

HOW TO GO FURTHER IN DESIGNING METHODOLOGY OF MACHINE TOOLS?

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1.Introduction

Are properties of a product (of a machine tool) determined by the market or rather the opposite is true ? There is no explicit answer to this question. In every case, the machine tool can be successful only if it is bought and if customers are interested in it. If it is necessary to keep the rule, that the designer must think using a customer's head, feel by a customer's heart and dream by his soul, it is also necessary to keep in mind the factor of product utility values. Who will specify these utility values, a customer or the development department ? Again, it is not possible to give an explicit answer. During 47 years of its existence, TOSHULIN, a. s. has manufactured and supplied 13 000 machine tools (especially vertical lathes) on the market in 58 countries in the whole world. These machine tools have been developed, manufactured and mounted by the company itself. TOSHULIN, a.s. covers 12-15 % of the world market. Competition pressure increases and due to this, there is still a question how not only to keep this world market share but even to increase it in the future. According to our experience, the development department (designing department) creates 70 % of the costs necessary for the future machine tool. It follows from this fact, that the way how to keep the market and to decrease the costs leads through the development (designing) department which must:

- optimize the product technically
- optimize the product regarding to its price
- take all necessary measures to make the product safe and reliable regarding to its function

Therefore, the designing department is a weak (narrow) place in the company's hierarchy (Fig. 1). Systematic designing, designing methodology, theory of technical systems and designing theory can represent one of the possibilities how to increase the bottle neck, and due to this, to be able to respond to customers' requirements more quickly and to keep the share on the world market. Hereinafter, the problems will be discussed which can be met at application of systematic designing.

2.Influence of the market on machine tools design

TOSHULIN, a.s. performs the development of new machines in two ways:

1. Development of customer oriented machines – a machine is specified for a particular customer. There is a customer for the prototype available and the company supplies a customized machine. Customization, i. e. design adaptation for particular customer's needs increases exponentially (Fig. 2). Even if – for purely business reasons – the numbers of designers are not given in Fig. 2, these numbers have been constant since 1998. It means practically that productivity of work has increased

4x. Based on our experience, we can declare that application of 3D software meant 50 % increase of productivity of designer's work (i. e. productivity increased 2x). However, the question remains, whether it could not be possible to increase productivity of mental creative work 2x, 6x, 8x applying systematic designing ?

2. Development of prototypes without a customer.

This method is also usual in the machine-tool category. Company TOSHULIN, a.s. invested almost 100 mil. Kč in this way within the time period from 2000 to 2006. After new machine assembly groups are tested, the prototype will be sold to a customer. Also here it is possible to apply the systematic designing methods.

