Rian Drogendijk

USING AN OPTIMAL MATCHING PROCEDURE TO ANALYZE FOREIGN EXPANSION PROCESSES
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ABSTRACT: With the increasing interest in complex and dynamic processes in the field of IB, the call for systematic analyses of rich datasets is often heard. In this paper I use an Optimal Matching (OM) procedure (cf. Abbott, 1990; Abbott and Tsay, 2000; Sabherwal and Robey, 1993) to analyze the foreign expansion processes of firms. I argue that OM offers a fruitful approach for the analysis of qualitative and longitudinal data on internationalization processes. It is used to identify typical 'sequences of events', in the current paper: sequences of expansion steps by internationalizing companies.

I collected data on the expansion processes of thirteen firms entering the emerging markets in Central and Eastern Europe through field interviews and analysis of archival sources. Analyzing the resulting thirteen expansion processes with OM results in three distinct ‘typical expansion processes’, which can be meaningfully interpreted in correspondence with existing literature on growth strategies. With these findings, this paper goes beyond testing existing models on the internationalization of the firm, such as the Uppsala model (Johanson and Vahlne, 1977), and answers to the call for investigations on the differentiated expansion strategies of modern MNCs (Johanson and Vahlne, 1990; Autio, Sapienza and Almeida, 2000; Buckley and Ghauri, 2004).

KEYWORDS: Optimal Matching, Entry Strategy, Internationalization Process
1. Introduction

The study of internationalization and foreign expansion processes has been at the core of 30 years of IB research (Buckley, 2002; Ricart, Enright, Ghemawat, Hart & Khanna, 2003) and although repeated calls were made for methodological diversity in studying international expansion strategies (Ginsberg, 1988; Leonidou and Katsikeas, 1996; Buckley and Ghauri, 2004; Peng, 2004; Shenkar, 2004) most papers published in relevant journals have employed a quantitative, cross-section approach (Werner, 2002).

An important stream of research on international expansion processes builds on the dynamic model developed by Johanson and Vahlne (1977), the Uppsala model, grounded in behavioral theory (Cyert and March, 1963) and based on empirical observation of four case firms’ internationalization paths over several decades. This model has been the offspring of much empirical work, often based on smaller or larger cross-section datasets (Hedlund and Kverneland, 1984; Juul and Walters, 1987; Calof and Beamish, 1993; Li, 1995; Barkema, Bell and Pennings, 1996; Autio, Sapienza and Almeida, 2000; Delios and Henisz, 2003). The earlier studies, mostly based on small samples and personal interviews, provide tests on the accuracy of the Uppsala model’s predictions on companies’ foreign expansion steps and offer mixed results (Hedlund and Kverneland, 1984; Juul and Walters, 1987). Statistical analyses in these studies are limited (mainly counts and correlations), but at the same time the reported results do not fully reflect the potentially rich datasets collected through the interviews. More recent studies have used large-scale datasets and more rigorous statistical methods such as event history analysis, and have supported the driving force of learning in the internationalization process, showing
that firms benefit from prior relevant experiences when expanding abroad (Li, 1995; Barkema et al. 1996; Delios and Henisz, 2003). These recent studies have focused away, however, from building understanding of the apparent differences in internationalization patterns. An exception has been the study by Autio, Sapienza and Almeida (2000), investigating the pace of internationalization processes among high-technology companies. Studies investigating foreign expansion processes and patterns of international strategy using longitudinal, qualitative data are rare (a notable example is a study by Penner-Hahn, 1998, on the sequence of foreign R&D activities based on data collected through personal interviews). The current paper adds to the literature in answering to the call for using diverse methods for the analysis of longitudinal processes in the field of IB and describes an approach that combines the strengths of qualitative data collection methods with the rigorous analysis techniques employed in quantitative studies: Optimal Matching.

The optimal matching (OM) technique is a valuable method through which qualitative data can be quantified and analyzed systematically in order to understand the longitudinal processes of international expansion. OM allows for combining the advantages of rich qualitative data collection with the rigidity of systematic and quantitative analysis (compare case surveys; Larsson, 1993, although in contrast to the case survey approach my study is not based on existing cases but uses original data collected for the purpose of this particular study). As a contextual research method, OM analysis offers a maximum degree of contextuality in time, less so in space (Abbott, 1997), offering ample opportunities to analyze the temporal dynamics of international expansion (cf. Webb and Pettigrew, 1999). OM has been used before in analyses of career paths (see for instance, Abbott, 1990; Abbot and Hrycak, 1990;
Abbott and Tsay, 2000), information systems' implementation processes (Sabherwal and Robey, 1993) and patterns of core business and strategy change (Ginsberg and Baum, 1994; Webb and Pettigrew, 1999).

