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Process Planning For CNC Machining of Swedish Subcontractors – A Web Survey

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Abstract

Process planning of CNC machining is critical to ensure cost, time and quality parameters of manufacturing operations. At the heart of process planning is, typically the process planner, who must make a multitude of decisions regarding machines, cutting strategies, tools and process parameters etc. Today there are a number of different tools and methods available to aid the process planner. This paper explores today's industrial use of some of these aids and outlines potential underlying reasons for the current state. The empirical data is based on a questionnaire survey of Swedish CNC machining sub-contractors. The main conclusion is that despite a long history of development of various aids (CAD/CAM, PLM standards etc.) there is still a large proportion of the industry, which has not yet adopted these aids. By the responding companies 32% do not use any CAM system and only 2% use a PLM system. On the other side of the spectrum is a group of 25% that uses CAM in 75% or more of their planned products. The learning from this survey can be used to better understand the industrial needs and focus research and development efforts.

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1 Introduction and background

To better understand the current state of industry regarding process planning for CNC machining a questionnaire survey was developed and distributed to a large sample of Swedish sub contractors. This focuses on the level of digitalisation, the use of various performance indicators as well as short comings of process planning work.

Over the last centuries the maturity level of different computer aids has increased and the commercially available software to aid process planning are many. This has e.g. been manifested in the development of various CAD/CAM and PDM/PLM systems. Theodorou and Florou [1] studied the impact of advanced IT system as e.g. CAD/CAM on financial performance in the Greek industry. The results showed some ambiguities, where implementation of manufacturing IT

systems rendered benefits for some companies and little impact in other companies [1].

However, no good overview of the actual industrial use of these systems is available. A few previous studies are available, but which only partly focus on process planning Korn [2], Dunn [3] Anderberg, et al. [4, 5]. This paper is therefore important, in order to raise the awareness of any possible discrepancy of the software aids available and their usage so that more effective process planning aids can be developed. To focus on sub contractors and small and medium enterprises (SMEs) is relevant since it is a large part of the machining business and which is associated with certain characteristics when it comes to the use of computer aids. Miller [6] states that this is due to limited IT resources and resources for making process improvements. Another problem identified by Denkena et al. [7] is that e.g. PLM systems mainly suit in-house mass production companies, thus excluding SME sub-contractors.

1.1 Process planning aids

The objective of process planning aids are to enhance the performance of the planner to carry out the work needed to deliver a process plan and program to manufacture a product according to specified requirements and costs. These aids are many and can support the process planner on different levels. The aids can support in producing better machining operations, resulting in higher product quality, reduced manufacturing costs etc. or minimising the resource and time used for process planning work.

Figure 1 gives an overview of the herein regarded process planning aids. This paper uses a principal distinction between technical aids and methodological aids. The technical aids principally aim to automate planning work by replacing advanced analyses and calculation steps with algorithms. The methodological aids instead provide the individual planners with work guidelines and best practices and management as well as the planners with data on performance to better understand effects of decisions made and how improvement measures take effect etc.

2 Method description - Questionnaire development and respondent characteristics

The questionnaire survey was developed to minimize the respondents' efforts in participating, so that a larger number of companies would participate. In total the questionnaire contained 18 questions plus voluntary additional comments by the respondent. The following areas were included in the questionnaire:

- Use of digital information and computer aids;
- Use of performance measurements and standards;
- Use of environmental performance indicators;
- Deficiencies in process planning;
- Company characteristics.

The survey was distributed to 600 companies found at the Swedish sub-contractor portal www.industritorget.se and a smaller part consisted of companies, which previously had responded to other surveys by the authors. In total, 144 companies responded (response rate of 25%). The

questionnaire was web-based, and each company's websites were visited to ensure that their main business was CNC machining and to retrieve appropriate respondent contact data. The survey was made available online and a link to the survey was mailed to the companies after that a suitable person had been found within the companies. Only companies with e-mail address have been approached. This may influence the survey response.

Questions referring to the extent of use were filled out by the respondent by giving a percentage value (0-100%) and other questions gave the respondent the possibility to choose between different alternatives. Hence the use of open ended questions was limited.

It is important to remember that all presented data herein are based on the perception and estimations of the responding persons in the companies. This implies that figures presented should not be considered as the absolute truth.

2.1 Characteristics of responding companies

The size of the companies that responded differs significantly, ranging between 1 and 500 employees, see Figure 2. The bulk of the companies are SMEs, where 95% are small companies (fewer than 50 employees). The rest are middle size companies (50-250 employees), except one company with 500 employees. The average size is 21 (median 10) employees. The number of persons working with process planning is reflected in the size of the company, but 70% of the companies have three or more persons working with process planning.

In the responding companies, 17% have primarily one-piece production and the majority has mixed production volumes. 27% have on average larger volumes than 100 parts/batch (based on 99 responses), see Table 1. With low series or one off production, the process planning time will constitute a larger part of the total product realisation lead time, hence stronger incitements for efficiency improvements of process planning. The product price in the companies varies between 5 SEK and 7 MSEK (based on 44 responses), and thus there is a large variation in prerequisites of the different organisations participating in the survey.

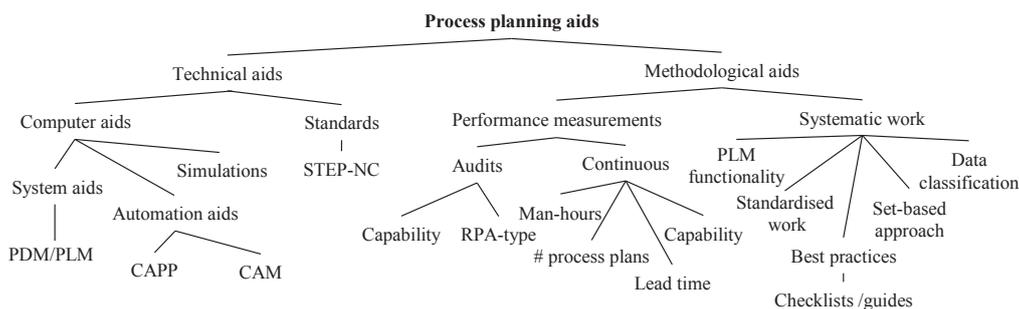


Figure 1. Overview of process planning aids [3].

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