

## THE ASSEMBLY AS SYSTEM

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**Abstract:** Slovakia in the short time will be the "Assembly hall of Europe". In Slovakia will be produced and eminently assembled the most of automobiles on the 1000 citizens in the all world.

In the all words assembly presented the most consumption of the human work in machinery and represents more that 50 % of the all production expenses. In spite of this is little attention dedicated to assembly.

In the some papers are layer that questions as:

1. What is the assembly in principle?
2. Has assembly his own theory?
3. Is the assembly only one from the many technologies or it is only complicated operational manipulation with using of foreign technologies?

In this paper we will attempt to introduce the assembly into the system of the production sciences by using of systematical access known from the cybernetics.

According to this access the assembly has the main goal to produce the profit and this goal is influenced by seven factors whose harmonic envelopment is the fundament of the Sciences of Assembly.

**Key words:** Assembly, Productions Systems, Theory, Science

### 1. INTRODUCTION

### 2. ASSEMBLY AS SYSTEM

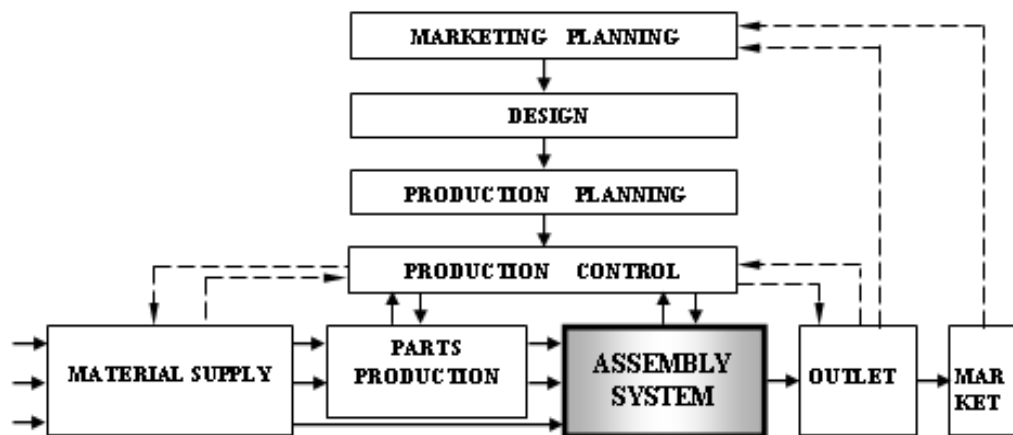
(What does it mean when we say an assembly?)

Considering a hierarchy of production the assembly is the last stage of production where parts are consolidated to one final product.

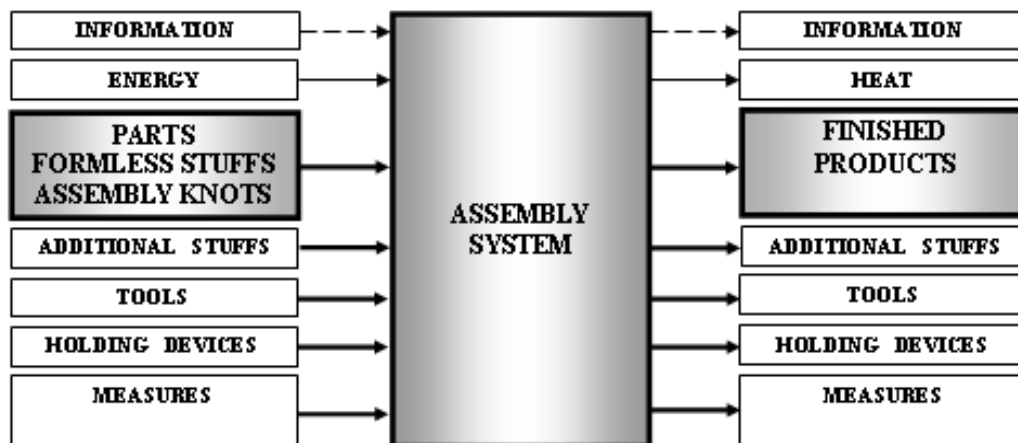
This definition is not adequate for a deeper investigation. Cybernetics says (2) that a deeper examination of any object needs so called „ system access“. First of all we have to define: a goal of investigation, the determining factors and their linkages affecting this goal, then necessary inputs and possible outputs and finally so called surroundings i.e. (nature, market etc.). Generally speaking every examined system is a subsystem of some higher system. We define the linkages among the examined system and other systems, either higher or at the same level.

The examined system normally looks like a regulating loop – malfunctions at the input generate information about needful changes at the output.