This paper applies OM to a question central to IB-research: the foreign expansion process. I analyze the sequential expansion steps of 13 Dutch firms into three markets in one region: Central and Eastern Europe. Data were collected mainly through personal interviews and follow-up discussions with general managers of local operations of Dutch companies and were validated through analysis of company documents and public archival resources. I identify sequences of critical events (cf. Van de Ven & Polley, 1992) in the expansion processes and, in contrast to earlier studies in the field based on qualitative data, I employ a statistically rigorous method in order to classify these sequences into typical expansion processes by means of optimal matching (OM). It is the first time that the OM procedure, which has proven to be a useful tool for identifying typical processes in other fields of research, is applied to the field of international business.

The paper is organized as follows: I start with a brief overview of the literature on international expansion processes in section 2. In section 3, I address the methods, including sample selection, data collection method, and analysis technique used in the current project. Section 4 presents the findings, following the different stages of analysis, while section 5 provides a short discussion of the typology that results from the analyses. In section 6 finally, I evaluate the contribution of the paper and the optimal matching method for studies of dynamic processes in the field of IB and present some concluding remarks on the use of this method.
2. International expansion processes

The process of international expansion has been described as a series of cumulative decisions on market selection and resource commitment levels (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977). Each internationalization decision is dependent upon decisions that the firm has taken before and in other places (Aharoni, 1966). The path dependency of these consecutive decisions, however, does not prohibit diversity in the internationalization processes of firms (Johanson and Vahlne, 1990).

According to Johanson and Vahlne (1977) the accumulation of foreign market knowledge, or learning, is the engine for further local expansion leading to increasing commitment in foreign markets. Because learning is a time consuming process, the firm is expected to adjust its operations incrementally to its accumulated experiences. In the original Uppsala model, four stages of increasing market commitment were distinguished (consequently irregular export, export through a local sales agent, sales office, production site), labelled the ‘establishment chain’ (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977). Later contributions to the literature on internationalization processes have questioned this predetermined order of stages and have raised doubts on the validity of the proposed stages of the establishment chain in the globalizing world economy of today (Hedlund and Kverneland, 1983; Johanson and Mattson, 1984; Nordström, 1991; Turnbull, 1987). In a reply to these critical notes Johanson and Vahlne (1990) call for the development of models that are able to describe more differentiated internationalization processes. An example of such a model is the
internationalization framework proposed by Welch and Luostarinen (1988), which describes the internationalization of firms to develop on six dimensions, including the operation methods used in foreign markets. Instead of predicting a certain order of entry modes used, Welch and Luostarinen propose that expansion occurs both through deeper committed and more diverse operation methods.

The empirical results with respect to the pattern of growing resource commitment are mixed. Some empirical studies were supportive to the incremental internationalization pattern, although in none of these studies firms were found to have followed the predetermined order of stages (Buckley, Newbould and Thurwell, 1978; Engwall and Wallenstal, 1988; Hedlund and Kverneland, 1983; Juul and Walters, 1987; Vahlne, Nordström and Torbacke, 1996). Hedlund and Kverneland (1983), for instance, found that the 18 Swedish firms in their sample expanded in Japan in sequential steps, though often at a faster pace (skipping one or more stages) than expected according to the establishment chain. They explained these shorter entry routes from the extended prior international experience of the respective firms (compared to the firms that did follow all the stages) that allowed them to acquire market knowledge faster and therefore skip stages in entering Japan. Juul and Walters (1987) achieved similar results in analyzing the investment strategies of 12 Norwegian firms in the UK. Most Norwegian firms started with export activities before setting up sales or manufacturing subsidiaries, though only three firms used an intermediate step. Buckley, Newbould and Thurwell (1978) investigated the international behavior of 43 small UK firms and found that although taking all steps of the establishment chain was not the most popular entry strategy it resulted in the highest success rates. Incremental learning through small steps of
local commitment was concluded to be "of great value" for British firms abroad. More recently, Vahlne et.al. (1996) found that Swedish firms have started to invest in Central and Eastern Europe with less committed entry modes (e.g. sales offices) and later extended to more committed modes and activities (like local production). The authors report a variety of entry processes used by the firms entering these new markets, but they do not explain the differences among these expansion patterns. Autio et al. (2000) suggest that the age of the firm explains the pace of its international expansion process: they found that young firms still take incremental steps when expanding internationally, but they do so at a higher pace than older firms. Turnbull (1987), finally, rejected the stages model based on his observation that the stage of commitment of 72 expansions by UK firms in three foreign markets was not related to either firm size or international orientation (measured as the proportion of export to total turnover). He further reports that the firms in his sample are often active in foreign markets through more than one of the market modes as distinguished in the establishment chain, at the same time. He offers no suggestions, however, for other explanations that could help understand the different entry strategies of firms.

