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THE SYSTEM OF MANAGEMENT OF MINOR MECHANIZATION (HAND TOOLS)

Pavel Kovář[1]

[1]*CTU in Prague, Faculty of Civil Engineering, Department of Economics and Management in Civil Engineering, Thákurova 7, Prague 6 - Dejvice, 166 29, Czech Republic, pavel.kovar@fsv.cvut.cz, +420 777 021 251*

Abstract

Nowadays, there is an over-pressure of takers interested in one order, which makes the prices of implementation to go down persistently. The prices decrease so rapidly that some companies are forced to produce nearly at the level of their own costs. This approach does not meet with approval from a long-term point of view. Thus, it is the decision of each company in how they lower their costs in order to succeed in the hard fight and reach the desired profit. This article deals with the system of minor mechanization (hand tools) which provides a lot of reliant expenses, which are possible to decrease. Furthermore, it also concerns a software support, which is an inherent part of the system management.

Keywords

Lowering of costs; minor mechanization; software, technology; the system of management

Introduction

A construction company implements each order with the goal of reaching profit to be able to cover all needs, and invest in new machinery and technologies needed to withstand the competition. The extent of the profit is dependent not only on the amount of an order, business strategy, equipment of a company, but chiefly on the ability of the company to implement the order with minimal production and administrative costs. At the present time, when there is a huge excess of offers concerning one order, construction companies are forced to lower their sales prices to the level of direct costs of implemented product. The only way to prosperity is lowering all the costs irrespective of their amount. The cost nature of constructions is huge and so every lowering of costs reflects immediately in profitability of an order and, by extension, the whole company. The main task of every construction company is not only to get an order, but mainly to control expected costs during implementation to minimise unexpected costs. The specification of construction industry is precisely a building, its partial section or a functional whole. Almost every construction is in a way a unique object and it is possible to implement it in various ways and technologies. Due to the expenses on implementation, it is always important to design an optimal solution. Each construction company would spend on an identical building different amount of money. The amount of these expenses is dependent on qualification of employees, the acquaintance of an environment, price of inputs, equipment of the company and the choice of technology.

The great contribution on costs is involved in the total system of material management, human resources and last but not least, machines and mechanization. And precisely the system of management of minor mechanization and costs that are related to it will be the object of the article. Into minor construction mechanization, it belongs hand tools of all kinds along with cement mixers, hand rammers, vibrators and dryers. In the construction field, there exists a lot of systems of management linked to management of costs during implementation with managing smooth work and running of buildings.

Currently, from the point of view of implementation of a product, the most significant model of management is Building Information Modelling (BIM) [1], which is supported by a lot of CAD softwares. The maintenance of buildings is realized by facility management [2], which is supported by the software Revit and many others. Construction companies usually own the management system of the big construction mechanization, such as excavators, loaders and trucks. What is neglected or dealt with marginally in many cases of construction companies is the minor mechanization, which forms a great part of a company's funds [3]. Provided that a construction company focuses on minor mechanization, it is able to save significant costs on maintenance of machines and, furthermore, during implementation of buildings when the technology is designed well. At present, modern management of any type demands a software support, which simplifies the whole management on the account of archiving and consequent sharing of needed data.

Support and contribution of the software

A custom designed software is a complete system for management and maintenance of minor mechanization and processes connected to their usage. Owing to its use, construction companies will significantly simplify and hasten the processes connected to management of minor mechanization and mainly management of costs associated with them. The main domain of the custom designed software is the overall database of all the machines and information related to them. These are then shared among executives and workers that hand them over from the store, alternatively for workers that provide maintenance of machines. Thanks to the shared data, the executives can control and manage costs connected to any machine or a group of machines because all of the information are matched directly to a particular machine in the database according to the title and a production number.

Management of costs

By virtue of the custom designed software, the costs that are directly connected to buying and running machinery can be managed. Furthermore, costs connected to a choice of the right technology can be managed too. The management of expenses from both points of view is very important for reaching the maximal effectiveness.

Direct costs connected to purchasing and running the machinery

Companies usually have an annual outline of total costs for purchased machinery and total costs for maintenance of machinery. In order to manage costs, they should be matched to a particular machine. Likewise, all that is associated with the Life Cycle of Machinery (LCC) needs to be watched as it is usually done with buildings. A construction machinery has its own life cycle and costs in individual stages of the cycle. The costs of the life cycle of a construction machine are shown in the Fig. 1.

