a software product line realized with our initial set of common and variable features would not be beneficial. This was caused by our inability to meet the second condition of an efficient software product line. Having three variants seemed like we would have enough products to absorb the overhead of a SPL (this is because benefit in terms of effort is abstracted as $(\text{decrease in effort for a product}) * (\text{number of products}) - \text{SPL overhead}$, if this number is positive than one could say that there is some amount of benefit). The amount of common features we had in our initial analysis did not match the desired amount of common features required for an efficient SPL.

After the fault in our initial analysis was realized the focus of the team was to increase the amount of commonality. The team tried to come up with new features however that process was unsuccessful. The features we come up could not be considered as common features for all of our variants. This led us to analyze our already existing products. We saw that there was a considerable amount of commonality lost in our "Retiree Management System Variant". This variant was already considered to be the weakest link because its user base and use cases (purpose of the application) was irrelevant to our other variants. Such aspects of the "retiree" variant made it more expendable and the team decided to move on with other two variants. In this stage the product line needed to have more than %60 commonality since it needs to be beneficial with two variants. A simple "required effort analysis" was done in order to assess the features an amount of man hours required for their implementation. This analysis showed that our commonality was higher than the minimum %60 in terms of total effort required to implement all the common features.

After the irrelevant variant was dropped by the team, it was easier to increase commonality because now even though the user bases of the products were different, now their purpose was much more similar. A product line can still be very beneficial with two variants. The establishment of domain assets allows room for other new variants to be developed effectively while also reducing the development cost of each product. After dropping the “retiree management system” variant, we were able to add some features directly to our domain assets. These features were core for the “student” and “employee” variants but because of the irrelevant variant we were not able to put them in our domain assets (common features) therefore they were to be implemented at a later stage in the product lines lifecycle. Since now we have two strongly related variants such features were prioritized and therefore they were added to domain assets. These new features increased the level of commonality to a level where we can now have a beneficial software product line with our two variants.

The structure of the new system’s variants are visualized in the section below.

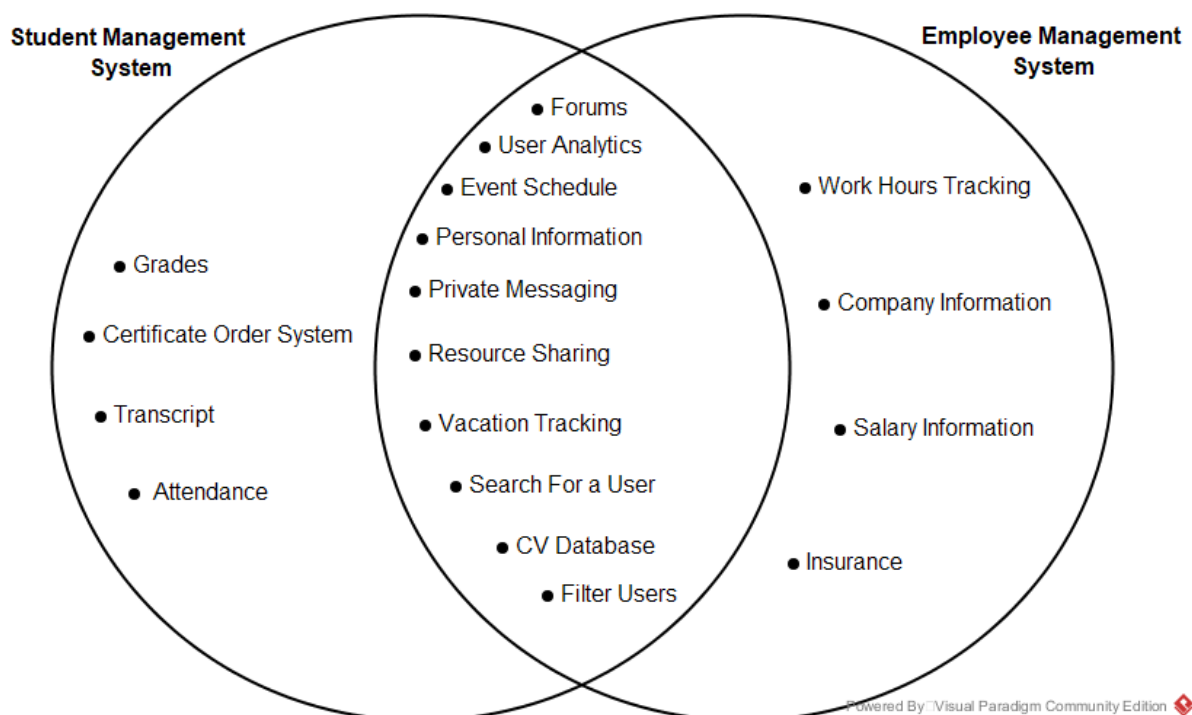


Figure 1: cluster representation of the system

2. KANO METHODOLOGY

2.1. Identifying Customer Requirements

We identified the customer requirements from our initial feature model. The set of customer requirements we are using is a reduced set of all the requirements. Our goal was to include the requirements that would concern the users of the management system product line most. In order to achieve we did not consider requirements that concern the login system, the database and application settings.

