

SCHEDULING INFRASTRUCTURE PROJECTS IN POLISH LOCAL GOVERNMENT UNITS

Ewa MARCHWICKA

Wroclaw University of Science and Technology, Poland; ewa.marchwicka@pwr.edu.pl,
ORCID: 0000-0001-6097-784X

Purpose: The purpose of this article is to identify scheduling problems in Polish local government units, examine the standards that are already used and identify the possibilities of improvement. For these reasons, three research questions are stated and then answered.

Design/methodology/approach: A questionnaire method is used. The answers are collected from Polish local government units. A quantitative data analysis is performed, supplemented by an in-depth analysis of the open question answers.

Findings: The results reveal that public projects do not always end on time and that standard scheduling and estimation are not always used. We provide recommendations for scheduling improvements.

Research limitations/implications: The scheduling procedure is subject to further research, as it has not been verified and adjusted. Other countries' insight is also needed.

Practical implications: We believe that our work has a practical aspect for many Polish local government units and helps them in standardizing project scheduling supported by IT tools.

Social implications: Infrastructure projects include the interests of local businesses and communities. Scheduling is a crucial element of providing project transparency and accountability, as well as enables communication with the stakeholders and the general public.

Originality/value: The work tries to fill in the gap in standardizing scheduling practices in Polish local government units. The questionnaire data collected can also be used for further research.

Keywords: infrastructure projects, scheduling, project management.

Category of the paper: Research paper.

1. Introduction

In recent decades, we observed changes in public administration doctrines (Winch, 2010). Initially, conducting public projects was treated as an official task to be performed. It was managed in a hierarchical manner and compliance with the procedures was a critical factor. It was characterized by little communication and little agreement with the community

(Crawford, and Helm, 2009). The next phase of development is New Public Management (NPM), described, among others, in (Christensen, and Legreid, 2007) or (Funk, and Karlsson, 2019). In this phase, public sector was inspired by the functioning of private corporations. The role of the community increased during this phase. Public projects have been consulted with the public sector environment. Finally, the new phase has been recognized, referred to as Public Value Management (PVM), described, among others, in (Alford et al., 2017) and (Liddle, 2018). In this phase, public sector builds a network of relations with the sector's environment.

Private corporations operating in Poland carry out their projects based on known standards for project management, that define how to proceed in the process of managing a specific type of project. It is worth considering if Polish local governments use these standards to carry out their projects. The most important standards in projects management are PMBoK® Guide, PRINCE 2®, PCM and TenStep (Nowak, 2014; Trocki, 2017). According to PMBOK® Guide, there are 49 project management processes assigned to two dimensions: five process groups and ten areas of knowledge (PMI, 2017). One of the ten areas of knowledge is project schedule management. These are processes that, primarily, consist in planning the project in time and ensuring that deadlines are met. As a part of project schedule management, the following processes are distinguished: planning of schedule management, defining activities, sequencing activities, estimating activity durations, developing and controlling the schedule. Different methods and techniques are proposed in the literature for individual processes (Table 1).

Table 1.

Methods and techniques used in the processes of project schedule management

Process	Sample methods, techniques and tools, which can be used in the selected process
Planning of schedule management	Expert judgment (Booker and Meyer, 2001), meetings
Defining activities	Work Breakdown Structure (DOD and NASA, 1962), rolling wave planning (GAO, 2015)
Sequencing activities	Precedence diagramming method (IBM, 1964)
Estimating activity durations	Expert judgment, data analysis, analogous estimating, parametric estimating, three-point estimating, bottom-up estimating (PM Study Circle, 2020)
Developing the schedule	Gantt chart (Gantt, 1910), critical path method (Kelly and Walker, 1959), milestones, project management information system (Trocki, 2013)
Controlling the schedule	Project evaluation and review technique (Malcolm et al., 1959), critical path method, milestones, project management information system

Scheduling is a crucial element of providing project transparency and accountability and, therefore, is very important from the social point of view. Scheduling enables communication with the stakeholders and the general public (Silvus et al., 2014) about the list of activities and the time of their realization. The time spent on communication campaigns and information meetings should be included in the schedule as well (Kivilä et al., 2017).

