

## Optimization of Information Resources in Industrial Ecology

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**Abstract:** An important task in business of any enterprise and, in particular, enterprises working in the industrial ecology is the timely transmission of data and relevant information. The article provides an overview and analysis of technologies of employee notification about any type of events. The model of optimization of data transmission over messengers is given. Today, there are a huge number of different applications for instant messaging: from ordinary messengers to social networks with built-in messaging modules. Among the usual messengers one can mention such as WhatsApp, Viber, Skype, Snapchat, KakaoTalk and others. Social network messengers include such examples as Vkontakte, Facebook, Instagram, etc. The special optimization model is developed for enterprises operating in industrial ecology, which allows to manage the notifications and alerts of employees involved in specific business processes.

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**Keywords:** optimization models, industrial ecology, information resources, data transmission, notification systems, messengers.

### 1. INTRODUCTION

One of the best solutions in business management is introduction of information technologies in the form of, for example, web or mobile applications in the process, in the work of the enterprise itself and all processes occurring on it. Such applications optimize the processes of information dissemination among employees of the enterprise.

This makes it easier and helps to formulate alternatives and make the right choice in favour of one of them, which can largely establish and improve (or stabilize) business processes. As a result, the organization is easier to achieve its goals - to increase the efficiency of the enterprise (see Kurbel, K. (2013); Shkarban, F.V., Avdil, S.L., Elvedinov, D.E. (2017)).

The relevance of the research lies in the fact that in the modern world, the automation of business processes, as well as the involvement of information technologies in any form, are inalienable aspects not only in the production spheres of human activity. Also in the sphere of interaction with customers at the level of partnership, the sale of goods and services as individuals in the field of industrial ecology.

This article examines an enterprise "Lider", which is one of the fast growing enterprise, operating in the sphere of industrial ecology and focuses on optimization of its information resources.

An important task in business of any enterprise and, in particular, enterprises working in the industrial ecology is the timely transmission of data and relevant information.

The purpose of the study is: analysis of the main business "contract" process of the organization for the sale of industrial facilities, identification of problematic locations in subprocesses or transitions between them, solution for their elimination through development and implementation of a mobile application to notify employees and counterparties on the basis of an available information system by forces of a company (see Aksenov, K.V. (2014)).

To achieve the set goals, the following tasks should be resolved:

- to consider mobile technologies used for development for enterprises operating in the field of industrial ecology;
- to specify and justify the concepts, aspects and information flows that will affect the future mobile application;
- to create a mobile application for alerting employees to the stages of customer orders.

The research is directed on analysis of the mobile applications technology in order to alert employees about events. The subject of the study is automation of the business "contract" process at an enterprise, which is related to the main activity of an enterprise and brings the principal income.

## 2. OVERVIEW AND ANALYSIS OF NOTIFICATION TECHNOLOGIES OF STAFF EMPLOYEE ABOUT EVENTS

### 2.1 Internal group chats in messengers

To date, there are a huge number of different instant messaging programs: from regular messengers and ending with social networks with built-in messaging modules. Among the usual messengers one can single out such as WhatsApp, Viber, Skype, Snapchat, KakaoTalk and others. The messengers of social networks include such applications as VKontakte, Facebook, Instagram, etc.

It is worth to mention such products as Agent Mail.Ru, various modifications of ICQ-clients in the form of ICQ ICQ, Yandex ICQ, etc., a desktop and mobile QIP client with a huge set of supported messaging protocols. One can refer also to the classical protocols IRC and Jabber. Now they provide the basis for other applications.

However, in the work of many companies and enterprises too complex technologies are simply not needed. Only messaging functions are sufficient, but not only between individual users-employees, but also between departments or groups of people. For example, for the manager it is much more convenient when all the information from his department is in one place – in one group chat, in which there are all employees subordinate to him.

What else are messengers good for? For instance, by the fact that all its counterparties can be kept in one place. Group chats also help here - you can establish communication between company representatives and be aware of all the movements and situations with suppliers, buyers or contractors. For example, you can leave a link on the corporate portal to join a group chat or, which is now more compact and more convenient (especially mobile devices support such a function "out of the box"), generate a QR code.