Here is the set of customer requirements chosen for the questionnaires:

<i>1-Forums</i>
<i>2-User Analytics</i>
<i>3-Event Scheduling</i>
<i>4-Personal Information</i>
<i>5-Private Messaging</i>
<i>6-Resource Sharing</i>
<i>7-Vacation Tracking</i>
<i>8-Search for a User</i>
<i>9-CV Database</i>
<i>10-Filter Users</i>
<i>11-Work Hours Tracking</i>
<i>12-Company Information</i>
<i>13-Salary Information</i>
<i>14-Insurance Information</i>
<i>15-Grades</i>
<i>16-Certificate Order System</i>
<i>17-Transcript</i>
<i>18-Attendance</i>

2.2. Constructing Questionnaire

The difference of this product line from the general lifecycle of others is that we did not start out with a big, unmanageable idea or evolved into a product line from a single successful product, we are using the Kano model in order to prioritize our selected set of requirements. Any observed patterns in the questionnaire are potential variation points. This questionnaire is performed on potential users of a management system. See Appendix for the questionnaire.

2.3. Analysis of the collected data

The results of the survey filled out by our target audience are below, the cells indicate the number of user answers that falls under a certain requirement category.

<i>Planned Features</i>	<i>Basic Requirements</i>	<i>Satisfiers</i>	<i>Delighters</i>	<i>Indifferent Requirements</i>	<i>Undesired Requirements</i>	<i>?</i>
1-Forums	2	1	3	1	0	0
2-User Analytics	0	1	2	4	0	0
3-Event Scheduling	3	4	0	0	0	0
4-Personal Information	3	1	1	2	0	0
5-Private Messaging	2	2	2	1	0	0
6-Resource Sharing	0	1	4	2	0	0
7-Vacation Tracking	0	4	0	3	0	0
8-Search for a User	3	3	0	1	0	0
9-CV Database	0	2	0	4	0	0
10-Filter Users	3	2	1	1	0	0
11-Work Hours Tracking	0	5	0	2	0	0
12-Company Information	0	4	2	1	0	0
13-Salary Information	0	3	1	2	1	0
14-Insurance	0	0	4	3	0	0
15-Grades	0	6	0	1	0	0
16-Certificate Order System	0	1	1	5	0	0
17-Transcript	1	5	0	1	0	0
18-Attendance	0	0	3	4	0	0

2.4. Interpretation of the collected data

A table for data interpretation which sums up the survey results:

Frequency of Occurrence(%)

Requirements	1	2	3	4	5	?	Total in %	Category
1-Forums	28.6	14.3	42.8	14.3	0	0	100	Delighter
2-User Analytic	0	14.3	28.6	57.1	0	0	100	Indifferent
3-Event Scheduling	42.8	57.1	0	0	0	0	100	Satisfier
4-Personal Information	42.3	14.3	14.3	28.6	0	0	100	Basic
5-Private Messaging	28.6	28.6	28.6	14.3	0	0	100	Basic
6-Resource Sharing	0	14.3	57.1	28.6	0	0	100	Delighter
7-Vacation Tracking	0	57.1	0	42.8	0	0	100	Satisfier
8-Search for a User	42.8	42.8	0	14.3	0	0	100	Basic
9-CV Database	0	28.6	0	57.1	0	0	100	Indifferent
10-Filter Users	42.8	28.6	14.3	14.3	0	0	100	Basic
11-Work Hours Tracking	0	71.4	0	28.6	0	0	100	Satisfier
12-Company Information	0	57.1	28.6	14.3	0	0	100	Satisfier
13-Salary Information	0	42.8	14.3	28.6	14.3	0	100	Satisfier
14-Insurance	0	0	57.1	42.8	0	0	100	Indifferent
15-Grades	0	85.7	0	14.3	0	0	100	Satisfier
16-Certificate Order System	0	14.3	14.3	71.4	0	0	100	Indifferent
17-Transcript	14.3	71.4	0	14.3	0	0	100	Satisfier
18-Attendance	0	0	42.8	57.4	0	0	100	Indifferent

3. FEATURE ANALYSIS

3.1. Common Features

- Forums
- User Analytics
- Event Scheduling
- Personal Information
- Private Messaging
- Resource Sharing
- Vacation Tracking
- Search for a User
- CV Database
- Filter Users