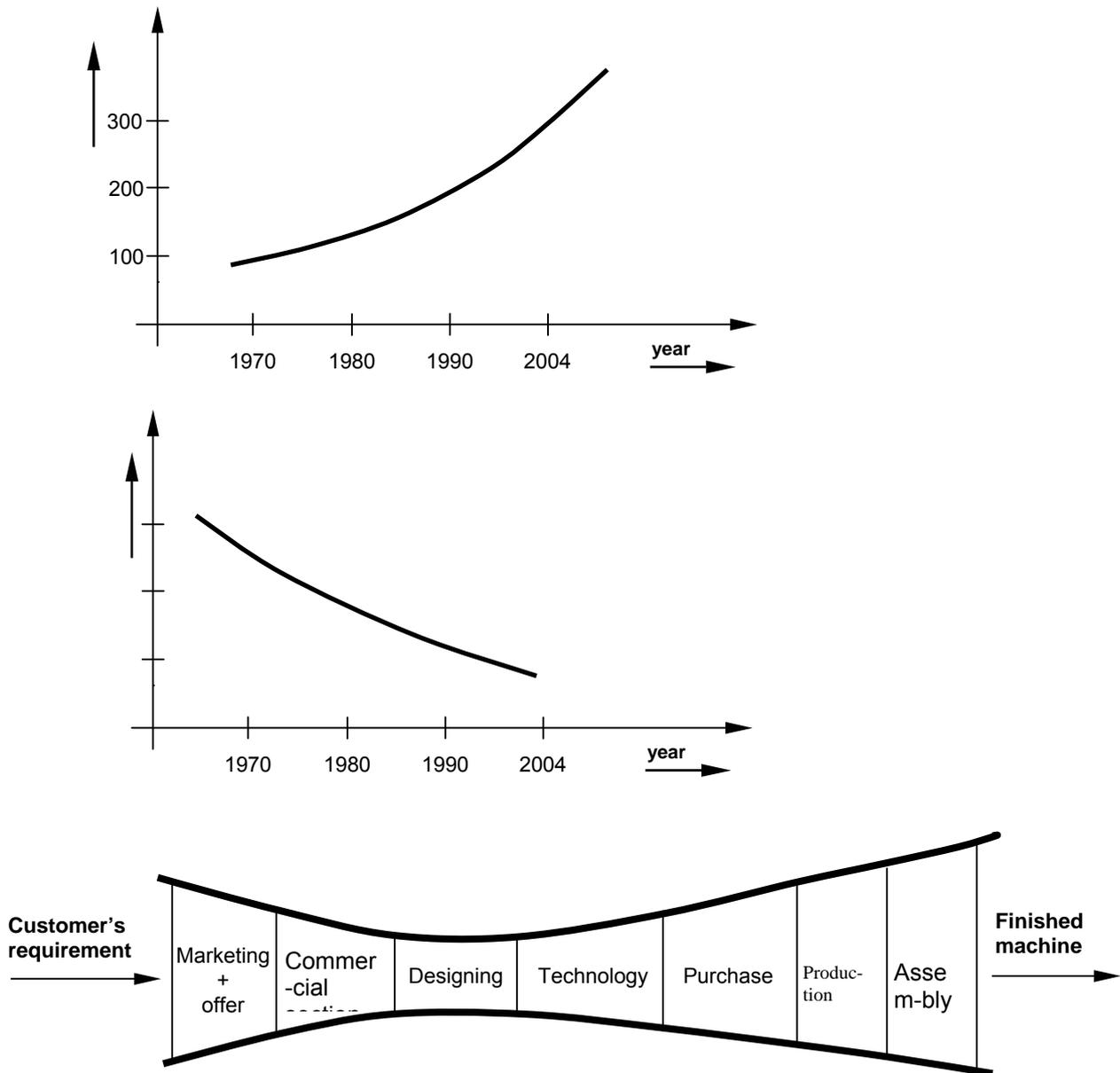


Fig. 1 Narrow place (bottle neck) [Marek 2004]

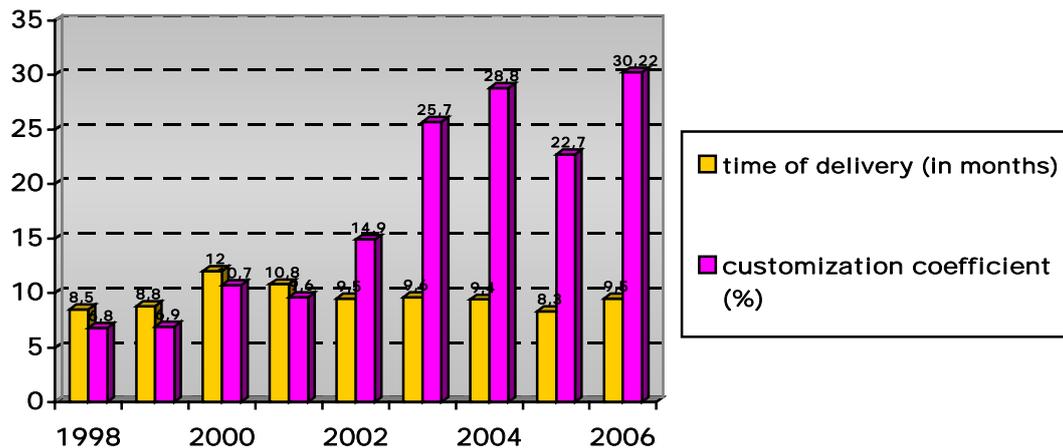


Fig. 2 Customization of vertical lathes TOSHULIN, a.s.