Of course, in order for a company to be client-oriented, sometimes it is not enough to settle in only two or three instant messengers. For maximum coverage, it is worth to install and implement the maximum number of popular communication channels so that any client remains "always close". Besides, not everyone likes the requirement of a company to install this or that messenger simply because they are accustomed to use one, and do not use the others.

It seems also that it is not always optimal when a real person, a customer service manager, talks to potential customers. The number of such customers can be hundreds or even thousands. As a rule, most of them handle the same questions and generate the same situations that managers are forced to react to and spend valuable time on answering the same questions instead of serving a truly solvent buyer. Then the automated programs (bots) come to the rescue. They talk with a client, and notify the right people about the need to take further action.

In addition, the needs of managers and employees are growing. They want to not only be aware of all the events of each department, but also manage the department from the same application. Therefore, one more messenger function appears to help users, more precisely, not just a function, but even a separate module – these modules are bots. Somewhere they appear officially as a part of the application, somewhere it is just scripts developed by programmers. Scripts may use authorization of a real user but read and send messages instead of him. It depends on whether a messenger provides a public API for accessing the contact browsing functions, for reading messages and sending them.

As an example for analysis of the technical part, one of the existing instant messengers is selected. This messenger has the ability to create bots without tying them to a specific phone number of a person. However, the downside of a messenger system is that the messages sent to the bot can not be read by regular methods without writing a special application that could take advantage of the special methods of this bot. Also in this system, it is impossible to find out the phone number of a contacting person if such number is not in the contacts database. Nevertheless, even this circumstance does not prevent to provide an acceptable system solution for working with potential clients.

The client does not directly interact with an embedded CRM-system at an enterprise. All interaction goes into the intermediate layer; let us call it "webhook". The CRM-system only aggregates the data. The scheme of customer interaction with the company's information system is shown on Fig. 1.

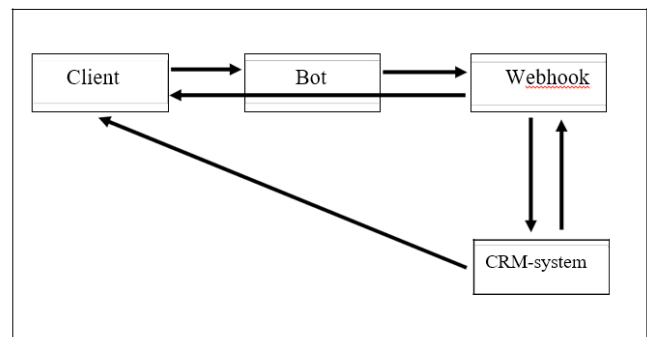


Fig. 1. Scheme of interaction between the bot and the client and the Information system

Let us consider the basic ways of motion of messages (information). Such a scheme is a conditional one and describes one of examples of implementing the interaction of information systems within a company with an instant messenger.

Let us consider the link from a client to the bot. A client sends a message, or just starts a dialogue with the bot, adding it to its contact list. This is a very important interaction, because the bot can never be the first to write to someone who has not started a dialogue with him, or has removed it from his chat rooms. However, the bot itself is only a motionless doll - it requires a puppet master. The bot itself can not react on a message from a client or send him any answer. Therefore, on

the next step the bot is sending the accumulated stack of messages (or events) to the webhook.

Now we make a look at the link from the bot to the webhook. Here a specific URL receives a POST request from the bot and can process it through its programming language. To date, for this purpose there exist many ready-made modules for popular programming languages such as Python, PHP, Java, C ++, etc. Thus, the information received from the bot can be processed. Depending on the result of processing, the stream goes to the CRM-system and / or some message is sent to a client. In this case, a longer route is proposed for consideration.

Let us analyse the link from the Webhook to CRM. Here the script may have several functions. One of them - adding a comment or clarifying the information in the counterparty's card. Secondly, the script can create a new counterparty or run the business process of the new order in the system, notifying the responsible managers about it. Third, the script can initiate a callback function if a client directly wants to contact the manager. We provide more details about this function later.

Let us examine the link from CRM to a client. As mentioned above, the customer relationship management system can receive a "bell" that it is necessary to initiate the direct contact with a client. A trigger is started which prompts to the free manager to make a call to the counterparty and talk to him directly. This concludes the interaction cycle; the client receives the necessary information from the employee. This treats the situation when a customer simply wants to receive some information, for example, the status of his order.