3.2. Variable Features

- **Group 1:**
 - Work Hours Tracking
 - Company Information
 - Salary Information
 - Insurance Information
- **Group 2:**
 - Grades
 - Certificate Order System
 - Transcript
 - Attendance

3.3. Variants

Student Management System: (Common set) + (Group 2)

Employee Management System: (Common set) + (Group 1)

Based on this analysis, our **Application Requirements Matrix** is provided below:

Requirements/Applications	Variant 1 (Student)	Variant 2 (Employee)
1-Forums	1	1
2-User Analytics	1	1
3-Event Scheduling	1	1
4-Personal Information	1	1
5-Private Messaging	1	1

6-Resource Sharing	1	1
7-Vacation Tracking	1	1
8-Search for a User	1	1
9-CV Database	1	1
10-Filter Users	1	1
11-Work Hours Tracking	0	1
12-Company Information	0	1
13-Salary Information	0	1
14-Insurance Information	0	1
15-Grades	1	0
16-Certificate Order System	1	0
17-Transcript	1	0
18-Attendance	1	0

4. FEATURE MODEL

Vitamin Software Product Line Explanation: Vitamin is a management application that utilizes product lines to help people by collecting their personal and all domain related information in a system and has the following usage:

- Users should authenticate themselves to be able to use the system.

- System should keep personal information of each user and show them if it is requested. This personal information includes name, surname, contact information (mail, address and phone number).
- System should support 4 types of users namely student, teacher, employee, manager
- System should provide a calendar to schedule the events of each user.
- Employee management system should support a system to arrange a meeting on the calendar and adjust the status of the meeting. The default status of a meeting is "pending" and it can be accepted or rejected.
- System keep track of the vacation days of each user. Medical reports are applicable for all users whereas day-off information is only available for employee management system.
- System should store CVs and give opportunity to manage them.
- Insurance information should be provided for employee management system.
- System should have internal messaging system.
- Users should be able to search the other users of the system and filter the results.
- There will be forum page to discuss some important topics.
- System should store some resources and enable resource sharing with other users.
- Employee management system should keep track of working hours of each employee and show them to the managers.
- Apart from personal information, employee management system should show company information to both employees and managers.
- Salary information should be demonstrated to the users of employee management system to inform about upcoming bonuses or cuts from the original salary.
- Student management system should acquire and store grade information of each student for each course.
- Students should be able to view and order certificates like official enrollment certificates and transcripts via the student management system.
- Student management system should keep track of the attendance record of each student for each course.

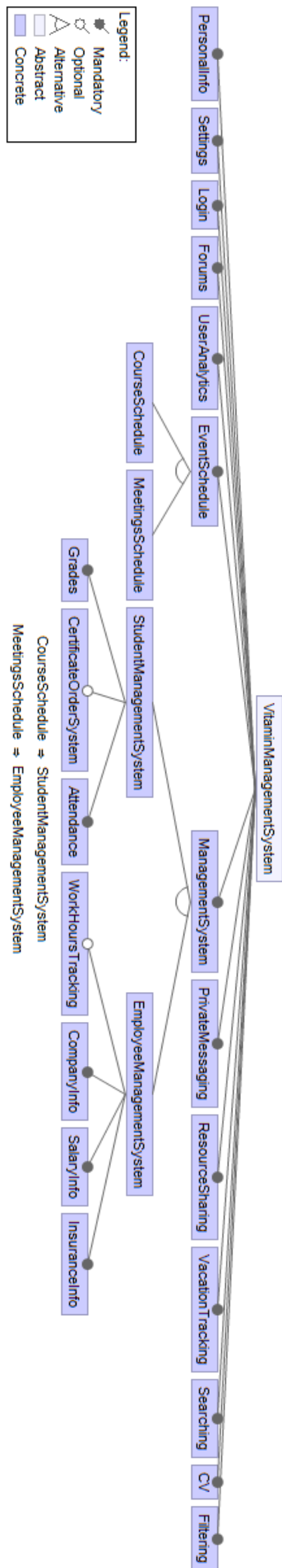


Figure 2: Feature Model

4.1. Calculation of the number of possible variants

Number of configurations/possibilities without considering the rules:

$$2(\text{Event Schedule}) * 4(\text{Management System}) = 8$$

Now consider the rules:

1. Opposite of rule 1 in above diagram: There is a course schedule but student management system does not select.

$$1(\text{Course Schedule}) * 2(\text{Employee System}) = 2$$

2. Opposite of rule 2 in above diagram: There is a meetings schedule but employee management system does not select.

$$1(\text{Meetings Schedule}) * 2(\text{Student System}) = 2$$

The final number of configurations = $8 - 2 - 2 = 4$;

4.2. Variability configurations

- For our first product variant, which is Student Management System, the variability configuration (binded) picture from our feature modelling is provided below:

