Improving the Effectiveness in Research and Developments Department from Automotive Industry

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ABSTRACT
The scope of this paper is to propose a solution for decreasing the rework that has to be made inside a team, in a new offshore Research and Development department, mainly because of assumptions and lack of experience. This is based on learning and applying the lessons learned. First, it will be presented an order assignment in an offshore branch in the field of automotive software companies. From the concept, further on, the usual process that takes place is presented and the potential flaws are analyzed. The major problems identified are random allocation of the orders and assumptions that are made in the branch offices. After inspecting the steps of the process, a model of process is proposed in order to avoid the problems identified at the usual process. This proposal has the principles from Advanced Product Quality Planning and the Scrum framework. The goal is to reduce the rework using the learning process presented. If no assumptions are made, if everything is clear from the beginning, if all the necessary documentation is done, if the proper mentoring is made and if the process is continuously improved, the probability of the identified problems to occur again is highly decreased.

The most important points in the proposed process for improvement are the following: weekly meeting for status update, assigning the orders according with the needs, assign a mentor for new entries, eliminating the assumptions, discuss the problems as fast as possible and obtain feedback fast from the client to check the direction of the work.

Keywords: process improvement, task assignment, software, management.

INTRODUCTION
In a software automotive company, Research and Development department (R&D), the orders or the tickets are usually given randomly without a specific plan, which includes the complexity of the task, to the employees who don’t have a task and because of the random allocation of the tasks to the employees, there are high chances that the most complex orders are assigned to the most unexperienced employees. This allocation usually leads to:

- Tests or software implementation not done correctly or according to the client’s requirements or specifications of functionality, this causing a high probability of rework for the task.
- Stress on the employee.
• Knowledge is not increased step by step.
• Exceeded deadlines.
• The quality has a high chance to not meet the customer’s expectations.
• Money loss and affecting the image of the company.

This is predominant in the case when the company opens a new branch. The orders that are coming from the headquarters to be solved, should be assigned properly in order to avoid one of the causes enumerated earlier. Assigning the tasks suitably means that each task is assigned based on certain criteria to the employee. For developing the offshored branch at the same level with the headquarters, certain steps must be made.

Herbsleb notices that the technical work and the challenges for a project are at least equal in the situation in the distributed teams as in grouped teams (Herbsleb et al., 2005). It can be expected that due to distance the challenges met while the project is running, are at least at the same size if not increased. In practice there have been observed some cases where due to the project management inexperience on the part of service provider the plan that was made was late, without details and unrealistic (Herbsleb et al., 2005). Another cause of projects not running healthy is the process immaturity, which leads to major problems (Herbsleb et al., 2005). It has been observed that giving the teams, in the lowest appropriate level, decision power, it has saved time and effort (Herbsleb et al., 2005).

The most common problems that appear in a company which has opened a new branch and where the knowledge transfer must be made, are the following:

- Communication problems between the sites.
- Different behaviors in managing the teams.
- Diverse approaches towards conflict.
- Different decision-making styles (Radoff, 2006).
- The written documentation is rarely suitable when solving misinterpretations about the requirements or changes in the requirements’ specification (Conchúir et al., 2009).
- When a project is built in different branches, inconsistencies can occur in the work and documents (Bhat et al., 2006).

The success of a software development project is strongly linked with the quality of the project management activities. The project management activities are the following: handling the resources, shaping the software teams, assigning the tasks to appropriate stakeholders, time, budget and resource checking. These activities can be done in different ways, depending on the project management approach each company decides to follow. In a software development process, the project manager has a very important role in task allocation. The central task of a project manager is to allocate orders to the project teams with the next attributes in the mind: knowledge, skills, experience, and proficiency (Masood, 2017).

Task or order assignment is one important topic not only in the automotive industry, but also in mobile crowdsensing. Crowdsensing is referring to a technique where a big group of individuals are using mobile phones or tablets capable of computing to collectively share and extract data for computing, evaluating, assessing or predicting of a process of common interest. In this area, task assignation has the goal of reducing the task penalty consequence and to maximize the quality of the task. High quality and low employment costs are vital objectives in the plan of effective task assignment aimed at mobile crowdsensing. Gong, discovered that the performance can be significantly improved if the tasks are no longer attributed randomly but it can choose the best path for the user and the human involvement is marginally bigger. An algorithm was proposed for improving the solutions (Gong et. al., 2019).