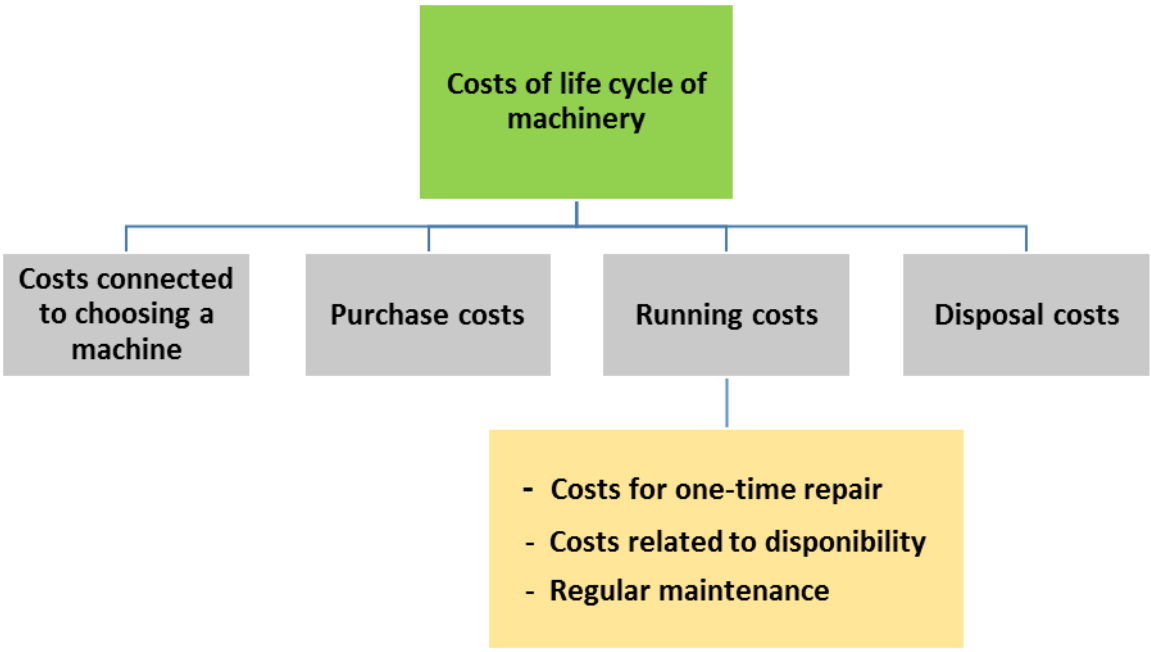

Figure 1: Costs of a life cycle of a construction machine

As seen in Fig. 1, the costs of the life cycle can be divided into four categories. The most remarkable category, with respect to the amount of costs, is the purchase and running costs. Each manager responsible for purchasing and maintenance machines should focus on both. After taking into consideration the most convenient parameters, the majority of construction companies focuses mainly on the purchase costs when demanding a machine from suppliers or producers of construction tools. Consequently, the vast majority of them get a machine that is the cheapest in terms of purchase costs or they choose the one with positive references. However, it is not always the right choice to purchase a machine by its lowest price. The low price can reflect the quality of processing or the output of a machine in a negative way, which results in higher costs for running. Last but not least, the price can have an impact on the costs that are connected to choosing the technology that is mentioned in the chapter - Indirect costs connected to the choice of technology. Otherwise, purchasing a machine from the highest price category might not be the right choice. It is important to choose a machine according to the frequency of use. In case that a machine, with a higher potential than a company was able to utilize was purchased, the resources suitable for further investment would be in vain. At this point, it is noticeable how important the management of costs is right from the beginning. The next significant costs, which should be taken into account, are the costs connected to the running of machinery. Companies deal with these costs only marginally while they do not consider them from the perspective of every individual machine. But the right definition and allocation of costs of every individual machine is what is important when managing the costs of machines. Furthermore, it is important to watch the cumulated costs in order not to exceed the utility value and not to invest into machines more than it is needed with regard to their lifetime. In Fig. 2, the ideal division of costs into individual parts of the machine life cycle is shown in terms of percentage. The graph in Fig. 2 is important mainly for its running costs and maintenance costs closely connected to them. If everything was quantified in real value, the running costs would not exceed more than a half of the purchase price. The investment into a machine loses its real value at this point.