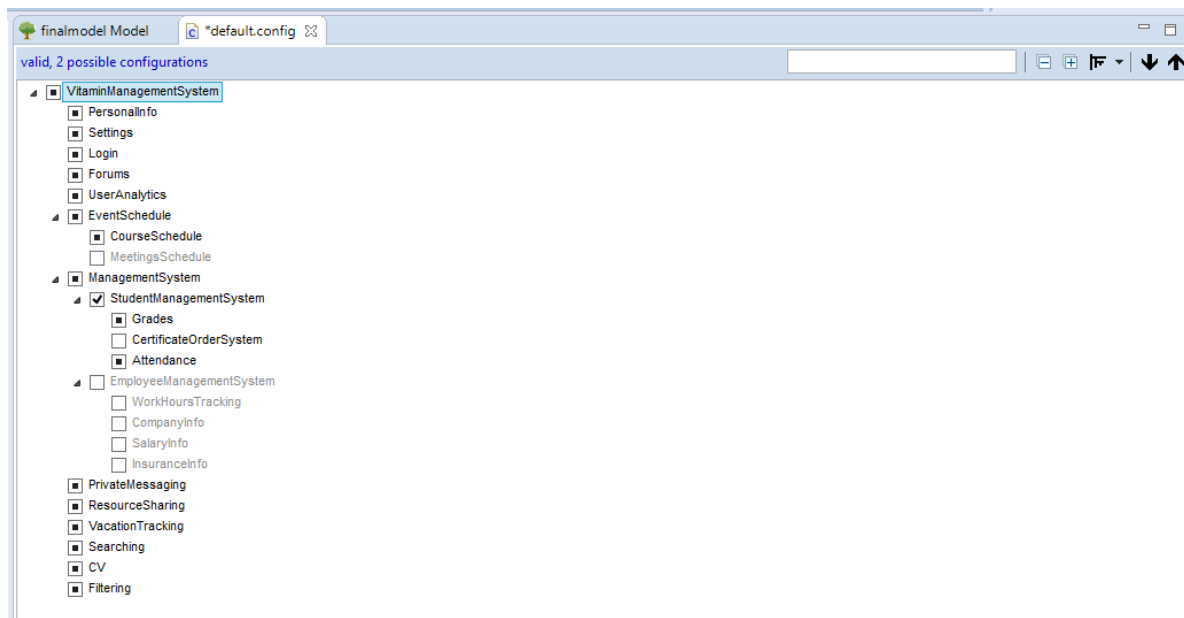


Figure 3: Variability configuration for Student Management System

- For the second product variant, which is Employee Management System, the variability configuration (binded) picture from our feature modelling is provided below:

