POLITECNICO
MILANO 1863

Computer Science and Engineering

Software engineering 2 Project

DREAMS

RASD

Requirement Analysis and Specification Document

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Sommario

Introduction

Purpose

Resulting from the commission by Telangana's government, this document aims to illustrate the project of DREAMS, a farming support system based on mobile application and web application, addressed to people within two different targets, namely:

. Farmers

. Policy Makers

Since these two personalities have different needs, the system is projected in such a way to satisfy both parts without losing its global unity.

The very first goal is that of acquiring and combining a variety of data involved into the farming activity, in order to facilitate providing with consistency and efficiency the aimed support to the work of the already mentioned personalities.

For the purpose of giving them the possility to keep track of their production, the system allows farmers both:

- to easily access and visualize information such as weather forecast based on the location of their field, humidity of soil and amount of used water; those information are taken externally, real-time from meteo stations, sensors deployed in the fields and the state irrigation system;
- to easily insert and visualize information about their production (type of product, quantity) in various farming seasons, from sowing to harvest time;

The system is also well conceived in such a way to ease networking between farmers by providing them a real digital forum where they can discuss whatever subject and interact

From the point of view of a policy maker instead, the system appears a great tool of assistance; yet it allows the policy maker to directly supervise and assist the farmers, as well as to understand the results from the application

of the steering intiatives carried out by the governmental agronomists: to help in fulfilling this duty, the system is equiped with an algorithm that periodically provides the policy maker data analytics based on all the registered information.

All the data are stored into a MySQL database.

Finally, this document has the goal to guide the developer in the realization of DREAMS.

Scope

Description of the problem

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  At first sight the problem announces itself as a Smart Farming problem. Indeed it requires a solution that is using and applying information and data for optimizing complex farming systems, such as the farming system of the State of Telangana.

  Not only, but the problem also represents a good opportunity to bring Telangana's State farming system on another level, that is a Precision Farming system's level, which aims to make agricultural system to be thought as everything that makes the practice of farming more accurate, optimized, and controlled when it comes to the growing of crops and raising of livestock.

  Thus, goals, world phenomena* and shared phenomena* have to be highlighted.
  The results of the analysis is reported below, further in the document.

World Phenomena

[WP1] Climate changes

[WP2] Problem with irrigation system

[WP3] Farmer uses a fertilizer

[WP4] Farmer plants a crop

[WP5] Farmer reaps products

[WP6] Problem with sensor

Shared Phenomena

SP1	farmer reports a problem	WC
SP2	farmer inserts a type of product	WC
SP3	farmer inserts produce amount of product	WC
SP4	weather forecast update	MC
SP5	farmer inserts a help request to another farmer	WC
SP6	farmer receives a help request from another famer	MC
SP7	farmer inserts a suggestion request to another farmer	WC
SP8	farmer receives a suggestion request to another farmer	MC
SP9	farmer receives a special incentive notification	MC
SP10	farmer creates a discussion in forum	WC
SP11	farmer gives a reply in other user discussion	WC
SP12	farmer gets a notification about irrigation system error	MC
SP13	policy makers insert a special incentive description	WC
SP14	farmer receives updates about humidity of soil	MC
SP15	policy makers obtain information about amount of water used by farmers	MC

Goals

[G1] Policy makers obtain information about performance of a famer.

[G2] Create a network of farmers.

[G3] Allow policy makers to give farmers special incentives.

[G4] Farmer visualize his production data

[G5] Farmer visualize weather forecast

[G6] Farmer visualize suggestion based on production and location.

[G7] Allow policy makers to understand whether the steering initiatives produce significant results.

[G8] Allow farmers to ask for help and suggestion to other farmers

Definitions, acronyms and abbreviations

Definitions

- Special incentive : an encouragement given by the policy maker to the farmer
- Weather forecast: meteo conditions of a given location
- Forum discussion: a virtual discussion between the farmers
- Meteorological adverse event: particularly bad weather conditions a farmer could encounter
- HelpTicket: special help support request generated by a farmer to a policy maker
- Direct Connection: a virtual connection a policy maker can establish between 2 farmers; one having bad performances and the other having good performances so that he can help the first one into improving his production

Acronyms

- RASD : Requirement Analysis and Specification Document
- API : Application Programming Interface

Abbreviation

- WP : World Phenomena
- SP : Shared Phenomena
- MC : Machine Controlled
- WC : World Controlled
- G : Goal
- D : Domain
- R : Requirements

Revision history

Date	Modifications
23/12/2021	First version
18/02/2022	Update: • World Phenomena • Shared Phenomena

References

- Specification Document “Assignments AA 2021-2022.pdf”
- Telenagana state documentation : https://agri.telangana.gov.in/content.php?U=3%20&&%20T=Action%20Plan
- https://agri.telangana.gov.in/open_record_view.php?ID=959
- AlloyDynamic Model example: http://homepage.cs.uiowa.edu/~tinelli/classes/181/
- Spring10/Notes/09-dynamic-models.pdf"
- IEEE Std 830-1993 - IEEE Guide to Software Requirements Specifications.
- IEEE Std 830-1998 - IEEE Recommended Practice for Software Requirements Specifications.

Product Perspective

SCENARIOS

Harvest Time: evaluation from a Policy Maker

Ishaan, a policy maker, who has already loged in Dreams. It's been harvest time: Dreams notifies him that the seanson's production results are ready. He needs to see the results so that he can evaluate the productions of the farmers he has been assigned. As he opens the application, he selects the option that leads him to the analytics and classifications provided by the system from the lately registered production data inserted by the farmers. The system asks him to insert the type of production: here he can see graphs, classifications, diagrams showing the performances of his farmers, and a summative indicator of their performances with respect to the last harvest time. He can send a direct comments to a farmer or collective comments from the ranking list:

- he sends encouraging messages to his farmers,
- notifies a farmer of his bad performance and give him some support
- notifies the farmers who obainted good results of their well deserved special incentives, and asks them to give the bad performing ones some useful tips and help, instauring a "direct connection" between a well performing farmer and a bad performing farmer: both the farmers receive a notification.

"Any-other-day" kind of situation : Policy Maker

Today Shyla, a policy maker, has received four notifications. She enters the application and selects the option to see the list of all the suggestions & help requests generated by her farmers through the "HelpTicket" service offered by the system to them farmers. she decides to see the new ones; then she opens the second notification of the list: it is a request fromDhruv; she reads the description of the problem and gives a look at the attached pictures. She replies to the request giving Dhruv specific instructions and suggestions, and tells him, she will contact him later on. She then opens another of the requests. This time, it is a request from Ajay's farm. Ajay has complicated problem: his rice crops are dying; he had been controlling the humidity of the soil, but the problem does not seem to be there, he also explains that he had been asking for suggestions on the forum, but among the answers, there were different opinions, and many of the farmers advised him to ask for special help through "HelpTicket". Shyla replies to the problem of Ajay, gives him some advice about fertilizers used in the treatment of such cases, and tells him she will open a "direct connection" between him and Sahil, who is a really well performing farmer, so that he can assist him in curing the crops. So Shyla opens the option of the application that allows her to see the profile of each of her farmers more in detail. Here she select Sahil's profile, and creates

a "direct connection" between him and Ajay. Both Ajay and Sahil receive a notification of their newly instaured connection.

Basic use: a Farmer

Shaan is farmer. On a regular day he opens Dreams application. On his profile, he can see realtime the wheather broadcast and the humidity of soil of his fields location or select to see his personalized schedule to look for suggestions about crops to plant and fertilizers to use. He can also open the forum section: here he can create discussions about his doubts concerning his production, or ask for suggestions about a specific issue, or reply to an open discussion, so that he can confront hiself with other farmers, in order to maximize his performances. Moreover, he has the possibility to generate at any moment a specific request through the "HelpTicket" service to the policy maker he has been assigned to.

Seeding Time: A farmer

It's seeding time! Avan is a farmer who usually cultivates spices and rice. This time among his cultivations, he decided to have a mais field for the first time. Although he is proposed well documented indications, he still has some doubts. He then decides to open the forum section. He writes in the search bar "mais first time"; the system shows him several discussions. He takes the time to read them, but he is still not convinced, so he decides to create a new discussion. The system asks him to insert and object/title and then a description; he also has the possibilty to attatch pictures, but for this case he does not find it necessary; so he posts what he wrote. Later on during the same day, he receives some notifications about some answers. He finds them interesting and replies to thank the farmers who have now reassured and encouraged him with some more tips.

While farming

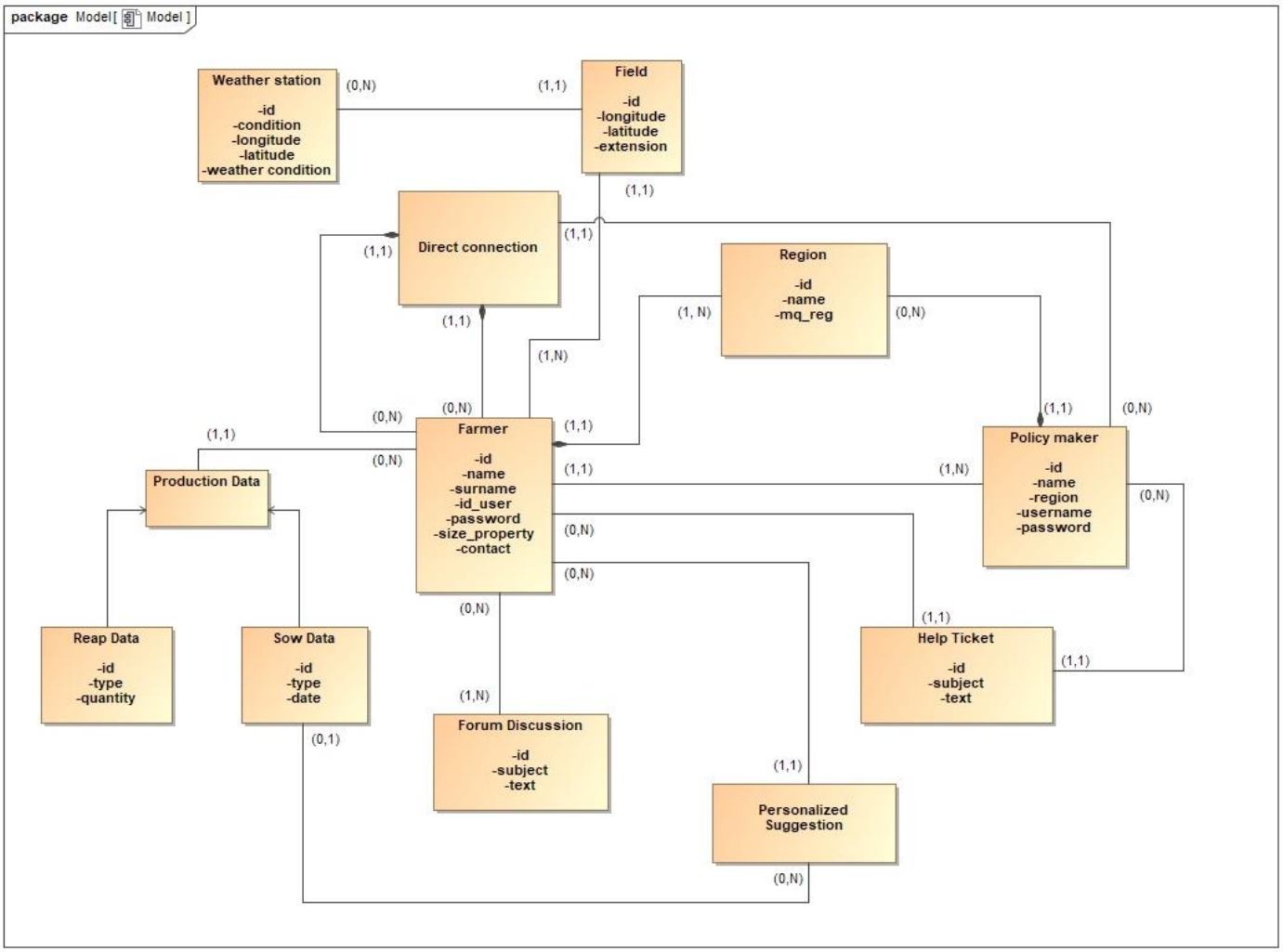
Jaya, a small farmer from Raikal, is having a tough period with her cultivations, especially with those of Cinnamon and Saffron: the leaves of both the crops do not have the expected colours and are somehow damaged. After several hours of discussion in forum, she is suggested to ask for a special help through the "HelpTicket" service. So she opens the section of the application dedicated to help and suggestions. Here she can see the personalized suggestions about the crops

she is farming at the moment, and her already generated tickets. She creates a new ticket: the system asks her to insert the type of production, the object and then the description of her problem. She also adds some pictures, and then generates the ticket. Two hours later, she receives two notifications related to the ticket she has generated. The first one regarding the answer from her policy maker giving her more instructions, and telling her she will be assisted by Diya, a brilliant small farmer, famous for his production of spices. The second notification, always related to the ticket, tells her that she now has a "direct connection" with Diya. she opens the notification and starts talking with Diya to find a solution to bring her plants back to life.

Harvest time: a Farmer

Ishani is a little farmer from Medipalle. This season she cultivated two different types of production: ipomea batadas and cinnamon. She got notified by Dreams days before that the functionalities that allow to insert the production data are now unlocked. The notification tells how many days the service will remain available. Ishani enters the application, opens the section about production data and correctly inserts the amounts of reaped products for both the cultivations. She can automatically see her grades, and her perfomance improvement: she did great this season! For the next season however, she decided to plant rice and mais as suggested by the agronomists among the different propositions the offered to her weeks ago for the up-coming season. Shen then actualizes her choices in the right sections, but mistakenly selects the number of slots for the rice plants in such a way the total number of slots for mais and rice exceeds the the available slots from her field, so as she is about to register the non-correct information, the system alerts her to check and correct it. So she does: she rightly selects the number of slots she wants to dedicate to her cultivation, and the system accepts and registers the data. She recieves in the next minutes a notification conferming her that the information she inserted have been successfuly registered in the system, and telling her the personalized suggestions section of hers has been actualized and updated. She suddently goes ahead in the help and suggestions section, sees the updates: ipomea batadas and cinnamon have been replaced by rice and mais; she then starts reading the proposed indications about fertilizers to use and different methods and ways to take of the plants, based on the meterological previsions.

