The evolutionary development of the methodology of operational planning of construction production

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Abstract. The article describes a pilot implementation in the area of specialized work in the company "Stroy-West" system "Last planner". In the course of implementation, it was concluded that accurate planning can increase the productivity of construction activities, improve the efficiency of resource use. Usually, the significant part of the construction preparation process is reflected in business plans, which simplifies the design and content of the calculations. Meanwhile, this significantly deteriorates the quality of preparation process, and then the construction organization process, all the nuances of which must be determined by the project of organization of work, which establishes the process sequence and methods of organization of works on issue of the company's products. The need in material and technical resources can be assessed by two methods. The first method is the direct counting method which suggests evaluation of the material need based on the amount of work multiplied with corresponding consumption rate or by technology cards that indicating the requirement of vehicles, mechanisms, outfit, etc. by piece. Such method focuses on standards associated with the cost of the product. This method is most suitable for the purchase of simple items used in mass and impersonal way (fasteners, hardware, packaging material, etc.) by all divisions of the company. At the same time, operational control by itself is not decisive because is limited by information of organizational and managerial content. A comprehensive forecast of the costs of planning are the main preliminary factors for the successful construction management. "The last planner" can be consistently used, engineers-planners to make project schedules more predictable and to increase the likelihood that a workflow will flow evenly and projects are completed on time.

1. Introduction

Method of "last planner" is a good way to improve the efficiency of construction operations on a construction site. It implies comprehensive control of the processes occurring on the construction site and their comprehensive evaluation in terms of PPC (percent plan complete) by a responsible person.

Operational planning as a system of arranged events is the organizing principle and the link between the plan and current economic and industrial activities. At the same time, operational control by itself is not decisive because is limited by information of organizational and managerial content.

Analysis of practical experience of organization of operational planning showed the following milestones: Engineering preparation of construction; Projects of organization of work development; Logistical maintenance; Provision with labor resources; Development of monthly plan and
weekly/daily schedules; Institutional maintenance; Information maintenance; Sales; Organization of supervisory control; Operational production management; Summing up over the reporting period.

Aforementioned milestones are typical either for the planning process as a whole or for the operational planning system in particular. The basis of timely and high-quality preparation of construction is based on careful and comprehensive study of technical documentation by all technical and engineering employees, considering the specific characteristics of the construction, existing tradition and prevailing conditions of the work.

Engineering preparation of the construction is the process which is not based only on the existing experience of the construction organization but also accompanied by implementing new elements, which underlie the novelty. Usually, the significant part of the construction preparation process is reflected in business plans, which simplifies the design and content of the calculations. Meanwhile, this significantly deteriorates the quality of preparation process, and then the construction organization process, all the nuances of which must be determined by the project of organization of work, which establishes the process sequence and methods of organization of works on issue of the company's products.

Logistical maintenance is organized to ensure the complete supply of material and technical resources (materials, semi-prepared product, building units, etc.), fuel and energy and technical equipment (vehicles, tools, mechanisms, outfit, etc.) in the time specified by calendar plans and delivery scheduling.

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2. Methods
Institutional maintenance of operational planning is based on legal (legislative or administrative) consolidation of relations between administration of the company and workforce; between the company, supplier, and the consumer; between the company and local and state government. In that case, legal uncertainty in any of these issues can cause the stop of the company in unexpected ways in most unfavorable moment, which can lead and leads many companies to bankruptcy. Economic-law research is helpful for solving this problem. Such kind of research help to overcome the conflict situations both as a result of external interruption and disagreement inside the workforce.

Informational maintenance of operational planning solves several problems. Firstly, it improves the quality of the process of registration of the company business activity facts and the control of its divisions for comparison with applicable regulations.

Secondly, it provides the formation and accumulation the database. This function is necessary as mean of the generalization of the results of business activity, allowing to establish mathematical correlations between economic laws in construction organization.