We pass to the link from CRM to the webhook. Here information requested from IP may return to the Webhook. It would not be very safe to transfer all information from the CRM system directly to a client, bypassing the webhook. It is due to the fact that there is a lot of insider information, which is simply not needed to a client or may have a negative impact on the company's reputation (occasionally, it may contain a personal opinion expressed by an employee about a client, perhaps not very good or not very positive). Therefore, the webhook makes additional processing of the received data, and then it is able to provide a client with the required information.

Let us look at the link from the webhook to a client via the bot API. As already indicated above, the bot itself can not send a message. It is only an instrument of interaction with a client. Therefore, it is necessary to send a POST request to the service API with the chat client ID so that the bot can indeed respond from its face to a client. Thus, a client receives from the system the information that he requests. Of course, at any stage of this chain, one can hang special listeners who additionally notify certain departments about the current status of communication between the bot and a client and react in time to these actions.

Thus, bots in instant messengers are a very powerful tool for interaction of employees with a client on any aspects of transactions or mutually beneficial shares. Bots allow to

receive information and notifications as soon as a customer decides that the business relationship with the company is benefit to him. It is worth to mention here about one important detail. The bot may create notifications not in all situations. In some of them the own software development may help in resolving the problem of the proper interaction within the information system.

## 2.2 Specialized mobile application

Trello Kanban boards are well used in small projects where a group can hold up to 10 people. Otherwise, you will get chaos and inability to keep track of everything physically. It is perfect if the company has its own boards for each department. Moreover, it is ideal for interaction between the employees of the department. However, for example, the manager of the company is no longer able to understand all that is happening on each board. Then, of course, a new generalizing board is created. Somewhere unnecessary, somewhere, on the contrary, very important notifications can be lost among the rest. Somewhere an employee is unable to react to the customer's order in time, because he is filled with notifications about expired tasks in the record. However, clients are the main source of the income.

Programmers can implement their own modules in the company's IP based on the Trello API. One can also organize execution of certain own scripts for any events on the boards. However, it is too big pieces of code, too much time should be spent for this job. What happens if there is a lot of such actions? Would be the server of the company, which is already spinning a CRM-system, sustain? Probably not. What happens if the developer of the system, on behalf of whom the actions are performed, leaves? In this case, it is necessary to receive new authorization data and there is large dependence on external factors.

Let us consider another example, when it is necessary to write a heavily loaded system using the Python programming language. Assume the condition that it has a ready-made module for implementing HTTP requests. Any messenger, whatever it is, allows to receive instantly messages anywhere in the world when one has a smartphone at hand.

In the same way, the bot can get the necessary information from a client about the order, about the statuses of transactions, about any changes in the work processes. However, this is only a tool, not a whole system. The script that manages the bot can not support the chain of the business process, because in most cases, it does not remember the context of the dialogue with a user (except for situations when the developer specifically writes an intelligent bot in addition to analysing the natural language). Of course, the script is able to execute a set of commands for a specific message from a person. However, it does not know what may follow, and what could precede the current situation.

One of the solutions to all these problems is creation of a potentially new information system that would collect all communication channels and generate new information. Such a system can be written in any other programming language.

It can act as a full-fledged internal web application, either as a specific API gateway or a kind of router through which the embedded IPs communicate at the enterprise. In this case, highly skilled developers who already have experience working with APIs and understand the principles of implementing the transformation of data from one finished system to another are needed.

Such a development can not be cheap due to the fact that experienced developers are now an expensive pleasure for the owners of companies. In addition, if the developer is not experienced enough, for example, "junior" - he is not always able to cope with the task in time, which also increases the cost of developing this system.

The second approach, which we are interested in, is our own mobile application. At one of the meetings of department heads, it was decided to develop such an application, which would be minimalistic and at the same time provide the right information at the right time to the right managers. After all, in the modern world it is already difficult to imagine a mobile device without access to the global Internet.

Any smartphone can now connect to the Internet using a cellular connection or a wireless Wi-Fi connection. Therefore, any manager or employee, who leads the project, can be aware of everything that is happening now in the related direction. He is aware what stage is being carried out now, and what results have been achieved at the previous stages.