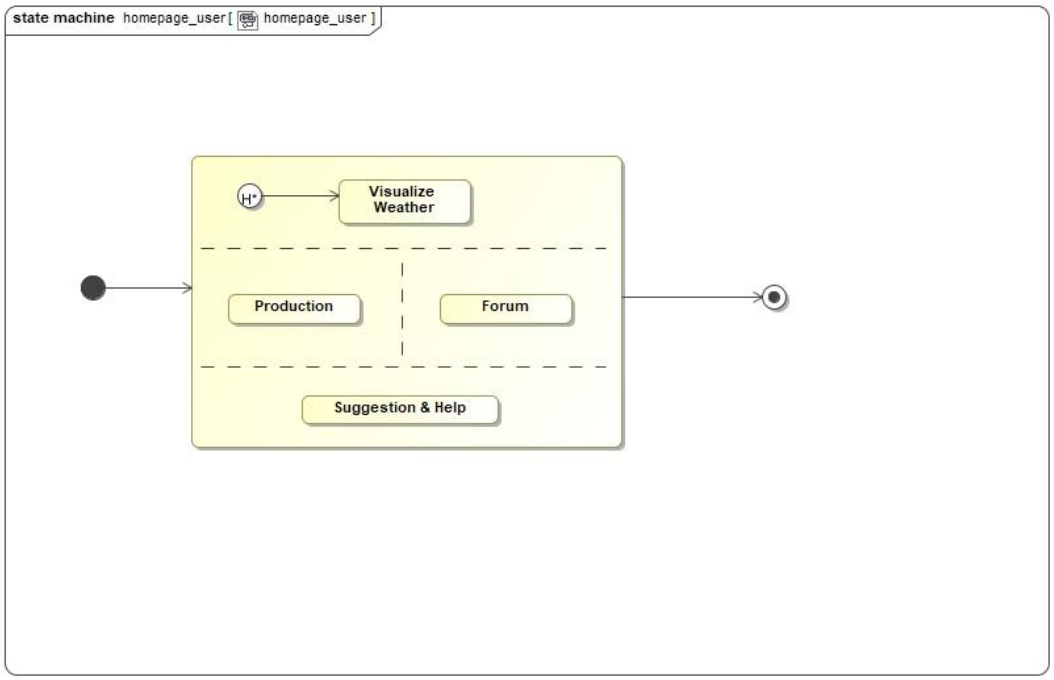
Class Diagram



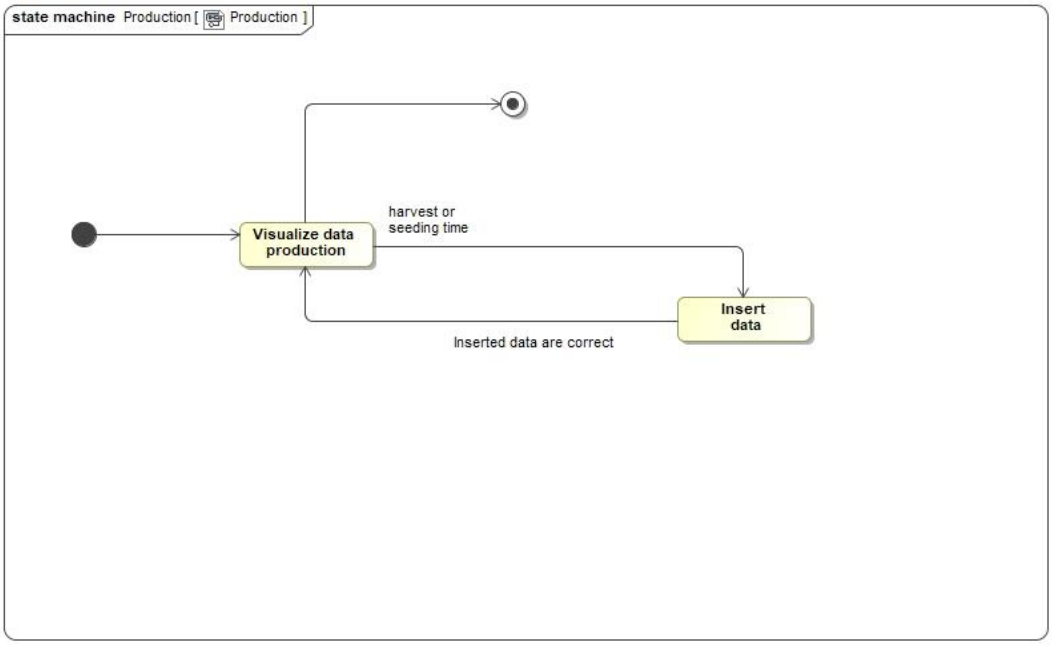
Statecharts

From the Farmer point of view

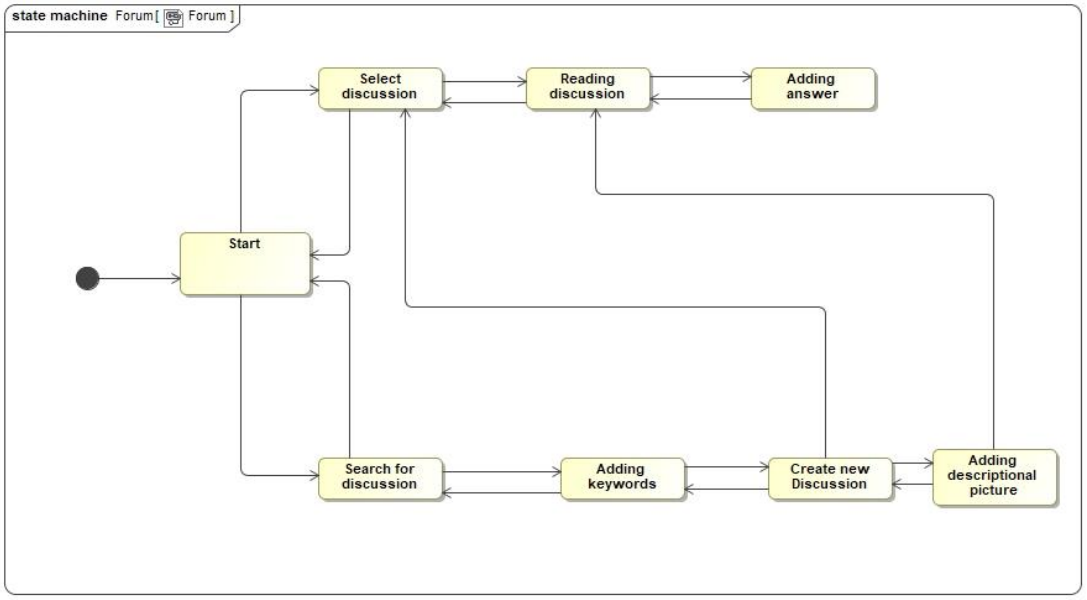
1) Standard Home Page



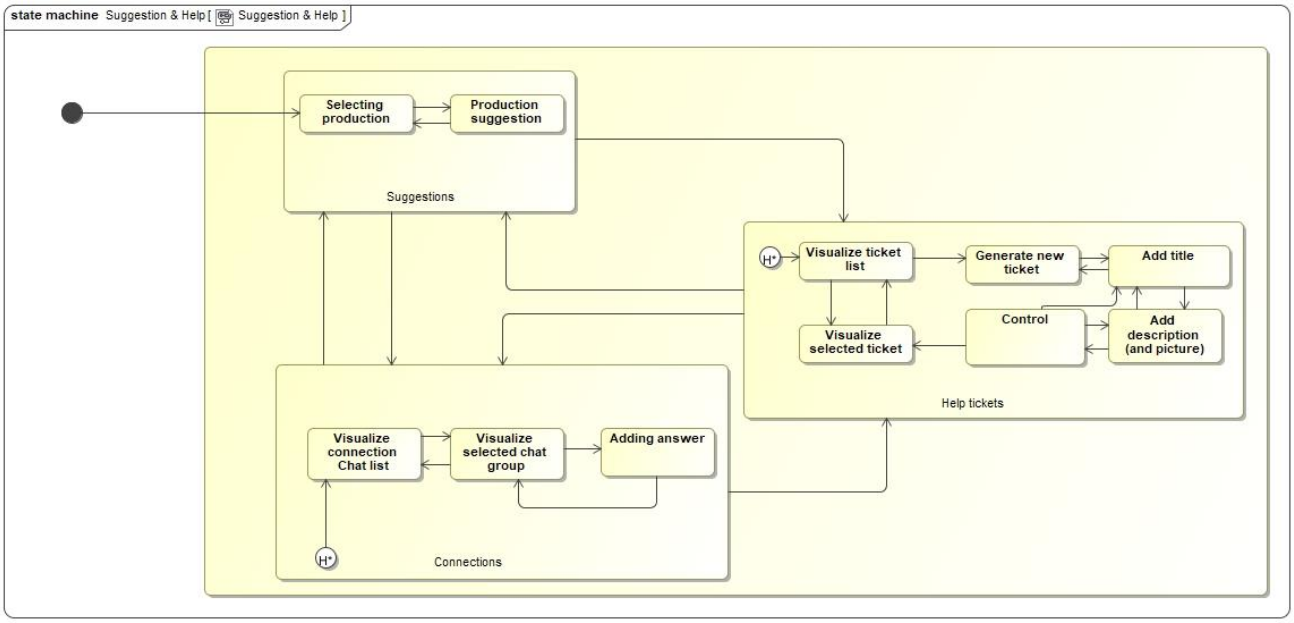
2) Production Section



3) Forum Section

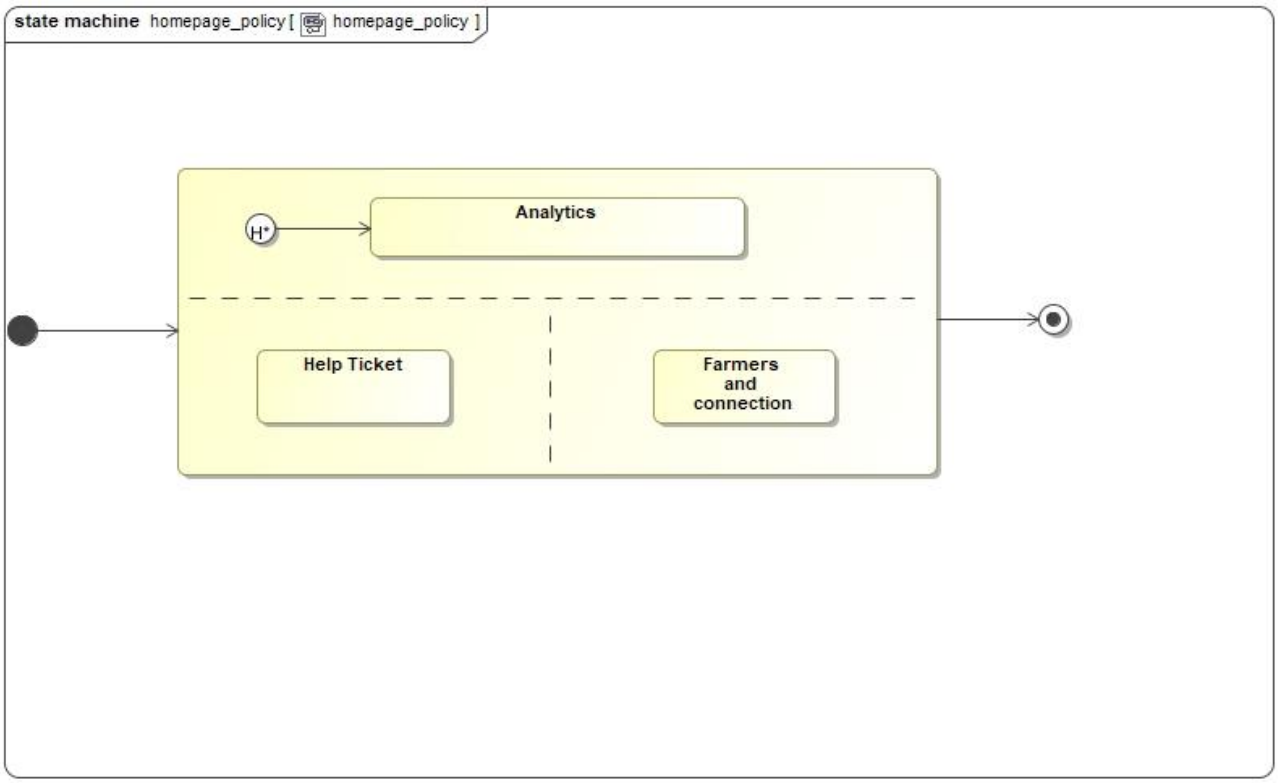


4) Suggestions & Help Section

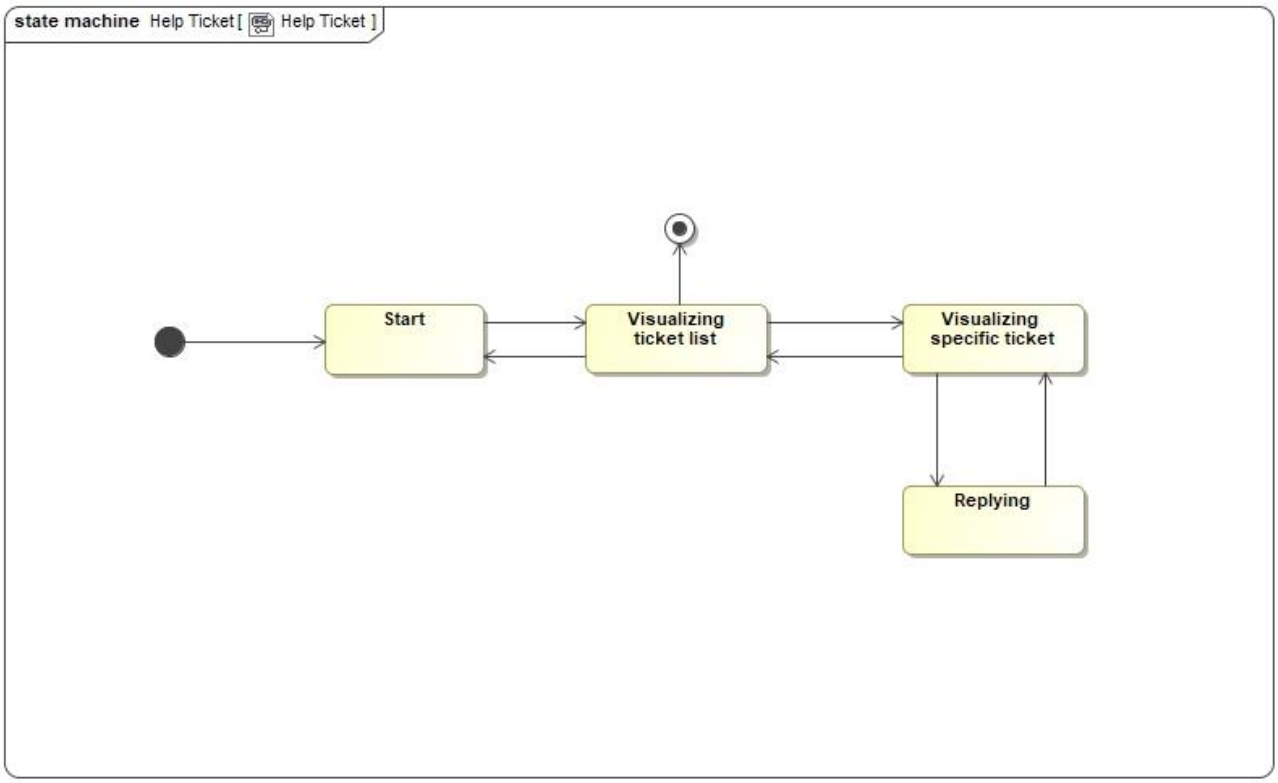


From the Policy Maker point of view

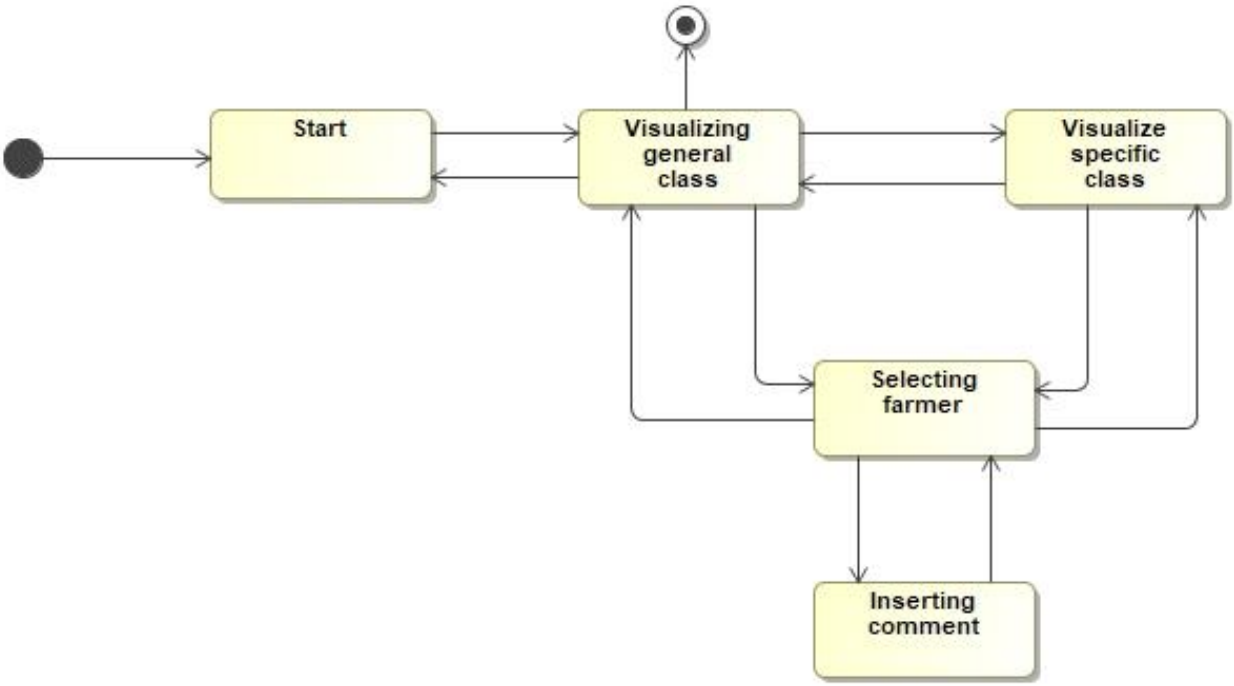
1) **Special Home Page**



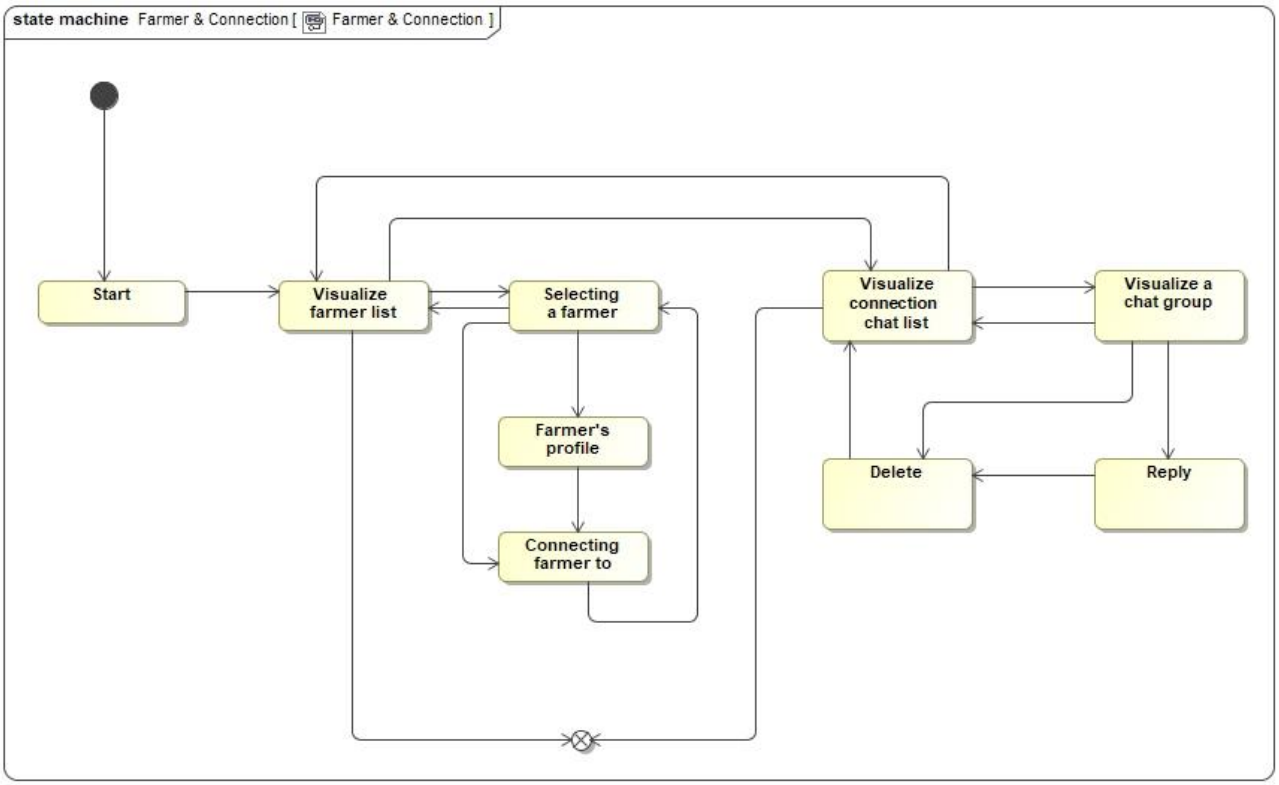
2) **HelpTicket Section**



3) Analytics Section



4) Farmers & Connections Section



Product Functions

Algorithm

During the harvest period, a section of the system which allows the farmers to insert their production data is unlocked. The data will be registered in a database connected to the system. An algorithm will be in charge to calculate the performance of the farmer, based on the production data, the already registered data about amount of water used by the farmer - data provided by the irrigation system - the dimension of the field and the associated estimated quantity of planted crops for the considered product. The algorithm provides evolutional graphs, diagrams (histograms) for each farmer and different levels of classifications: type of product based rankings and general rankings and curves. For each production of his, each farmer is assigned a erformance grade from 1 to 100 and an overall performance grade from 1 to 100 also. It outputs for each farmer a percentil of improvement for each product and an overall percentil mprovement as well. All the results are visible to the Policy maker, while a farmer can only see what concerns the performance grades and improvement of their own production.

HelpTicket

In the suggestions & help section of the system the functionalities have different levels of visibility, depending on if the user is a Policy Maker or a Farmer:

- Firstly it appears to be as a notice board for the farmer, containing suggestions about his current production. The suggestions are constantly updated by the agronomists. This section contains a help service, crucial to the support of the farming life and activities: a farmer can generate a "HelpTicket" adding information and a description about his specific problem, and also can join pictures to document the farming event.The system saves all the tickets generated by the farmer, and he, by opening a ticket can see all the activity related to it between him and the policy maker. The system notifies the farmer whenever there is a new activity in this section.
- When a "HelpTicket" is generated, it is received by a Policy maker: he receives a notification that he opens. He has the possibility to reply to the problem of farmer.

Direct Connection

This feature of the system is kind of a breakthrough. It is accessible only to the Policy Maker. Right through this, the system allows him to institute a connection between a farmer and another. The policy maker, from his part has a list of his assigned farmers; from there he can see all the details about each of them. Still, he has the possibility to associate the farmers between them. To unlock that functionality, the system asks him to insert into an associated filter the type of production - which corresponds to the type of production a farmer is asking help for - then outputs a list of farmers who had been cultivating the specific crop and their performance grade about it plus their overall performance grade. In the list will appear also farmers that are actually cultivating the specific crop for the first time, and for them will appear only their overall performance grade. After having selected the appropriate farmer to help the applicant farmer, the policy maker can create the "direct connection". When the connection is made available to a pair of farmers, they can contact each by chat modality supported by the system. The policy maker is also present in the chat group but he can decides whether to get notified or not about new activities in the chat group, he can decide to end up the connection as well; the other participants do not have these possibilities.

Weather Broadcasting System

The weather broadcasting section, through suitable APIs allows the farmer to have proper meteorological indications directly from the nearest meteo station to the fields in his/her possession. It is in fact expected to have in the database data about longitude and latitude of each farmer's fields. They automatically confronts them with those of the already registered meteo stations, and outputs the weather broadcast realtime.

Forum

This section of the system is visible only to the farmers. The forum allows to create a communication network between the farmers: opening this section, a farmer sees the last updates about the most followed discussions. Generally he can join/follow, insert an answer or just read a discussion if he/she desires. She/He receives a notification about a discussion she/he has joined/followed whenever there are some new activities related to it. Furthermore, the forum allows to carry out a "dictionary" created by the farmers themselves. Yet, when a farmer opens the forum and types in some key words about a certain issue, curiosity or advice in the research bar, the system shows him the discussions related to the uplooked subject. She/he also has the possibility to create a new discussion and interact with other farmers, in order to take the maximumize the growth his production.

Production Data Uploading

This important functionality of the system is in control of the Government of Telengana (Agronomists' association).Yet, it is activated during the harvest time for a considered crop. When available, a farmer has the possibility to insert his production data about the amount of collected products in the dedicated slot appearing beside each type of product he has been cultivating.Further more, this function also allows the farmer to insert the new types of crop she/he is going to plant and so cultivate during the following seeding season.She/he also has the possibilty to insert the number of field slots to dedicate to the considered product. The system takes account of the total number of inserted slots so to allert the farmer not to exceed the total number of slots compatible with his field's dimensions.

User Characteristics

There two kind of users:

Farmer:

Any citizen enrolled in the state register of farmers who needs to easily keep track of her/his production at any of its phases, comunicate with other farmers, and comunicate his/her doubts and problems in such a way to be efficiently helped both in the short and long terms.

Policy Maker:

An authority who is assigned a number of farmers to oversee. He/She needs to access any production data about the farmers, in order to evaluate their performances, and to comunicate with them. He also needs to undertand the overall evolution of the impact of the established farming initiatives.

Assumptions, Dependencies and Constraints

DOMAIN ASSUMPTIONS

[D1] - Information about dimensions and positions of fields acquired from

the State Land Register Office and already registered in the database; each farmer has his fields attached to his account.

[D2] - Sensors measuring the humidity of soil are strategically deployed