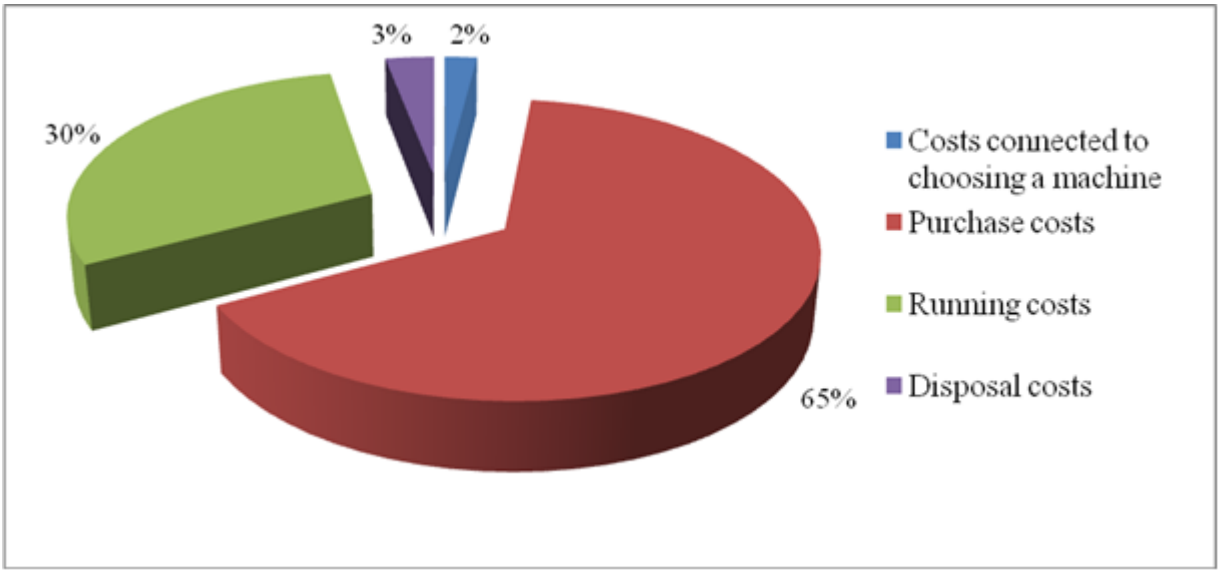

Figure 2: The division of costs into LCC

What is obvious from the Fig. 1 is the fact that the regular maintenance, one-time reparations and the costs connected to availability are included in the running costs. The costs related to the availability are, for example, the expenses for renting machinery in case that the company's own machinery is being repaired or is currently deployed in another work. In this case, the executives have to define the costs right and exclude them from the total cumulated running costs. The reason for this is to avoid decommissioning machinery that is still in a good condition for exceeding the maximum running costs. The border percentage of running costs was defined from the graph of the intensity of malfunction in the time of the machinery running cycle in Fig. 3. According to, so called, Bathtube curve of the malfunction intensity progress in the time, it is obvious that after the period of the stable life of machinery, an ageing period supervenes during which the intensity of malfunction rapidly rises. This is a period that comes at the time when the maintenance and repairs cost more than half of the purchase costs. This value is based on the statistic quantity of median from the sample of cross-section of 400 various machines. It was found that periodically invested sums for maintenance significantly prolong the total service life of machinery up to half at the same amount of invested costs. This raises a question why the intensity of malfunction is considerably higher in the run-in period than in the period of machinery's stable life. This is caused by manufacturing defects which occurs after 6 month time frame from commissioning at the latest. After exceeding the first six months of regular use, it should be clear whether there was or wasn't a hidden defect within the machinery.