In this article, we present the analysis of infrastructure projects realized by Polish local government units in the context of scheduling. Infrastructure projects realized by such entities

are very important in a long-term perspective (Köhler, 2012). There are a few important aspects that characterize infrastructure projects:

- 1) they have strong influence on the future,
- 2) they consume huge amount of resources,
- 3) they build the commonwealth of the future generations,
- 4) they are influencing the environment,
- 5) they involve the interests of local businesses and communities.

Summing up, infrastructure projects have a strong influence on the future, involve the cooperation of many stakeholders, consume huge amount of resources and often change the environment (Kivilä et al., 2017). For this reason, it is crucial how well the infrastructure projects are managed. In particular, it is important if infrastructure projects are properly scheduled and initiated. There should be time for informative campaigns directed towards the stakeholders and the general public, while the costs should also include environmental factors, like pollution (Martens, and Carvalho, 2016). People's work schedule should be realized in a way, so that people are not overloaded with work. The schedule should include time for innovations, so that project can optimize the resource usage.

The rest of the paper is organized as follows. Section 2 describes the questionnaire used as a research method for analyzing the problems of scheduling infrastructure projects in Polish local government units. In this section, there are three subsections: the first presenting the research questions, the second showing the questionnaire design and the third summing up the questionnaire statistics. Section 3 describes results of this analysis. Section 4 contains discussion and Section 5 is the summary.

2. Methods

In this section, we describe the research methodology used for analyzing infrastructure projects scheduling in Polish local government units. Research questions and research methods are presented below.

2.1. Research questions

We asked three questions related to project scheduling:

- 1) Are standard methods of scheduling infrastructure projects used in Polish local government units?
- 2) What are the scheduling problems occurring in infrastructure projects realized by Polish local government units?
- 3) How to mitigate the problems and what recommendations to suggest?

2.2. Questionnaire design

The data collection for the purpose of analyzing scheduling problems occurring in Polish local government units was performed using a questionnaire (Sinclair, 1975). The questionnaire was divided into five sections: Basic Information, Schedule Creation, Tasks Estimation, Schedule Control and Monitoring, Open Problems. Basic Information section was used to collect the basic statistics of the responses. These statistics are being presented in the next subsection. Schedule Creation and Task Estimation sections were used to analyze the process of scheduling. Schedule Control and Monitoring section was used to analyze project management practices used in Polish local government units. Open Problems section is an additional section that was added to identify some potential scheduling problems that were not identified earlier and were not included in the list of questions. The questionnaire consists of 27 questions in total: 5 in the first section, 10 in the second section, 4 in the third section, 3 in the fourth section and 5 in the last section. What is important, 60% of the questionnaire questions are open questions and only 40% are closed questions. Open questions are harder for analysis, but they do not impose any point of view and allow to collect more detailed answers (Brancato et al., 2006). Open questions are particularly important for identification of scheduling problems, as we obtain a full picture of all scheduling problems that can appear during infrastructure projects realization, not only the problems that are already known as standard problems in project scheduling. The last section of the questionnaire tries to collect the list of those new problems, not known to the author before constructing the questionnaire. The estimated time for filling in the questionnaire is 20 minutes. The questionnaire design is summed up in the table below (Table 2).

Table 2.
Basic characteristics of the designed questionnaire

Total number of questions	27
Basic Information questions	5
Schedule Creation questions	10
Task Estimation questions	4
Schedule Control and Monitoring questions	3
Open Problems questions	5
Number of open questions	16 (60%)
Number of closed questions	11 (40%)
Time for filling in the questionnaire	20 min

Based on the data collected, we performed data analysis, the first step of which was initial data processing, when we removed some of the answers that were not complete. The main data analysis was based on simple aggregation of closed questions and counting the answers collected in the background of all possible answers. Where there was a need for a more accurate understanding of the results, we used an in-depth analysis of open questions that were part of the questionnaire we designed.

2.3. Questionnaire statistics

The questionnaire was sent to 2738 units of Polish local governments: communes, districts and voivodeships. The response rate was 15,3%, which means that 420 answers were collected. This is summed up in Table 3.

Table 3.

Questionnaire answers statistics: response rate

Statistic	Value
Number of questionnaires sent	2738
Number of responses	420
Response rate	15,3%

The answers were given by the people working in the following roles (Figure 1): inspectors, managers, secretaries, heads of departments, specialists, mayors, others.