in each registered field

[D3] - The Government provides each farmer and each policy maker both Dream Software and a tablet

[D4] - Each tablet is equipped with a photocamera and an internet connection

[D5] - The pictures taken taken are not blurry

[D6] - Production and collection data are uploaded correctly and verified

by the Government

[D7] - Each policy maker supervises a limited number of farmers

[D8] - Farmers under the supervision of the same policy maker are 10 kilometers

far from each other at most

[D9] - Data acquired from the sensors are correct

[D10] - Weather broadcast is updated real-time [1]

[D11] - Agronmists provide well updated guidelines and suggestions based on the

location and meteorologic conditions of each field

[D12] - For each production problem encountered by a farmer there is

always at least one farmer ready to help out

[D13] - The forum is cured by external operators and moderators

[D14] - The forum is always accessible

[D15] - The Database is well uptdated

[D16] - Each field is distributed water directly from the state irrigation system; Data about amount of water used by each farmer is taken from the state irrigation system database

[D17] - Registration information of Farmers and Policy Makers are already stored in DREAMS' database: they don't need to sign up

[D18] - All the fields of a considered farmer are in the same region

[1] The weather informations are updated with API from Telengana weather website.

SPECIFIC REQUIREMENTS

EXTERNAL INTERFACE REQUIREMENTS

Hardware Interface

The software can be utilized from three kind of hardware interfaces:

- tablet: the device is fully provided by the government to the users just the time
  It already has the software installed; users can access and use the system's functionalities with their provided login credentials.
- Smartphone & Computer: From these devices, users can access the system only through the WebApp. On a smartphone, all the functionalities are accessible, while from a computer, the system does not allow users to take pictures.

Software Interface

The Dreams makes use of an external Database dedicated to his utilities only: the system takes the information provided from the Database and processes them through its Classification Algorithm; it uses them as inputs to the weather broadcast and humidity of soil functionality So within this Database are contained:

- data of a farmer about the dimensions and locations of his fields, and the production data inserted by him/her
- data collected from the sensors measuring the humidity of soil
- data obtained from the water irrigation system concerning the amount of water used by each farmer

Communication Interface

The devices connect to Dreams via internet connection.

FUNCTIONAL REQUIREMENT

LIST OF REQUIREMENT

[R1] - A farmer that uses the system should be logged

[R2] - A farmer obtains the standard DREAMS home page after he has logged-in[1]

[R3] - A policy maker that uses the system should be logged

[R4] - A Policy Maker obtains the DREAMS special home page after he has logged-in[1]

[R5] - A farmer can see the weather broadcast of every field in his possession

[R6] - A farmer can visualize only the production data related to him

[R7] - The system allows the access to the forum to farmers only.

[R8] - The system allows a farmer to do a research within the forum

[R9] - The system allows a farmer to create a discussion within the forum

[R10] - The system allows a farmer to join pictures to the description of a discussion when creating it

[R11] - A farmer can add an answer[2] to a discussion

[R12] - The system allows a farmer to add pictures to an annswer

[R13] - All the pictures added should be taken directly from the software

[R14] - The system allows a farmer to visualize the suggestions provided by

the government (Agronomists)

[R15] - The system allows a farmer to generate a HelpTicket so he can receive more suggestions and help

[R16] - The system allows a farmer to add pictures to a HelpTicket when creating it

[R17] - The system allows a policy maker to visualize all the production analytics

in output from the classification algorithm

[R18] - The system does not allow the farmer to see the analytics, but his performance grades only

[R19] - The system notifies a farmer every time there is an activity in a forum discussion he follows

[R20] - A farmer that creates or adds an answer to an already existing forum discussion, automatically starts following it

[R21] - The system allows a farmer to follow an already existing forum discussion even without adding an answer to it

[R22] - The system allows only a policy maker to establish a Direct Connection; A Direct Connection can be established only between two farmers at a time

[R23] - The system allows a policy maker to directly reply to a HelpTicket

[R24] - The system allows a policy maker to visualize all the generic production data of each of the farmers under his supervision

[R25] - A policy maker can comment on farmers performances grades calculated by the algorithm[1]

[R26] - When a group chat is created, the system automatically names it with the pair of farmers names

[1] Better explained further in the document

[2] In text format

Mapping on Goals

Goal	Domain assumption	Requirement
G1	**D1, D2, D3, D4, D6, D7, D8, D16, D17, D18**	**R3, R4, R17**
G2	**D3,D4, D5, D12,D13,D14, D17**	**R1, R2, R7, R8,R9, R10, R11, R12 - R15, R16, R19,R20, R21, R22, R23, R26**
G3	**D1, D2, D3, D4, D6, D7,D8, D9, D15, D16**	**R3, R4, R17, R25**
G4	**D1, D2, D3, D4, D6, D9, D15, D16**	**R1, R2, R6, R18**
G5	**D1, D2, D3, D4, D10, D15, D16, D18**	**R1, R2, R5**
G6	**D1, D2,D3, D4, D11, D15**	**R1, R2, R6, R14**
G7	**D1,D2, D3, D4, D6, D7, D8, D9 D11, D16**	**R3, R4, R24**

G8	**D1, D2, D3, D4, D5, D9, D12, D13 D14, D15, D17**	**R1, R2, R7, R8, R9, R10, R11, R12, R13, R15, R16, R19, R20, R21, R22**

Use Case

1)

Name	**First Login of a Farmer**
Actors	**Farmer**
Entry Condition	**Farmer is already registered in Dreams and has accessed Dreams on his tablet.**
Event Flow	**1-Farmer visualizes the initial page of Dreams** **2-Farmer fills in all the mandatory fields: username and password** **3-Farmer clicks on "log-In"** **4-Farmer visualizes the standard home page*** **(*home page with farmer credentials)** **5-Farmer opens the "Production" section of Dreams** **6-Farmer clicks on "Select Production" form*** **(* the Select Production form is always available;** **Through this the system allows the farmer to see his personalized suggestions)** **7-Farmer presices the types of product he is cultivating/ he will cultivate in the early time** **8-Farmer clicks on "Send"** **9-The system asks for confermation** **10-Farmer conferms** **11-Farmer receives a notification about the update of his personalized suggestions he can find in "Suggestions & Help"**
Exit Condition	**Policy Maker has access to Dreams' services**
Exceptions	**1-"username" is not correct** **2-"password" is not correct** **3-Farmer does not click on "Send"** **4-Farmer does not conferm** **1&2 are notified by the system bringing the user back to step 2 of Event Flow** **3 is handled by the system letting the user on step 7 of Event Flow** **When 4 is verified the system bring the user back to step 8 of Event Flow**

2)