The objective of this concept analysis is to propose a new model in which the time delays are reduced and a new process for task assignation inside the team.
THE CONCEPTUAL MODEL FOR ORDER-EMPLOYEE IN A SOFTWARE AUTOMOTIVE COMPANY

The customer is satisfied if the product is delivered on time and at a cost that represents value. Advanced Product Quality Planning (APQP) is an organized method for defining and establishing the compulsory phases to make sure that a product is scheduled, calculated, built and sent to the customer so the buyer’s needs are fulfilled. The main goal of this method is to enable communication and update the status at different stages between all the parties involved in order to make sure that all the steps are done properly and on the specified time frame (Chhim, 2017).

One of the goals of the process planning is to develop a process with a foreseeable result. Hence, the decisions taken in the process planning influence the manufacturing conditions for the final product quality (Magnus Lundgren et al., 2016).

The global trends like the increasing product complexity, rising the time pressure and the reduction of the internal costs have an effect on the general product making process like more error-prone due to the higher complexity of the product (Kiefer et al., 2017).

The following chart, Product Quality Planning Timing Chart, shows that the feedback assessment should be present from the beginning to the end of production:

![Product Quality Planning Timing Chart](image)

Figure 1: Product Quality Planning Timing Chart (APQP, 2008)

The principal steps of the APQP are:

1. Prepare for APAQ.
2. Plan and define program.
3. Product design and development.
4. Process design and development.
5. Product and process confirmation.
6. Reaction, assessment and corrective action (Chiliban et al., 2014).
The following picture is a definition of a concept model order-employee for creating conditions as close as possible to perfection out of imperfect situations. An order can be external, which comes directly from the client to the employee, or it can be internal, coming from somebody who works inside the company to another colleague. In this article the orders will be treated from the internal orders’ perspective.

![Diagram](image)

**Figure 2: The conceptual model of an order-employee flow.**

The factors implied in the order creation and the order attributes for the employee working on the ticket are observed. This is a general model in a software automotive company and presents the interaction and the necessary factors and attributes for a successful one. In the proposed model, the order from the client will be assigned to an employee, only after a specific process of order evaluation. The order will be evaluated based on objective facts, like complexity, to find the most suitable employee to be assigned to the task, so the following objectives will be achieved:

- Fulfill the quality requirements.
- The documentation is updated and available.
- Give to the customer the highest quality product.
- Finish the task in the agreed time interval.
- Grow the experience and the knowledge of the team members.

**USUAL ORDER-EXECUTION FOR A NEW BRANCH**

The usual process in a new offshored branch can be seen in the next figure:
Figure 2: Usual order execution process in an offshore branch.

As it can be seen in figure 2, once the ticket is sent to the company and the employees from the headquarter have enough tasks, the ticket is sent to the offshored branch. When the ticket is in the branch center, it is assigned to an employee without task. Since this is a new R&D branch, all the tickets that are coming represent new projects and after a time they can be seen as a type of ticket that was already made. During the task for example in software testing, there is the following workflow:

1. **Review of the requirements:** In this step of the process, all the requirements must be carefully read and a first impression of the functionality of the software is obtained. The tester must check if the requirements can be tested or if relevant information is missing. If it is a black-box testing, the access to the code is forbidden. In case that exists one or more requirements, which are not testable, the responsible requirement engineer for the software that is tested, must be informed. After this step, there is the possibility to estimate the implementation time of the requirements. In case if the requirements are in a different language than English, the requirements are sent to the translation department.

2. **Development of the software test or software module.** During this process it is a high chance to have problems in developing or testing the code:
   
i. Not understanding the functionality.
   ii. Not enough knowledge for implementing or testing the requirements.
   iii. Insufficient information in requirements.
   iv. Unexpected behavior of software.
   v. Opposite requirements.
vi. Changing of requirements without informing the developer or tester.

vii. Wrong usage of the tool.