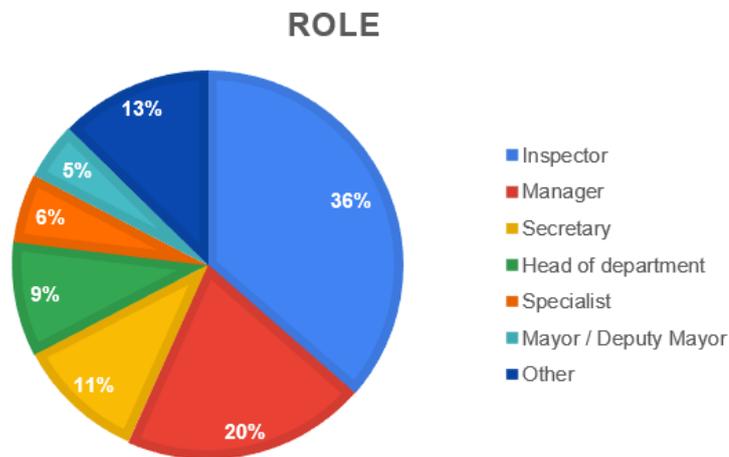


Figure 1. Questionnaire answers statistics: responder role in government units.

Most of the answers were collected from the communes (Figure 2), which reflects the fact that it is the largest group of local government units in Poland.

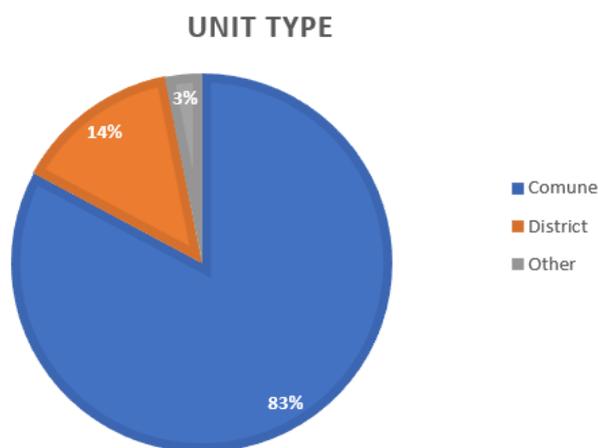


Figure 2. Questionnaire answers statistics: government unit type.

The answers were collected from all 16 Polish voivodeships and were roughly uniformly distributed (Figure 3). Most of the answers were collected from the: Masovian Voivodeship, Lesser Poland Voivodeship and Lublin Voivodeship.

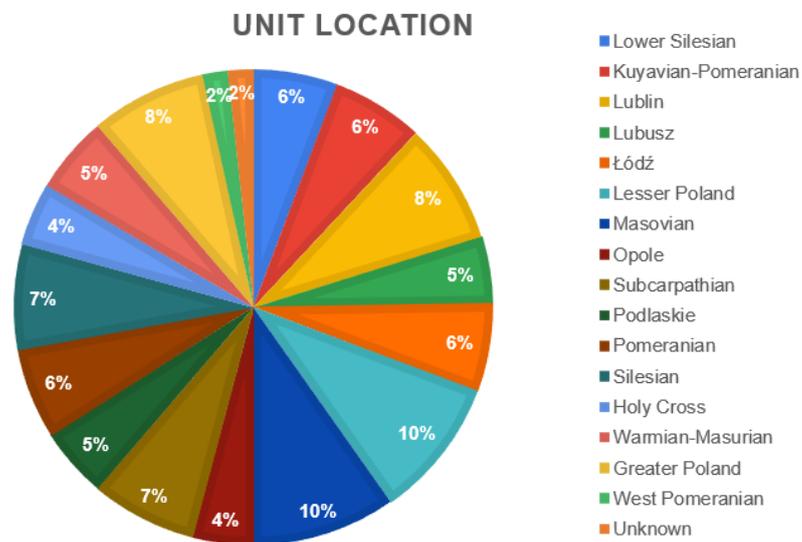


Figure 3. Questionnaire answers statistics: government unit locations.

The analyzed government units were asked about the size of the unit. Most of them are small size and the number of employees is between 20 and 50 (Figure 4).