Name	Login of a Policy Maker
Actors	Policy Maker
Entry Condition	Policy Maker is already registered in Dreams and has accessed Dreams on his tablet.
Event Flow	1-Policy Maker visualizes the initial page 2-Policy Maker fills in all the mandatory fields: username and password 3-Policy Maker visualizes the standard home page* (*home page with Policy Maker credentials) 4-Policy Maker clicks on "log-In" 5-Policy Maker receives all the notifications he missed while logged out9-The system asks for confermation 10-Farmer conferms 11-Farmer receives a notification about the update of his personalized suggestions he can find in "Suggestions & Help"
Exit Condition	Policy Maker has access to Dreams' services
Exceptions	1-"username" is not correct 2-"password" is not correct 1&2 are notified by the system bringing the user back to step 2 of Event Flow

3)

Name	Production data uploading
Actors	Farmer
Entry Condition	Farmer already logged in Dreams; Dreams' functionality to insert production data is available.
Event Flow	1-Farmer opens the "Production" section of Dreams 2-Farmer clicks on "Insert Production" form 3-Farmer selects types of product 4-Farmer precises amount of reaped products for each type 5-Farmer precises the dimension of the dedicated slot/field for each type 6-Farmer clicks on "Send" 7-System asks for confermation 8-Farmer clicks on "Conferm" 9-The system automatically updates the farmer's results
Exit Condition	Farmer has successfully inserted his production data of the season
Exceptions	1-Farmer does not fill in the form correctly 2-Farmer does not click on "Send" 3-Farmer does not click on "Conferm"

	1 is handled by system notifying the user and underlining the wrong fields which could be steps 3, 4 and or 5 2 is handled by the system letting the user on step 5 of Event Flow When 3 is verified the system bring the user back to step 6 of Event Flow

4)

Name	HelpTicket generation and gestion
Actors	Farmer, Policy Maker
Entry Condition	Farmer already logged in Dreams; Farmers has a problem Policy Maker has already logged in Dreams;
Event Flow	-Farmer opens Dreams' "Suggestions & Help" section -Farmer clicks on "HelpTicket" -Farmer clicks on "Generate new ticket" -Farmer inserts the object* (*a title) -Farmer adds the description -Farmer clicks on "Send" -System asks Farmer for confermation -Farmer clicks on "Conferm" -System notifies Policy Maker about a new "HelpTicket" activity -Policy Maker opens Dreams' "HelpTicket" section -Policy Maker visualizes the list of tickets with the new recieved one in evidence -Policy Maker selects the ticket -Policy Maker clicks on "Reply" -Policy Maker adds an answer* (*answers are added in text format) -Policy Maker clicks on "Send" -System asks for confermation -Policy Maker clicks on "Conferm" -System notifies the Farmer about a new "HelpTicket" activity
Exit Condition	Farmer has successfully generated a "HelpTicket"; Policy Maker has successfully replied to a "HelpTicket"
Exceptions	-Farmer does not insert any object -Farmer does not add any description -Farmer does not click on "Conferm" -Policy Maker does not add any answer -Policy Maker does not click on "Conferm"

5)

Name	Check of the personalized suggestions' schedule
Actors	Farmer
Entry Condition	Farmer has already logged in Dreams; Farmer has already updated his production data by filling in the "Select Production" form; Suggestions

Event Flow	**1-Farmer opens Dreams' "Suggestion & Help" section** **2-Farmer clicks on "Suggestions"** **3-Farmer visualizes an interactive page with all the types of product he is cultivating** **4-Farmer selects the preferred type** **5-Farmer visualizes all the related documentation**
Exit Condition	**Farmer visualizes his personalized schedule**
Exceptions	**1-Farmer does not select any prefered type of product on the interactive page** **When 1 is verified, the system remains on step 3 of Event Flow**

6)

Name	**Direct Connection**
Actors	**Farmer1, Farmer2, Policy Maker**
Entry Condition	**Farmer1 has already logged in Dreams; Farmer2 has already logged in Dreams; Policy Maker has already logged in Dreams**
Event Flow	**1-Policy Maker opens Dreams' "Farmers & Connections" section** **2-Policy Maker clicks on "Farmers"** **3-Policy Maker visualizes the list of the profiles of all the farmers under his supervision** **4-Policy Maker clicks on Farmer1's profile** **5-Policy Maker clicks on "Link to"** **6-The system shows Policy Maker the list of the other farmers with their summarized performances for each type of product** **7-Policy Maker selects on Farmer2** **8-The system asks confermation** **9-Policy Maker clicks on "Conferm"** **10-The system creates a group chat with as members Policy Maker, Farmer1 and Farmer2** **11-The system notifies Farmer1 and Farmer2**
Exit Condition	**Policy Maker, Farmer1 and Farmer2 can communicate directly through the chat group**
Exceptions	**1-Policy Maker does not select Farmer2** **2-Policy Maker does click on "Conferm"** **1 is handled by the system not activating step 8 of Event Flow** **When 2 is verified the system remains at step 8 of Event Flow**

7)

Name	Search for a forum discussion
Actors	Farmer
Entry Condition	Farmer has already logged into Dreams; Farmer has a curiosity
Event Flow	1-Farmer opens Dreams' "Forum" section 2-Farmer clicks on "Search" 3-Farmer digits some key words 4-Farmer clicks on "Go" 5-Farmer visualizes a list of discussions related to his research 6-Farmer selects one discussion 7-Farmer visualizes the discussion
Exit Condition	Farmer can interact with the discussion
Exceptions	1-Farmer does not digit any key word 2-Farmer does not clicks on "Go" When 1 is verified the system does not activate step 4 of Event Flow When 2 is verified, step 5 of Event Flow does not verify

8)

Name	Create a forum discussion
Actors	Farmer
Entry Condition	Farmer has already logged into Dreams; Farmer does not find any discussion that satisfies his curiosity
Event Flow	1-Farmer opens Dreams' "Forum" section 2-Farmer clicks on "New Discussion" 3-Farmer inserts a title 4-Farmer inserts a description* (*he can add pictures if he wants; in this case the system asks the farmer the access to the photocamera only the first time) 5-Farmer clicks on "Create" 6-System asks for confermation 7-Farmer clicks on "Conferm"
Exit Condition	Discussion created successfully; Farmer can interact with the discussion
Exceptions	1-Farmer does not insert any title 2-Farmer does not insert any description 3-farmer does not click on "Conferm" When 1&2 are verified the system notifies the user by underlining the corresponding fields as wrong, and inviting the user to correct and/or fill them The system handles 3 by not creating the discussion, but leaving the user

	on step 6 of Event Flow2-Farmer does not clicks on "Go" **When 1 is verified the system does not activate step 4 of Event Flow** **When 2 is verified, step 5 of Event Flow does not verify**

9)

Name	**Check a followed forum discussion**
Actors	**Farmer**
Entry Condition	**Farmer has already logged into Dreams; Farmer received a notification about a discussion he follows.**
Event Flow	**1-Farmer opens Dreams' "Forum" section** **2-Farmer clicks on "MyDiscussions"** **3-Farmer visualizes the list of the discussions he has joined*** **(*the discussion with the latest activity is on top)** **4-Farmer clicks on the first discussion in the list** **5-Farmer visualizes the discussion7-Farmer clicks on "Conferm"**
Exit Condition	**Farmer visualizes the discussion; Farmer can interact with the discussion**
Exceptions	**NONE**

10)

Name	**Join a Discussion**
Actors	**Farmer**
Entry Condition	**Farmer has already logged into Dreams**
Event Flow	**1-Farmer opens Dreams' "Forum" section** **2-Farmer selects a theme** **3-Farmer visualizes the list of the discussions realted the selected theme** **4-Farmer selects a discussion** **5-Farmer clicks on "Follow"** **6-System asks for confermation** **7-Farmer clicks on "Conferm"**
Exit Condition	**Farmer has joined successfully; Farmer can interact with the discussion**
Exceptions	**1-Farmer does not click on "Follow"** **2-Farmer does not click on "Conferm"**

11)

Name	Unfollow a Discussion
Actors	Farmer
Entry Condition	Farmer has already logged into Dreams; Farmer follows a discussion
Event Flow	1-Farmer opens Dreams' "Forum" 2-Farmer clicks on "MyDiscussions" 3-Farmer visualizes the list of his followed discussions 4-Farmer selects a discussion 5-Farmer clicks on "Unfollow" 6-System asks for confermation 7-Farmer clicks on "Conferm"
Exit Condition	Farmer visualizes the list of his followed discussions
Exceptions	1-Farmer does not click on "Unfollow" 2-Farmer does not click on "Conferm"

12)

Name	Farmer adds an answer to an already followed discussion
Actors	Farmer
Entry Condition	Farmer has already logged into Dreams; Farmer has already followed a discussion
Event Flow	1-Farmer opens Dreams' "Forum" 2-Farmer clicks on "MyDiscussions" 3-Farmer visualizes the list of his followed discussions 4-Farmer selects a discussion 5-Farmer clicks on "Add answer" 6-Farmer digits the answer 7-Farmer clicks on "Send"
Exit Condition	Farmer visualizes the discussion; Farmer can interact with the discussion
Exceptions	1-Farmer does not click on "Send" The sytem handles this situation by not making the user's answer public on the forum discussion, so it won't be visible to other users.

13)

Name	Farmer adds an answer to a discussion he does not follow
Actors	Farmer
Entry Condition	Farmer has already logged into Dreams;
Event Flow	1-First FOUR steps of Event Flow of Use Case 10 2-Last THREE steps of Event Flow of Use Case 12
Exit Condition	Farmer visualizes the discussion; Farmer automatically follows the discussion Farmer can interact with the discussion
Exceptions	Exceptions are the same as Use Case 12, and they are handled in the same way as well.

14)

Name	Policy Maker adds a message to a chat group
Actors	Policy Maker
Entry Condition	Policy Maker has already logged into Dreams; Policy Maker has already created a Direct Connection
Event Flow	1-Policy Maker opens Dreams' "Farmers & Connections" section 2-Policy Maker clicks on "Connections" 3-Policy Maker visualizes the list the chat groups related to the connections he had established between pairs of farmers 4-Policy Maker selects a chat group 5-Policy Maker clicks on the "Message" box 6-Policy Maker digits a message 7-Policy Maker clicks on "Send"
Exit Condition	Farmer visualizes the discussion; Farmer automatically follows the discussion Farmer can interact with the discussion
Exceptions	Exceptions are the same as Use Case 12, and they are handled in the same way as well.

15)

Name	Farmer adds a message to a chat group
Actors	Farmer

Entry Condition	**Farmer has already logged into Dreams; Farmer is involved in at least one Direct Connection**
Event Flow	**1-Farmer opens Dreams' "Suggestions & Help" section 2-Farmer clicks on "Connections" 3-Farmer visualizes the list of all the chat groups he is involved into 4-Farmer select a chat group 5-Farmer clicks on the "Message" box 6-Farmer digits a message 7-Farmer clicks on "Send"**
Exit Condition	**Message is successfully sent; Farmer visualizes the chat group; Farmer can interact with chat group**
Exceptions	**1-Farmer Maker does not click on "Send"**

16)

Name	**Interruption of a Direct Connection**
Actors	**Policy Maker**
Entry Condition	**Policy Maker has already logged into Dreams; Policy Maker has established at least one Direct Connection between a pair of farmers**
Event Flow	**1-First FOUR steps of Use Case 14 2-Policy Maker clicks on "Interrupt Connection" 3-System asks for confermation 4-Policy Maker clicks on "Conferm" 5-Policy Maker visualizes the updated list of chat groups**
Exit Condition	**Policy Maker visualizes the updated list of chat groups**
Exceptions	**1-Policy Maker does not click on "Interrupt Connection" 2-Policy Maker does not click on "Conferm" The system handles 1 by not activating step 3 of Event Flow When 2 is verified, the system does not actualize the operation requested at step 2 of Event Flow: it brings the user back to the last step of step 1 of Event Flow.**

17)

Name	**Policy Maker visualizes Analytics**
Actors	**Policy Maker**
Entry Condition	**Policy Maker has already logged into Dreams; Analytics are ready.**

Event Flow	**1-Policy Maker opens Dreams' "Analytics" section** **2-Policy Maker visualizes general Analytics** **3-Policy Maker clicks on "Specific Analytic"** **4-Policy Maker visualizes a filter** **5-Policy Maker compiles the obligatory fields of the filter** **6-Policy Maker clicks on "Go"** **7-Policy Maker visualizes the specific ranking and analytic**
Exit Condition	**Policy Maker visualizes the specific ranking and analytic**
Exceptions	**1-Policy Maker does not compile the filter correctly** **2-Policy Maker does not click on "Go"** **The system handles 1 by underlining as wrong the concerned fields and** **When 2 is verified, the system does not actualize step 7 of Event Flow**

18)

Name	**Comment/Special Incentive from a Policy Maker**
Actors	**Policy Maker, Farmer**
Entry Condition	**Policy Maker has already logged into Dreams;** **Analytics are ready; Policy Maker is visualizing some analytics;** **Farmer has already logged into Dreams**
Event Flow	**1-Policy Maker clicks on Farmer's name** **2-Policy Maker clicks on "Send Message"** **3-Policy Maker visualizes a slot in which he can digit some text** **4-Policy Maker digits the message** **5-Policy Maker clicks on "Send"** **6-System shows "Sent"** **7-Farmer receives a "HelpTicket" notificafion type**
Exit Condition	**Policy visualizes the analitycs; Farmer has received the notification**
Exceptions	**-Policy Maker does not click on "Send"** **The system handles this situation by not validating steps 6 and 7 of** **Event Flow**

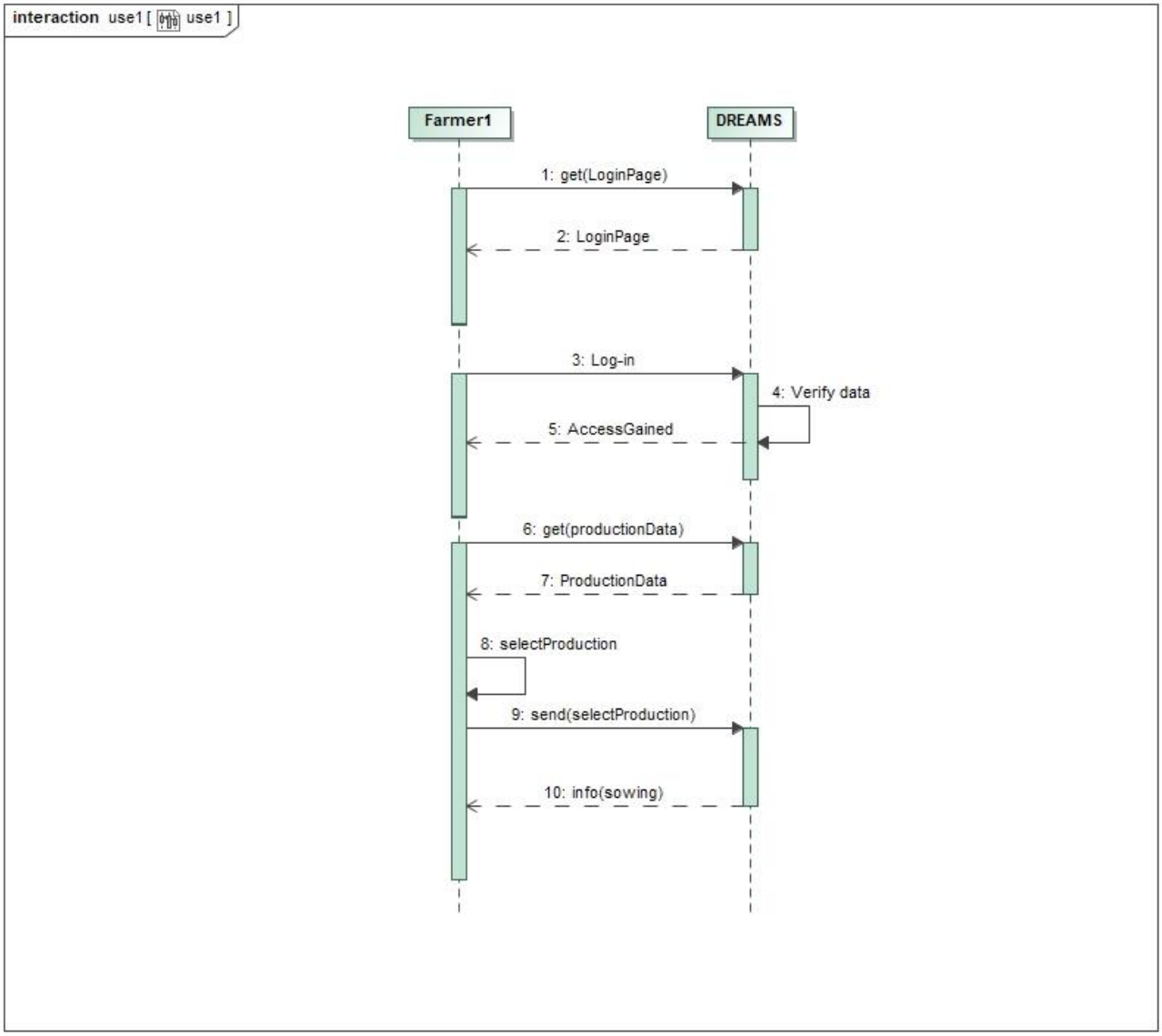
19)