3. Analyze and report findings.
4. Review of work.
5. Rework of findings.
6. Close the ticket.

The steps from the figure 2 are the following:

a. The task is started, and if there are problems in resolving the task, usually the local team is asked about how the problem should be solved. If the project is new, and also the process for this specific project is new, so when a problem regarding how to proceed in certain situation is discussed just in the local team without involving the colleagues from the headquarters, they can only make assumptions since the team is new.

Assumptions are usually made because the new formed team wants to impress the colleagues from the headquarters.

When assumptions are made, there is more than one opinion, and time is consumed in choosing what the team thinks that it is the correct answer.

If a solution about the process, for example, from the local team is implemented, it has a high probability to be reworked based on the fact that specific part from the process is implemented in a different manner in the headquarters. It can delay the entire project if the solution proposed locally is found later in the project and it needs a lot of time to be corrected.

Developers can take more time to resolve a problem because they do not have the ability or may not even know the appropriate contact person for asking for help. This happens because the meetings with the scope to get to know each other are not held (Bird et al., 2009).

Because the communication is deficient and the level of awareness is low, these facts increase the difficulty in coordination of the projects and also the number of failures in the code developed by the teams from other branch is bigger (Bird et al., 2009). The Scrum principle says that the project should be presented as soon as possible to the customer for checking if the direction is the right one (Rossberg, 2019). This can be observed on the left side of the proposed process, in figure 3, where it is suggested that a weekly meeting should be held with all the team members implied in the project so that everybody knows the status and the problems.

If the questions are discussed from the beginning with the more experienced colleagues, the rework is no longer present in the orders and the quality of the product is obtained much faster.

b. After the task is finished, it is verified by the colleagues from the headquarters. This is a good idea in maintaining the quality of the output of the task, especially in the new projects. Another advantage of this review made by peers from the headquarters is that the employees from the offshore branch can learn the criteria and the “how to” - methods to have in the end qualitative results.

Usually the assumptions made in the team for solving the problem are not the most efficient and correct. This fact can be observed in the result of the client review. The assumptions are wrong in a high percentage and lead to a lot of rework. This is a strong reason for not having assumptions in the team regarding the functionality of the project or about the details of the process and how the stages of the process should be made. The process takes a longer time at first sight, but afterwards it will be made correctly and accordingly to the standard and the demanded quality. A good idea about
which questions should be asked inside the local team are the questions about programming syntax, a peer review over a new test case, helping in implementing the ideas received from the internal customer, sharing the knowledge about a certain topic, e.g. slide angle, understeering or oversteering in physics.

An example of how assumptions can be destructive is the following: in a branch team from a company which has its headquarters in Germany, a task is given from a colleague from Germany to a colleague from Romania. The other two colleagues don’t know about this task until the next morning. The entire team is engaged in finishing the order, but some questions arise about when it is considered that the order is finished. Should it be made more steps or what was asked? A lot of discussions took place inside the Romanian team, without asking the colleague from Germany, because the connection member thought that he is too busy to answer our questions. This thing brought a lot of stress over the team members. At around 20:00, the entire Romanian team manages to discuss with the coordinator from Germany, just to find out that the team made extra and unnecessary work over the order.

**PROPOSED MODEL FOR INCREASING THE EFFECTIVENESS OF THE TEAM**

The goals of APQP presented earlier were also part of the goals for the propose model. The most important thing is that the customer is happy with the delivered products. This implies that resources are used properly, that the software respects the customer’s requirements and that the product is finished on time with the lowest costs.

From the way APQP is organized, it makes sure that a product is scheduled and calculated. The following process takes into consideration that the orders which are coming from the client are treated with an objective approach and with the main objective in mind that the customer receives the best quality for his software products.

A process is required so the management of the offshored team is done in a transparent, clear, qualitative and learning oriented manner. Like Javidan observed, the culture is not the direct factor influencing the knowledge transfer process, rather the poor management can cause the plans and projects to fail. An example would be a clear definition of success and goals, aspects which have to be defined in advance. If the regular contact between the involved parts is maintained, the difficulties are reduced and a stronger mutual support is created. Knowledge development is path-dependent and accumulative in the way that it includes an ongoing, gradual and incremental process of learning about the development of the product. Involved parties wrongly assume that their criteria for success and their objectives are identical (Javidan et al., 2005).