Thirdly, informational maintenance is connected with wide integration of information technologies that could be used to solve the problem of processing the available information for operational planning and forecasting on the basis of appropriate software.

Fourthly, it suggests the organization of standard designing by the creation of automatized working places (AWP), which are going to be placed on departments, services and divisions of the company and to perform calculations according to professional assignment of executor.

Fifthly, it implies the necessity of development of the calendar plans of operational planning, which provides the AWP users with all the necessary information for their development according to the profile of their assignment.
Sixthly, it implies the necessity of the information computer network. By that it is meant “A set of technical resources, programmes, and information for technic and economic management is based on achievements of modern information technologies and use of connected personal computers as a technical base” [1,2,3,4].

In addition to monthly and weekly schedules there are requests on materials, vehicles, equipment, cargo carriage, etc., which provides the accomplishment of planned amount of production. After a comprehensive examination of the consolidated and local mathematical model, approving the possibility of current plans realization, administration of the company confirm weekly schedule which becomes main guideline for all the executors.

It is important that current activity should not replace the matter of tasks on the higher level, which need not only high qualification, professional experience, creative intuition, but scientific approach. The diagram of the relationship of plans of all levels in the overall system of enterprise planning is presented in the figure. 1. Operational management implies the clear definition of the order of management decisions oriented on the realization of the construction process within the approved calendar plans and in the case of their updating due to construction circumstances.

![Diagram of the relationship of plans in the whole planning system in company](image)

**Figure 1.** The relations of plans in the whole planning system in company

### 3. Results

Despite the plans of the building organization administration, sooner or later the process of planning goes to the leader of operating group (building plot, brigade). In interaction with other group members this leader should define what physical work should get done on the next day or next week. Leader of the group makes an assignment on workers to do define work in upcoming period of the time (following day, following week). The leader of that group plays the role of ‘last planner’. This part of planning is extremely important for organization success as a whole.

After the assignments of workers on specific work, the leader of the group (brigade, building plot) undertakes the obligations to the company to get construction and installation work done timely and
qualitatively. In that way, the leader decides what actually will be done taking into account the limitations of the work, which means what is possible to be done in specified circumstances and dues.

Nevertheless, usually the upper management does not differentiate the planned tasks and tasks that are possible to be done, which affect the assessment of leader’s group work. Often, upper managers are tend to force the working sites, brigades and their leaders. At the same time, they ignore the fact that different circumstances such as delay of materials supply or the overdue accomplishment of previous tasks lead to the discrepancy in what is planned to do and what is done actually. It is important to note, that observed problem is not only specific for the Russian but for foreign practice too.

Evaluation of planning system functioning on the level of the last planner is the crucial part of the lean construction. In other words, high level of productivity and quality becomes possible due to high-quality weekly work schedule made by the last planner. Weekly work schedule can be assessed as high-qualitative in the following cases: The order of actions is correct (order of tasks corresponds to the project schedule and construction technology); Necessary amount of work is defined (the defined amount of work is possible to be done by brigade); The defined work could be implemented (all previous tasks are accomplished, the necessary materials and equipment are provided).

The result of planning system functioning can evaluate in the indirect way: by assessment of plan accomplishment results. To serve that purpose the system includes assessment index, which is crucial for lean construction. The index reveals the share of works accomplished on time and is known as percent plan complete (PPC).

PPC is the ratio of amount of tasks accomplished during the specified period (week) to amount of tasks that were planned during the specified period (week) and is expressed in percents. For example, PPC = 50% means that 50% of planned tasks were actually accomplished during the specified period. A Higher number shows that the system works with more success, the smaller number, in turn, shows less success. The experience of foreign projects shows that projects with PPC > 50% have higher productivity than projects with PPC < 50%.

PPC is used as a primary management tool on the level of a working group (site, brigade). This index reveals the complex of factors which affect the quality and productivity. Hence, each project manager should have the answer to the following question: do you know the index of PPC of your project and engaged working groups? The negative answer means that a high level of productivity and quality is unlikely to be provided.

