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To cite this article: G A Blagodatsky *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **537** 042037

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# Information system UML-model development by OMG RUP technology for Food industry enterprises

G A Blagodatsky, S V Vologdin, M M Gorokhov and D E Dokuchaev

Information systems Department, Izhevsk State Technical University, Studencheskaja, 7, Izhevsk, Udmurt Republic, Russia, 426069

E-mail: insys2005@mail.ru

**Abstract.** An important element in planning the development of computerized control systems is a systematic study of the subject area. Such modeling used to solve the problem of "software development crisis" - to assess the scale of the system, and the necessary means for its implementation. The paper presents the UML-model of the classes of a food industry enterprise using the example of a bakery. The enterprise actually works by the JIT system way. Therefore, during automation, one must take into account that the main process is strongly associated with the results of auxiliary processes. Based on use-case diagrams, a UML - model of classes for production has been developed. An approach is proposed to solve the problem of designing the structure of an information system based on the UML - classes model of the subject area. The RUP approach to the development of the model of an information system for managing auxiliary business processes of an industrial enterprise was implemented. As a result of the research it was revealed that the data structure will consist of 3 main sections providing information needs of production, management and delivery of finished products to implementation points. The high complexity of the information system's database is indicated; because of the minimum number of basic classes of domain entities that group tables according to «1- to - n» - connections is not less than 15.

## 1. Introduction

High technology projects implementation process of the complex technical objects, large volumes of heterogeneous and distributed data are often created and used; this information load makes it difficult not only to effectively use the accumulated data and knowledge, but also to understand the characteristics of the development of the project itself.

To solve this problem, scientists offer various methodological approaches to reducing the level of uncertainty of knowledge-intensive projects, for example: analysis of knowledge of experts and stakeholders [1], analysis of organizational structure, staff and information resources of the project [3], critical chain planning and principles of the theory of constraints according to the subject area of the project [2], analysis of the social network and project links [4].

At different times, models for the analysis of projects of complex technical systems were proposed. Takenberg S., Dukwitz S., and K. Schlick proposed a design engineering approach based on process and actor-oriented models [5]. Bukhin E. and Rozens H. [3] developed a multi-purpose optimization model for choosing a solution for implementing a project from a set of alternative options. In [6] examples of solving problems of project optimization in various situations are given on the basis of the structure of the decision tree constructed by the authors in time, called the "project tree". The authors



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of [7] proposed graphical structures for representing knowledge about the project on the basis of a thematic and situational analysis of the life cycle. In [8] an optimization model of the planning task for project management processes with the constraints of several executive modes, multi-profile staff and priority of tasks is presented.

It should be noted that the modeling and management of knowledge-intensive knowledge-based projects is used in many fields of activity: the development of transport infrastructure [11], construction [10], the introduction of lean manufacturing methods [9], electricity generation [12], the development of strategies humanitarian logistics [13].

Important element of planning of development of the computerized control systems is the system research of subject domain. Similar modeling is intended to solve a problem of "crisis at development of the software", i.e. to estimate the system scale, and necessary means for her realization. The first that needs to be realized at this approach is a model of precedents of subject domain. For the considered enterprise of the food industry modeling of precedents of subject domain is carried out [14].

As a result of a research it is revealed that as a part of a production system there are 15 active elements which interact among themselves as a part of 3 subsystems of the main system (10 main packages of precedents of subject domain are revealed). The production system represents (1):