3. Systematic designing of machine tools at TOSHULIN

The origination process of a machine tool (of a technical system) is performed under the influence of

3 internal factors:

- a) quality
- b) price
- c) time

and 3 external factors:

- a) competition
- b) market
- c) frame conditions (ecology, standards, technology)

It is possible to imagine these factors as a system influenced by the mentioned 3 external and 3 internal factors (Fig. 3).

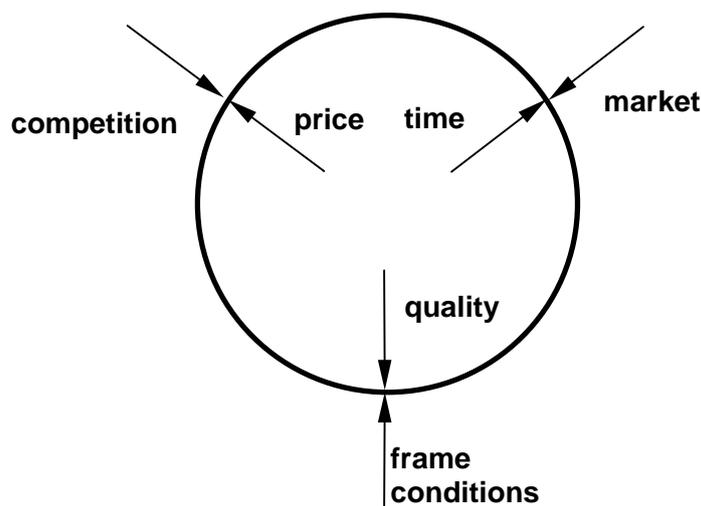


Fig. 3 Factors acting on origination of a machine tool [Marek 2004]

The company can solve internal factors (quality, price, time) applying creative and systematic work methods, especially by putting the responsibility for quality of work to the particular company's departments. Creating a new machine tool intuitively leads often to the target, solution can be found soon; however, no contribution can be shown after a particular time

period. If the solution is searched systematically, it takes more time (Fig. 4), but the contribution should be more effective.

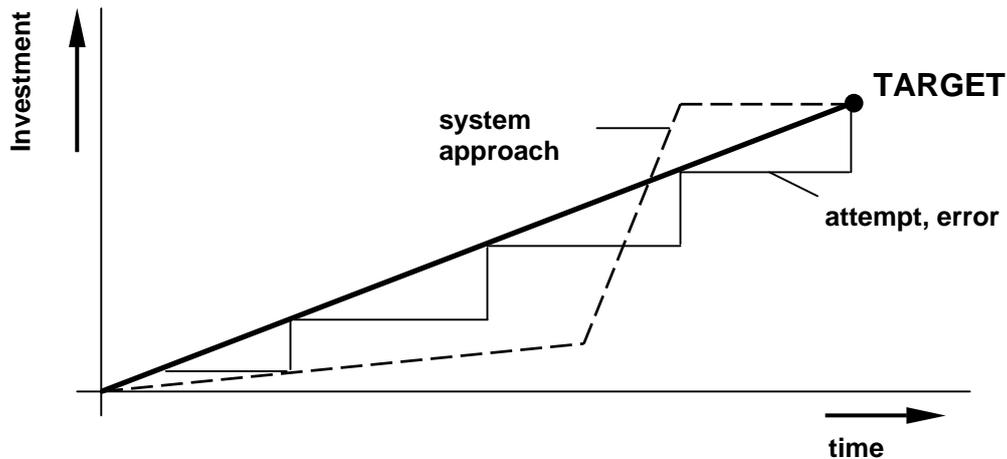


Fig. 4 Comparison of the intuitive designing component and of the systematic designing element [Marek 2004]

The so called synergy effect acts during designing (Fig. 5).