Name	**Weather Broadcast, Humidity of soil data visualization**
Actors	**Farmer**
Entry Condition	**Farmer has already logged in Dreams;** **It is not Farmer's first access**
Event Flow	**-Farmer opens Dreams' "Weather" section** **-Farmer visualizes meteo conditions broadcast real-time,** **percentil of humidity of soil, amount of water used so far for the current** **product**

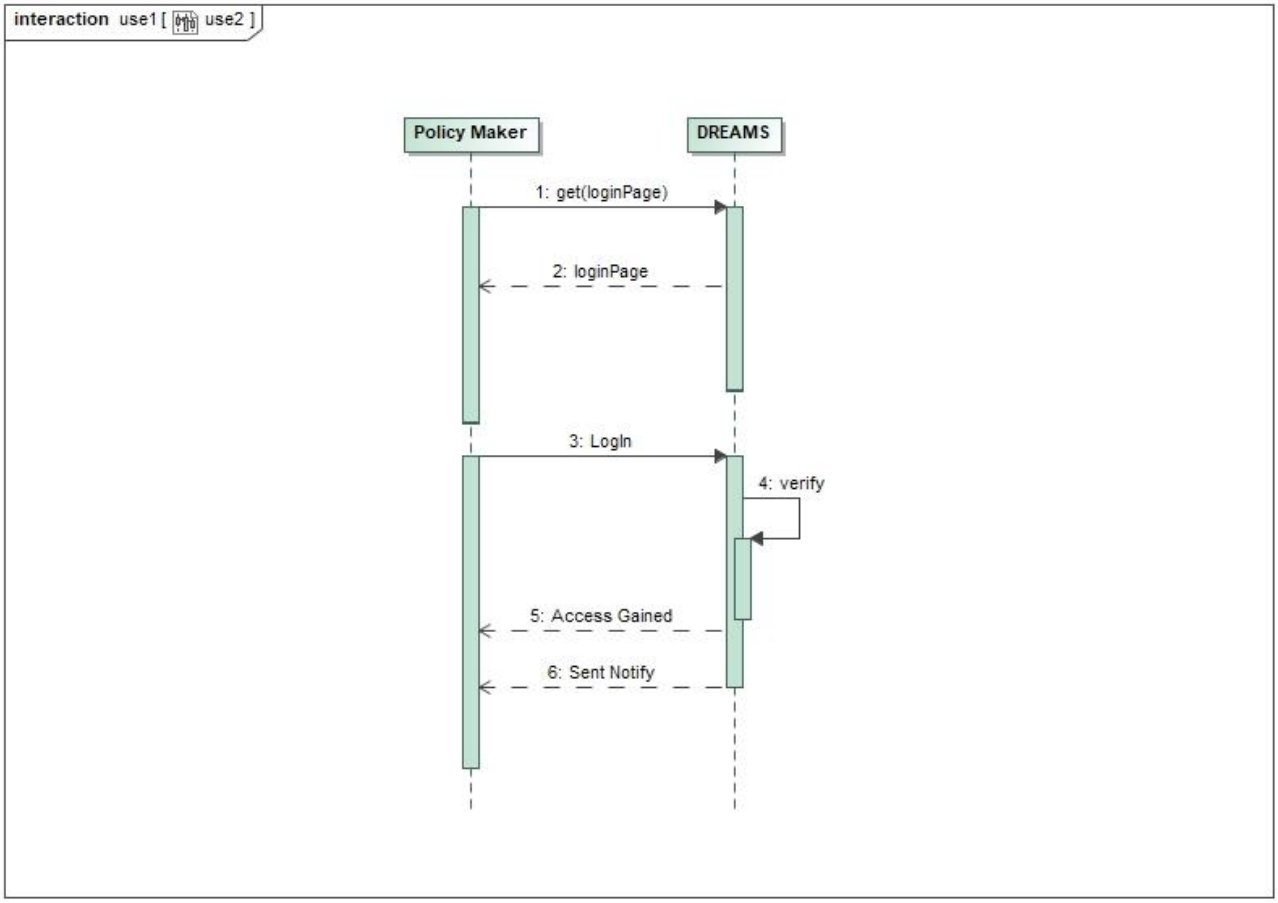
Exit Condition	**Farmer visualize the weather forecast and humidity of soil data for each field in his possession.**
Exceptions	**1-Farmer has fiedls in different locations of the region** **2-Farmer does not select the field** **In the case Farmer owns many fields in different geographical location he will have first to select a preferred one from an interactive page as he enters the "Weather section".** **If the farmer does not select any field, the system will leave him on the interactive page.**