$$S = \{\bar{y}, Q, \bar{B}\}, \quad (1)$$

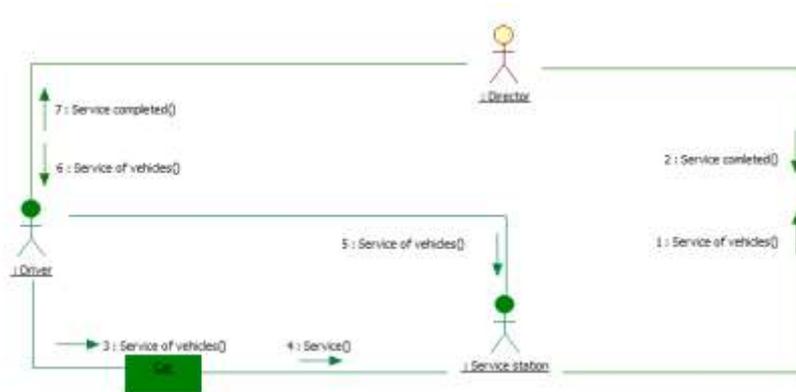
where  $\bar{y} = \{y_i\}, i = \overline{1, m}$  - product assortment,  $Q = 16625$  - release volume (depends on needs of consumers),  $\bar{B} = \{B_j\}, j = \overline{1, n}$  - realization points. Restrictions are imposed on system (2):

$$\{\bar{v}, \bar{t}, \bar{r}, \bar{s}, c_g, c_c, g\}, \quad (2)$$

where  $\bar{v}$  - capacities of places of storage,  $\bar{r} = \{r_i\}, i = \overline{1, n}$  - times of deliveries,  $\bar{t} = \{t_i\}, i = \overline{1, n}$  - periods of storage of materials,  $\bar{s} = \{s_i\}, i = \overline{1, m}$  - periods of storage of finished product,  $c_g = 128$  - car capacity,  $c_c = 16$  - tray capacity,  $g = 3$  - vehicle fleet volume [14].

## 2. Delivery system

The enterprise actually works on the JIT system. Therefore, at automation it is necessary to consider that the main process is strongly connected with results of auxiliary processes [15] (it is necessary to deliver reliably and in due time raw materials and materials and to quickly carry out delivery of finished goods to realization points), and the system (1) represents difficult, multilevel system with active elements. We will consider process of delivery of finished goods to realization points (see figure 1).



**Figure 1.** Collaboration diagram of "Car park".

In the figure 1 the participants connected with automobile economy of the enterprise are marked out. These actors conduct activity connected not only with delivery of the goods, but also with service and car repairs which are available at the enterprise. These are such actors as: "Driver", "Director", "Service stations", their activity is directed to maintenance of ability of the enterprise to carry out delivery to the made production. The driver receives a task to make service of the car from the director. After that the driver on the car goes to service station where makes all works then the service station makes out the director a bill for the performed works are necessary.