It would also be nice to control the context and know at what stage and what has already been done so that the next employee can correctly make a decision based on the results of the previous stages of the business processes. At the same time, the developer of the business process should have the flexibility: he can simply carry out a "contract" group of users through the stages, for example, of the same process, or he wants certain actions to be performed at some specific stages of the customer's order. However, it is necessary to understand that flexibility requires victims - and the more flexible an application is, the more knowledge is required from a person who sets up the information business processes.

### 3. ORGANIZATION OF THE PROCESS AND DEVELOPMENT DETAILS

Next, we describe the technical aspects of developing the project with specific features of working with Android Studio.

Nevertheless, at the beginning it is worth to say that on the server, with which the application interacts, has already installed a small own framework for working with the database. There are many ready-made solutions in the form of full-fledged frameworks like Yii2, Laravel or ordinary Symphony.

The basic functionality of the server module is based on the concept of CRUD (Create, Read, Update, and Delete). These

four basic functions are performed with the database and they generate interaction with the data.

From the client side, API interaction with the same data is realized. That is, a user receives (exceptionally self-related) notifications, then he can translate them into the next stage, thereby updating the information of his notification and creating a new notification to the next person in charge. In addition, he can reject the notifications made in the previous step - so, it deletes its notification and creates a notification to the previous person in charge.

The interaction of all modules associated in one way or another with this application is shown on Fig. 2-4. The scheme described in the UML language helps to determine correctly the dependencies of the blocks and modules of some parts of the system on others (see Kurbel, K. (2013); Shkarban, F.V., Avdil, S.L., Elvedinov, D.E. (2017); Aksenov, K.V. (2014)).

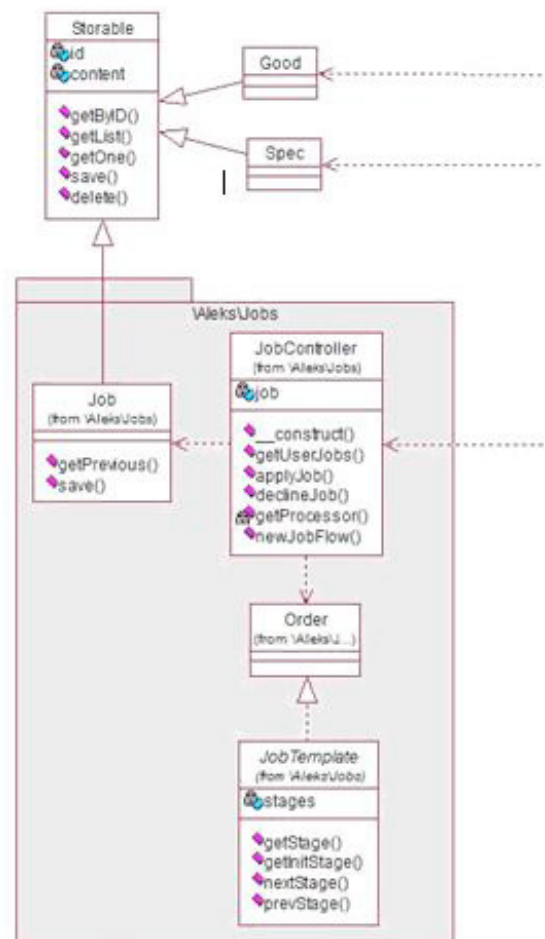


Fig. 2. The architecture of the interaction between web and mobile applications. Block "Jobs".



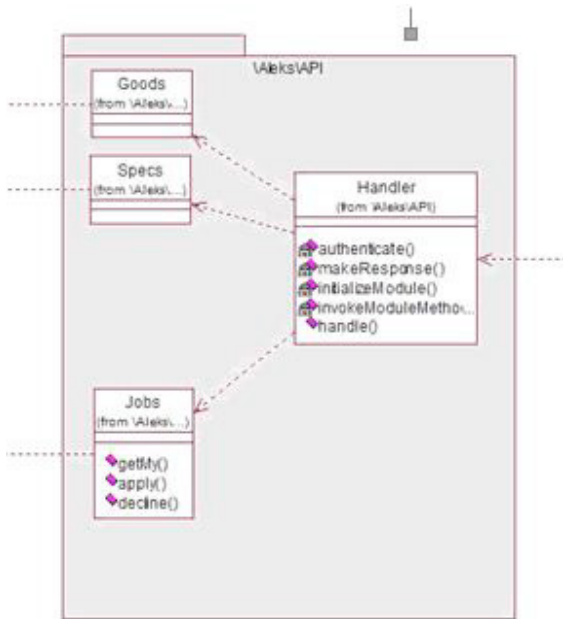


Fig. 3. The architecture of the interaction between web and mobile applications. Block "API".