The PPC index reveals the share of fulfilled obligations toward the company which was taken by the last planner. If an index is not equal 100%, which is usually the ordinary situation, managers should know the reasons of deviance. Analysis of discrepancy helps managers to find out the deeper reasons for its emergence. Actions towards activity improvement, in turn, should evoke improvement the works results in the future.

Figure 2. Algorithm of planning in the contract organization
The opportunity of application of the new methods, which are tested and used in the foreign countries, in the Russia. Very likely, it may help construction companies to establish new strategies and policy to improve their management practices. Members highlighted the positive effect and particular companies expressed the desire to develop this system and the principle of lean construction per se.

An important result which indicates the success of LSP is the fact that the project for some works was completed three weeks ahead of schedule. Another important result of the study is that with the new method, you can clearly see the "bottlenecks" in the operational activities and effectively to eliminate them, thereby preventing their recurrence.

Weekly meetings on planning were highlighted as important and were supported by the participants. After two weeks of observations, the planning algorithm was developed. In this algorithm the contractor acts not only as a "task performer", but also as a direct participant in planning. The algorithm is shown in Figure 2. Contractors appreciated the fact that the planning system improves communication and exchange of information. This helped to avoid misunderstanding during the work control and clarifying responsibilities. During the meetings, participants got acquainted with each other providing the enhancement of working atmosphere.

Also one of the benefits is that foreman of the General contractor in considered In planning. Six weeks calendar schedule provided the consideration of key project milestones and definition of further work opportunities.

4. Discussion
Throughout the study it was found out that there is a growing awareness of importance of daily/weekly planning, which creates workflow more reliable due to coordination of work with a contractor. Methods of identification and elimination of restrictions on planned works showed that principle of lean construction affected workflow positively. Contractors recognized that more reliable plan cause less frustration than planning without considering the actual time of the plan accomplishment.

In this paper Russian experience of operational planning was described as the continuation of the tradition of the Soviet construction practices. That’s why it includes the drawbacks of planning economy specific for the Soviet Union. In the context of market-driven economy such approach is inefficient due to lack of flexibility and focus on the clients.

Lean construction is actively developed in plenty of countries. Founders of this approach theoretically define the application of lean production in the construction industry and suggest management tool-kit which let building companies improve the work process both in the broad variety of approaches in general and operational management in particular.

One of the management components of lean construction is ‘the last planner’ system. This system was integrated experimentally into a site of specific works in the company "Stroy-west" in order to prove the reliability of this method in practice. The research lasted 10 weeks. During the research, it was found that planning can increase productivity and efficiency of resources usage. A comprehensive forecast of costs and planning are crucial factors of successful construction management. ‘The last planner’ can be used by planners in order to make project schedule more reliable and to make the workflow more smooth and done on time.

In order to increase the share of operational plans accomplishment the preparation of working area and flattening of a flux of the construction and installation works should be considered as a crucial part of construction process management. Results of management should be evaluated and should lead to improvement of project accomplishment.

5. Conclusions
As a result of the "Last Planner" system, we were able to achieve positive results and prove the reality and effectiveness of this approach to operational planning. This shows that the "Last Planner" improves the reliability of the flow. This means improved deadlines and minimization of project costs.
However, the duration of the study was not long enough to analyze the global changes in the organization "Stroy-west".

Also, this study allows us to initiate a discussion about the possibilities of the philosophy of "Lean Construction" in Russia, which in our country is at an embryonic level, and the method of "Last Planner System" has never been used in the construction industry.

Unfortunately, it is impossible to blindly copy this method and introduce it into the domestic construction industry. We need to go through the optimization stage under our conditions and methods of doing business. Often, as practice shows, all efforts to equalize the construction flow and smooth out all restrictions may come to naught, due to the unstable financial situation of the organization, bureaucratic delays or the corruption component of the controlling bodies.

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