

Studien zur Wirtschaftsgeographie

Evolutionary development of regional production clusters

**A case study of the packaging
machinery industry in Germany**

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1. The packaging machinery industry in Germany – Introduction and aims

The production of packaging machinery in Germany is only a small subsection of the mechanical engineering sector, with ca. 25000 employees in around 300 businesses. The factories are for the most part individual small- to medium-sized enterprises. Only 2.6% have more than 500 employees. More than half have fewer than 50 employees. In spite of the small size of the production units these businesses operate on a global scale. In 1997 78% of the machines were exported. Germany occupies the leading position in the world market with a market share of just under 30%. The production structures are oriented towards the demands of the customers and characterized by craftsmanship. Innovations are less the product of systematic research and development, but rather develop as a result of processes of adaptation to the requirements of the customers. As a whole the production of packaging machinery can be characterized as a 'low-tech' branch of industry (see Tab. 1).

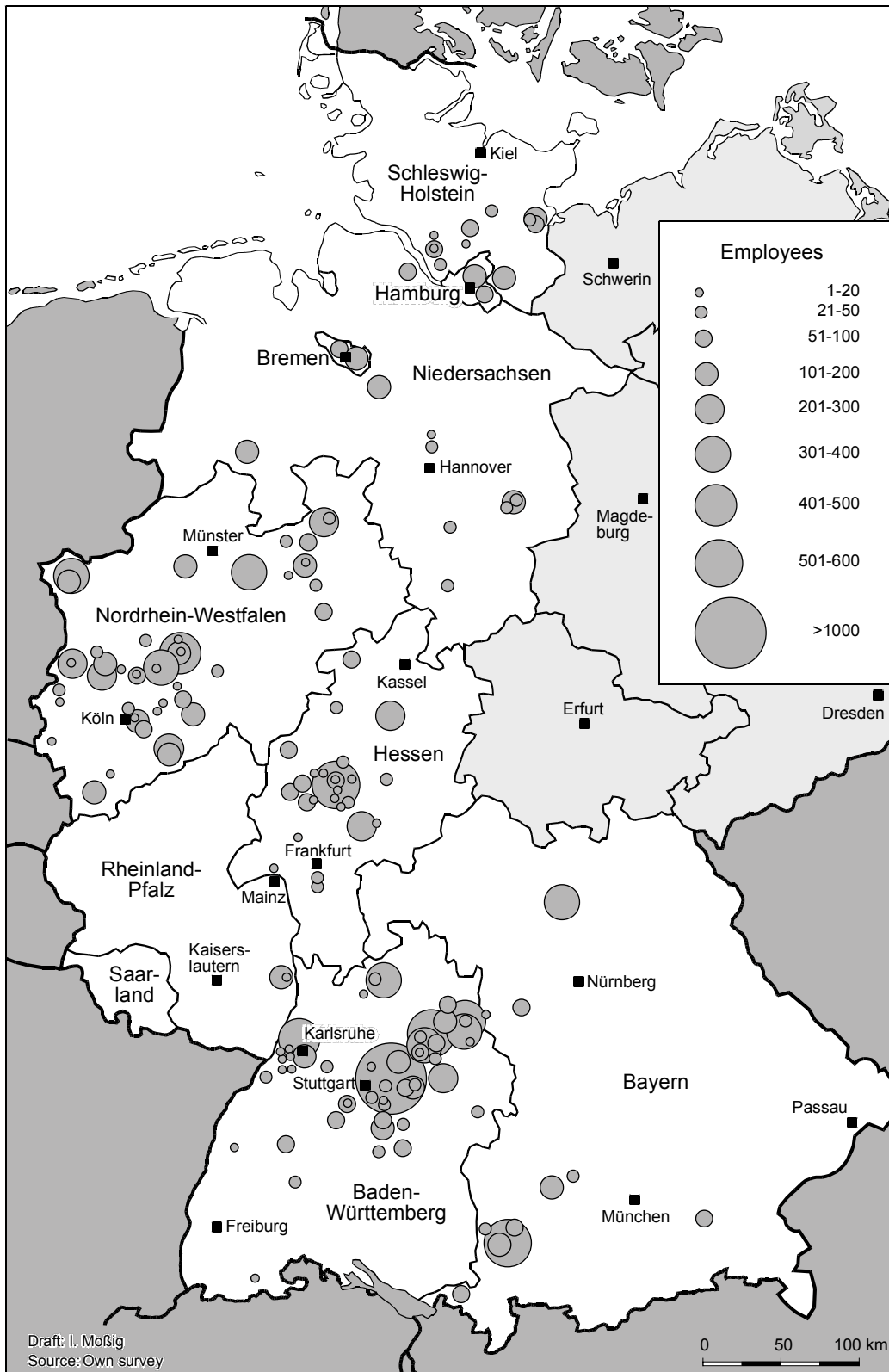
Tab. 1: Characteristics of the packaging machinery industry in Germany in comparison to the mechanical engineering sector as a whole

