

## **THE POSSIBILITIES OF OPTIMIZATION OF MANUFACTURING TIME IN CASE OF RAPID PROTOTYPING**

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### **ABSTRACT**

As is well known, when choosing Rapid Prototyping technologies, we have to take into account the manufacturing time. In this context, the work presents a model that can become the base of the optimization, that is to say the reduction of this time.

### **1. INTRODUCTION**

As is well known nowadays, probably the most important criteria in selecting the manufacturing technology, is the manufacturing time. This is maybe the most important of all.

That's why it is extremely important to establish this execution time as exactly as possible. But this can raise numerous problems, because nowadays there is a series of technologies (procedures) which differ little from one another. In this case it is absolutely necessary to study all the details in order to determine with great accuracy all the component times.

The Rapid Prototyping (RP) technologies are also in this situation. It is well-known that these are relatively new technologies which have known a great development in reference to the increase of applicability, of materials to be used, and of improving the quality. That's how a technology ended up having more variants of raw material used, for instance. Apart from the properties of the obtained model, this also defines the execution time.

In this train of thoughts, starting from a few general ideas, we'll present a manufacturing time model of optimization in the case of previously mentioned technologies.

### **2. THE ASSESSEMENT OF MANUFACTURING TIME IN RP TECHNOLOGIES**

#### **2.1. GENERALITIES**

As we outlined in other works too, [1, 2, 3, 4, 12], in the case of RP technologies, the manufacturing time, which is in fact the actual realization time of the RP model, is made of more component times, i.e. preparation time, realization time and a time for ulterior processing. This can be written as follows:

$$T_M = T_P + T_R + T_U \quad (2.1)$$

respectively

$$T_m = T_P + T_R + T_U \quad (2.1')$$

where:

$T_M$  respectively  $T_m$  - the execution time of the product/model;

$T_P$  - the preparation time;

$T_R$  - the realization time;

$T_U$  - the ulterior processing time.

Their assessment is presented in [3].

### 3. MANUFACTURING TIME OPTIMIZATION IN RP TECHNOLOGIES

#### 3.1. GENERALITIES

As is well known, in the case of a manufacturing technology, its optimization means reducing the manufacturing time.

This can be expressed as follows:

$$T_M \rightarrow \min \quad (3.1)$$

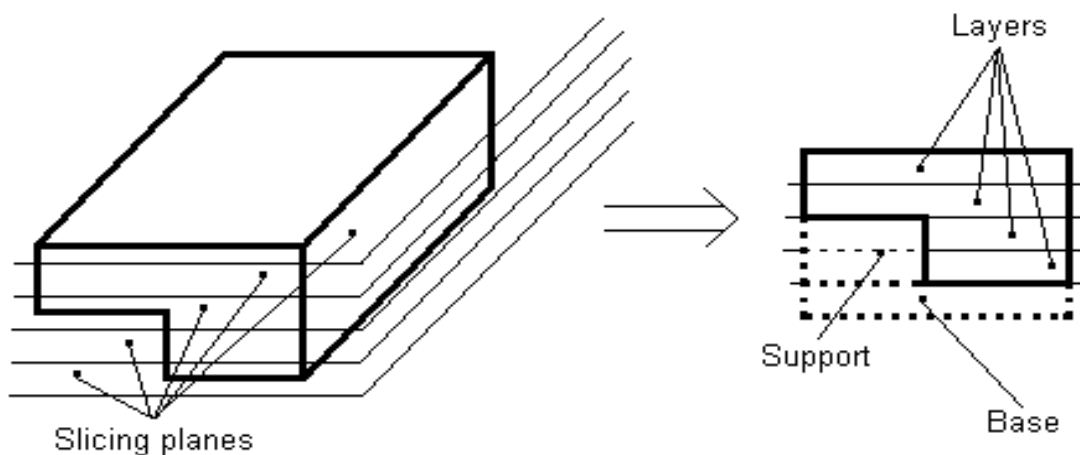
respectively

$$T_m \rightarrow \min \quad (3.1')$$

We study next the possibilities of optimizing the various times involved.

#### 3.2. OPTIMIZATION OF REALIZATION TIME IN CASE OF RP TECHNOLOGIES

As it is the most important, we begin with its study.



**Fig. 3.1. The basic principle of RP technologies**

The realization time (which is actually the machining time) in case of these technologies – based on Figure 3.1. – can be expressed best in the following report:

$$T_R = \sum_{i=1}^n t_i \quad (3.2)$$

where:

$t_i$  - the machining time for layer  $i$ , layer that can be expressed as follows, considering the working mode in the case of RP technologies [1]:

$$t_i = \frac{A_i}{vD} + \frac{S_i}{kvD} + T_d \quad (3.3)$$

where:

$A_i$  - the area of  $i$  section – of the model;

$v$  - the medium forwarding speed of the active element;

$D$  - the characteristic of the active element;

$S_i$  - the area of  $i$  section – of the base/support;

$k$  - correction coefficient, because the base and the supports have a smaller hatching scale so that they get a smaller mechanic resistance – needed for an easier evacuation;

$T_d$  - indexation time.

This sum has to decrease, in order to realize the optimization, i.e.:

$$\frac{A_i}{vD} + \frac{S_i}{kvD} + T_d \rightarrow \min \quad (3.4)$$

As the areas, the characteristic of the active element, and the indexation time are given, only the average speed of the active element and the correlation coefficient can be modified. This can be done increasingly, and the formula can be expressed as follows:

$$v \rightarrow \max \quad (3.5)$$

respectively

$$k \rightarrow \max \quad (3.6)$$

It's also possible to minimize the relation 3.4 by an eventual decrease of the number of layers, and that means the increase of layer thickness, which can be usually made using different raw materials.

### **3.3. OPTIMIZATION OF PREPARATION TIME IN CASE OF RP TECHNOLOGIES**

This component raises great difficulties in the context of optimization, due to the fact that it has a strong connection with the calculation system used, and with the qualification and experience of personnel.

And we can't forget about the fact that in this component is also included the

amount of time needed for optimization, fact that eventually could lead to an apparent increase of the time needed.

### **3.4. OPTIMIZATION OF ULTERIOR PROCESSING TIME IN CASE OF RP TECHNOLOGIES**

Analyzing in detail it can be observed that in essence, in a given process this time can't be modified either. It can be possibly influenced by changing the mechanical characteristics of the supports and of the base. It can be possibly reduced by mechanizing the operations to be made.

## **4. CONCLUSIONS**

As it can be seen in this work, there are various possibilities of optimizing the manufacturing time in case of RP technologies also. But – like other technologies – these have a different efficiency, influencing directly upon quality.

Therefore it has to be reminded that the best method has to be chosen, i.e. a good correlation price/quality, the best report time/quality. In order to do that, it has to be analyzed the possibility of leading the model in the working space, and the raw material used, as they influence directly the quality of the area. We also mustn't lose sight of the fact that the modification of the active element speed and of hatching density has a direct influence upon the mechanical characteristics of the model.

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