The two large blocks "Jobs" and "API" refer to the web application (the server part). There are two modules involved: one is responsible for storing and processing the steps of the notifications themselves and transmitting the "move", the second is responsible for the interaction of the client requests with the data from the database.

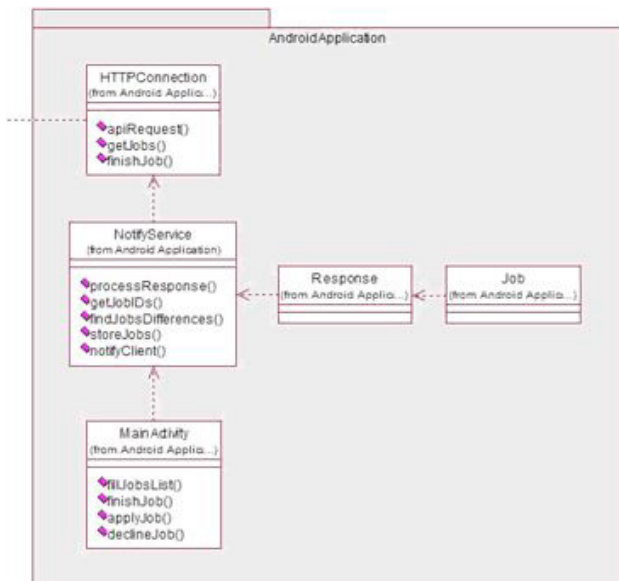


Fig. 4. The architecture of the interaction between web and mobile applications. Block "Android Application".

The third block "Android Application" is a mobile application with classes. Some of them are responsible for converting data from the JSON format to objects using the GSON library, in part for creating and sending HTTP requests to the server and accepting data from it. Let us note that here the architecture of the application is of great important.

Usually, if the application is more or less simple, it consists of one or more activities. They are its basis, because they perform certain functions, tied to the interface, and display the data on the screen to the user. However, in this case, the basis is Service. Namely Service allows the application to be active in the smartphone's memory and not be afraid to be unloaded (some more minor tricks are required, but fundamentally this structure is sufficient).

During the implementation of the research, the main technologies and tools used in the development of mobile applications, in particular, for development based on the Android operating system, are considered. The main business process analysed that brings significant revenue to organizations and proposed a solution to reduce the time delays in terms of the transition of information and state between the subprocesses of the "Contract" process via the mobile application.

It is noticed that for a fairly long time the information from one executor of the process does not go to the next one, following the chain, to the performer. There is a kind of temporary delay, when one employee can not continue treatment of the business process from the partner in time, without receiving a signal about the end of the task of the previous person in charge. The same error can occur if you need to communicate something to the partner, for example, intermediate results of treating the business process. Thus, while the manager hands over the phone or e-mail the necessary information to the client, it takes some time for the partner to react.

#### 4. CONCLUSIONS

The main result of the study is development of a specialized mobile application that would send a notification about the end of the next stage of order processing to the next important task. Every manager has a mobile phone - standard, the phone generates a beep, a vibration alarm and a flashing light that indicates that there is an unread system notification. This is unlikely to be missed by a person. The employee as soon as possible is able to react to the "transition of the course" and begin to perform his task immediately.

Thus, development of the information system takes a long time and efforts, but it allows the most flexible automation of the company's specific business processes with their individual characteristics. At any time, you can make fine-tuning of any functions and modules so that the business logic meets the new conditions of the modern world, as well as modern methods of software solutions for certain tasks.

Development and commissioning of the mobile application is an important task of optimizing the activities of enterprises in

the natural resources sector. It is one of the main goals of introducing information technologies into the business of the enterprise: increasing the final profit and reducing the costs of current business processes.

The information resource optimization tool described in the article was introduced to the enterprise working in the field of industrial ecology.

We received the following results six months after the launch of the mobile application to the enterprise “Lider”:

1. The decision making time for concluding and maintaining contracts has been reduced (10%).
2. The number of "contract" business processes has also increased (7%).
3. The company revenues has grown (4%).

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