Packaging machinery production	Mechanical engineering sector as a whole
<ul style="list-style-type: none"> • ca. 25000 employees in 300 factories • Small- to medium-sized units dominate: 2.9 % of factories have more than 500 employees 52.3% of factories have fewer than 50 employees • Export ratio: ca. 78% • Share of world market: ca. 30% • 'Low-tech' branch of industry 	<ul style="list-style-type: none"> • ca. 984000 employees in 5866 factories • Small- to medium-sized units dominate: 6.3% of factories have more than 500 employees 39.3% of factories have fewer than 50 employees • Export ratio: ca. 64% • Share of world market: ca. 19% • R&D expenditure as percentage of returns: 2.7%

Source: Information from the VDMA (Verband deutscher Maschinen- und Anlagenbau e.V. = German Machinery and Plant Manufacturers e.V.), author's research

The Enterprises of the packaging machinery industry are not evenly distributed in Germany, but they are strongly spatially concentrated in a few regions. The most significant cluster with the greatest number of units and employees is to be found ca. 70km northeast of Stuttgart in the administrative district of Schwäbisch-Hall. The second most important concentration is ca. 60km north of Frankfurt in Mid Hesse. Both clusters thus lie at some distance from a large agglomeration in semiperipheral or rural regions (see Fig. 1).

Fig. 1: The spatial distribution of packaging machinery factories according to numbers of employees in 1999



The spatial concentration of businesses in a production chain, so-called regional production clusters, has enjoyed increasing attention as a factor explaining regional economic growth (Dybe/Kujath 2000, Rehfeld 1999). In the debate on industrial districts, important themes are the advantages of competition and co-operation which result from flexible specialized networks of small- to medium-sized enterprises. Further spatially oriented approaches in network research analyse 'creative milieus' or discuss the concept of 'learning regions' as engines of prosperous regional development (Camagni 1991, Maillat 1998, Sabel 1994, Scheff 1999, Scott 1988).

In this context, the question of causes for the emergence of such production clusters will be examined. Particular attention is to be paid to a discussion of the extent to which the spatial concentration of businesses in a production chain can be seen as a result of a dynamic-evolutionary process.

Secondly the question of the effects of the spatial concentration of businesses must be addressed. In particular it is to be established whether there were associated with the clustering process interconnections between packaging machinery producers or socio-institutional relationships at a regional or even broader level which had positively influenced the development process (Moßig 2000a).

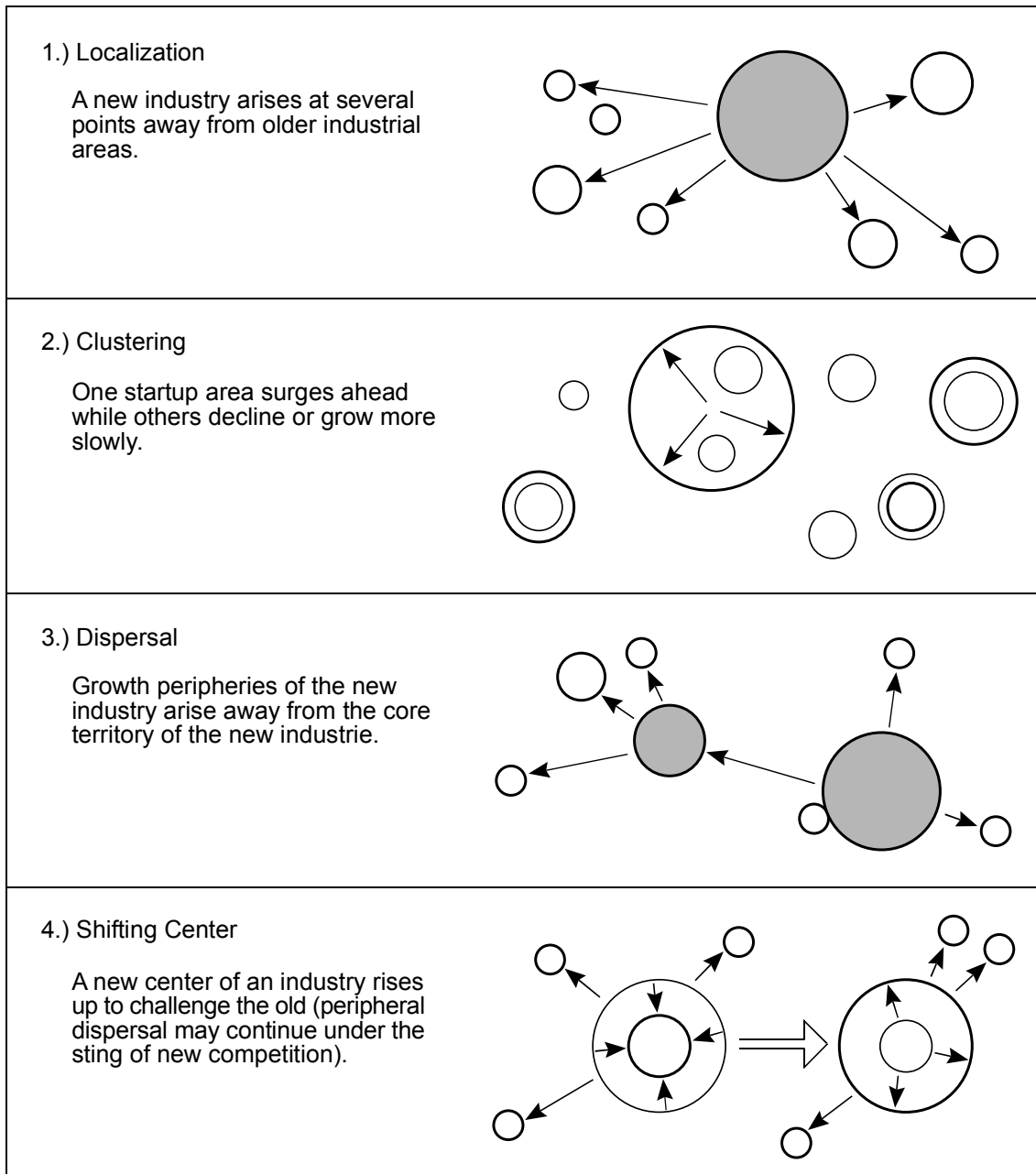
2. Theoretical considerations and methodology