The proposed model, in order to have a more efficient work distributed in the team for these activities, is the following:
Figure 3: The proposed model for effective order assignment and execution.

In the proposed model for effective order assignment and execution are the following steps:

1. A new ticket is open.
2. It starts the task assignment process, process which is described later on.
3. Is it a new project or a fresh employee?

Starting with point, the learning process begins.

4. If the answer is yes, then mentoring is necessary, if the answer is no, the order is assigned.
5. The next steps, are the review of requirements and development of the software module.
6. If there are questions about the task implementation, and if the person is in the same location then the step 7 is strongly recommended, otherwise steps 8, 9 and 10 must be made.
7. If the person is in the same location, a meeting is the most practical way to answer the questions.
8. If the contact person is not in the same location, an email with the questions must be sent.
9. If the response from the email is received, the work can continue, otherwise, the next phase is step 10.
10. If an answer is not received in a reasonable time at the sent email, the receiver of the email should be called for reminding him about email. This step is rare in the industry, but we must know how to handle it.
11. After the response is received and all the questions have been answered, the next step is Analyze and report findings.
12. Analyze and report findings, at this step, if there have been found any problems in the software implementation or the system’s behavior is not as expected in the requirements, a detailed report must be sent to the manager.
13. Peer review: after the work is considered to be done, before handing the results to the client, a good idea is to check with a colleague the most important points of the order. If this step is revised properly, the next step can be implemented.
14. Before the order is closed, a review has to be made by the client. If the client review is passed, the order can be closed.

In order to compare the proposed model with is actually happening, in figure 2, where the usual process takes place in an offshore branch, it can be observed that the task is assigned to the available employee, after the ticket order is complete, regardless of the employee’s experience.

The assignation of the task to the next employee that does not have a ticket is not the right path to follow, because the priority can be set high and if the employee is new in the project or inexperienced, the task will have a high chance to be delayed.

The problems of the usual task assignation are the following:

- Tickets not assigned to the employee who fits the best.
- Tickets are not weighted by the deadline or complexity.
- The employees do not follow a natural path of development of their skills.

The next step from figure 2, Problems in solving the order, is the step where questions arise about the order. If there are questions or problems about how the task should be solved, they should be addressed to the specified employee from the order ticket, not make assumptions like in the proposed model from figure 3. The step when the problems arise, as it can be seen in figure 3, if the person is in the same location, a face to face discussion would be preferred, but if it is not in the same location, an online meeting should be requested.

The technical staff should know or should be able to discover who they can contact about a problem that can occur during the project. The communication should not be slowed down by a person or by the process, like channeling completely the communication through a project manager (Herbsleb et al., 2005).

A very good suggestion for improving the communication between teams who do not work in the same location, is to spend the travel budget in the early steps of the project. Once the teams have met and worked together for some time, all the work runs smoother. There are more advantages from meeting the person face to face, like: overcoming the cultural differences, developing trust and improve all other means of communication (Herbsleb et al., 2005).

Following this idea, from the beginning of the project a list containing all the team members and their roles should be exchanged between the teams, in order to know each other better.

Another topic that has a high importance is the update of the documents. An easier way to keep them updated is to create a “virtual site” as much as it is possible. If the code is developed at multiple sites, the development of the code should be made and maintained on a single branch of development (Herbsleb et al., 2005).

If the code is developed at multiple sites, the development of the code should be made and maintained on a single branch of development. If the scrum principle is respected with the daily meetings and daily builds of the code, the problems will be fixed as soon as possible (Herbsleb et al., 2005). By implementing these ideas the APQP objective to keep the documentation updated and available for all the team members is easier to achieve.
The next process is proposed with the following goals: the new starter, or in this case, the new team, must be brought to the same level as the other colleagues from the headquarters regarding the processes and how-to do the orders and to have interaction with the more veteran employees in order to learn as much as possible from them. The new entries will learn how to handle the exceptions, how to apply the rules to real projects and how to interpret the environment. The top priority should be to find ways for forming new distributed communities (Herbsleb et al., 2005).