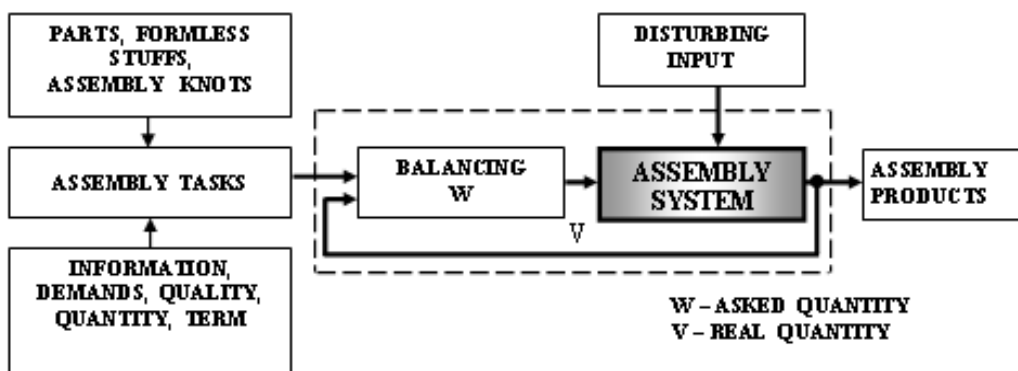
Warnecke introduces his point of view regarding the assembly. (Fig.1)



a - assembly as a subsystem of production



b - assembly systems function



c - assembly process as a regulation loop

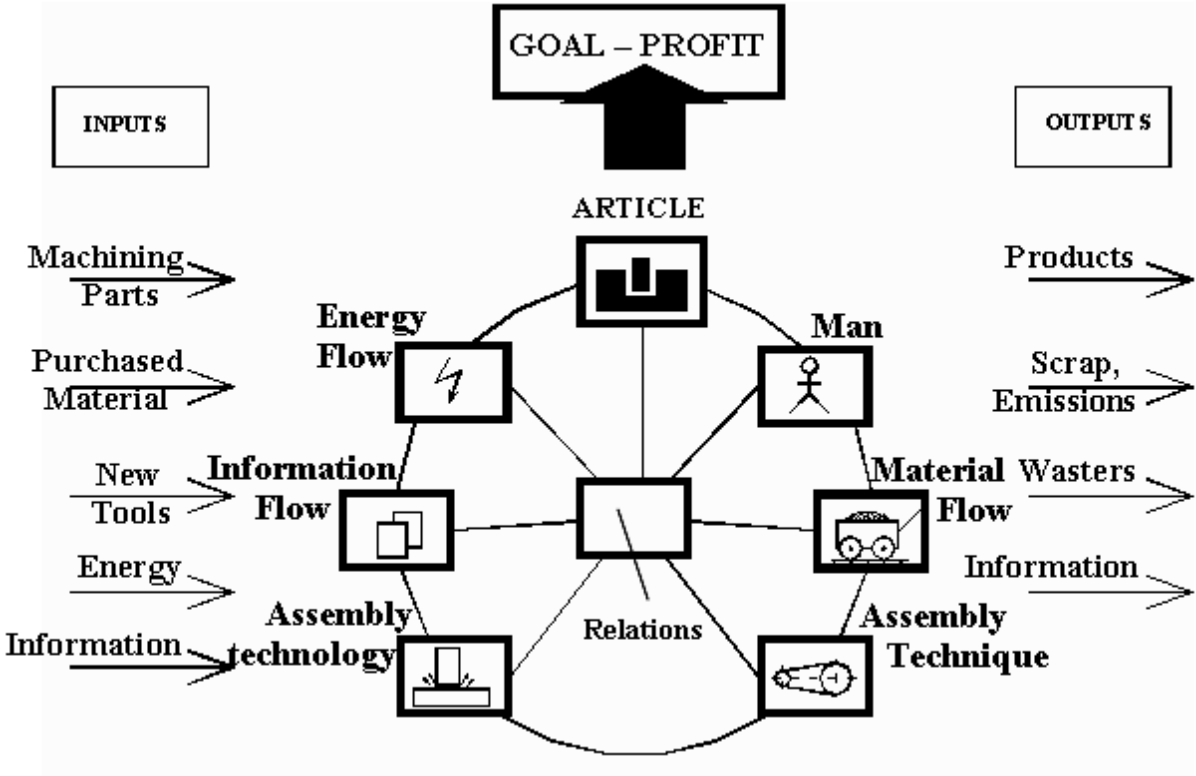
**Fig. 1** Assembly system. Function scheme [7]

- a.) assembly as a subsystem of production system,
- b.) assembly systems function,
- c.) assembly process as a regulation loop.