A common factor of the approaches to the explanation of regional economic growth mentioned above (industrial districts, creative or innovative milieus, learning regions) lies in the fact that they attribute a high level of significance to socio-institutional relationships. Even though socio-institutional relationships cannot be defined by spatial criteria, nevertheless some important components could be identified which can be localized or are favourably influenced by spatial proximity. These include in particular relationships of trust (Harrison 1992). The factors for successful action and interaction which are based on spatial proximity and which show results in learning processes and innovational achievements, for example, do not spring automatically into being. Rather, these are evolutionary processes, for the causal actions of the agents involved are dependent on context (Bathelt/Glückler 2000).

Thus, in order to explain the spatial concentration of the packaging machinery industry in Germany a dynamic-evolutionary approach has been used. This approach diverges from traditional assumptions in location theory in that the regional equipment with production factors is not viewed as an exogenously determined, ahistorical factor which is responsible for the development of local industrial structures. It is argued rather that established businesses and industries influence the framework conditions according to their needs in such a manner that suitable preconditions develop for a growth process with its own momentum. By means of an examination of individual growth paths an attempt will be made to explain why regions with similar conditions nevertheless go through different trajectories of development and have created the production clusters as observed (Bathelt 1991, p. 360ff., Specht 1999, p. 39f.).

STORPER/WALKER (1989, p. 70f.) have schematically presented the spatially relevant processes for the path of development of a branch of industry in their concept of 'windows of locational opportunity'. They thereby differentiate between four subprocesses which do not necessarily take place sequentially: processes of localization, clustering processes, dispersion processes and relocation processes from primary locations.

Fig. 2: Schematic representation of the four basic patterns of geographical industrialization



