

Chapter 1

Introduction

“As the wind of change begins to blow, some build walls, others, windmills”
(Chinese proverb)

1.1 Importance of Flexibility in Production

Manufacturing firms have been facing the “wind of change”, for several years, in the form of an increasingly complex and rapidly changing environment. The appropriate reaction to progressively dynamic markets and therefore different conditions for success are not “walls”, presented by fixed company structures; it is, much rather, found in the activation of all available internal efficiencies and their use as flexible resources in competition, thereby seizing the resulting chances.

Production, no less than the place where resources and capabilities are transformed into products, has to make an active contribution to ensuring the company’s long term prosperity [HaWh-88] [Schm-96] [AKN-06]. While product development, marketing strategies and financial power used to be considered the main factors determining competitiveness, production was attributed only a minor importance, until a reorientation process began in the early 1990s. This process was triggered by the Japanese industry’s success with their very efficient use of production resources, which gained them continuously increasing advantages over competitors. This led to a new perception of production, and its image of an operative assistant shifted to that of a strategic actor, which is confirmed more than ever in today’s age of globalization [ZaDi-94] [AKN-06].

The shifting importance of production was also followed by a change of production systems, which have been in a state of reorganization ever since [Chry-05] [AKN-06]. There were different approaches to increasing flexibility of production companies and facing the so-called adaptation-resistant factory structure [KRS-06]. Some traditional approaches are step-by-step product optimization, maximum planning of work processes in combination with division of labor, focus on the company’s core competences, reduction of payroll related costs by investing in automation, and reduction of environmental pollution related costs. These basic approaches, however, assumed certain relatively stable environmental conditions, which are no longer commonly

found [Lutz-96] [LWW-00]; they have changed at an unprecedented rate in the last years. The globalization of the job markets and production sites, advanced by new developments in logistics and the internet, as well as the higher level of customer individualization, are said to impose the biggest of the new challenges. In this context, the term *turbulent environment of action* was established, which makes demand more unpredictable and therefore production harder to plan. Accordingly, all parameters of relevance for production, such as product structure, competitors, sales, and available technologies, can change rapidly and erratically. Thus, the predictability of changes in the industrial environment decreases on one hand, as the continuing product range extension and quick advance of technological developments like new materials, production techniques, or information and communication technology indicate [Warn-93] [LWW-00] [WHG-02] [EBGK-02] [AKN-06]. On the other hand, companies take longer to react to changes of their environment. This becomes apparent in the decision and work processes in production [WJR-92] [Rein-02]. According to Lindemann, the time from realizing the need for a change to its implementation nearly tripled between 1994 and 2005 [Lind-05].

Bleicher illustrates the resulting problem by defining the “Time Scissors” according to which, due to the increasing complexity, more and more time is needed to decide about changes and finalize their realization, while at the same time the greater dynamic of the companies’ environment calls for quicker, more dynamic reaction (see Fig. 1.1) [Blei-04].

As part of this constantly changing flow, companies are forced to find new ways of reacting to the various influencing factors precisely and in time. The corresponding cost and quality levels are just as important as the reaction time for maintaining competitiveness [RoKr-06a]. Therefore, finding answers to the core questions regarding adaptability of production systems, efficient handling of

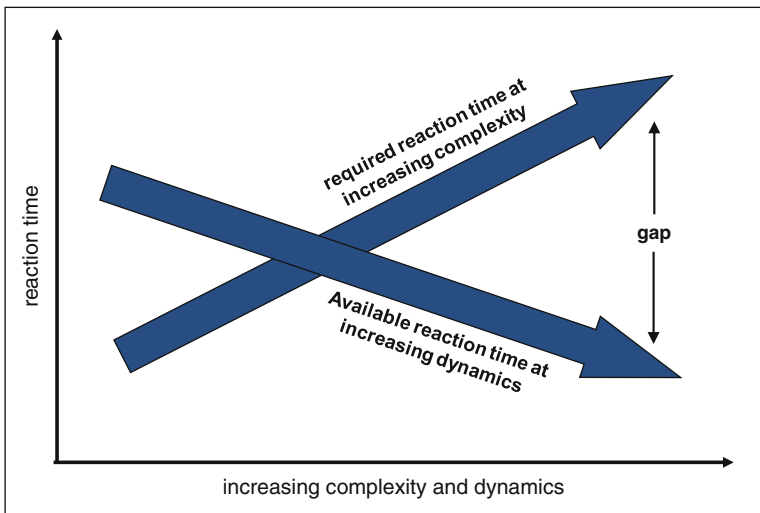


Fig. 1.1 Time scissors [Blei-04]

varying customer requirements and optimizing manufacturing processes is crucial [ARKO-07] [RSO-09] [Roga-10].

In light of this, reliable statements regarding a company's flexibility are of great value, as flexibility is an essential strategic factor. It represents production companies' capability of managing complex environmental situations, thereby increasing competitiveness and assuring long-term success [KaBl-05a] [RoKr-06b] [ARKO-07] [RoOv-09a]. Being able to gauge their production systems' flexibility allows production planners to evaluate their potential of adjusting to external influences, such as fluctuations in demand or product variations, as well as internal changes like additional capacities or staff assignment. Hence, invoking comprehensive flexibility evaluations in production management's planning and decision processes is a promising way of increasing the chance of production companies' successful existence in an ever changing competitive situation [RoKr-06b] [KRS-06] [RoOv-09b].

1.2 Current Trends in Handling Flexibility in the Field

Given the above-mentioned turbulent environment of action, the basic conditions for an efficient production and the importance of flexibility in this field have drastically changed. In this context, managing the steadily increasing planning uncertainty, regarding the type (range of products/product variations) and the amount (quantity) of manufactured products, has become a crucial competitive factor [KaBl-05b] [Niem-07] [ORK-07] [Roga-10]. As a reaction to this, production planners constantly strive to adapt their systems, strategies and concepts accordingly in order to gain sufficient agility to handle these uncertainties [KaBl-05b] [Bart-05] [KRS-06] [Roga-10]. A review of the last three decades will illustrate this.

While the market situation was still characterized by manufacturers in the 1980s, a trend towards more customer oriented production took hold in the early 1990s, triggering an ongoing sizeable expansion of the product palettes and variants [DoQu-04] [West-04] [Bart-05]. New company strategies emerged, which, after the diversification of production sectors, now focused on the core competences. Finally, production network management became the basic policy. At the same time, production strategies underwent a massive change. Computer Integrated Manufacturing (CIM) and Total Quality Management (TQM) were followed by the strategies of Business Reengineering and Lean Management, all still valid and in use, but enhanced over the years [Bart-05] [KRS-06]. Currently, Agile Manufacturing, mutability and Holistic Production Systems¹ are intensely pursued strategies, focusing on flexibility and other related qualities as important target values for adapting and improving production systems. They contribute to making production more flexible by including suitable concepts in the design and organization of production systems [Bart-05] [KaBl-05b].

¹Holistic Production Systems bring together existing approaches to production strategies to form a new organizational model and can therefore be understood as methodological standards (operative guidelines) for the manufacture of products. They are not to be confused with technical systems for production, such as transfer lines or workplaces (vgl. [Bart-05]).

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Handling Uncertainties in Industrial Production

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