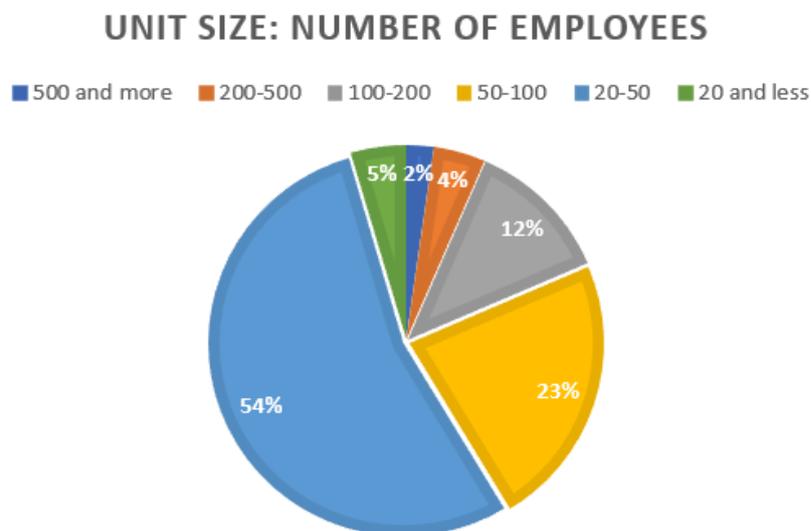


Figure 4. Questionnaire answers statistics: government unit size (number of employees).

What is more, most of the units are also small in case of the number of citizens belonging to an organizational unit. Almost 70% of the answers were collected from the units with less than 20 thousand citizens (Figure 5).

UNIT SIZE: NUMBER OF CITIZENS

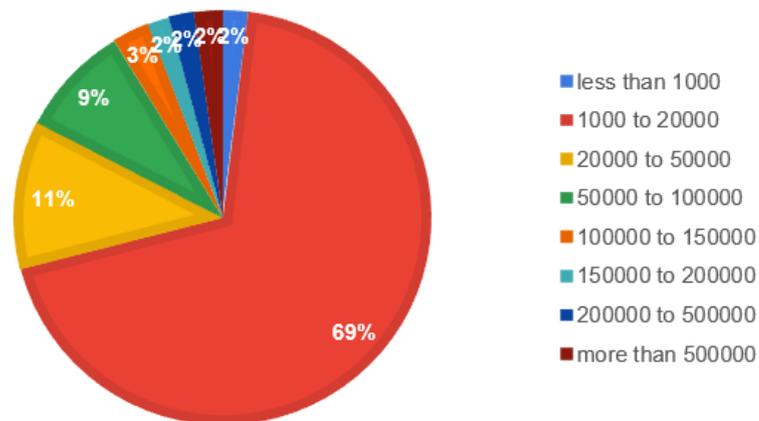


Figure 5. Questionnaire answers statistics: government unit size (number of citizens).

3. Results

According to the conducted research, it can be said that scheduling infrastructure projects in Poland should be required, and this is how it is perceived by most government units (Figure 6).

SCHEDULING SHOULD BE REQUIRED

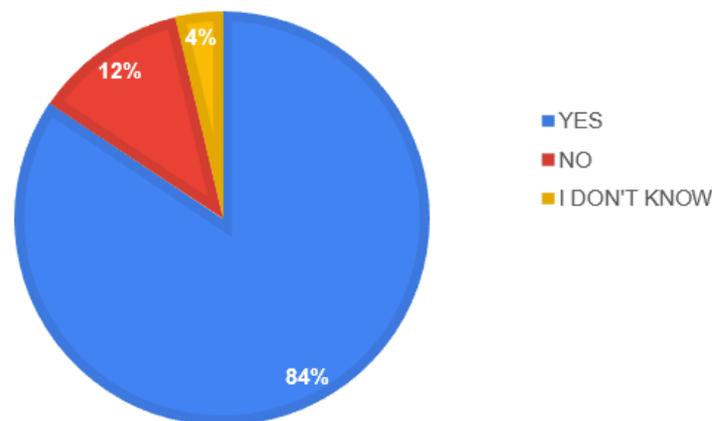


Figure 6. How strong is the belief that scheduling of infrastructure projects should be required.

We can list situations when scheduling of infrastructure projects is not required according to the interviewees. The most common reasons for the possibility to omit scheduling in infrastructure projects are:

- investment project is simple or is not time consuming,
- investment project has limited scope and value,
- investment project is not an EU project that requires scheduling,
- project contractors are responsible for scheduling.

Based on the research, it was also analyzed which methods are used by the tested government units for scheduling. The results are presented in Figure 7.