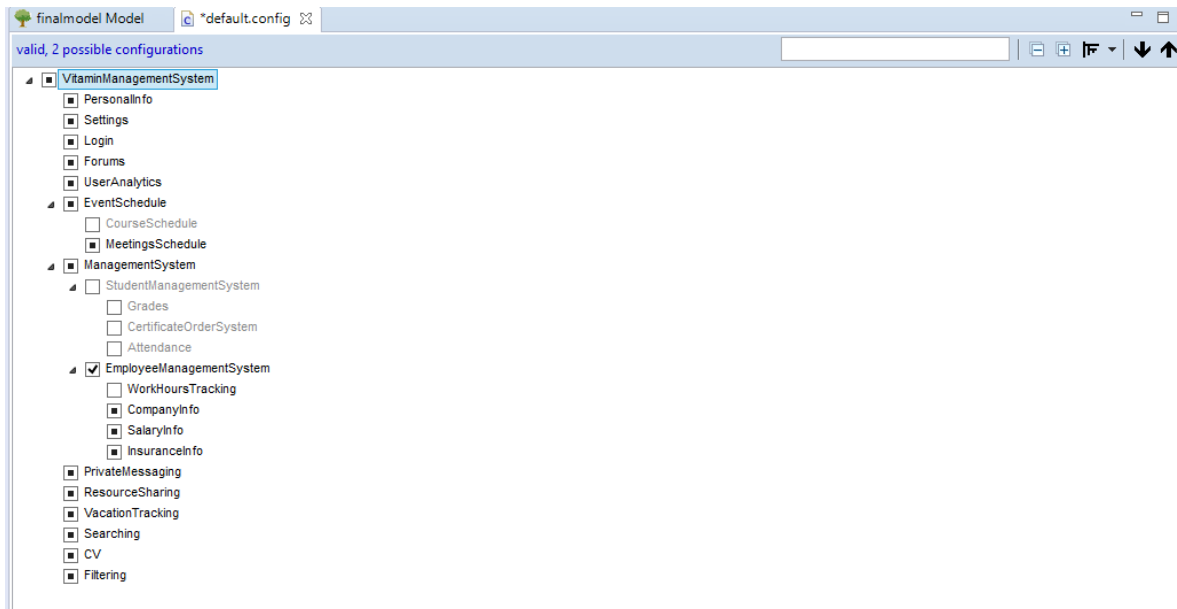


Figure 4: Variability configuration for Student Management System

5. HIGH LEVEL ARCHITECTURE

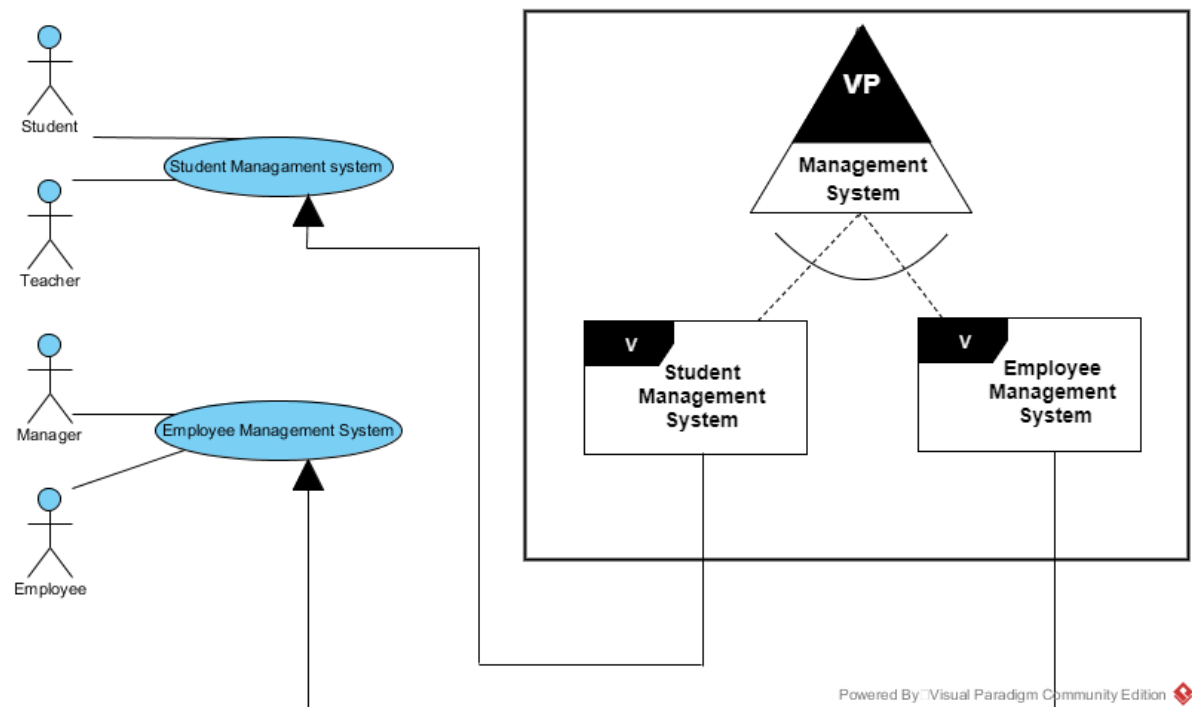


Figure 5: OVM diagram for Management System

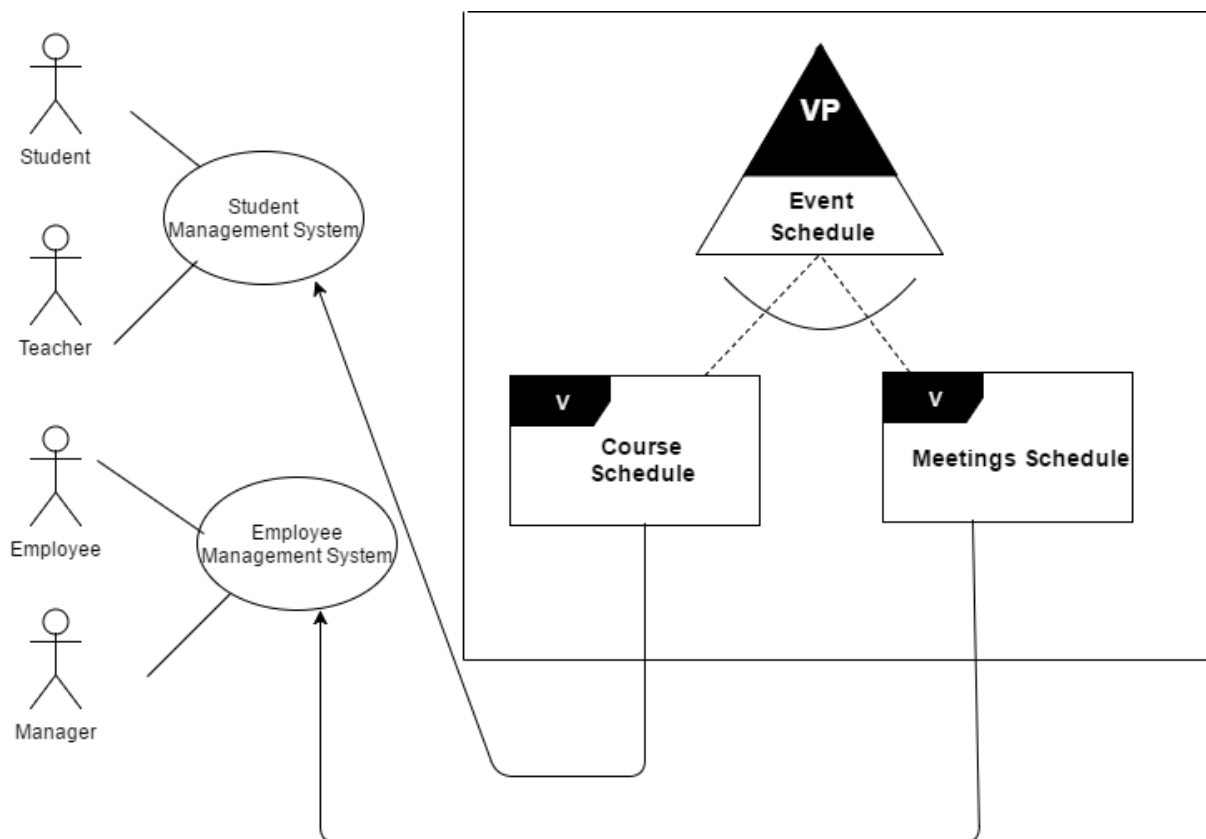


Figure 6: OVM diagram for Event Schedule

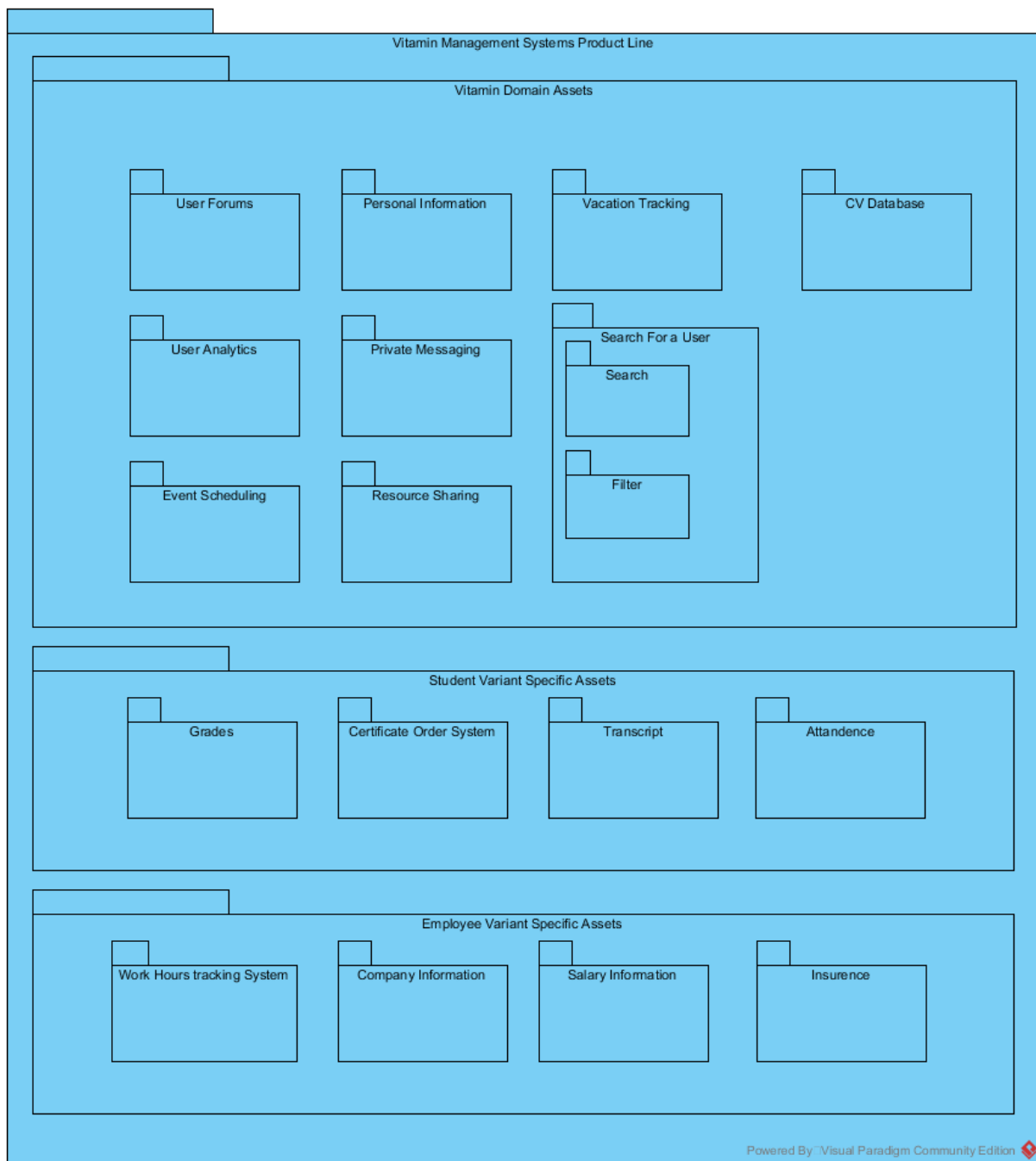