He is not interested in the interior of the assembly system. According to him this interior in comparison to the production is something like „black box“ which has to work behalf of the all system. The goal of our survey is to decrease an assembly costs. We have to open „ the black box“ and define the assembly at the part’s level, that means at the last level of hierarchy in order to uncover the possible resources for decreasing of assembly costs. (Fig. 2).

Practice shows that the crucial factors for decreasing of assembly costs are:

1. Assembled article (especially its design),
2. Jointing method (so called technology),
3. Assembly technique,
4. Information flow,
5. Material flow,
6. Energy flow,
7. Man.



**Fig. 2** Assembly as a subsystem of production system [6]

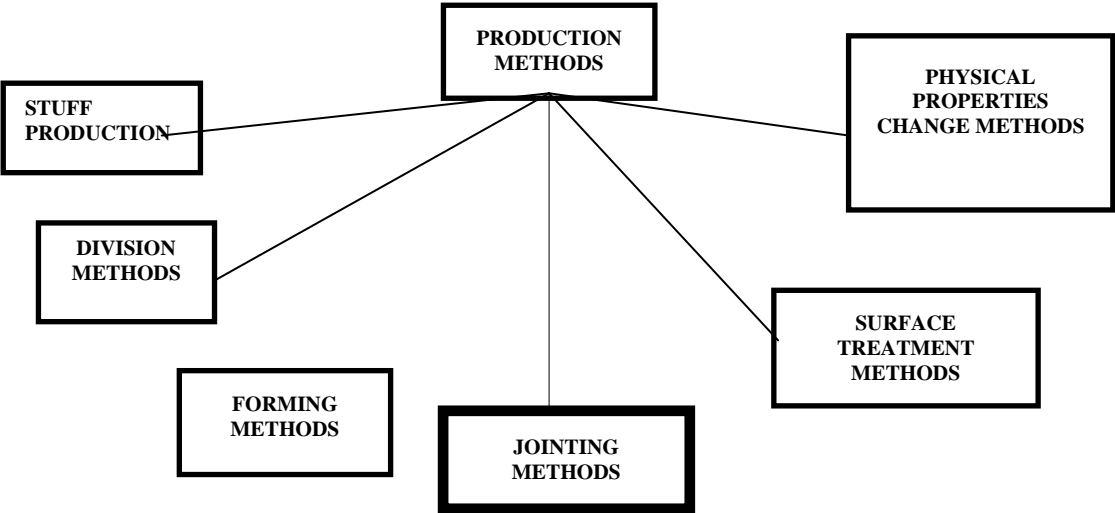
The goal of this investigation is to decrease the assembly costs by improving of product design from the assembly’s point of view. (Assembled article)

It is curious that a suitable design change generally eliminates the assembly costs and at the same time it is the most expensive solution (including only designer, technologist wages and overhead expenses).

Assembly from „ system access“ 's point of view is a subsystem of production system influenced by factors, inputs and outputs presented on picture 2.b His goal is to create the maximal benefit via part's jointing. Up to now we were describing the process in term of system but it is necessary to research it in term of technology either.

**3. ASSEMBLY AS PRODUCTION METHOD**

It is worth define the term „assembly“ according to the DIN standard 8580 Die Fertigungsverfahren (1), which describes the assembly as a kind of a technology process, which corresponds with the assembly. The production methods are divided to 6 groups and the assembly belongs to the group of „Jointing methods“, fig.3.



**Fig. 3** Diving the manufacturing technologies: DIN 8580 Die Fertigungsverfahren

Assembly according to the standard DIN 8580 [2] belongs to the group of methods creating things by jointing.

The chapters 1, 2 and 3 answer often given questions:

- What does it mean an assembly?
- Which kind of technology is it?
- Does any general theory of assembly exist?