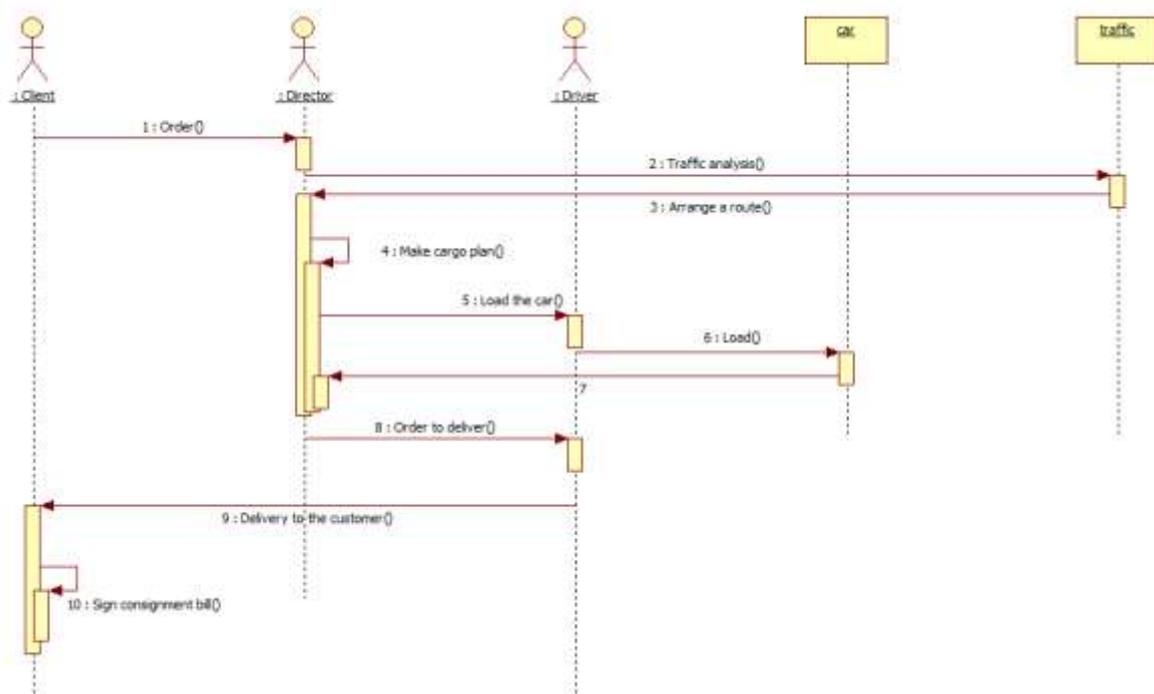


Figure 2. Sequence diagram "Delivery".

On the basis of the provided charts the model of classes is developed for delivery (see figure 3).

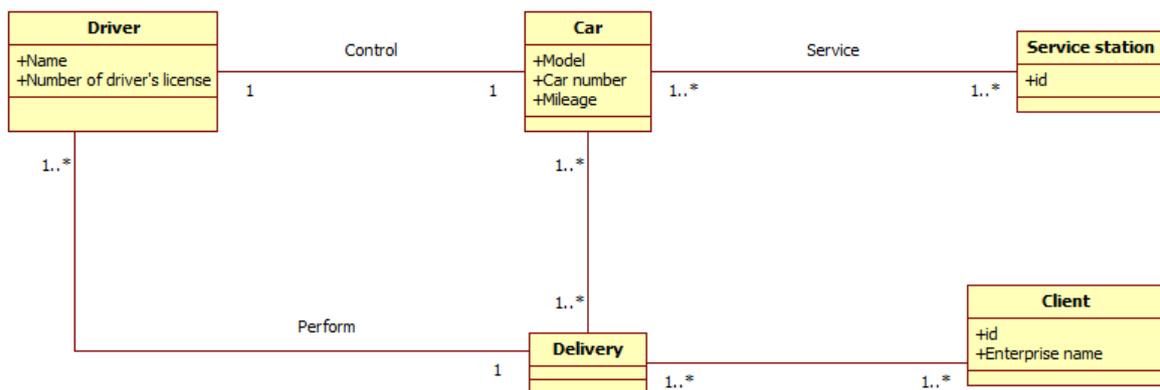


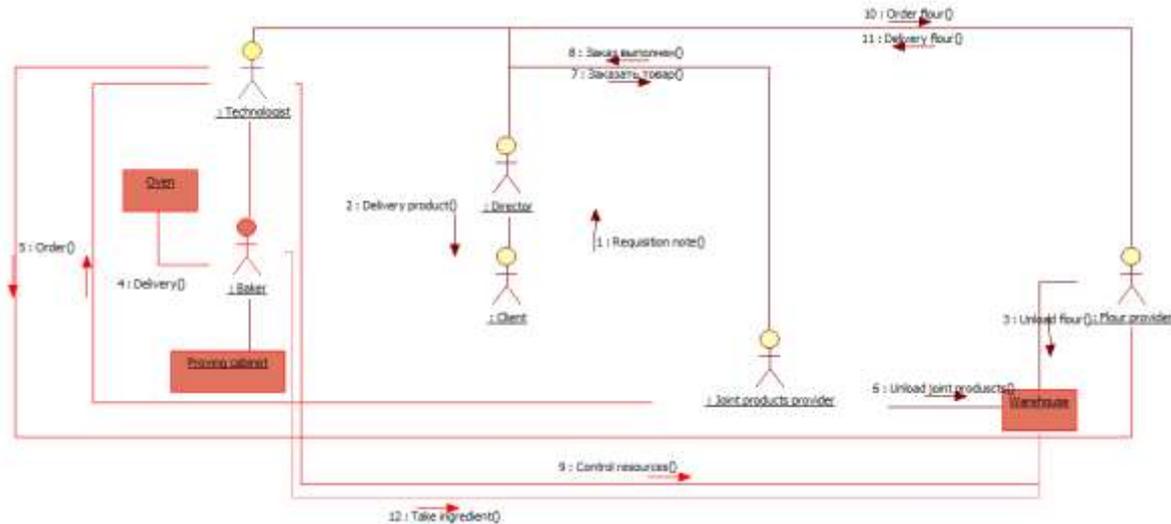
Figure 3. Class diagram "Delivery".

