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# STEP NC IN RELATION TO THE MANUFACTURING DATA FLOW
# STEP NC VO VZŤAHU K VÝROBNÉMU TOKU DÁT

**Abstract**

To store all information about production is very important today. It represents know-how of the plant what is the basis of its competitiveness. The flexible and continuous exchanging of information within the plant enables to increase of effectivity of production. New approach that simplifies the data flow during the production of the part is the using of STEP NC. The part is such made by means of data that are defined as "working steps" (a library of specific operations that might be performed on a CNC machine tool). It enables a product model database to serve as direct input to a CNC machine tool. No separate files of tool paths. No G or M codes. No postprocessors.

**Abstrakt**

V dnešnej dobe je veľmi dôležité uchovávanie informácií o výrobe. To predstavuje know-how podniku, čo je základom jeho konkurencieschopnosti. Pružná a plynulá výmena informácií vo vnútri podnikovej štruktúry umožňuje zvyšovať efektivitu výroby. Novým prístupom, ktorý zjednodušuje tok dát počas výroby súčiastky je využitie STEP NC. Súčiastka je tak vyrábaná pomocou dát definovaných ako „pracovné kroky“ (čo predstavuje knižnicu špecifických operácií, ktoré môžu byť na CNC stroji vykonávané). To umožňuje vytvoriť výrobnú databázu modelu, ktorá slúžia ako priamy vstup do CNC stroja. Nie sú potrebné žiadne ďalšie samostatné súbory, žiadne G alebo M kódy. Žiadne posprocesory.

## 1 INTRODUCTION

The present situation in the industry is characterized as a period of intense progress of technologies at the significant computer aid in all branches of industry. In connection with the technical progress it is increasing the pressure on the manufacturers to develop and make the products as soon as possible at the minimal cost in required quality. The product must be competitive, it must be up to qualitative and functional standard, it must have reasonable price, efficacious design, and it must have regard for safety, ergonomic and another aspects, which decided about its marketability.

All information represents the know-how of the plant, so it is important to store this information. It is suitable to archive all data in digital form today and use it in various stages of the manufacturing process. It is very important for the operator to know the data flow and on the basis of this knowledge made it as simple as possible. It enables:

- to increase of production effectivity and quality.
- to dynamically adapt data structure for actual situation and for user specific conditions with minimum negative effects,
- to select the way of process plan creation, whether it will be utilized approach of group technology or whether it will be done for every part separately. If the part will be manufactured using of NC machine, the producer will be able to decide how the NC program

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originate, whether it will be written manually or whether it will be created by means of CAM system.

- To select the parts with the similar material and dimensional characteristics, with the similar process plans; therefore it will be considerably able to save the batch time.
- to import of process parameters easier and faster,
- to short preparing time for the technological documentation
- to use information not only for the generating of technological documentation but also to the processing of details for store, economic and wage records.

The basic data flow in production today show Fig.1.

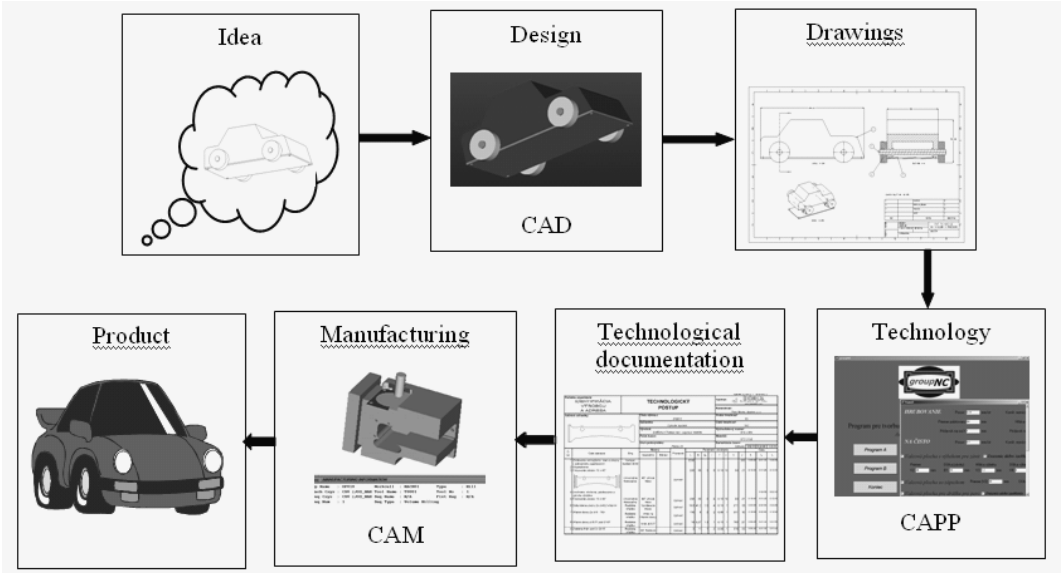


**Fig.1** Basic data flow in production today

One of the manners how to simplify the data flow and data translation at the manufacturing is the introducing of STEP NC into production. There will be done the comparison of the data flow and data transferring without and with the using of STEP NC in this article.