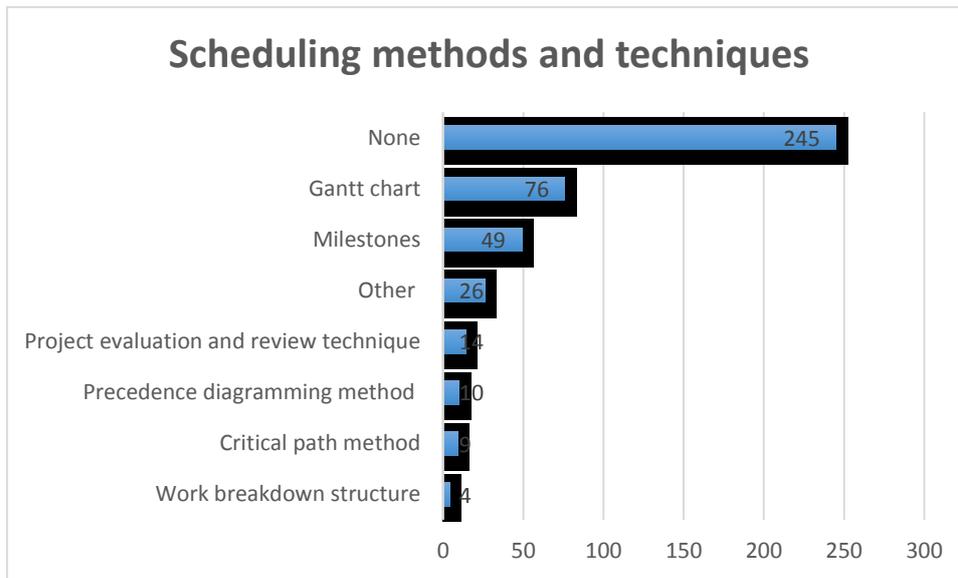


Figure 7. Scheduling methods and techniques used by local government units in infrastructure projects.

Project schedules for infrastructure projects in government units are developed on the basis of investor cost estimates, construction projects, community budget, documentation from previous similar projects, project co-financing agreements (if applicable), contracts with project subcontractors or obtained building permits. To control the schedule of infrastructure projects, the units use: document control, management control, comparative control, cyclical meetings of the project team, assessment of earned value, investment coordination meetings with the contractor and milestones. In turn, to estimate the tasks of infrastructure projects, mainly expert judgment and analogous assessments are used (Figure 8).

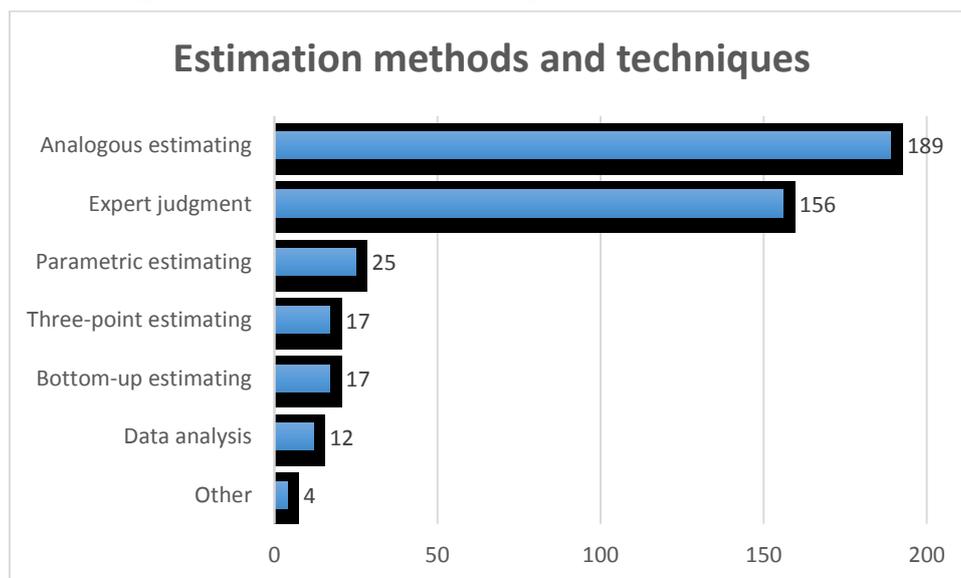


Figure 8. Estimation methods used by local government units in infrastructure projects.