Use Case Diagrams

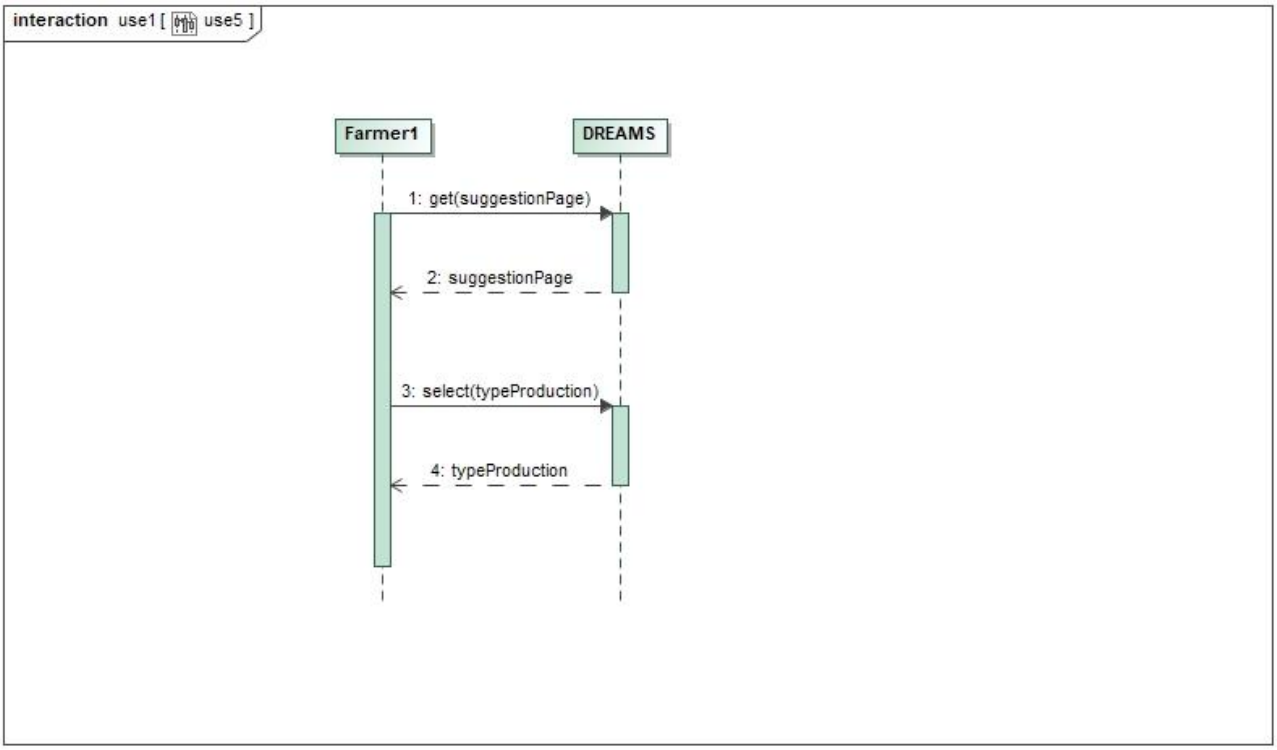
1) **First Login of a Farmer**



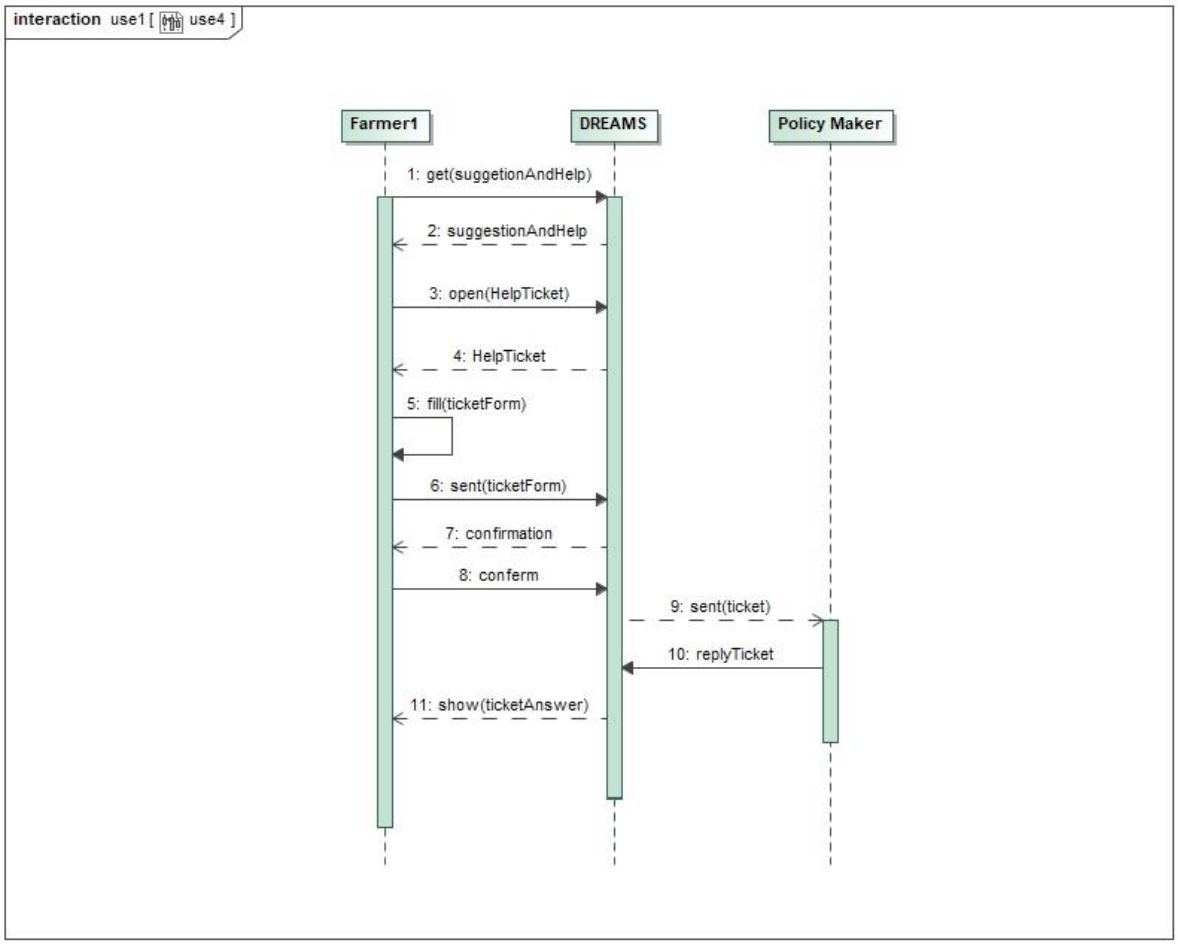
2) **Login of a Policy Maker**



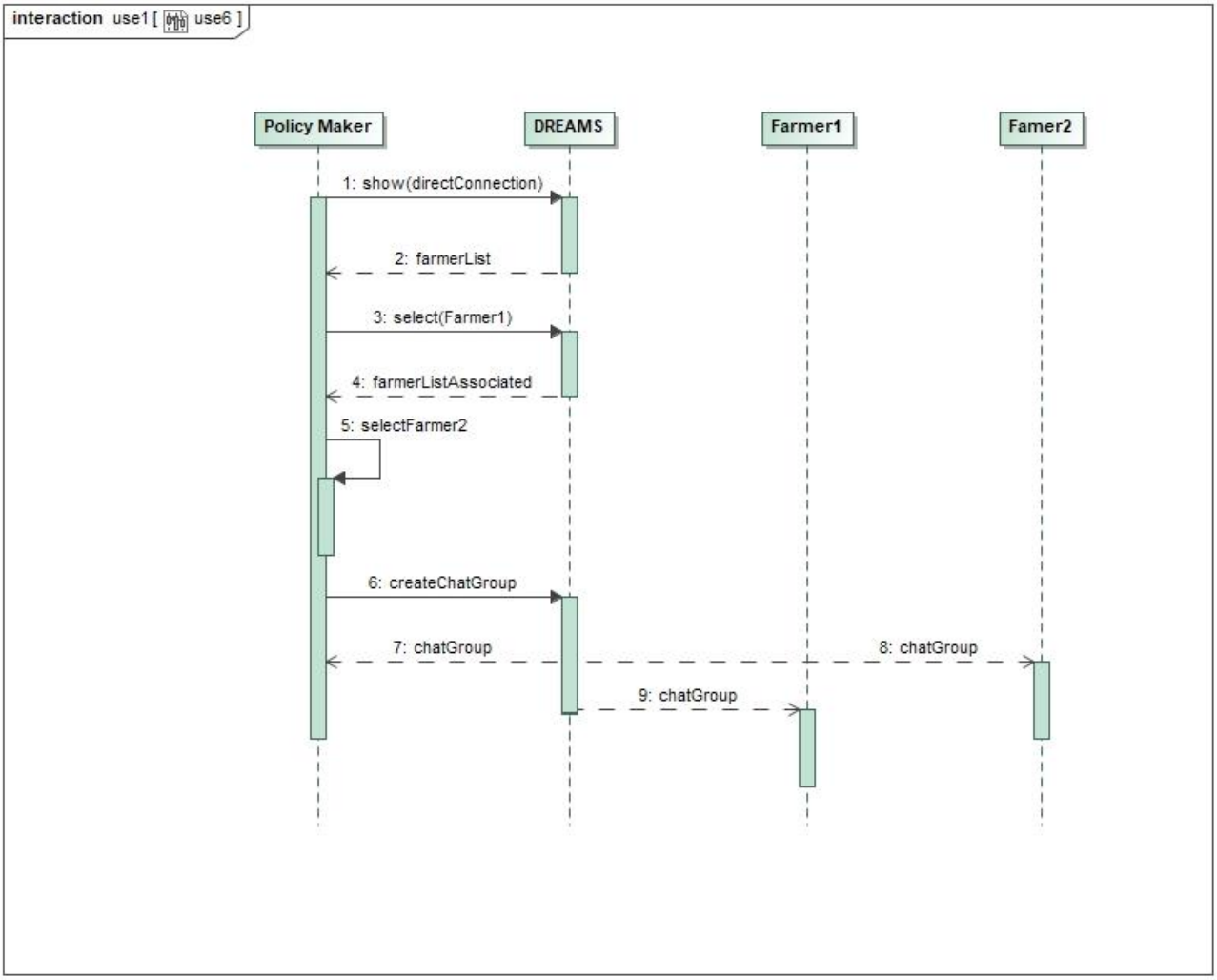
3) **Production data uploading**



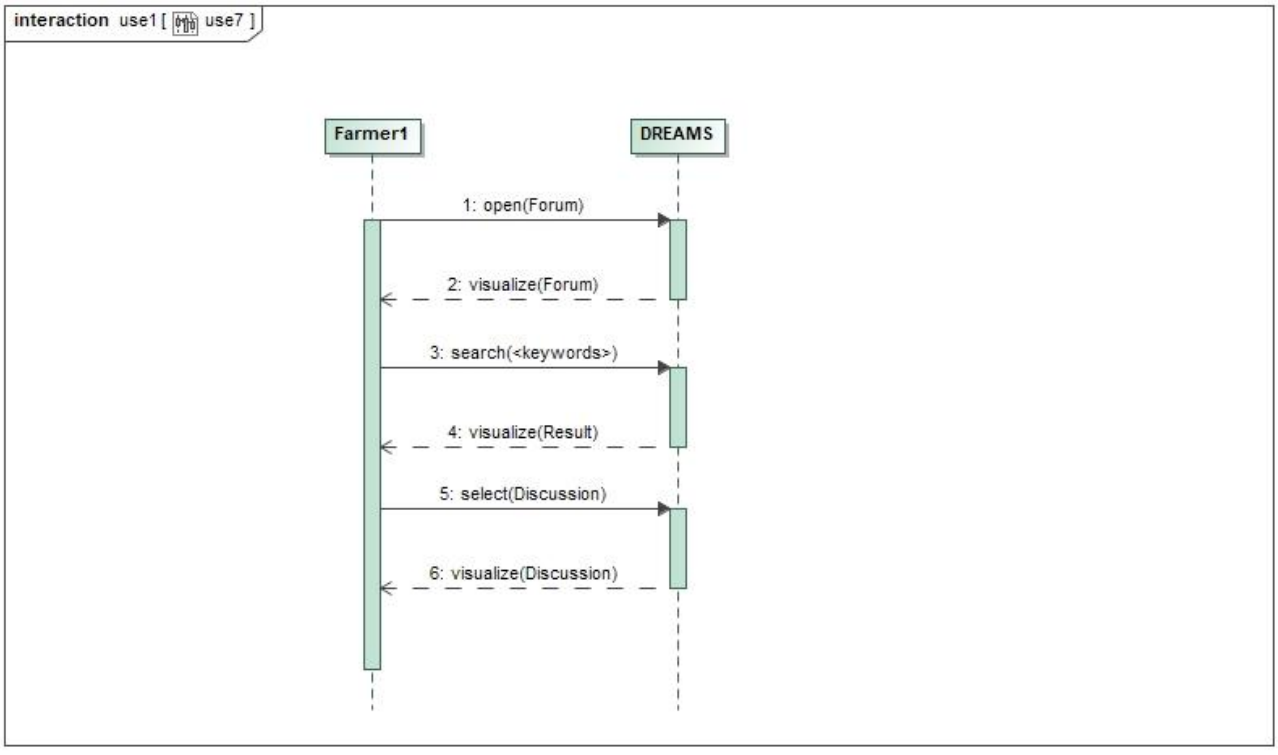
4) **HelpTicket generation and gestion**



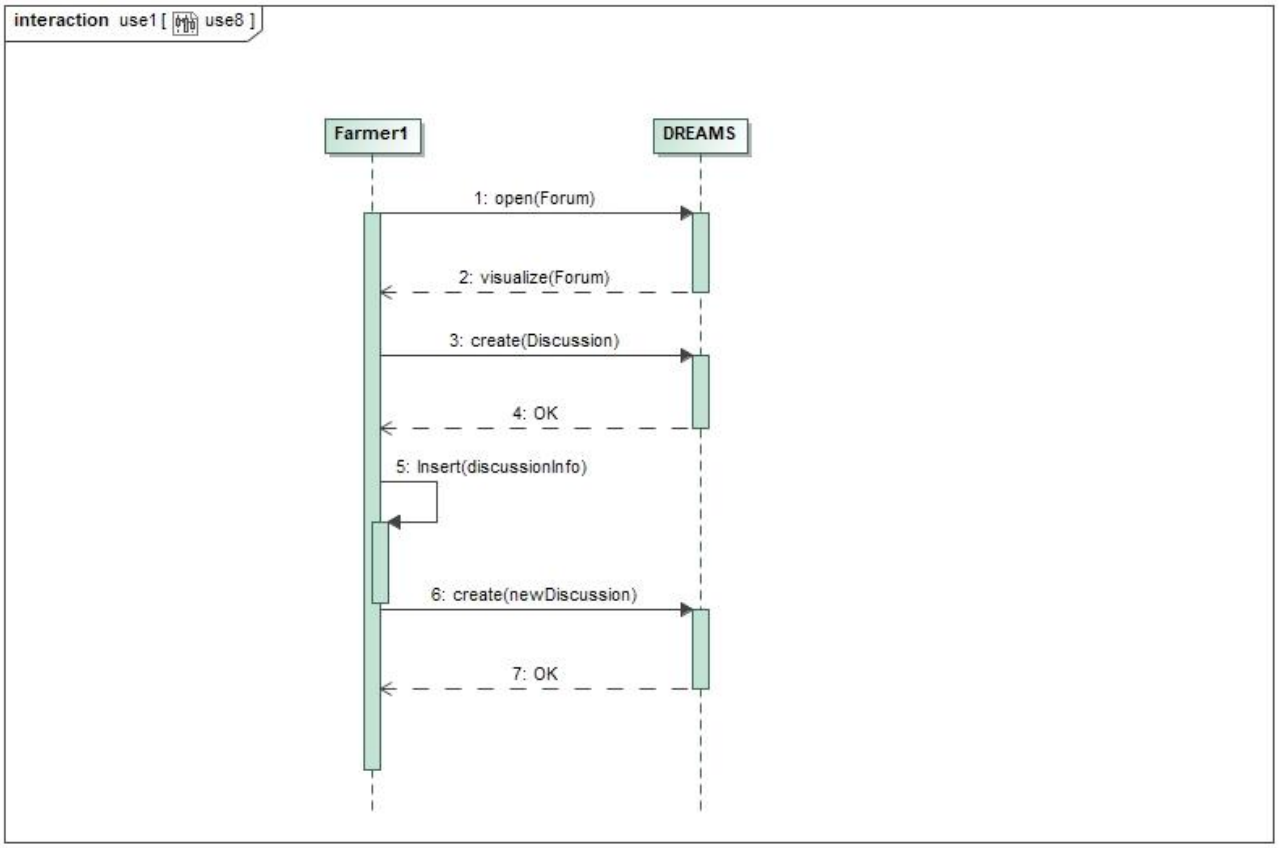
5) **Direct Connection**



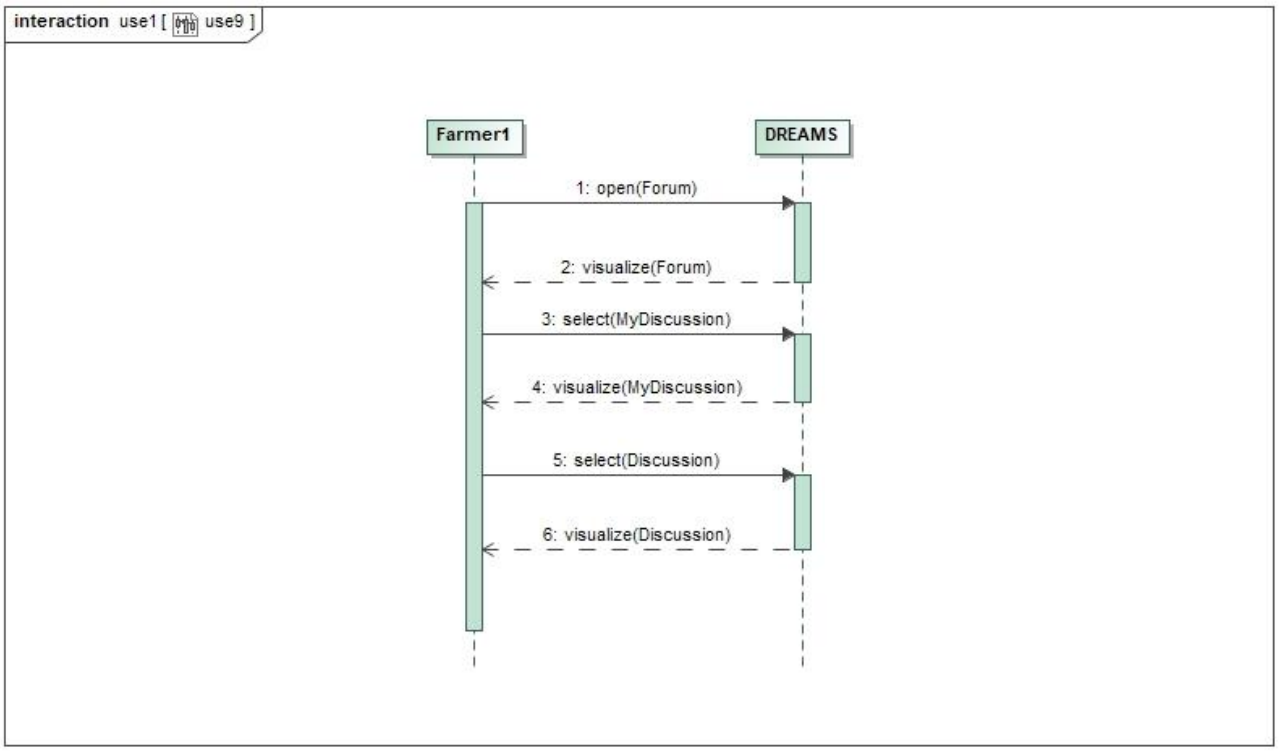
6) **Search for a forum discussion**



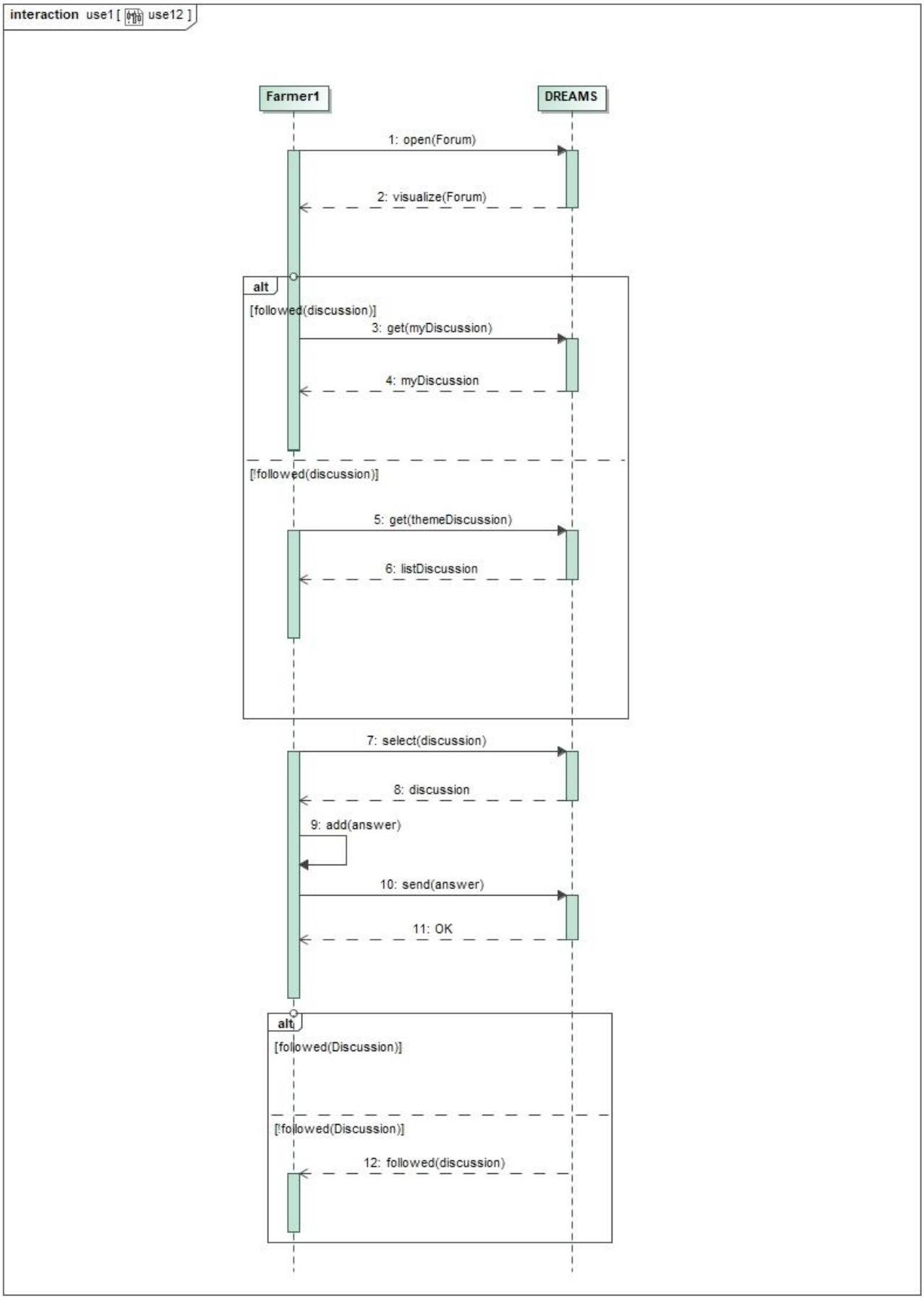
7) **Create a forum discussion**



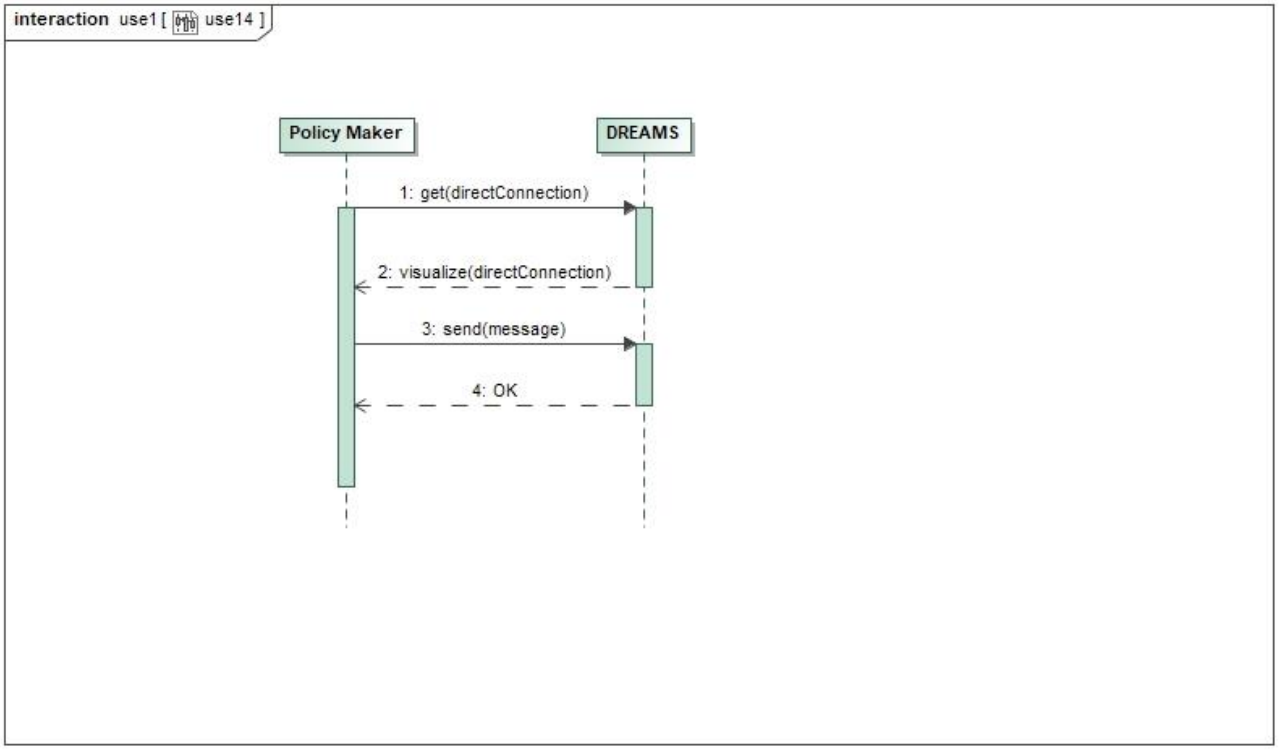
8) **Check a followed forum discussion**