## 2 DATA FLOW WITHOUT USING OF STEP NC

The data flow during the manufacturing of parts today can be divided into several steps (Fig.2)

- Primary information about a product is imported into the CAM system. Usually 3D CAD model is imported.
- In mechanical engineering CAM is used to calculate toolpaths to cut material. The CNC programmer just specifies the machining operations and the CAM system creates the toolpath, usually written in CL data (Cutter Location data) file.
- Calculated toolpath is imported to the postprocessor which converts the CL data to the NC program - the specific machine codes that are required to operate numerically controlled machine tools. Machine codes vary by machine tool. The output from a postprocessor should be usable in the controller without further modification.
- NC program written in a notation called G-code is exported to the NC machine and the manufacturing process can begin.

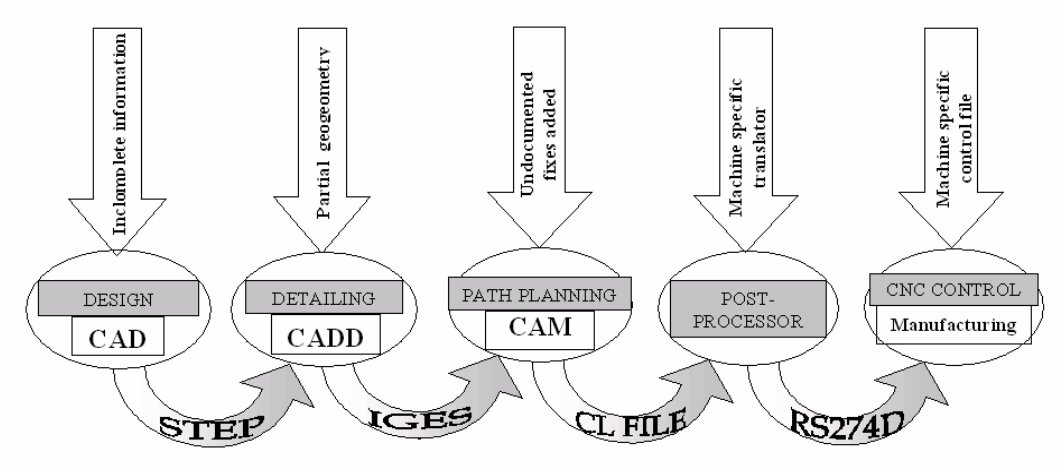


**Fig.2** The data flow without using of STEP NC

Digital product data must contain sufficient information to cover a product's entire life cycle, spanning design, analysis, manufacture, quality control testing, inspection and product support functions. The present situation in production data flow is show on Fig.2.

Design creates the specification for a product as a 3D model. Detailing decides the manufacturing requirements for the product by making a drawing. Path planning generates tools paths. Manufacturing controls production. The job of design is performed using a CAD (Computer Aided Design) system, the job of detailing is performed using a drawing CADD (Computer Aided Design Drafting) system, the job of path planning is performed using a CAM (Computer Aided Manufacturing) system, and job of manufacturing is controlled using a CNC system. In many cases the CAD, CADD and CAM functions are combined into a single integrated CAD/CAM system but in all cases the CNC function is performed by a separate system. [1]

## 3 DATA FLOW WITH THE USING OF STEP NC

The concept with the using of STEP NC is simple. It enables a product model database to serve as direct input to a CNC machine tool. No separate files of tool paths. No G or M codes. No post processors. This is a radically different approach to CNC programming. STEP NC is an extension to STEP, the STandard for the Exchange of Product model data.

STEP is the international standard that specifies a neutral data format for digital information about a product. STEP allows this data to be shared and exchanged among different and otherwise incompatible computer platforms.