Based on the research, we also listed problems that employees of communities involved in planning and implementation of infrastructure projects have to face. The most common were: lack of or insufficient funds for implementation of the project, for which the concept was developed, extension of the period of preparing technical documentation and obtaining permissions for construction works, lack of specification for investor cost estimates, too long time from the submission of the grant application to its examination by the co-financing unit, legal problems, problems in up-down communication, as well as between project team members, problems with subcontractors and issues caused by random situations (e.g. weather conditions).

The major problems faced by community employees responsible for developing infrastructure project schedules were also identified (Figure 9). This question was constructed in such a way, so that only one answer was possible, allowing to identify one major problem from the local government unit's point of view.

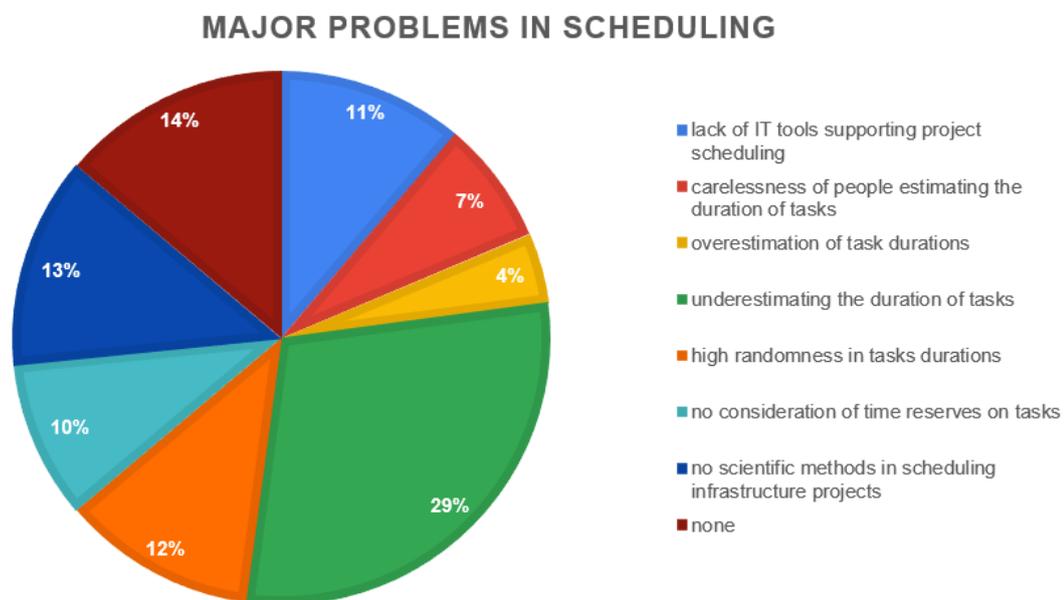


Figure 9. Problems faced by community employees, who develop project schedules of infrastructure projects in Poland.

4. Discussion

Based on the analysis of data from completed questionnaires, we are able to answer the three research questions stated in one of the previous chapters.

Regarding the use of standard tools for scheduling infrastructure projects (research question 1), many public institutions do not use them at all (61%). In addition, those tools are used selectively. For example, 46% of the respondents use Gantt, but do not determine a critical path for it, which means that the process of project scheduling does not take place in Polish

territorial units, according to the recommendations of standard project management methodologies.

As far as identification of scheduling problems related to Polish infrastructure projects is concerned (research question 2), we identified the main ones, which are: difficulties caused by underestimating the duration of tasks and the lack of scientific methods used for scheduling.

In relation to the issue of problem mitigation (research question 3), based on the list of major problems identified in infrastructure projects, we suggest improvements and recommendations that communities should implement. The following main improvements in scheduling infrastructure projects in Polish local government units were proposed:

1. Formal procedure for managing infrastructure projects, in which we distinguished four stages. The procedure is presented in Figure 10.

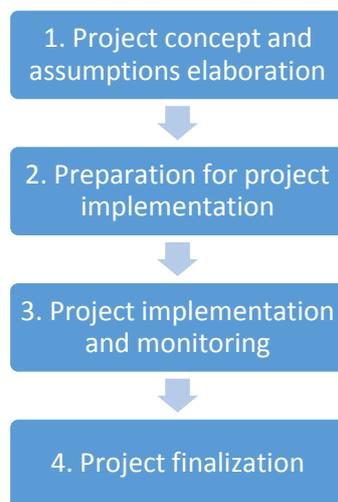


Figure 10. Formal procedure for managing infrastructure projects.