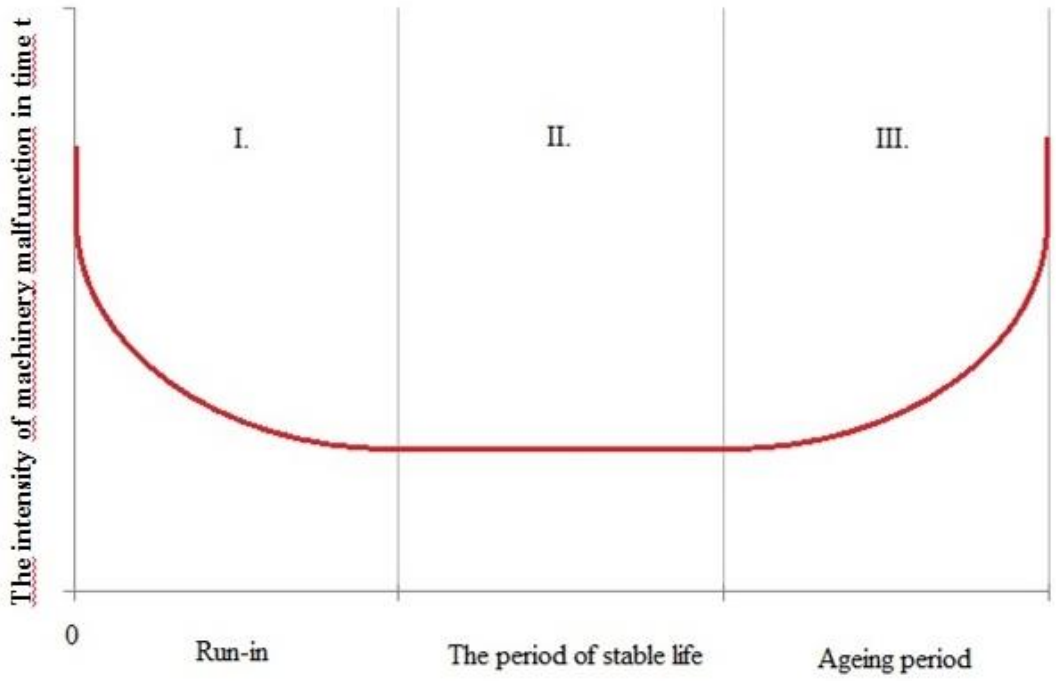

Figure 3: The intensity of machinery's malfunction in the time

Indirect costs connected to the choice of technology

Primarily, the indirect costs are hourly costs of workers for the time they are deployed in a particular order. To manage and consequently lower these costs to a minimal, firstly it is important to know technical parameters of machinery. If an executive manages to choose an optimal machinery for work with a corresponding output, the time spent on an order will be shorter in comparison with an inappropriately chosen machinery. If workers spend more time with the order than needed, it will give an impression that the company would have paid more. First of all, the costs for workers allocated to one order will go up. Secondly, the company will have added opportunity costs that are hard to deal with but are tangible. These are costs connected to the fact that if workers did not spend overtime completing the first order, they could acquire profit from the second order. As for the choice of machinery, it should be chosen by an executive that has the knowledge of technological features, in no case the choice should be done by regular workers. In a construction company environment, the situation when a machinery with a low output is used often occurs. This is especially true for hand tools, by means of which service workers do not have to put much effort in e.g. doing demolition jobs to a great extent with a light and small hammer as it is easier to operate. What they do not realise is that it happens at the expense of time and costs. Right in this case, the costs leak out of the company in the form of many factors. As mentioned before, one of the factors are increased costs spent on workers, followed by opportunity costs and finally, which has not been mentioned yet, excessive wear and tear of the machinery that considerably lowers its service life and as a consequence, the costs on repairs increase. At this point, there is a fuzzy border between the direct costs connected to running and costs linked to the choice of technology. As stated before, the choice of technology does not influence only the indirect costs, but it also largely influences the costs of the life cycle, concretely running costs. When choosing an inappropriate technology, more precisely when choosing insufficient machinery, there is a multiplier effect of costs that might raise the total costs of an order talking about a large construction with a lot of workers deployed in it. Otherwise, it is possible to reach great savings.

To work as a support for the system of management of minor mechanization, the software should contain as much relevant data about a particular machinery as possible.

Data in database

For managing all mentioned costs, it is necessary for a construction company to form a good database with relevant data that will be an essential source afterwards.