In the course of delivery classes have been allocated: "Driver", "Car", "Service station", "Client". The main participants of this process are "Driver" and "Client". "Driver" carries out delivery by means

of "Car". One "Driver" uses for delivery one "Car" for delivery of production to a quantity of clients, about 40 shops for one route.

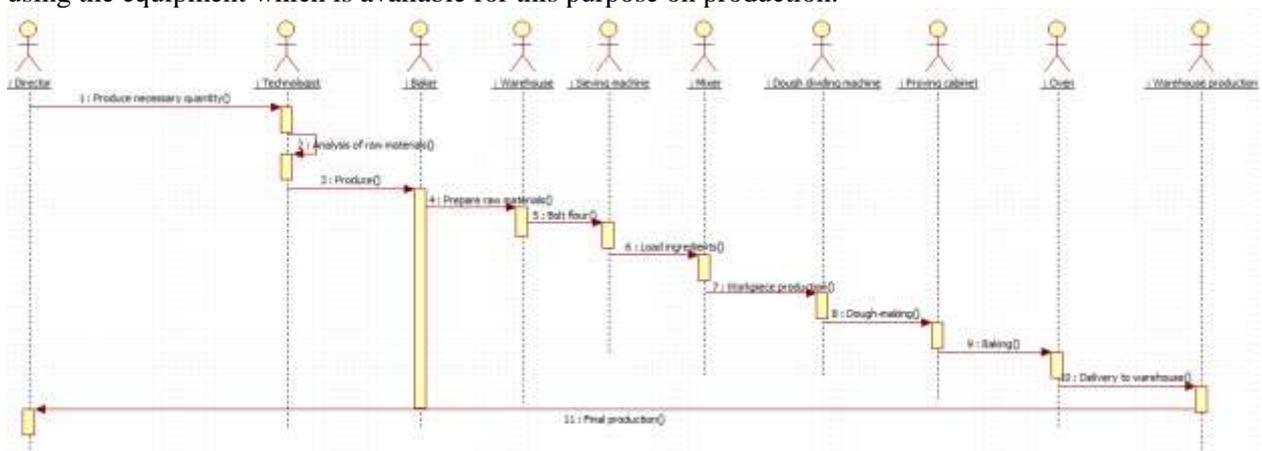
### 3. Production and purchase systems

In the figure 4 actors and their interactions in the enterprise are marked out.



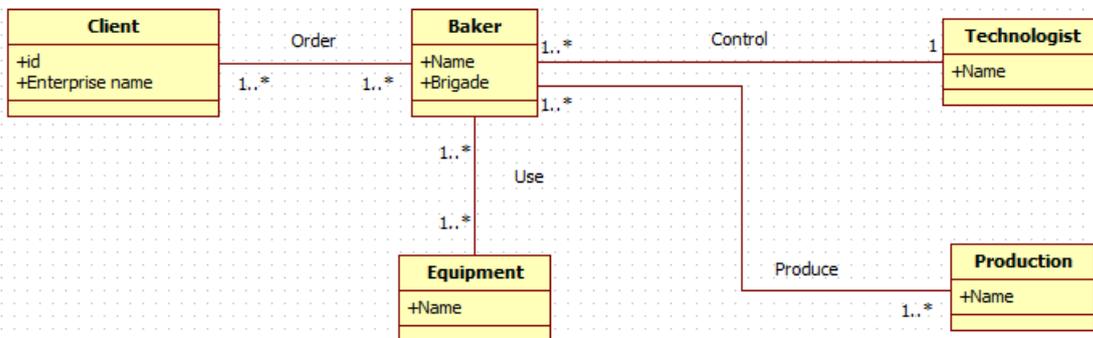
**Figure 4.** Collaboration diagram of "Production system".