Within the first stage, the following tasks should be realized: citizens' needs analysis, preparation of project documentation (including technical documentation), project financing determination, obtaining cash (EU subsidies, national subsidies, loans) and/or securing cash in the budget of the government unit. It should include "real" cost estimation and consider other important aspects from the ecological point of view, like fulfilling pollution and other ecological standards. The second stage is preparation for project implementation. It covers such aspects as preparation of tender procedures, application for project co-financing (in the case of projects financed from external sources) and contracts with project subcontractors (especially with construction companies), as well as organizing informative campaigns and discussion sessions with citizens. The third stage is the implementation of the project (construction and design works, acceptance) and its monitoring. Infrastructure projects are characterized by the need for ongoing supervision, monitoring and the need to make changes, respond quickly to various external factors, e.g. weather, legal changes, problems of the contractor etc. The last step is project finalization, under which the project should be settled (especially when it was financed from external funds), obtain permits for the use of created project products and

develop as-built documentation. Also the final costs should be calculated here, including the KPI indicators related to the ecological norms, human wealthiness and environment. The developed procedure described above still needs to be verified, assessed and possibly adjusted in real-world context, which is subject to further research.

2. Using scientific methods for scheduling infrastructure projects. We recommended using the following methods in Polish local government units: work breakdown structure, Gantt chart, critical path method, project evaluation and review technique, precedence diagramming method or milestones.
3. Applying feasible project schedule. To realize this task, the buffers should be added to tasks that may be delayed. Potential delays can be caused by subcontractors or can occur due to the problems with obtaining permissions required for project realization. They can also be a result of prolonged procurement procedure.
4. Using IT tools for task estimation and scheduling infrastructure projects. According to the conducted research, it was found that a few of the units use software for scheduling infrastructure projects. The main reasons for the lack of this type of software, that were mentioned, were the license costs and the lack of knowledge in this area. For this reason, we recommended using the software with no license costs and which is easy to use (e.g. Gantt Project). What is more, many government units admitted that some of the biggest problems are realistic task estimation and underestimating tasks. For this reason, we suggest using web tools for group-task estimations (e.g. the tools that enable voting) and tools that allow to store information about reference activities completed in past, together with their real durations. This simple knowledge base should be used as a list of patterns for realistic estimations. This type of estimation, also referred to as analogous estimation, is already known to some of the communities and has already been mentioned above (Figure 8), which means that local communities are open to this type of methods. We suggest standardizing them and applying each time when estimating project tasks. We also advice including risks in task estimations (e.g. prolonging legal procedures or obstacles in collecting appropriate documents and contracts).
5. Trainings for people involved in project scheduling. Human resources are crucial for the success of infrastructure projects implemented by Polish government units. Therefore, it is essential to properly prepare people involved in managing infrastructure projects. In the case of territorial units, the responsibility for implemented projects, including infrastructure ones, is taken by the people who are not prepared in the area of project management. This is mainly the administrative staff. For the above reasons, it is important that those people are also given recommendations of different project management methodologies (e.g. PMI, IPMA), so that they could train project management methods in practice. From the social perspective, it is important that they are taught how to avoid work conflicts and how to organize informative campaigns for the public during project realization. From the ecological perspective, it is also worth

providing trainings in using IT tools supporting project management, especially for project scheduling and “real” cost estimation, including standards on pollution and ecology, for the involved staff.

5. Summary

The obtained results clearly reveal that public projects do not always end on time (only 11% indicated that they always manage to complete infrastructure projects on time) and that there are many local government units that do not use any standard scheduling and estimation methods (58%), while vast majority uses only one method, e.g. only Gantt, but without setting a critical path or milestones or formulating only milestones, without a detailed schedule. This shows that more scheduling, supported by IT tools, should be included in infrastructure projects implemented by public government units. In this article, we suggest a list of recommendations for local offices that help mitigate problems identified in this article, which is also a starting point for further research.

As far as further research is concerned, and what was already mentioned above, we plan to assess the developed procedure on selected infrastructure projects, as well as adjust it for best effectiveness. What is more, we plan to further develop the formal procedure of managing infrastructure projects and distinguish specific tasks to be realized, as well as assign roles/positions that should be responsible for the realization of each task. Finally, we suggest comparing our results with those obtained for other countries in the context of tools and methods used in the area of scheduling.

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