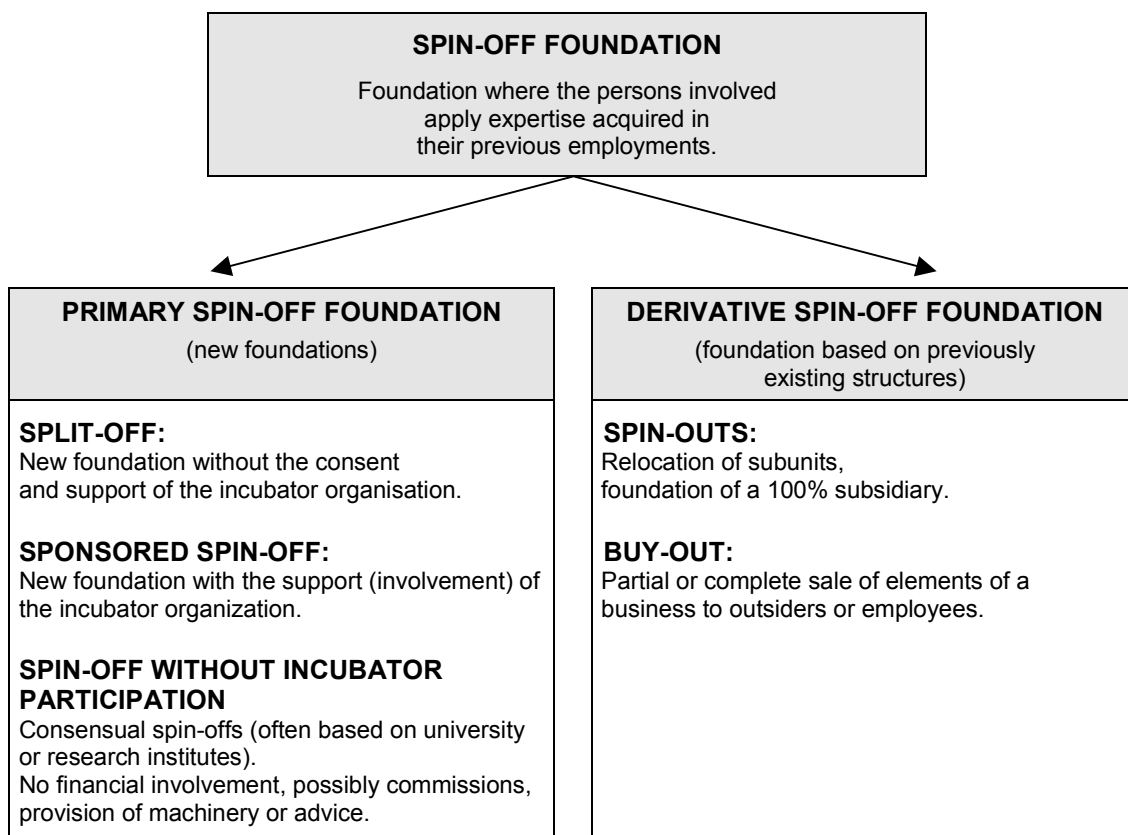
Source: Storper/Walker (1989), p. 71.

It must be tested whether the path of development of a particular branch of industry such as the packaging machinery industry has in fact taken place in a similar manner. With regard to the methodology discussed at the beginning of this section, the determinants of localization and clustering processes in particular are to be identified.

For this reason guided interviews with experts in both primary regional clusters have been carried out, in order to identify the foundation and development path of the individual factories and to analyse these. In the administrative district of Schwäbisch-Hall a total of 28 and in Mid Hesse 27 factories of the packaging machinery industry were identified. With 2 refusals in Mid Hesse and 4 in the administrative district of Schwäbisch-Hall the goal of total coverage was almost achieved.

Based on a carefully considered selection system a further seven businesses were examined whose location is outside the chief production regions and where no other packaging machinery producers have settled in the immediate surroundings. These case studies were intended to further the aim of explaining locational processes outside the chief production locations. Another aim was to establish why no clusters have developed in these singular locations (Moßig 2000a).

Fig. 3: Spin-off foundations: concept and definitions



Source: Author's research

3. Evolutionary development of regional production clusters

Based on the analysis of the foundation and development paths of the individual factories it can be demonstrated that the agglomerations primarily developed as a result of local spin-off foundations. The chief characteristic of a spin-off foundation is that the founders involved apply expertise which they acquired in previous employments. Without specific expertise a new foundation in a specialized industry such as packaging machinery construction is almost impossible. This includes, as well as technical knowledge and craftsmanship, in particular customer contacts and knowledge of the market as well as access to the expertise of specialized suppliers and qualified personnel. In Fig. 3 different types of spin-off foundations are summarized.

The development of a cluster can be represented by a family tree of local spin-off foundations (see Fig. 4) or in the form of a map clearly showing the spatial concentration (see Fig. 5).

What factors favoured the spin-off foundations observed and why did the clustering processes take place at these particular locations?

The first precondition for spin-off foundations is the presence in both chief production regions of suitable incubator enterprises with the necessary expertise. An analysis of the foundations and development paths of the individual factories shows that, analogous to the concept of 'windows of locational opportunity', a certain freedom of site choice existed in the first location phase. The locational choice of the first packaging machinery producers can only be understood after the fact by examining individual patterns of origin and development, and was not predetermined.

The pattern of development of the chief production regions as opposed to the singular locations shows that local spin-off foundations are favoured when expertise can be easily transferred. This is easier when the technology used is not too complicated and can be completely understood by one person. Further preconditions for the large number of spin-off foundations were a high potential demand and the relatively low capital investment required for the production of simple packaging machines.