#### 4. ASSEMBLY AS TECHNOLOGY

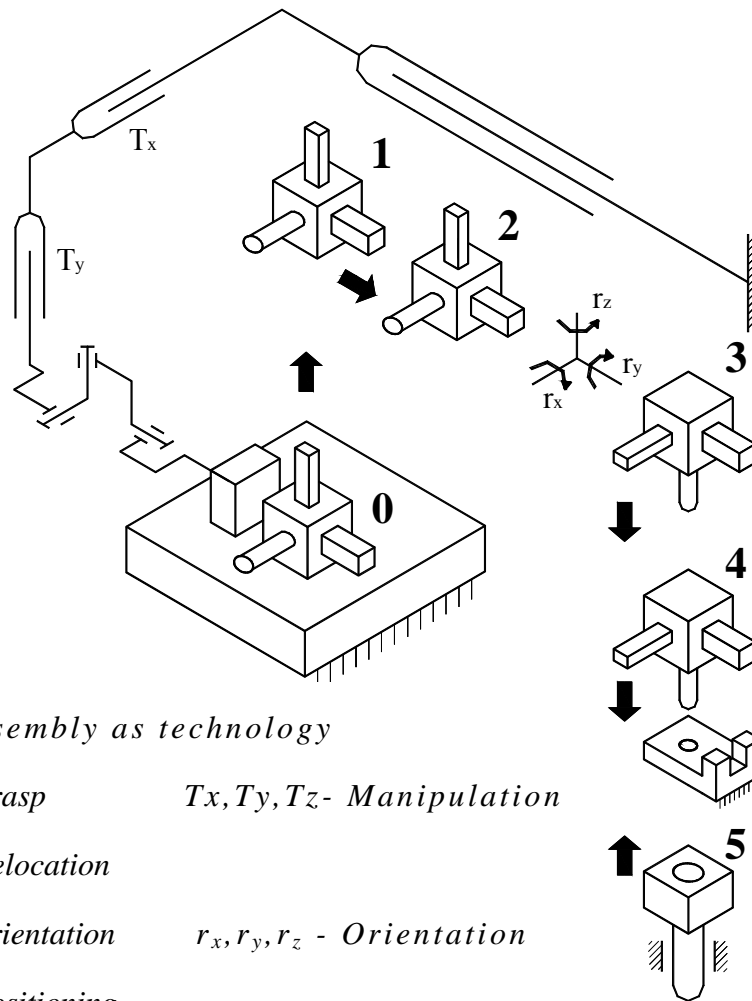
In Anglo-Saxon literature a word „ technology“ has different meaning that the word „ technologic“ used in Slovenian languages.

Whereas in English „technology“ means all activities belonging to the production in Slovak language means a way or method how the physical properties are changing to another properties. Germans do not use the word „technologia“, they use a designation „production method“ (Die Fertigungsverfahren).

According to our understanding of „technologia“, the assembly is only like „ jointing part methods“ where physical changes in material occur (plastic deformation by riveting, priestess’s changes in screw after tightening, etc.). This is not true and real view. The word „ technologia“ has to include not only the physical changes in material but even the changes of handled object and his component’s position. These changes of a position are included in so called “not-assembly“ technologies either but theist contribution to time and cost consumption is minute. On the contrary **an operation assembly manipulation is essential activity of assembly process**. In order to decrease an assembly costs it is necessary to reduce this activity, a movement’s number and a trajectory size. Figure 4 shows assembly as technology. The goal is to insert a rivet into the hole and riveting.

Following steps are unavoidable:

- 0 – grasp,
- 1,2 – relocation,
- 3 – Orientation,
- 4 – Positioning,
- 5 – Joining (physical change – e.g. riveting).



**Fig.4** *Assembly as technology*

- 0- *grasp*                     $T_x, T_y, T_z$ - *Manipulation*
- 1, 2- *relocation*
- 3- *orientation*             $r_x, r_y, r_z$  - *Orientation*
- 4- *positioning*

Object's shape and function are modified by the assembly. Joining of several items creates a new object. Steps 1,2,3,4 belong to the assembly manipulation. They are included in every assembly. Step 5 (Jointing) varies from coupling to coupling. We use a variety of methods (e.g. Welding, soldering, forming etc.). The number of needful movements to perform the assembly is commensurable to the number of necessary actuators realized by hand or with engine. The addition trajectory, of any point on the handled part's surface is in a connection with the time consumption, which is necessary for its assembly. The problem of withoutprobelm mechanical function of assembled parts are solved by simulations and following calculating on computers [1], [3], [5]. The next option for solution of these problems is capturing the dimensional information's by 3D scanning [4] and subsequent simulation.

Let us note the assembly – handling motions. Both an assembly system and a design of product are reliable for them.

The design impacts these motions:

1. Grasp (Exist both grasp friendly and unambiguous shapes and their opposite)
2. Orientation ( a shape of part)
3. Positioning ( a deepness of assembly hollow)
4. Transfer (a removal of part from box to product), the distance should be as short as possible and is designed by designer.

## 5. CONCLUSION

Building a new science regarding the assembly asks first of all define a content and goals of the new science. In this article is shown that even the assembly as a subject of science makes possible to specify the content and goals of this science, to create a such structure of science, which including all crucial factors, separately and in their mutual relations too.

The article appeal to the responsible authorities to do an adequate steps heading to change of present situation, when the assembly as science is situated at the end, behind another technologies. We hope that this article will help in this effort.

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