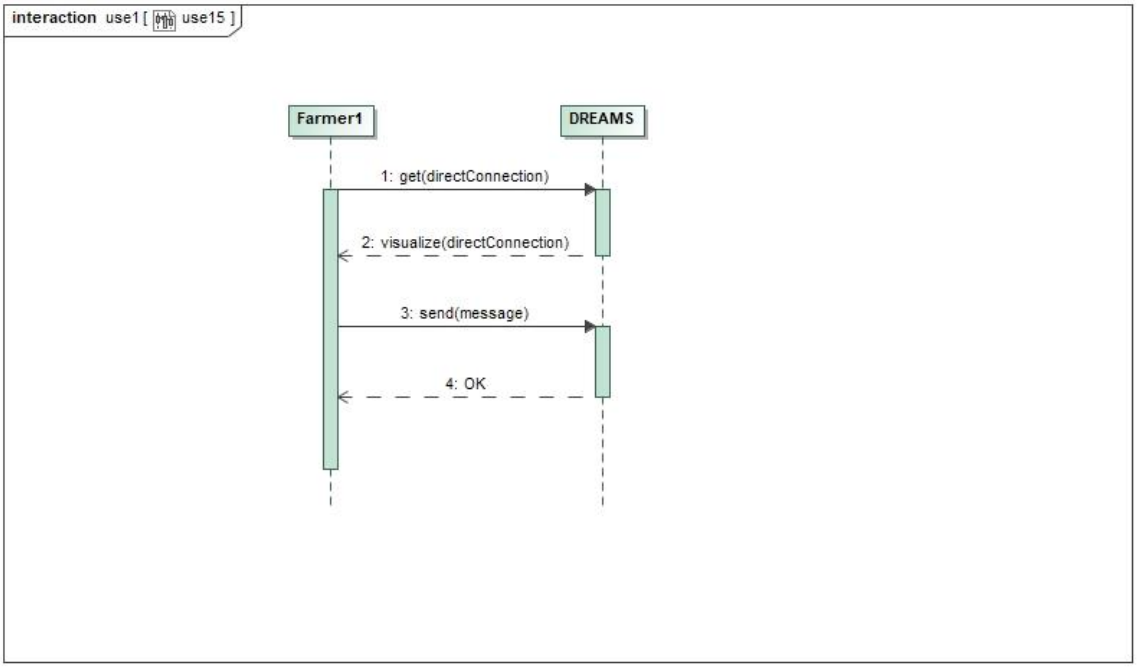
9) **Farmer adds an answer to a discussion he does not follow/Farmer adds an answer to an already followed discussion**



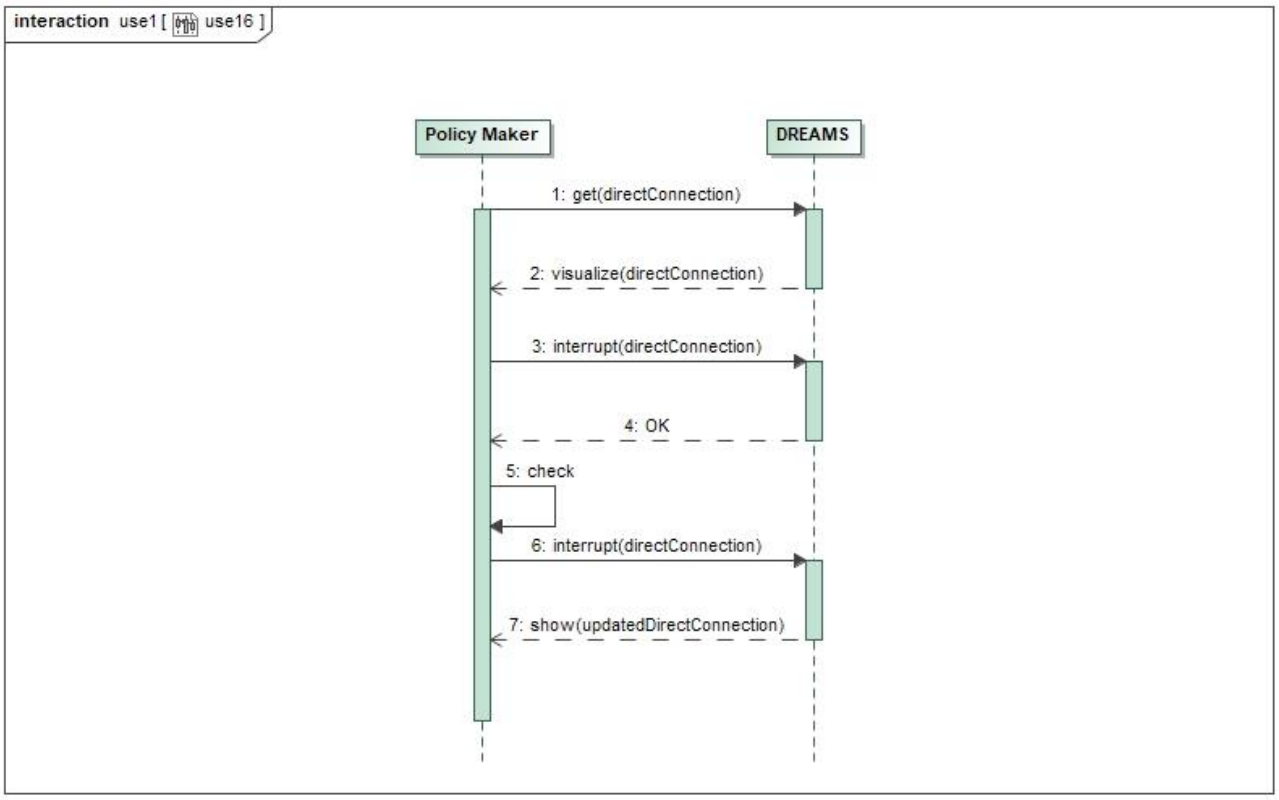
10) **Policy Maker adds a message to a chat group**



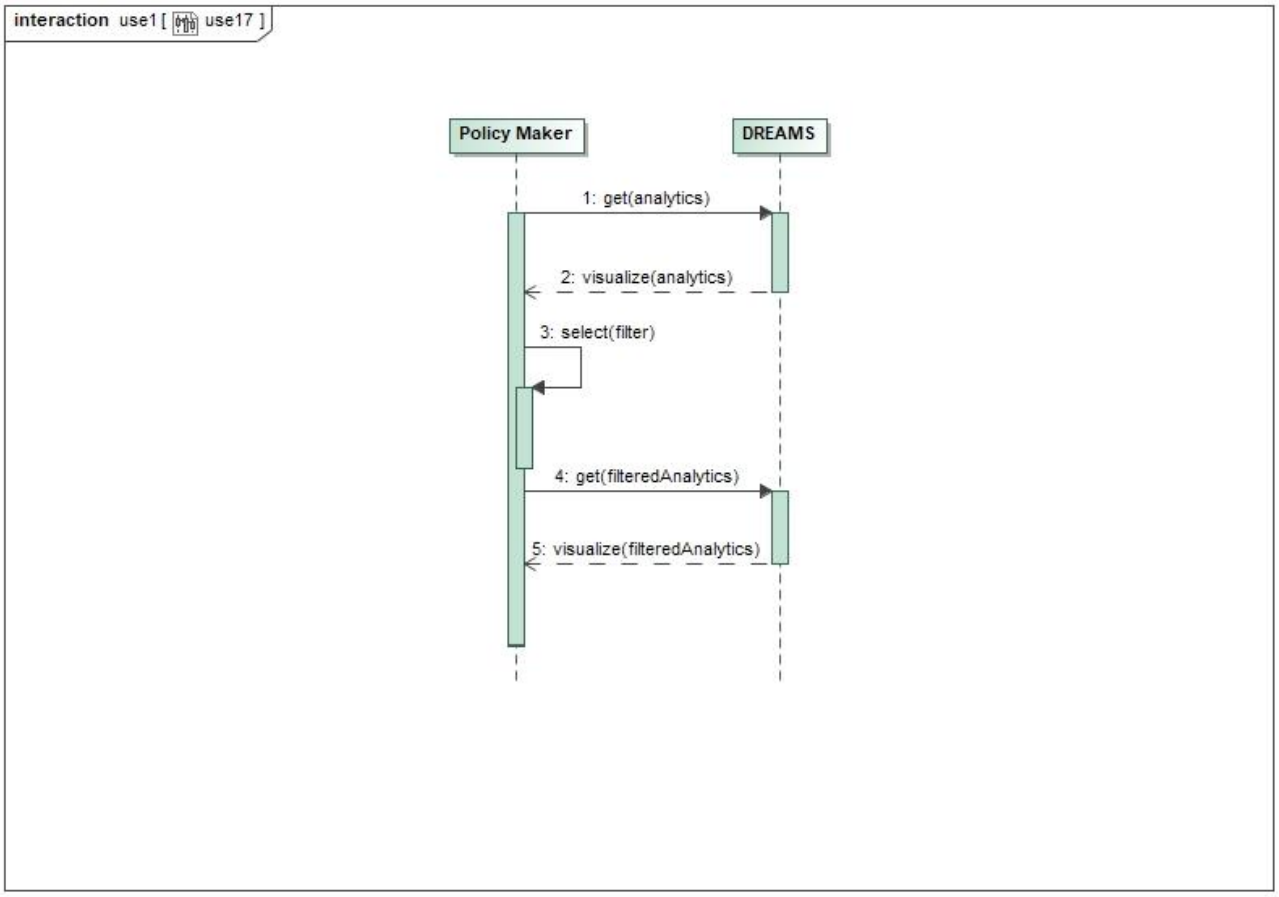
11) **Farmer adds a message to a chat group**



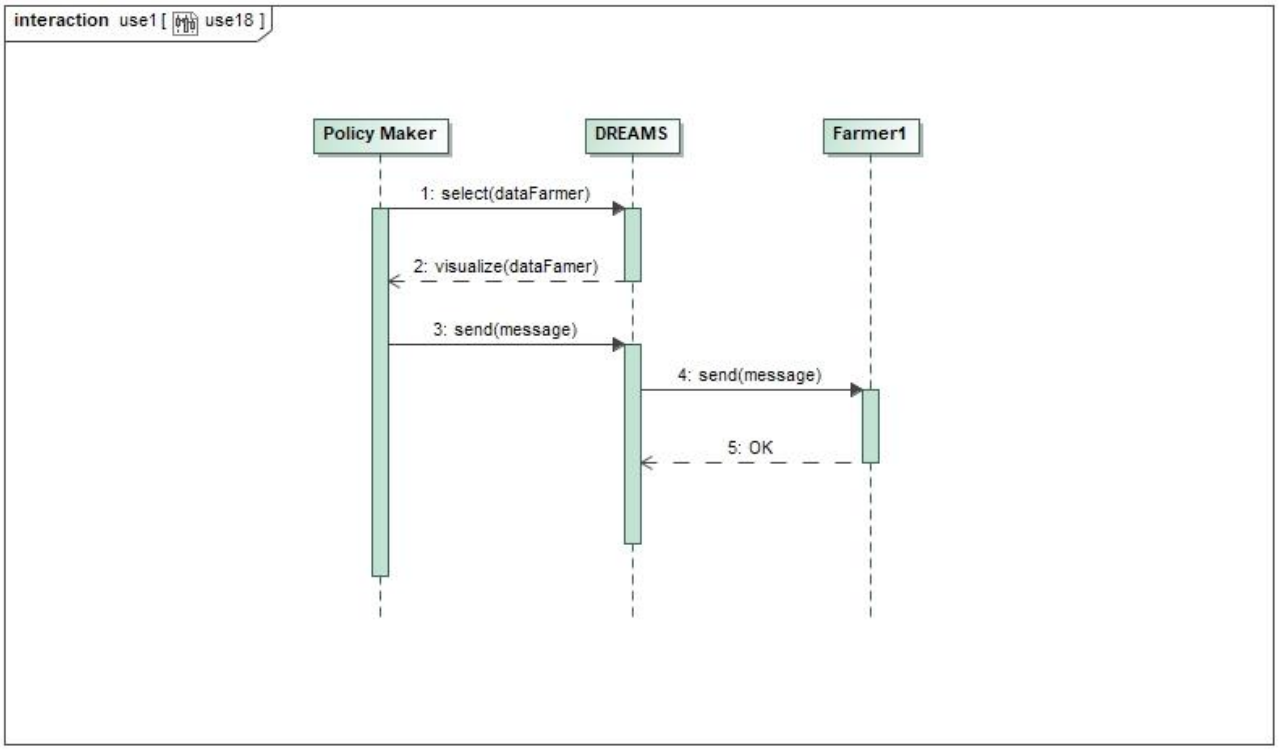
12) **Interruption of a Direct Connection**



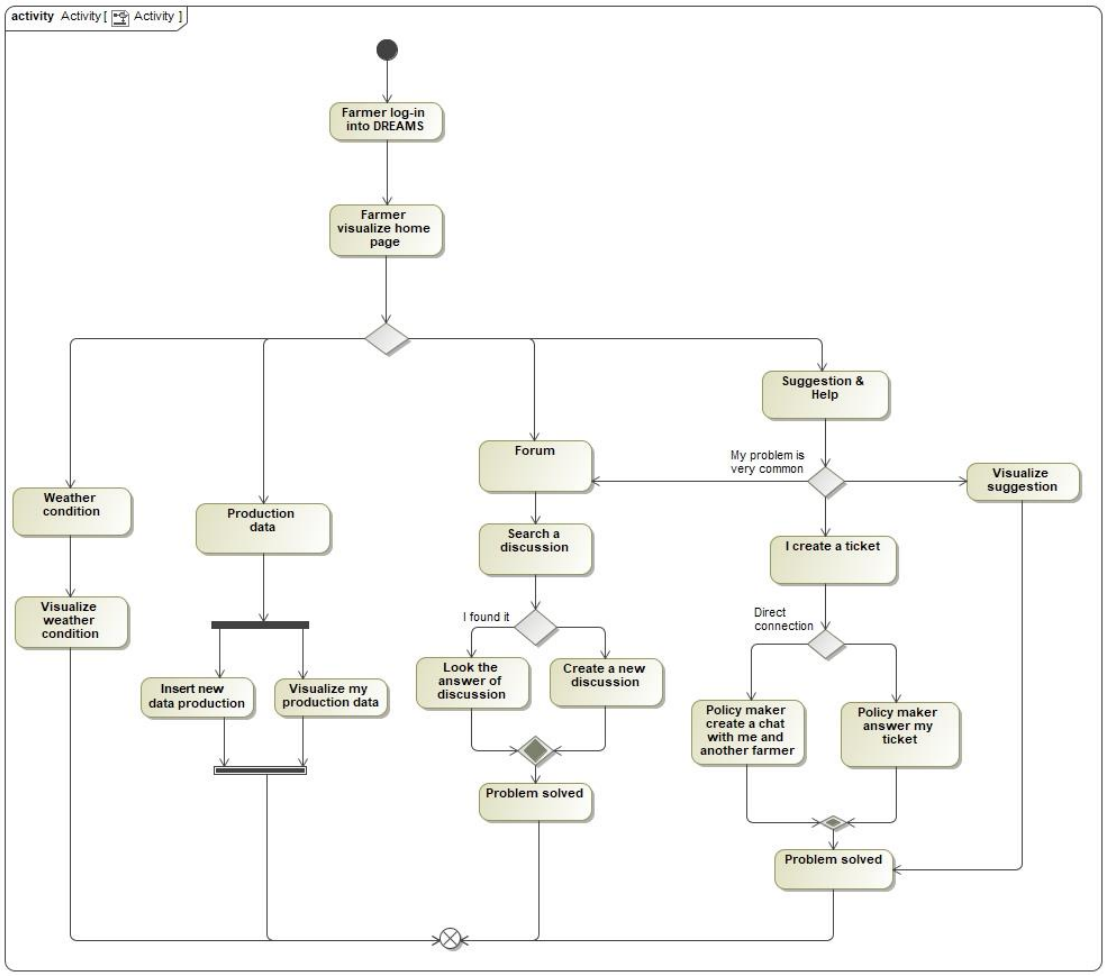
13) **Policy Maker visualizes Analytics**



14) **Comment/Special Incentive from a Policy Maker**



Activity Diagrams



PERFORMANCE REQUIREMENTS

- The sofwtare should be available 99% of the time
- The software should be to respond to users' requests in less than 5 seconds
- The software must be able to guarantee the simultaneous connection of at least 100.000 individuals

DESIGN CONSTRAINTS

STANDARDS COMPLIANCE

The code should follow the requirements contained in this document. Its comments must be readable, clear and focused.