As well as favourable preconditions, the motivations for new foundations as well as considerations in the process of making a locational choice are of particular significance in explaining the clusters. Both the decision to found a new factory and the choice of location are made by the respective founders. In the chief production regions the desire for independence, the realization of one's own ideas, lack of satisfaction with existing working conditions as well as recognized market opportunities were the most frequently cited reasons for new foundations. In Mid Hesse (potential) unemployment was a further important factor.

Spin-off foundations contribute to the creation of a branch cluster when a location close to the previous employer is chosen. The empirical research has shown that the founders considered alternative locations only in rare cases. A comparison of different locations and decision-making after a specific weighing-up of different locational factors did not take place. The availability of a site or suitable buildings close to the founders' home residence was thus the decisive factor in the choice of location, based on private connections and personal ties.

Fig. 4: Family tree of the packaging machinery industry in Mid Hesse (ca. 60 km north of Frankfurt)

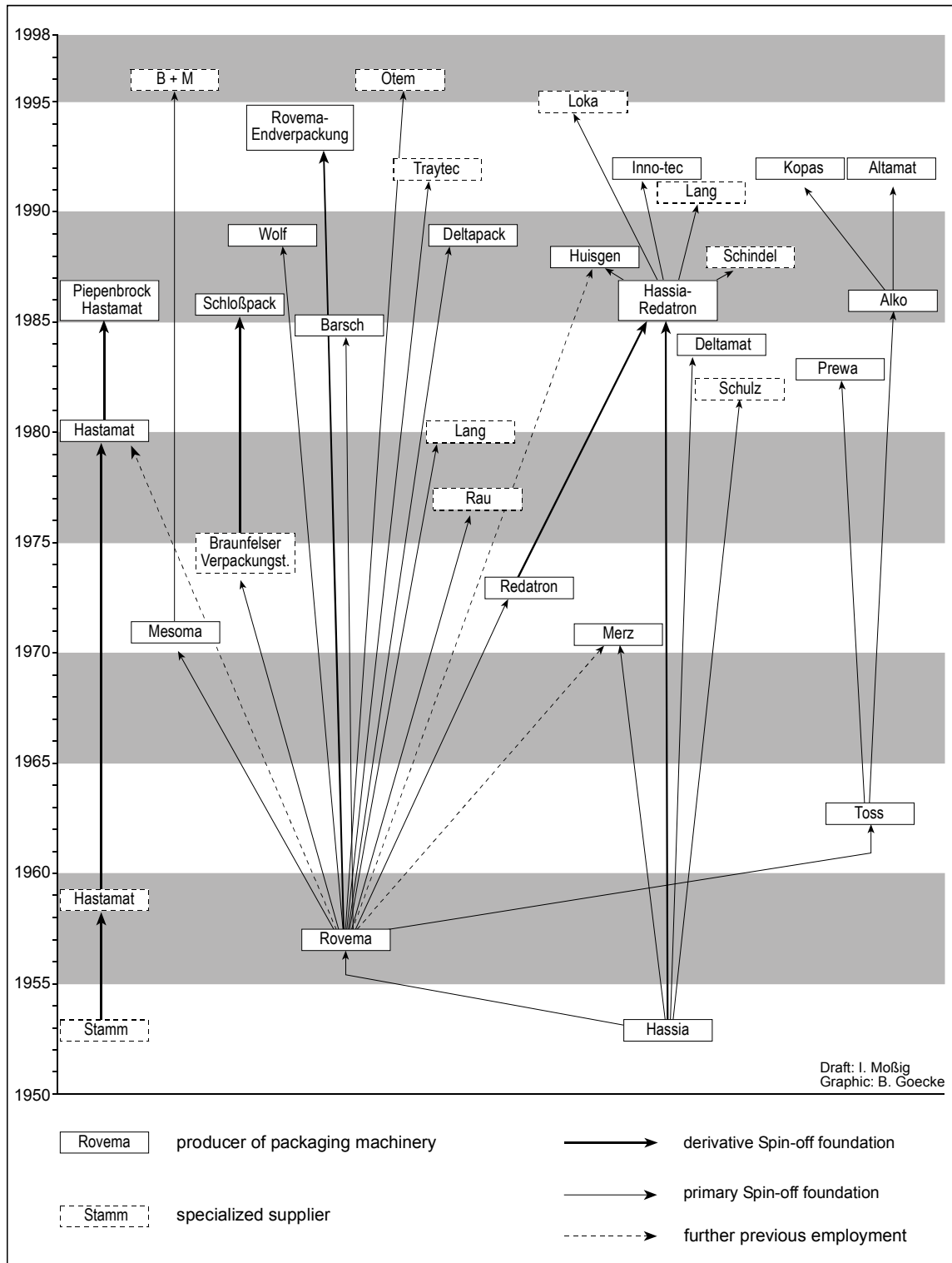
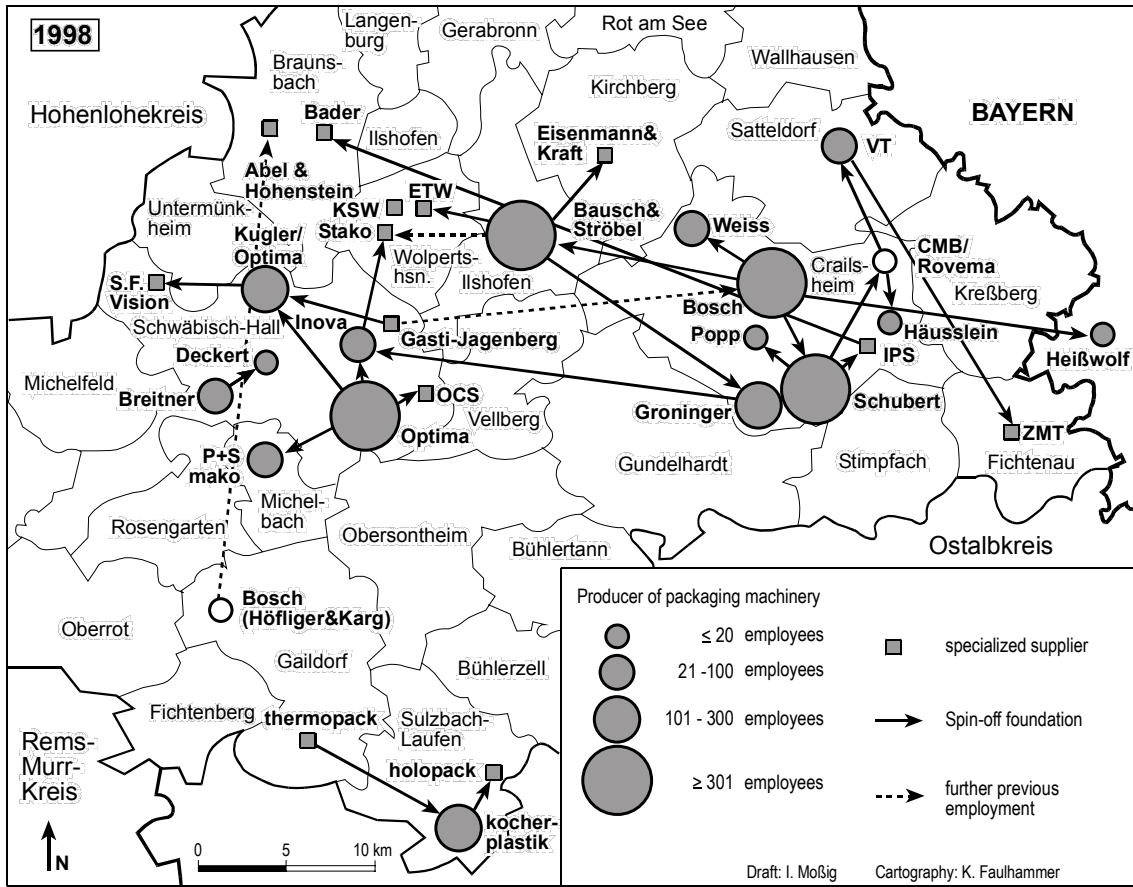