These actors participate directly in production. These are such actors as: baker, oven, dough dividing machine, warehouse. These actors are the main in the course of production. The baker receives a task from the technologist, to make necessary quantity of production, after that the baker goes to a warehouse behind necessary raw materials and begins process of production of production, using the equipment which is available for this purpose on production.



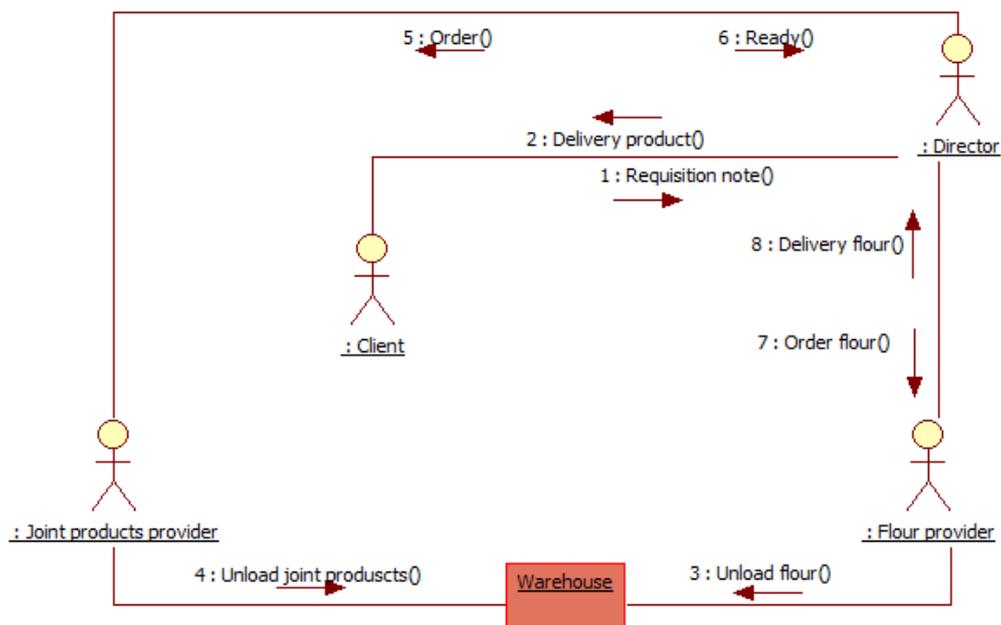
**Figure 5.** Sequence diagram of "Production System".

On the basis of the provided diagram class diagram is developed for production (see figure 6).



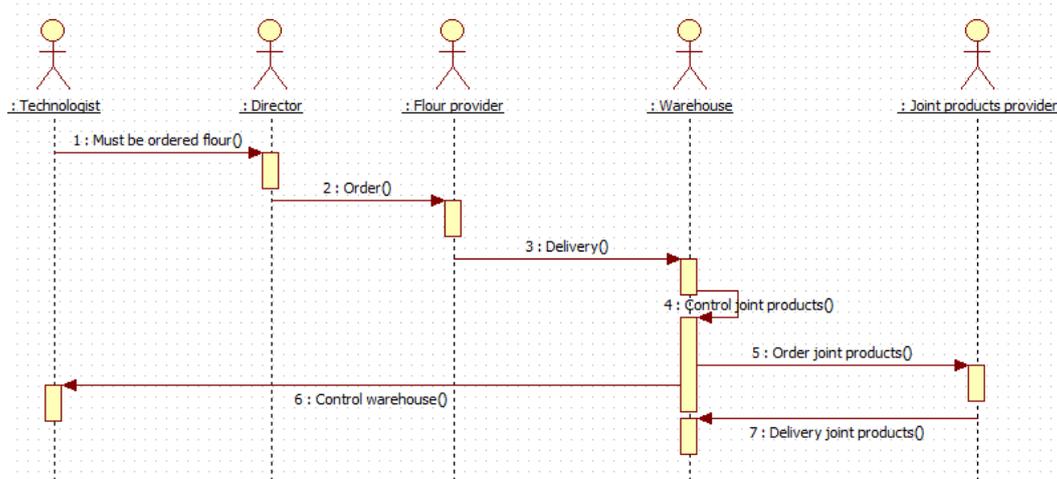
**Figure 6.** Class diagram of "Production system".