From the APQP principles, that a product is correctly calculated and scheduled, these steps must be verified periodically. Because the teams cannot meet every week for the status update, a weekly meeting must be planned, meeting where all the team members from both sites present their status and problems. In this way everybody is updated with the status and the problems and if somebody else had these type of problems, they can share their knowledge in how to fix them.

The vertical column that is available for the whole proposed process is another principle of APQP as it can be seen in figure 1, where the feedback loop is present during the entire process. The internal processes can be adjusted to fit the current projects or situations.

Companies can be compared with living organisms, so they must continuously adapt to the environment. This means that the proper process identified at one point in time, at a moment it will have to change or adapt the process, due to changes that are arising. For example, the strategy for knowledge management that is acknowledged as suitable at a specific point in time, will have to be transformed or reformed because the knowledge changes through the structural cycle to a different stage (Rifat et. al., 2009).

When a lot of orders are coming from the customer the project team leader must assure that those are ready until the deadline.

When discussing the step of mentor assigning, it must be taken in consideration that the number of mentors inside the team should be correlated with the number of unexperienced employees a team has. There can be the following situations:

![Figure 4 Possibilities of distributing the mentor inside the team](image)

Subfigure a, from figure 4: there is one mentor assigned for four new employees for knowledge and experience sharing. The circle of learning includes all the team members involved in the process.

Subfigure b: it can be observed that the number of mentors exceed the number of fresh employees, and when discussing about the teaching process, this is considered a waste. The circle of learning from the mentors, limits the full implication of all the mentors.

Subfigure c: there is a waste of time and rework since there is no mentor assigned therefore the employees must learn from their own mistakes.

By using the process from subfigure a, the learning process is more efficient.

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The next proposal comes with a strategy for helping in achieving the objective of completing the orders to meet the deadline.

The proposed model for assigning a ticket, with keeping in mind that the first criteria for assigning a task is the priority and afterwards the complexity, both attributes being established by the client, is the following:

![Diagram of the proposed process for assigning a ticket.]

**Figure 5: The proposed process for assigning a ticket.**

This process is developed for fixing the mentioned above problems. It is very important to assign the right task to the right person. The most complex one should be done by the most experienced employee. Both the company and the employees will have the following advantages:

- Increased probability that the task will be finished in time.
- The challenge will motivate the employee.
- The probability that the task is done correctly is increased.
- Increased probability percentage that the feedback from client will be positive.

If the order has a low complexity and low priority, it is better for the task to be assigned to the most inexperienced employee, because of the following reasons:

- The confidence of the employee is increased.
- The probability that the task is done correctly is increased.
- The skills of the employee are developed in a way that it is not stressful and the knowledge is built on strong base.

The idea of task evaluation is to not waste resources and as a comparison, it is not necessary to have a powerful car to go to the market for groceries.
On the other hand, it is not a good solution to assign the task to a person who has not the necessary skills to reach the mentioned objectives. When we need to carry heavy loads, a powerful car is needed, it is a necessity, not a waste of resources.

In the figure 1, for the evaluation of the work part from the conceptual model, the assessment of the task is needed to verify that the order is being done so that the requirements and the client’s quality standards are respected. The experience and know-how progress of the employee can be measured. If the employee has sufficient knowledge and experience, he can be assigned on tickets with higher complexity or he can help other colleagues with less experience, to finish their orders.

CONCLUSIONS

In order to solve the orders based on their complexity with the most suitable employees a process must be followed. This process was built in a manner that it can be easily shaped based on the company’s necessities.

The following concepts can be resumed from the proposed processes:

- No assumptions should be made inside the team.
- Clarify everything, so the rework is avoided.
- Assure proper mentoring.
- Documentation must be updated and clear enough to be understood.
- Continuous improvement of the processes.

Although these principles cannot guarantee the success of a branch opening, they will raise the changes of having a more qualitative work. If the mentioned methods are implemented, the knowledge inside a team will be at almost the same level, the communication between the teams will be improved, thus the problems will be solved much faster, this meaning saving both time and money.

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