Fig. 5: Spin-off foundations in the administrative district of Schwäbisch-Hall 1998 (ca. 70 km northeast of Stuttgart)

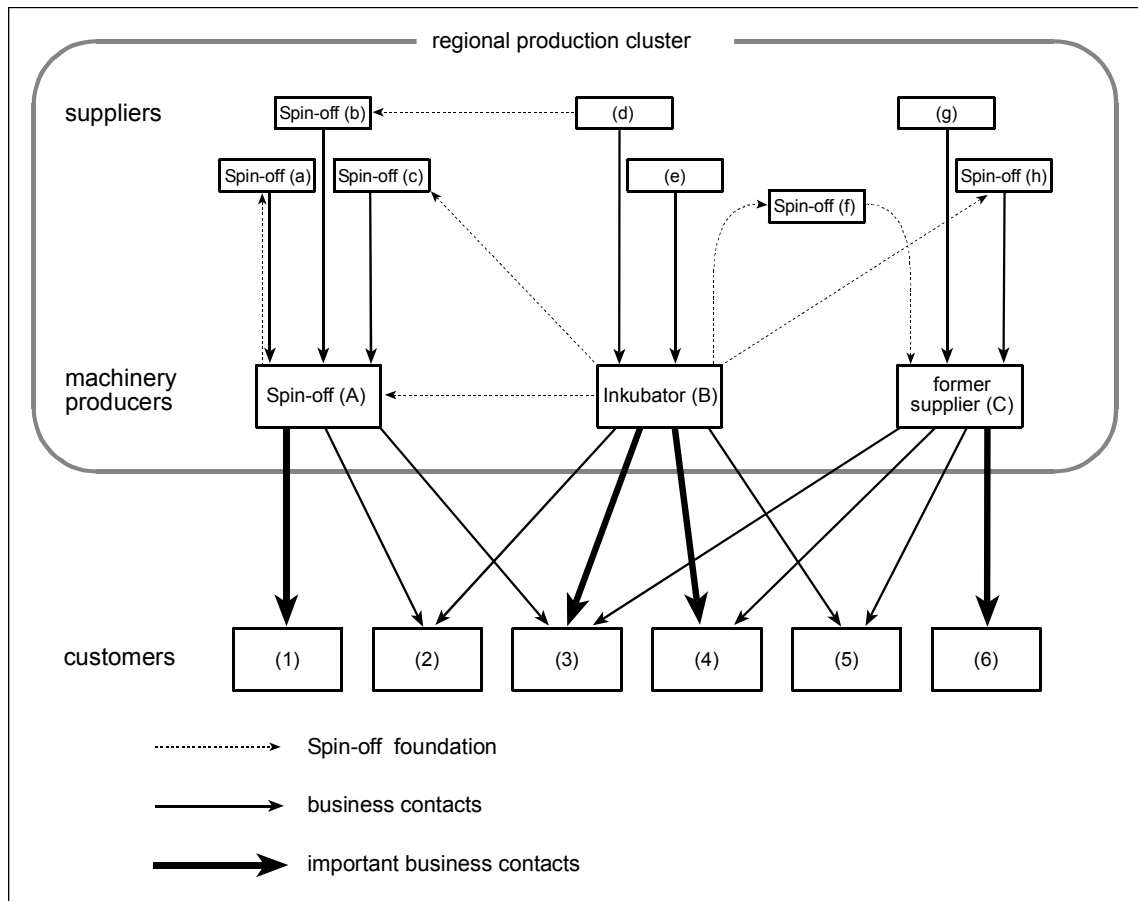


4. Regional and inter-regional connections in packaging machinery production

The development of clusters in the German packaging machinery industry can be explained by local spin-off foundations. Now the question arises as to the effects of these clusters. In this context the interconnections and relationships between factories will be analysed. In Figure 6 the relationship between the suppliers, the producers of the machinery and the customers (=users of the machinery) is portrayed schematically.

The broken lines emphasize once more the spin-off foundations which contributed to the development of the regional production clusters. The concentration of machinery producers and specialized suppliers can be traced back to a few dominant incubators, from which particularly large numbers of spin-off foundations originated (Fig. 6: Machinery producer [B]).

Fig. 6: Schematic representation of regional and inter-regional connections in the production of packaging machinery along the production chain in Germany



Within the chief production regions no notable horizontal co-operative relationships between the producers of machinery have developed. A similarly low level of co-operation at the same production level can also be observed in other parts of the German mechanical engineering sector (Grotz/Braun 1997). Based on the interviews the following reasons for this were established (Moßig 2000b):

(1) The difficulty of clearly defining the type and extent of co-operation

The producers emphasized that co-operation can only then be entered upon when it creates a clear advantage which a business could not or will not achieve on its own. This is however hindered by the specific activity of the branch analysed here. The production of packaging machinery takes place in the form of individual commissions according to the requirements and wishes of the customer. Thus only a small amount of the work can be described and documented before production, rather each commission must be projected anew in co-operation with the customer. Therefore it is difficult to establish a basis for possible co-operation with another machinery producer.

As well as this factor, the producers identify themselves with the technology of their machinery and are too little oriented towards their customer markets. The potential for co-operative exploitation of the market with complementary technology is thus generally not even considered.

(2) Entrepreneur mentality in owner-managed businesses

The mentality of the factory owners was the most frequently cited reason for the lack of co-operation. These are usually the founders who have built up their business on their own. Thus they put a high value on independence and fear any possible loss of autonomy. Usually the realization of individual ideas and a general desire for independence were significant reason for the foundation of a business in the first place.

(3) Suspicion based on the process of spin-off foundations

Co-operative behaviour can only develop where the agents trust one another, where the services provided are on a mutual basis and no-one tries to outdo the other (Schamp 2000, p. 64ff., Strambach 1995, p. 82ff.). With only a very few exceptions, however, most of the spin-off foundations in the packaging machinery industry take place without the consent of the previous employer. Thus relationships are characterized by suspicion from the very start. The wooing away of personnel, exploitation of customer contacts from previous employment (sometimes even involving new founders taking commissions with them) as well as competitively priced offers as a marketing strategy further strengthen existing personal dislikes.