In the course of production the following classes have been allocated: "Baker", "Technologist", "Client", "Equipment", "Production". To start production the client does the application, further the baker under control of the technologist and by means of the equipment turns out products.



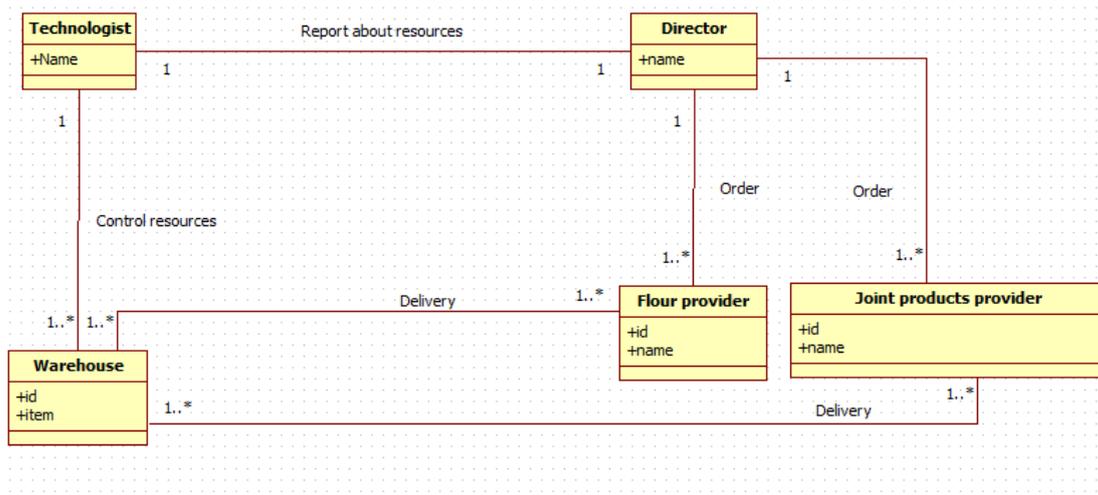
**Figure 7.** Collaboration diagram of "Purchase system".

In the figure 7 suppliers of the resources providing works of the enterprise are marked out, such resources are flour and other goods are necessary. The technologist analyzes the remains of flour and other goods in a warehouse then he reports about results to the director, that in turn contacts suppliers and does the order of necessary goods. Further suppliers fill a warehouse with flour and necessary goods.



**Figure 8.** Sequence diagram of "Purchase system".

On the basis of the provided diagram the classes model is developed for production (see figure 9).



**Figure 9.** Class diagram of "Purchase system"

In the course of "Purchase" the following classes have been allocated: "Director", "Technologist", "Flour provider", "Joit products provider", "Warehouse". "Director" and "Technologist" fill a warehouse with necessary goods using for this purpose classes: "Flour provider" and "Joit products provider".

**4. Conclusion**

As a result of a research it is revealed that the structure of data will consist of 3 main sections providing information requirements of production, management and delivery of finished goods to realization points. The minimum quantity of basic classes of the entities of subject domain grouping tables in the principle 1 to many not less than 15 that speaks about high complexity of the projected database of subject domain.

Based on use-case diagrams, a UML - model of classes for production has been developed. An approach is proposed to solve the problem of designing the structure of an information system based on the UML - classes model of the subject area. The RUP approach to the development of the model of an information system for managing auxiliary business processes of an industrial enterprise was implemented.

As a result of the research it was revealed that the data structure will consist of 3 main sections providing information needs of production, management and delivery of finished products to implementation points. The high complexity of the information system's database is indicated; because of the minimum number of basic classes of domain entities that group tables according to «1- to - n» - connections is not less than 15.

### Acknowledgements

This work was financially supported by the grant of ISTU № 09.04.02/18GMM.

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