Figure 7: Decomposition View of Vitamin Management System

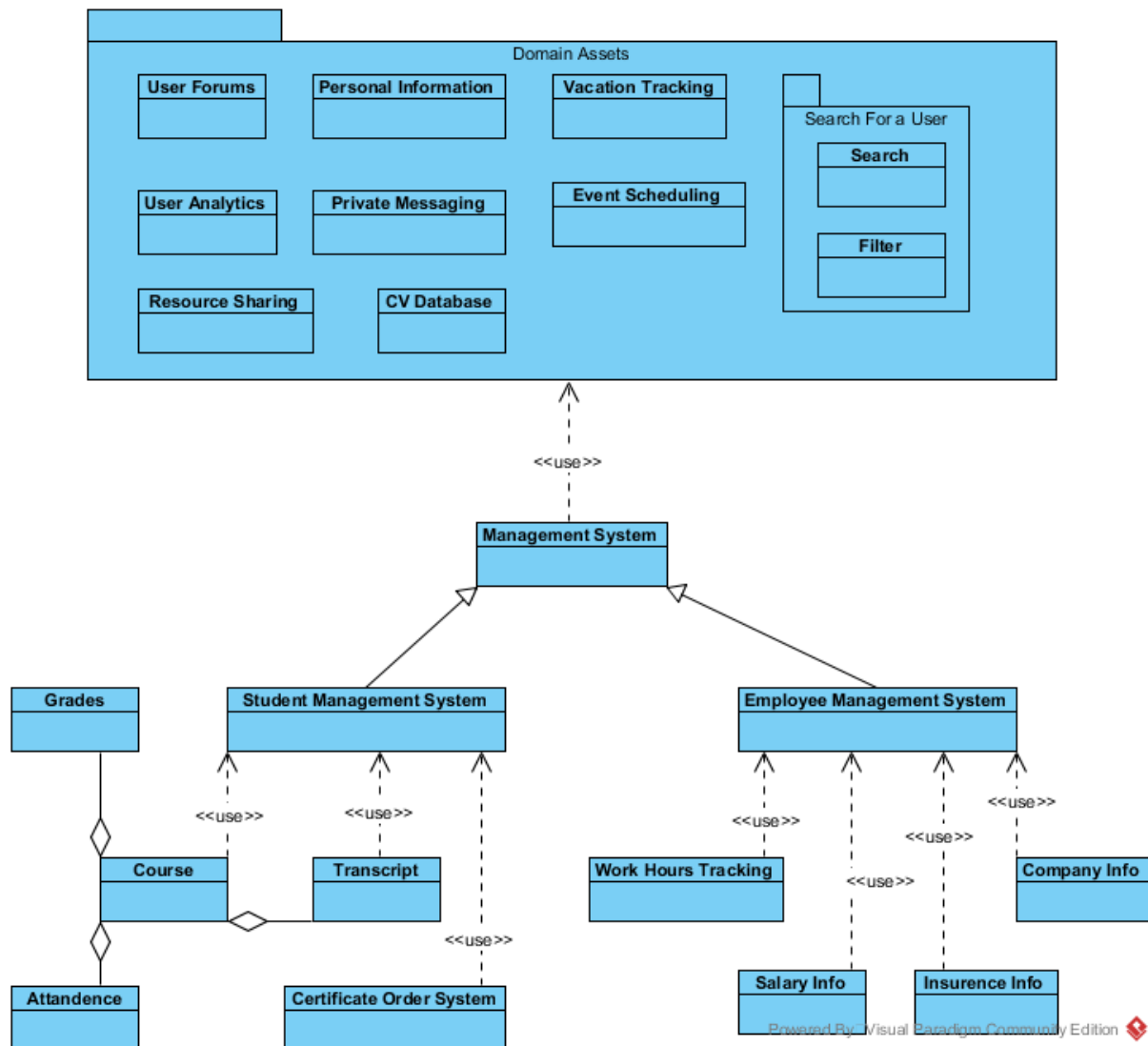


Figure 8: Class Diagram of Vitamin Management System

The implementation of the prototype assigns each user type a “user session” which decides what parts of the overall system that particular session can access. This makes it possible to automate new variants once we generate (define) a user type. To handle the access-control the “user sessions” all have entries in the “access control matrix”. Once a new user session is created and its access-control is filled we will have a functioning variant which is as close as we can to automation. However, it is not easy to come up with a distinct enough variant with our current domain assets.