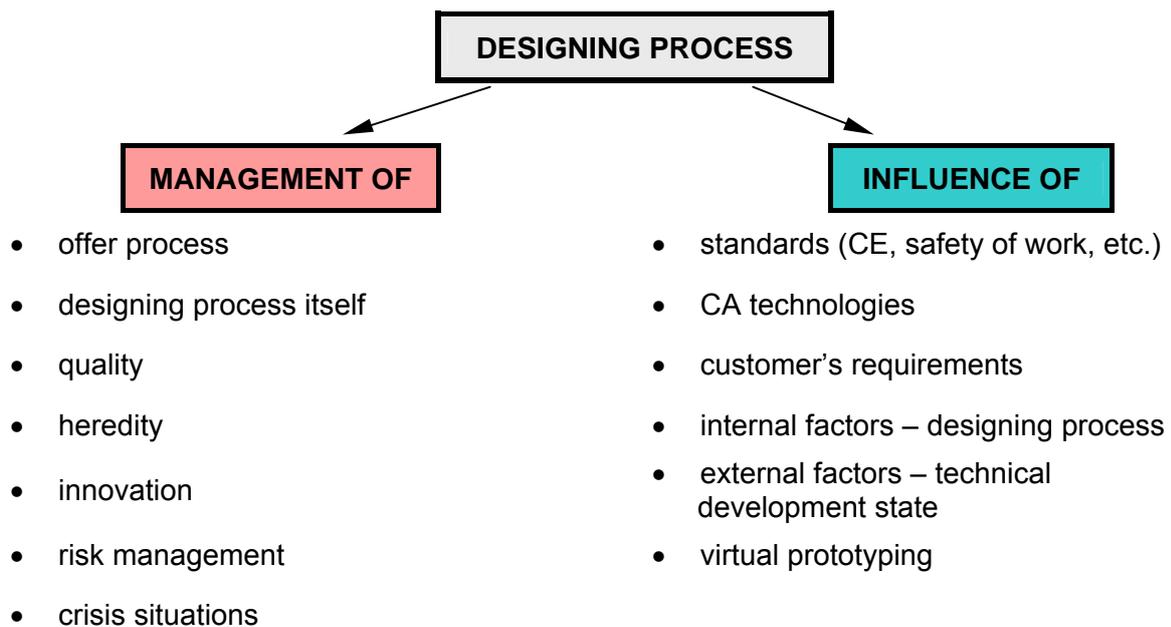


Fig. 5 Synergy effect at designing [Marek 2004]

It can be seen from the mentioned facts, that this is a very demanding process which must be managed. Now, let's modify Fig. 5 and Fig. 3 considering the known designing methodologies – Fig. 6. Hubka's design science [Hubka, Hosnedl 1995], [Hubka, Eder 1996] is the best known in the Czech Republic. This design science structure, which is logically ordered for a designer and spread in our country thanks to Prof. Hosnedl, is very close to thinking of Czech designers due to its arrangement, logic and clearness. Nevertheless, considered in general, the following aspects restrict the mass application of any designing methodologies at TOSHULIN company at the current time:

- It is not possible to apply the idea that every creative designer will solve design problems by means of this methodology. Various factors restrict him.

- Not all designers have abilities to think systematically and due to this, application facilities are restricted.
- Some creative designers have a very well developed feeling for the intuitive component of problem solution, but they are not able to describe origination of their ideas. However, the solutions designed by them function without any mistakes. Then, these designers ask why they should change their thinking.
- Some designing methodologies do not solve the complete context and relationship called "synergy effect" by the author (Fig. 5,6).

4. Notes and considerations

Regarding to the above mentioned considerations, we can state the following:

- Considering the machine-tool designing process at TOSHULIN, a.s., application of some designing methodologies goes down a blind alley at the current time.
- Mass application cannot be performed for the reasons that particular designers have various designing nature and disposition (Fig. 7).
- Methodology can be performed only by one person or two people who have preconditions for it (orderliness and systematism, patience and perseverance). These people cannot deal with any other activities more.
- In many cases, some designing methodologies are very complicated and work-demanding. A particular solution could be seen in Prof. Hosnedl's considerations (Fig. 8). The correct method may lead this way.