STEP NC standardizes how information about CNC machining can be added to parts represented in the STEP product model. [2]

STEP NC defines a CNC part program as a series of operations that remove material defined by features. The features supported include holes, slots, pockets and volumes defined by 3D surfaces. Each operation contributes to the manufacture of a feature by defining the volume of material to be removed, the tolerances, the type of tool required and some basic characteristics such as whether this is a roughing or finishing operation. The operations are then sequenced into a work plan that converts the stock into the final part. The work plan may be sophisticated and include conditional operations that depend on the results of probing operations, and it may be divided into sub-plans to be executed concurrently on machines that have multiple cutting heads.

STEP NC has the Application Protocol number AP-238 within the STEP framework. A key feature of STEP NC, AP-238 programs, is that they are machine and organization independent. If a machine has the underlying capabilities (axes, table size etc), then a STEP NC "compiler" should be

able convert the part program into a sequence of tool movements for that machine. If a CNC has a Tool Cutter Programming (TCP) interface then the tool movements can be executed directly without converting to axis movements. This has significant consequences for industry. [2]

In the new method enterprises can continue to use their existing systems for CAD, CADD and CAM, but the end result is sent to the CNC as a STEP NC AP-238 file instead of an RS274D file. Fig. 3 shows the modified data flow with the using of STEP NC. [3]

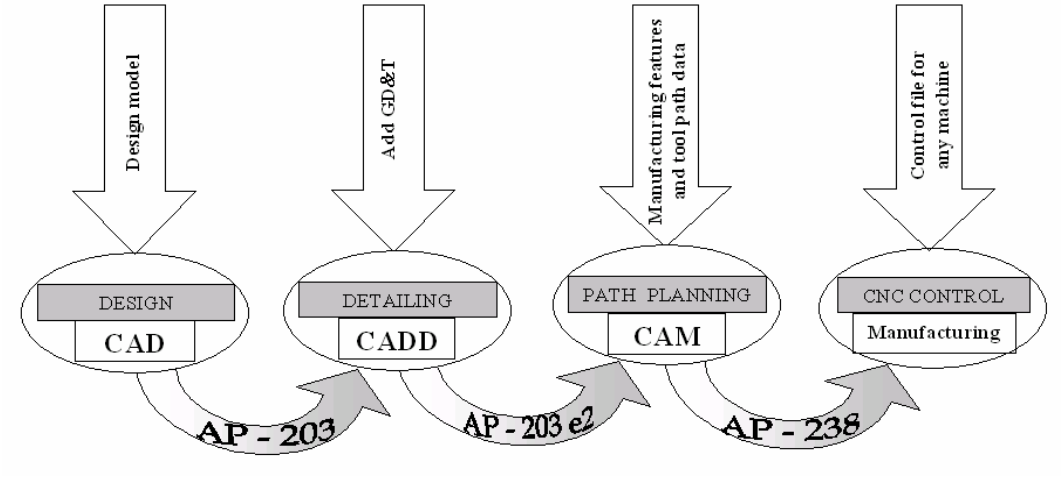


**Fig.3** The data flow with the using of STEP NC

STEP NC allows a complete database of machining information to be built around the digital product model and ultimately makes it possible for this enhanced product model to serve as machine tool input. This database is structured such that part features are linked to specific "working steps," generic descriptions of various machining operations. STEP NC working steps are roughly equivalent to machining commands formatted as traditional M and G codes. With the concept of "working steps" in place, the manufacturing process becomes streamlined. Now, a machine tool can receive a file with STEP NC data, "know" what it means, and proceed milling the piece without any more instructions. There will be no more programming the machine tool for each individual piece. Moreover, the benefit of the standard goes further. With a set of standard "working steps" in place, all manufacturers will be able to share information reliably and instantaneously. STEP NC converted CAD file that is completed on the east coast can be sent over the internet to a machine shop on the west coast and they can immediately start milling the part.

Machine tools with PC-based open architecture control systems may be able to install this software to upgrade to STEP NC compatibility rather effectively. The conventional input/output (I/O) structure and the servo system of the CNC machine do not need to be modified under STEP NC.

## 4 CONCLUSION

STEP NC allows building a complete database of machining information around it. The database, then, dictates what capabilities must exist in the machine tool controller to cut the part. By using STEP NC to capture instructions on what steps to follow for machining the part, the "productability" of this part would not be affected by the availability a certain brand of control unit, programming system or postprocessor.

The project that developed STEP NC has estimated that it can reduce the time required to program a CNC by about 35%, reduce the number of drawings that have to be sent from design to manufacturing by about 75% and decrease the time required to machine parts on CNC tools by about 50% for small to mid-sized job lots. [4]

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