(4) Competitive situation because of the lack of potential for specialization

In the course of spin-off foundations expertise is used which was acquired during the founders' previous employment. In particular in Mid Hesse it could be observed that the newly founded businesses were not specialized enough and that the individual entrepreneurs continually encountered each other as competitors for customers. In this

context it must be taken into account that the sale of packaging machinery is a unique transaction without regular and secure customer commissions. Every single commission is fought for. The businesses thus see each other as competitors and not as co-operation partners.

An analysis of the causes for the absence of horizontal co-operation clarifies two things: firstly, the potential for horizontal interconnections is significantly influenced by the area of activity of the packaging machinery industry studied here. Secondly, the evolutionary development process of the production clusters by means of local spin-off foundations damaged potential co-operative relationships and must therefore also be taken into account.

No notable co-operation or network creation was to be observed among the specialized suppliers. From the empirical data it can however be concluded that a high degree of regional business relations exist between the suppliers and the packaging machinery producers. Special components in particular are made by regional suppliers. Standardized parts in contrast were bought on a broader scale beyond the region. Long-term relationships with regional suppliers are highly regarded and perceived as advantageous. Their respective strengths and requirements are thereby known on both sides. Processes of agreement become simplified.

Only seldom do spin-off foundations supply their former employers (Fig. 6: Supplier [a] supplies its incubator, the machinery producer [A]). This can usually be explained by the suspicion already mentioned, based on the process of spin-off foundation.

It can further be observed that in spite of the large number of vertical relationships within the primary areas of production, no interconnections have developed between the producers based on common suppliers. Where common suppliers are used, only extra parts at a low technical level are involved. When the components become more complicated, contractual securities are built in forbidding the suppliers to process commissions from direct competitors.

The interaction with regional suppliers is one-sidedly dominated by the machinery producers. They fix prices, generally do not involve suppliers in new developments and always hold an option open to make the required parts in their workshop if necessary. Well-developed co-operative behaviour based on trust and reciprocity is not to be observed. A reaction of the suppliers to this situation is that in the course of their development they have begun with the production of machines in order to improve their position in the chain of production (Fig. 6: Supplier [f] is a spin-off from [B] and has further developed to become a producer of machinery [C]). Thus in both of the chief production regions almost half of the current machinery producers were originally specialized suppliers and became producers of packaging machinery only in the course of their further development.

At the point of intersection machinery producer-final customer (=the user of the machinery), super-regional relationships dominate. From the point of view of the producers, relations with their customers are seen as very important with regard to learning and innovation processes (see also Gertler 1996, Kalkowski et al. 1995). In this context an essential characteristic of the branch studied here again emerges. In the packaging machinery industry, machines are only

built after the commission has been given. No standard machines are made, which could be delivered from stores to the customer, but rather numerous adaptations of basic machine types to the individual production conditions of the customer have to be made. Because of this intensive interaction the customers and the process of interaction itself acquire a central significance (Gertler 1993, 1996) (Fig. 6: Represented by the bold arrows). At the same time the machinery producers meet frequently as competitors for customers in the course of the giving of commissions. Competitors' new developments are usually discovered during visits to customers, for example when a firm's engineers analyse in detail the workings of a competitor's machine when carrying out repairs and maintenance. Thus observation of the competition, which takes place in particular at trade fairs and on customers' premises, is an important source of information for new developments.

5. Conclusion

On the whole, the example of packaging machinery production in Germany shows that the evolutionary clustering process in a region does not automatically lead to marked interconnections between businesses at a regional level. The number of intraregional business contacts is high, but these could be identified as market relations, dominated one-sidedly by the machinery producers rather than suppliers, and not as co-operative relationships. Connections which encourage learning and innovation processes were primarily to be found in the inter-regional relations to the customers of the packaging machinery producers.

Nevertheless some advantages due to the clusters do emerge, which in particular aid small and newly founded enterprises. These advantages are to be found in particular in the well-developed, specially qualified pool of employees as well as the favourable situation with regard to suppliers in the chief production regions. Thus in the small businesses with fewer than 50 employees the average number of workers already previously employed by another producer of packaging machinery is about 40%.

In comparison to the producers at single locations, the situation with regard to suppliers is considerably more favourable. 61% of the value of all extra parts purchased in the administrative district of Schwäbisch-Hall is spent in the immediate region (up to 50km away). This draws attention once more to the intensity of business relations between suppliers and customers (machinery producers) in the main production regions.

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