6. SUMMARY

Work done by each group member:

Selin Fildiş: High level design

Emir Acımiş: Requirements and Kano model

Barış Ardiç: Requirements and Kano model

Afra Dömeke: Feature model and feature analysis

Yonca Yunatçı: Feature model and feature analysis

This was the initial division of labor. There was team collaboration while making decisions and correcting any mistakes found. The prototype was also developing with the same strategy which involved an incremental implementation process with group participation. The discussion section in this report reflects on this process of development.

7. APPENDIX

10.12.2017

Survey for Kano Model

Survey for Kano Model

This survey is for Kano model of the Management Systems Project

1. How would you feel if your management system did have forums in order to communicate with others?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

2. How would you feel if your management system did have forums in order to communicate with others?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

3. How would you feel if your management system did not have forums in order to communicate with others?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

4. How would you feel if your management system could display the user analytics?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

5. How would you feel if your management system could not display the user analytics?
Yalnızca bir şıkla işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

6. How would you feel if your management system had event scheduling functionality?
Yalnızca bir şıkla işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

7. How would you feel if your management system had not event scheduling functionality?
Yalnızca bir şıkla işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

8. How would you feel if your management system could display personal information?
Yalnızca bir şıkla işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

9. How would you feel if your management system could not display personal information?
Yalnızca bir şıkla işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

10. How would you feel if your management system had private messaging feature?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

11. How would you feel if your management system had not private messaging feature?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

12. How would you feel if your management system had resource shearing feature?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

13. How would you feel if your management system had not resource shearing feature?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

14. How would you feel if your management system had vacation tracking functionality?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it
-

15. How would you feel if your management system had not vacation tracking functionality?*Yalnızca bir şıkkı işaretleyin.*

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

16. How would you feel if you could search a user in your management system?*Yalnızca bir şıkkı işaretleyin.*

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

17. How would you feel if you could not search a user in your management system?*Yalnızca bir şıkkı işaretleyin.*

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

18. How would you feel if you could add your CV in your management system?*Yalnızca bir şıkkı işaretleyin.*

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

19. How would you feel if you could not add your CV in your management system?*Yalnızca bir şıkkı işaretleyin.*

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

20. How would you feel if you could filter the users in your management system?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

21. How would you feel if you could not filter the users in your management system?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

22. How would you feel if you could display your grades in your management system?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

23. How would you feel if you could not display your grades in your management system?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

24. How would you feel if you could order student certificate in your management system?

Yalnızca bir şıkkı işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

25. How would you feel if you could not order student certificate in your management system?

Yalnızca bir şıkki işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

26. How would you feel if you could display your transcript in your management system?

Yalnızca bir şıkki işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

27. How would you feel if you could not display your transcript in your management system?

Yalnızca bir şıkki işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

28. How would you feel if you could display your attendance in your management system?

Yalnızca bir şıkki işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

29. How would you feel if you could not display your attendance in your management system?

Yalnızca bir şıkki işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

30. How would you feel if you could tract your working hours in your management system?
Yalnızca bir şıkku işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

31. How would you feel if you could not tract your working hours in your management system?
Yalnızca bir şıkku işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

32. How would you feel if you could display your company information in your management system?
Yalnızca bir şıkku işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

33. How would you feel if you could not display your company information in your management system?
Yalnızca bir şıkku işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

34. How would you feel if you could display your salary information in your management system?
Yalnızca bir şıkku işaretleyin.

☐ I like it
☐ I expect it
☐ I am neutral
☐ I can live with it
☐ I dislike it

35. How would you feel if you could not display your salary information in your management system?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

36. How would you feel if you could display your insurance in your management system?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

37. How would you feel if you could not display your insurance in your management system?

Yalnızca bir şıkla işaretleyin.

- ☐ I like it
- ☐ I expect it
- ☐ I am neutral
- ☐ I can live with it
- ☐ I dislike it

You can reach the project via:

<http://sple2-vitaminmanagement.azurewebsites.net/Home>

(Using student or teacher or employee or manager for usernames and '123' for password)

Source code of the project available at with build instructions:

https://drive.google.com/open?id=1E1PdbddYyHZwNq2gz_1hZnsatXEOHUXx