It is possible to divide the data suitable for the database into two groups:

Specific data

- Machine type
- Machine name
- Photos
- Serial number
- Weight category
- Machine's output in relevant parameters
- Use application
- Extend of use
- Manual

Operation data

- The date of purchasing machinery
- Warranty cards
- Service cards
- Maintenance costs
- Other costs connected to a machinery
- Total time of running of a machinery
- Jobs that a machinery was used in
- Borrower that currently has a machinery
- Which job is a machine present at

The specific data are the data that characterize a machine and are constant during its life cycle. They are very important data for choosing optimal type of machinery. Executives should primarily consider the application and the extent of use when choosing new machinery in order to avoid an under-sizing or an over-sizing of machinery for a particular order. Furthermore, it is suitable to follow other indicators - One of them being, for example weight category in order not to place a very heavy machine above one's head. The running data are such that, in progress during the life cycle of a machine, they need to be permanently completed over time.

The running data are such data that are in progress during the life cycle of a machine and needs to be permanently completed over the time. Old data should not be rewritten as they ought to stay in the database to find out who borrowed a machine and at which construction place.

If the costs for repairs go up more than expected, owing to examination of the combination of data it will be possible to discover whether a particular machine had been used not properly or whether it was overloaded. Alternatively, a worker that used a machine and possibly damaged it may be traced back. Watching workers and machines that bounds with the amount of responsibility surely leads to better discipline of workers and chiefly to better care of entrusted machines. If workers do not have liability for machines, they tend to treat them in a worse manner than if the liability is present.

The example of the software and demonstration of information about machinery

In the Fig. 4, there is a user interface of custom designed software that shows the database of a particular machine including displaying information about the machine. To make the picture clearer, individual features had been enlarged. In the explicitly visible windows, it is possible to see for example the costs or construction places, where the machine had been or possibly is present.

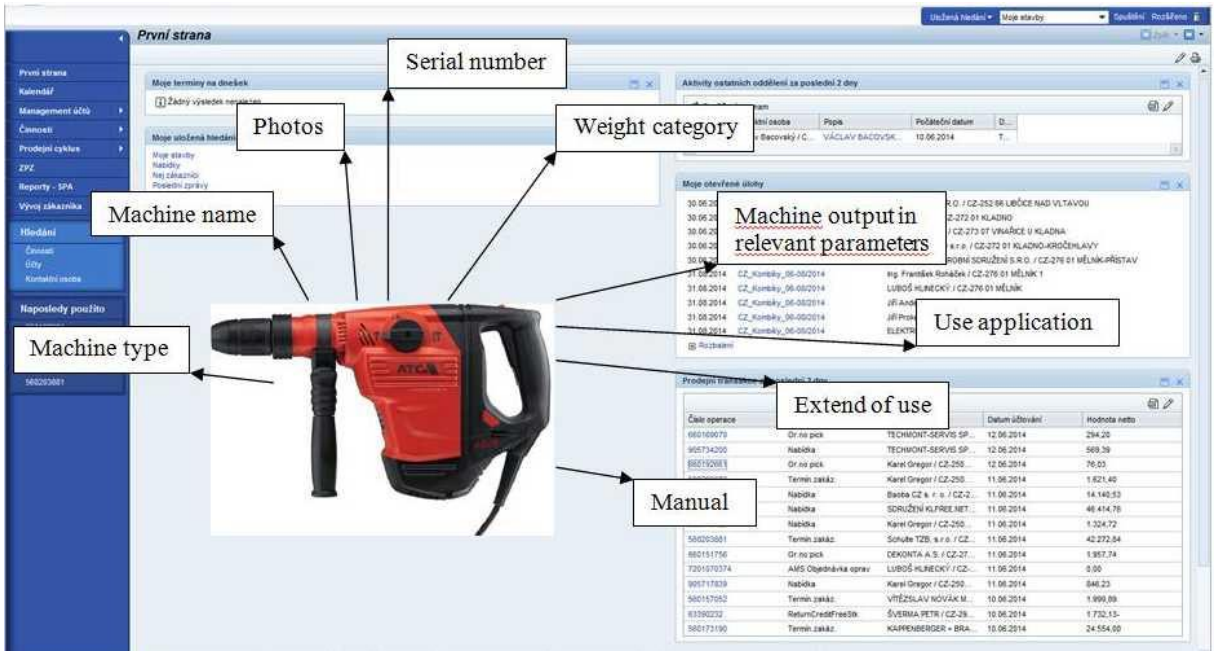

Figure 4: Example of a software and depiction of information about software

An example of a multiplier effect of lowering costs when choosing the eight technology