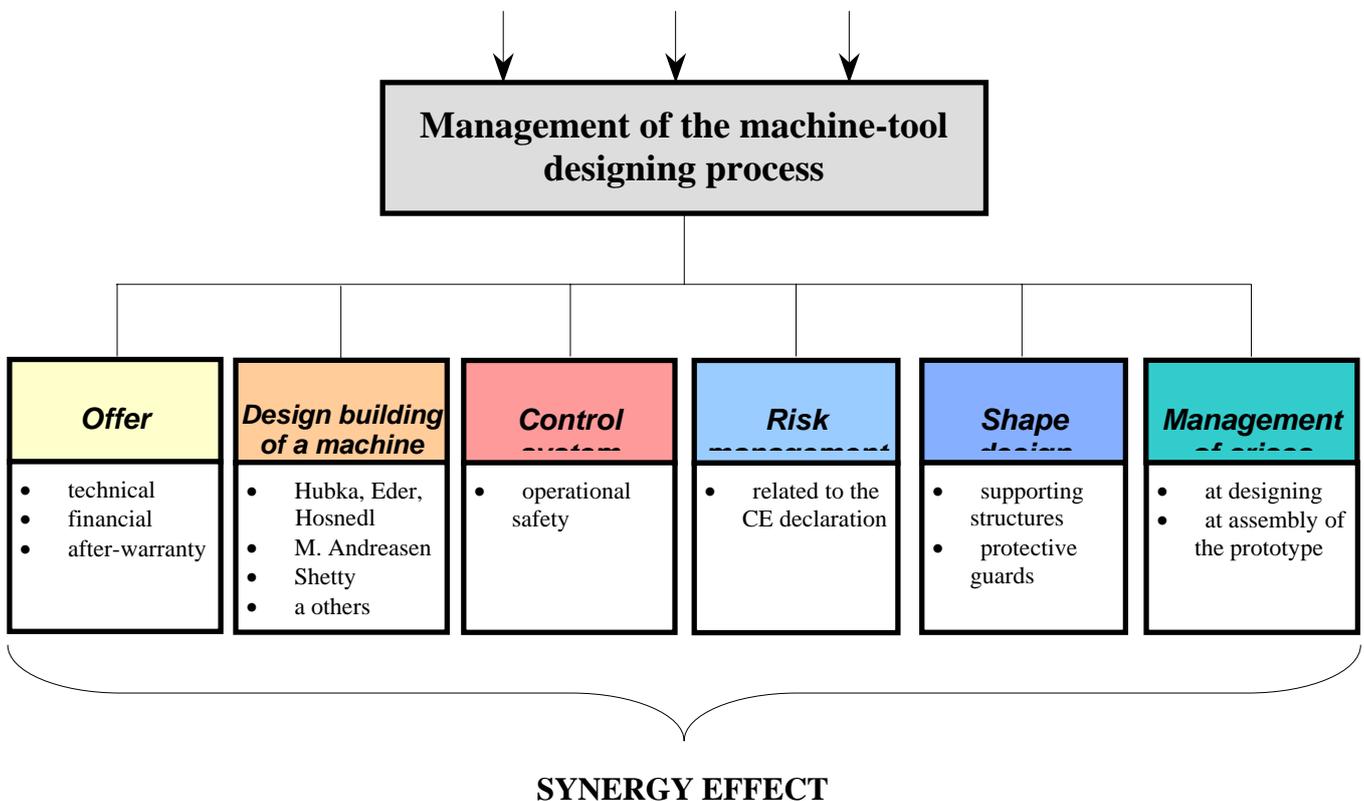


Fig. 6 Management of the machine-tool designing process

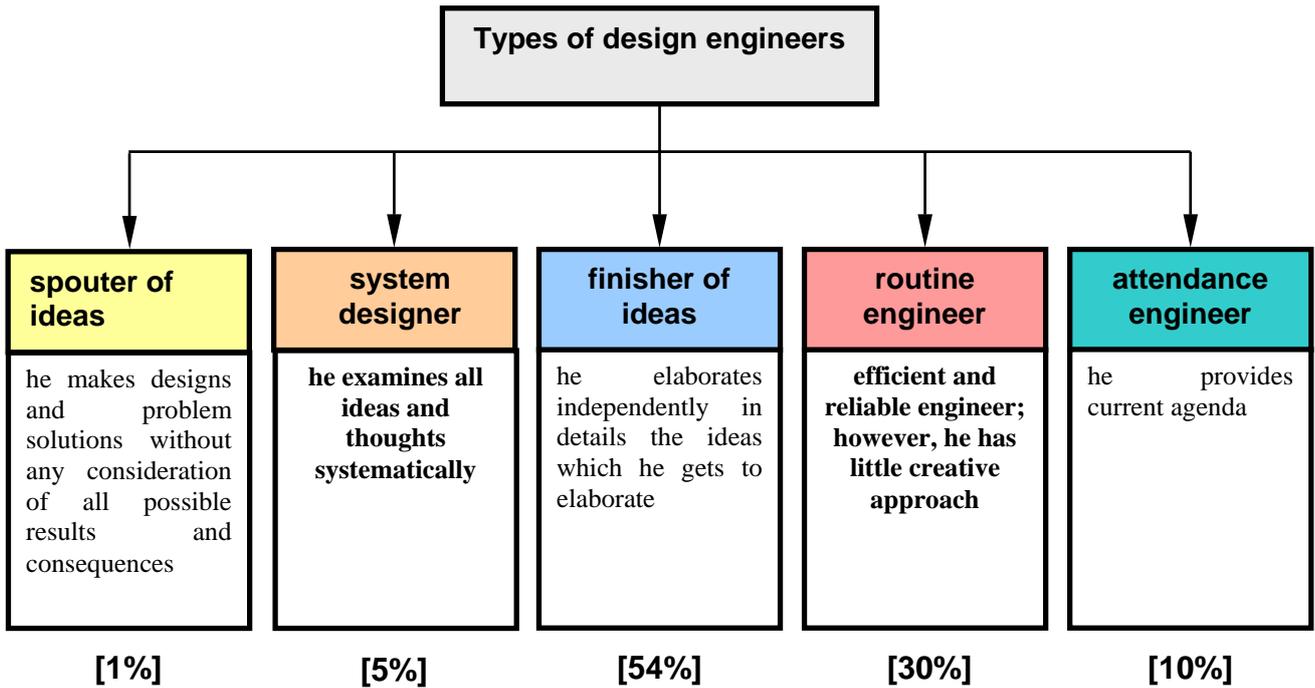


Fig. 7 Typology of designers in TOSHULIN, a.s. [Marek 2004]

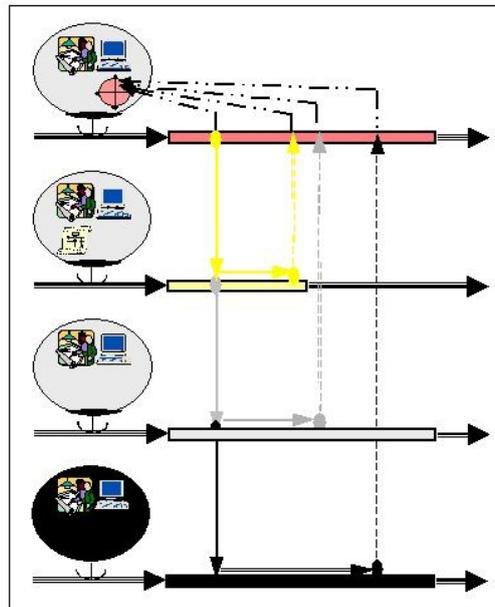


Fig. 8 Strategy integration [Hosnedl, Vanek 2005]

Acknowledgement

The article describes author's experience with methodic designing. It has been stated that mass application of designing methodologies goes down a blind alley at TOSHULIN, a.s. company. Systematic designing is one of the ways how to increase company's efficiency in time periods before manufacturing. The method how to get off from this blind alley could be seen in Prof. Hosnedl's considerations (see above) which modify designing methodologies so that the design problem can be solved on various complexity levels (so-called strategy integration). Testing Prof. Hosnedl's theories in designers' practice will show, to what extent the author's consideration is correct.

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