HARDWARE LIMITATIONS

The software application requires a mobile device: a tablet or smartphone. The tablet should be provided to the users together with the software system. Both the types of mobile devices should allow the users to take picture. Alternatively, users, especially farmers who don't need to take pictures can log into the system via webapp and access all its functionalities, the the attachment of pictures feature excepted.

ANY OTHER CONSTRAINT

The user cannot attach more than 8 pictures within any functionality of the system that allows the access to the camera.

SOFTWARE SYSTEM ATTRIBUTES

RELIABILITY

The system must be available 24/7. The system should be fault tolerant; its architecture should account for possible damage on system components, providing duplicates ready to be substituted. Only small deviations from this requirement will be accepted.

AVAILABILITY

Redundancy should be taken into account: a system of redundant servers may be considered - if possibly one server fails, the other one will be ready to take over, to ensure recovering from eventual data losses. Moreover, the system is expected to be available 99.99% of the time in order to guarantee the system to provide some high degree of availability.

SECURITY

Security of the data will be ensured for the system addresses a close category of users. Registration data will be directly taken from the national registers. As the user adheres, they will be assigned username and password that they will be invited to update periodically: those will be stored and encrypted with high-security encryption.

MAINTAINABILITY

The system is going to be free of excessive technical complexities, undetected vulnerabilities, source code defects and excessice dead code. To achieve this, clear and quality code following good design patterns that provide a standard terminology with a high level of abstraction will be used. Futhermore, the system is expected to be flexible in order to facilitate the enhancement of its current functionalities and the introduction and addition of new functionalities and features. More detailed, clear and complete documentation will be provided to sustain the achievement of that goal.

PORTABILITY

The software should be highly portable. Yet, it must support Android and iOS operating systems, as well as it must run in different platforms such as Windows, Linux and Mac operating systems, in order to guarantee the system a good platform flexibility and a scalable a replicable architecture.

FORMAL ANALYSIS USING ALLOY

For simplicity, the system is modelled in such a way to illustrate and highlight the functionalities of the class diagram

Code

```
open util/integer
sig PolicyMaker{
}
sig Farmer{
	policy: one PolicyMaker
}
sig Field {
	latitude: Int, //should be a float
	longitude: Int, //should be a float
	extension: Int, //should be a float
	weather_station : one WeatherStation,
	farmer: one Farmer,
	water_amount: Int //should be float
}
//Type of product
sig Type {}
abstract sig ProdData {
	farmer: one Farmer
}
sig ReapData extends ProdData {
	type: some Type
}
sig SowData extends ProdData {
	type: some Type
```

```
}
sig ChatGroup {
	farmer1: one Farmer,
	farmer2: one Farmer,
	chat_policy: one PolicyMaker,
	direct : one DirectConnection
} { farmer1 != farmer2 }
sig DirectConnection {
	chat: one ChatGroup
}
sig HelpTicket {
	policy_m: one PolicyMaker,
	farmer: one Farmer
}
sig PersSuggestion {
	farmer: one Farmer,
	sow_prod: one SowData
}
sig ForumDiscussion  {
	farmer: some Farmer
}
sig WeatherStation {
	latitude: Int, //should be float
	longitude: Int, //should be float
	weather: one Weather
}
enum Weather {
	rainy,
	sunny,
	windy,
	sultry
```

```
}
// a Field is associated to only one Farmer; a Farmer can have many Fields
fact {
	all f: Farmer | some t : Field | f in t.farmer
}


fact {
	all d : DirectConnection | one c : ChatGroup | c in d.chat
}
// The 2 farmers in a direct connection must be under the same policy maker, and also the policy maker has to be in the chat group
fact chatPolicy {
	all c: ChatGroup | all p: PolicyMaker | all f1: Farmer, f2: Farmer |
	p in c.chat_policy implies f1.policy = p and f2.policy = p
}
//every chat group is associated with one and only one direct connection and viceversa
fact {
	all c : ChatGroup, d : DirectConnection | c = d.chat iff d = c.direct
}
fact {
	all s : SowData, p: PersSuggestion | s.farmer = p.farmer
}
//A ticket generated by a farmer is Always received by the policy maker supervisioning the farmer
fact {
	all h : HelpTicket |   h.farmer.policy = h.policy_m
}
pred show {
	#Farmer > 0
	#PolicyMaker> 0
	#Field = 3
	#ReapData = 1
	#SowData = 1
```

#DirectConnection = 1

#ChatGroup = 1

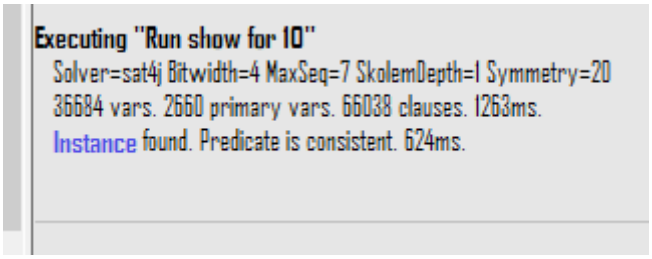
#PersSuggestion = 2

#HelpTicket = 2

}

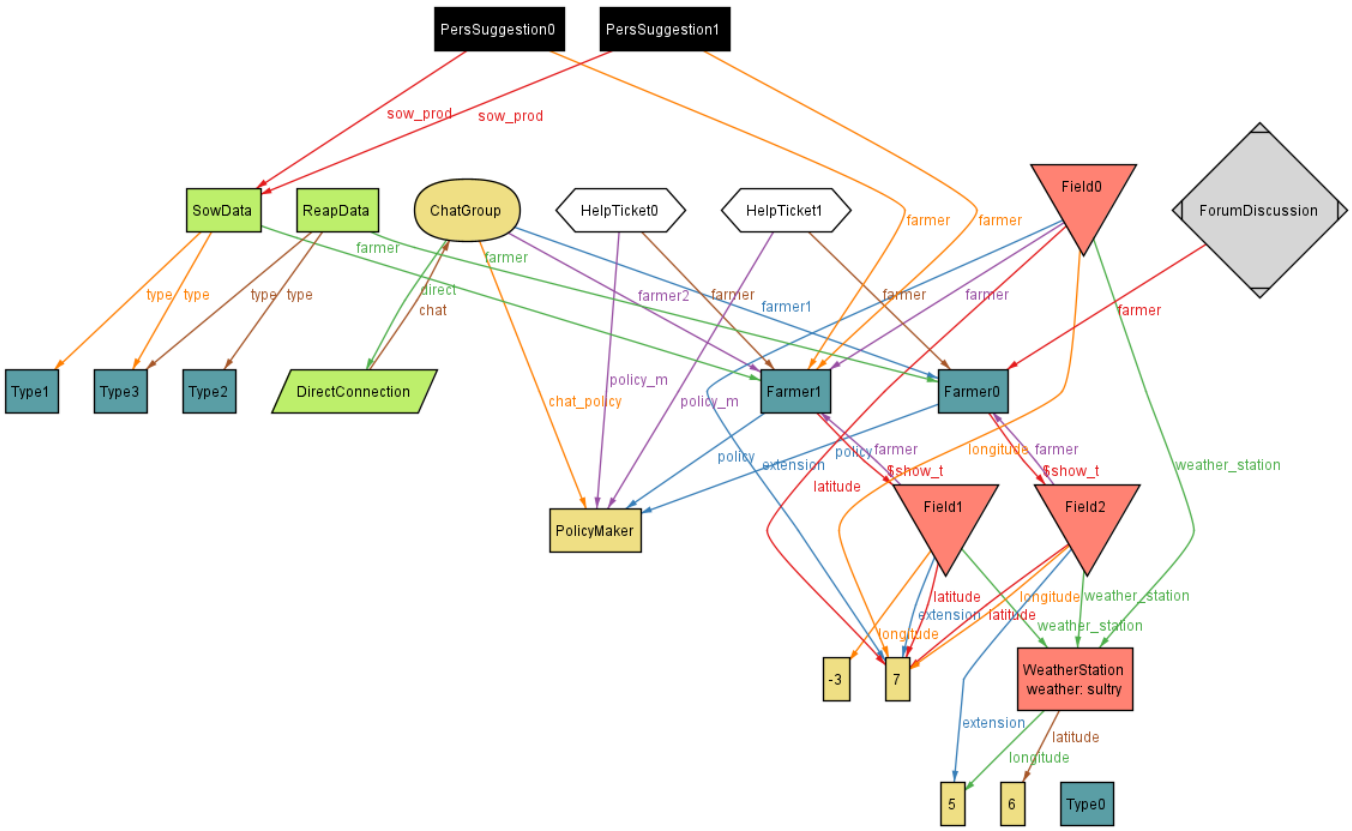
run show for 10

Result

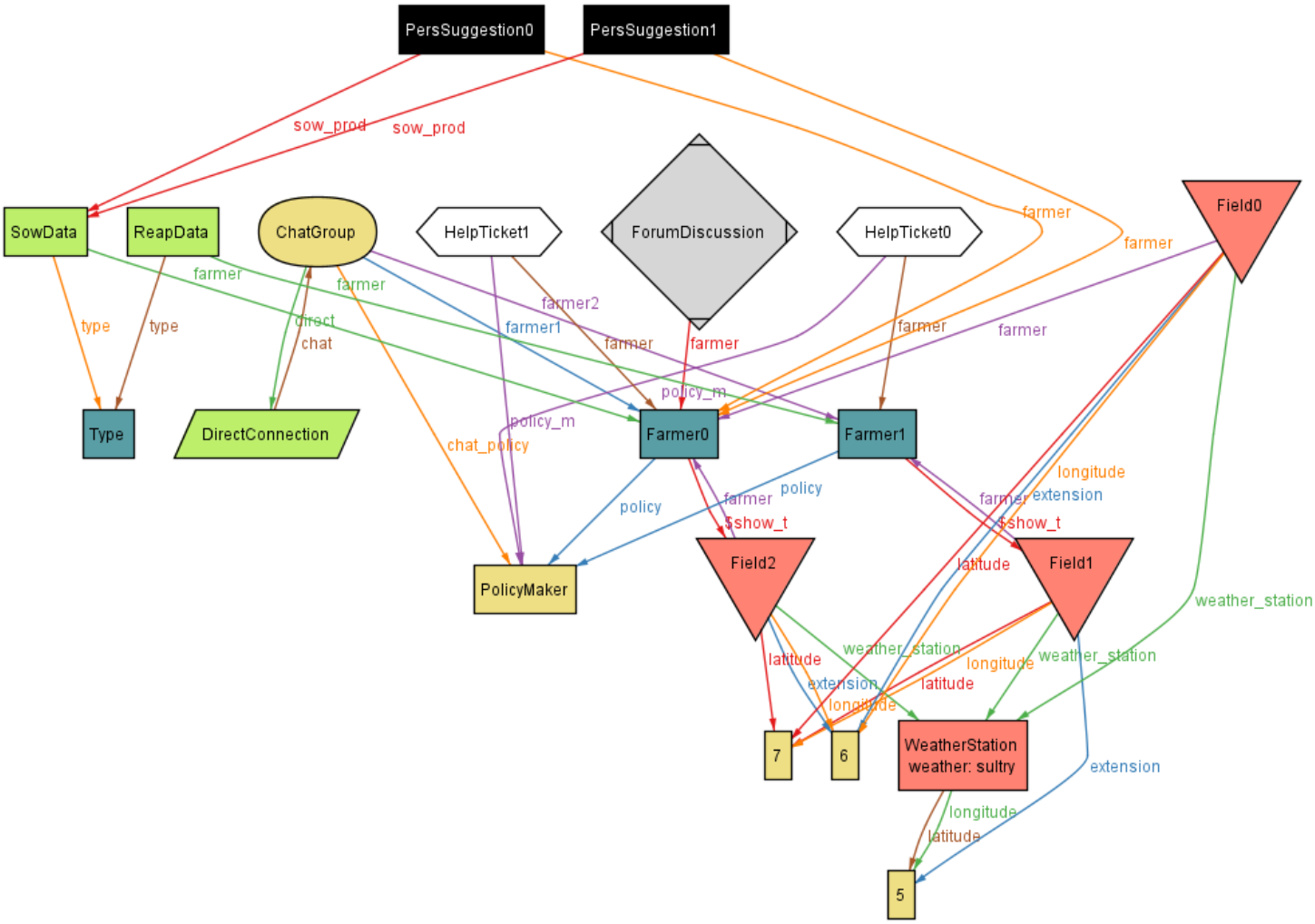


Generated Instance

First Run



Second Run


PersSuggestion0
PersSuggestion1
sow_prod
sow_prod
SowData
ReapData
ChatGroup
HelpTicket1
ForumDiscussion
HelpTicket0
Field0
farmer
farmer
farmer
farmer
farmer2
farmer1
farmer
farmer
farmer
farmer
type
type
direct
chat
policy_m
policy_m
chat_policy
Type
DirectConnection
Farmer0
Farmer1
policy
policy
farmer
$show_t
farmer
extension
$show_t
longitude
latitude
Field2
Field1
PolicyMaker
weather_station
weather_station
weather_station
latitude
longitude
extension
latitude
longitude
7
6
WeatherStation
weather: sultry
extension
longitude
latitude
5

Effort spent

Student 1

Topic	Hours
General Reasoning	**8:00h**
Class Diagrams	**3:00h**
Statecharts	**3:00h**
Product functions	**4:30h**
Functional requirement	**5:20h**
Alloy	**6:00h**
Document organization	**4:00h**

Student 2

Topic	Hours
General Reasoning	**6:00h**
Purpose & Scope	**2:00h**
Statecharts	**3:00h**
Domain assumption	**5:30h**
Use case & Use case diagrams	**12:20h**
Desing constraints	**6:00h**
Document organization	**4:00h**
System attributes	**1:30h**
User characteristic	**3:00h**

References

- All the diagrams have been made with MagicDraw
- Alloy code was made on the specific Analyzer too