This chapter presents an economic comparison of a cable routing project executed by the means of the traditional anchoring method, and by the means of direct fastening. Cable routing is realized in total length of 500 m in a two-floor administrative monolith building with ceiling height of 4,8 m. To conduct 500 m of cable routing, there will be need for 1,500 fireproof anchor points. In both ways of executing the project, anchor material is accounted for, as are the costs of workers, purchase and rental of necessary machinery.

With both anchoring methods, decking and scaffolding was rented, and costs of equipment needed for execution of the project were accounted for. Material costs and rental costs follow the usual market prices not including VAT. Productivity of both methods was measured on site of Florentinum in Prague. Each method was timed during an 8-hour shift, and consequently converted to hourly work rates. The traditional anchoring method with its consequent financial analysis is stated in Tab. 1. Total costs of the project were 58 025 CZK not including VAT.

Table 1: Economic study of traditional anchoring method

Project specifications	
Number of anchor points	1500 [pcs]
Assembly productivity and fastening times	
Assembly productivity	20 [anchor/hr]
Total time of project anchoring	75 [hrs]
Worker costs for entire project [2 workers]	
Hourly rate of one worker	150 [CZK]
Total worker costs per project	***22 500 [CZK]***
Material costs	
Fireproof anchor	8250 [5,5 CZK/pc]
Fireproof fixing lug	6750 [4,5 CZK/pc]
Drill 6/12 - 120 holes/item	1125 [90 CZK/pc]
Total material costs	***16125 [CZK]***
Machinery purchase and equipment rental costs	
Drifter drill purchase	4900 [CZK]
Electric screwdriver purchase	4000 [CZK]
Decking rental	10 500 [1400 CZK/day]
Scaffolding rental	- [550 CZK/day]
Total costs of machinery purchase and equipment rental	***19400[CZK]***
Project costs	
Total costs per anchoring project	**58025** ***[CZK]***

Direct fastening method and its economic analysis is shown in Tab. 2. Total costs for the project were 43,200 CZK not including VAT. When compared to the traditional fastening method, the costs of the project are 14,825 CZK lower. Should this case study be a project that does not need to take purchase costs of machinery into account, the savings would be higher. Saved time which is due to better work productivity also influences other areas with potential for cutting down costs. Easement time may be shortened, and therefore paid less for, worker accommodation and transport costs may be reduced as well.

Table 2: Economic study of direct fastening method

Project specifications	
Number of anchor points	1500 [pcs]
Assembly productivity and fastening times	
Assembly productivity	20 [anchor/hr]
Total time of project anchoring	30 [hrs]
Worker costs for entire project [1 worker]	
Hourly rate of one worker	150 [CZK]
Total worker costs per project	***22 500 [CZK]***
Material costs	
Fireproof anchor	6000 [4 CZK/pc]
Fireproof fixing lug	6000 [4 CZK/pc]
Total material costs	***12000 [CZK]***
Machinery purchase and equipment rental costs	
Gas-actuated tool purchase	18000 [CZK]
Decking rental [1400 CZK/day]	4200 [1400 CZK/day]
Scaffolding rental	- [550 CZK/day]
Total costs of machinery purchase and equipment rental	***22000[CZK]***
Project costs	
Total costs per anchoring project	***43200 [CZK]***

Conclusion

In this article, it is described into detail that focusing on minor mechanization might have a positive influence on lowering costs. Furthermore, there are types of costs that relate to minor mechanization and the ways that can lower them. It was shown that a very important part of savings of costs is the choice of an optimal machine that saves time and finally also costs for workers and possibly opportunity costs. Last but not least, the choice of an optimal machine saves the machine itself. Regular maintenance of a machine lengthens its lifetime and prevents pricey one-time repairs that are, with respect to the costs, undesirable. In the conclusion, the fact that the choice of the right technology saves costs in many ways, which can be a significant sum of money in the final result, is confirmed. A very important support for the system of management of minor mechanization and costs connected to it is the software with the well designed database.

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