The above suggests that investigations of international expansion processes of firms should take into account the diversity of modes that firms can use to enter and consequently use at a foreign market, the different sequences in which they do so and the possible use of multiple modes as complements instead of consecutive substitutes. The abovementioned studies further proposed a number of explanatory factors that could guide our search in explaining the variations in expansion processes followed, like international experience, size and age of the firm.
3. Method

This study takes an inductive approach in order to identify typical expansion processes and explanations for differences among these typical processes. Inductive qualitative case studies are specifically strong in investigating "how" or "why" questions, in situations of complex causality and in studies that generate novel and empirically testable theory (Eisenhardt, 1989). Data are collected through semi-structured field interviews with key respondents in 13 selected cases. With interviews at the site, i.e. in the natural setting of the local subsidiary (Van de Ven, 1992), I gathered information on the entry process from the start of activities up to current developments in the respective subsidiary, which resulted in 13 retrospective case studies (cf. Leonard-Barton, 1990). The benefit of semi-structured interviews is that while the interview covers a number of predefined topics, the interviewer is still able to clarify the meaning of questions and to adapt questions to the specific situation (Miles and Huberman, 1994).

Selection of Cases and Data Collection

I followed recommendations of Eisenhardt (1989) and Pettigrew (1992) to select a limited number of cases that were different with respect to variables that might influence expansion decisions in subsidiaries. The 13 selected case companies are different with respect to their size and international experience (i.e. factors suggested to influence expansion processes in earlier studies, see above), the industries they are active in (horticulture, food and beverages and industrial manufacturing) and the host country entered (Poland, Hungary and Russia) (see table 1). I selected three host
markets in Central and Eastern Europe, because these markets opened up to FDI rather recently and offer therefore unique opportunities for investigating modern expansion processes from a comparable starting point. Poland, Hungary and Russia are among the top destinations in the region for receiving foreign investment, though they are very different with respect to economic development and transition strategy. Poland followed a "shock therapy" in transforming from a planned towards a market economy, while Russia and Hungary took a "gradual approach" though from very different starting points (Hungary starting from an economically advantageous position in comparison to Russia, see for instance, Paliwoda, 1994; World Bank, 1996). The horticulture, food and beverages and industrial manufacturing industries are among the industries with large investments in the region of Central and Eastern Europe. The cases are from a single home market, The Netherlands, which is one of the largest investors in the region. The selected subsidiaries are established more than three years before the date of the interview. Interviewees were local General Managers (9 cases), Marketing Managers (two cases) and Financial Managers (two cases), who had been with the subsidiary since its start or else long enough (more than two years) to have considerable knowledge about the subsidiary’s expansion history. In five cases, I also interviewed a headquarters’ respondent allowing for cross-validation of the data and insights provided by the subsidiary respondents.

***INSERT TABLE 1 ABOUT HERE***

The interviews took place in July and November 1998, and they lasted between one and four hours, with an average of 105 minutes. The respondents provided data on expansion processes and expansion steps without determining a number of steps or
categories up front. In the beginning of the interview they were asked to describe how the focal subsidiary started and expanded up to its current state. The interviewer took care that changes in operation methods, control exerted by headquarters and the extension of activities of the subsidiary were discussed in depth. During the interviews, extensive notes were made and processed into comprehensive case descriptions, or case histories, within 48 hours. The case histories were sent to the respondents for approval (only two respondents had comments that resulted in minor adjustments) and were used as the basis for the analyses reported on here. Apart from the cross-checks by means of interviews at the headquarter level of the companies involved in five cases, the accuracy of information on operations methods or business extensions was validated whenever possible through comparison with information published in annual reports, and other publicly available archival sources. In case of deviations, I returned to the respondents for clarification. Table 2 provides an overview of key features of the case companies and their expansions into the respective markets.

***INSERT TABLE 2 ABOUT HERE***

4. Data Analysis & Results

As the literature review shows, studies on the foreign expansion process of firms have been based either on large cross-section datasets, or have provided descriptive accounts based on interviews, sometimes also providing tentative explanations for differences in expansion processes are suggested (most notably Hedlund and Kverneland, 1984).

This paper adopts a technique that is capable of analyzing sequences of events inducted from qualitative case histories, i.e. the optimal matching (OM) procedure (cf.
Abbott, 1990; Sabherwal and Robey, 1993). The input in the analysis is sequences of events as described in the case histories, rather than individual events or data points. A matrix of distances between these sequences is computed, based on a minimum of operations of insertion, deletion ('indel' operations) and replacement that is required to transform one sequence in the other for every pair of sequences. A critical, and not undisputed, stage in the analysis involves the setting of the replacement and indel costs (Abbott and Tsay, 2000; Wu, 2000). For this paper, I adopt the replacement and indel costs as defined by Sabherwal and Robey (1993), because like in the current study they analyzed strategic decision processes of relatively short length. The resulting distance matrix is consequently analyzed with multidimensional scaling techniques, like hierarchical cluster analysis, in order to determine similar groups of sequences. Up till this stage, and for the purpose of this paper, the analysis is descriptive in identifying and describing typical sequences of events in international expansion. In further analyses, explanatory variables may be identified and hypotheses can be tested with the typical sequences as dependent variables (Wu, 2000). Below, we will follow the different stages of analysis in order to provide as rich information possible on the application of the OM technique for IB research.

**Identification of ‘critical events’**

Following Van de Ven and Polley (1992), I define ‘critical events’ as “incidents when changes were observed to occur” in the operation methods and value chain activities of the cases. For each case, I determined the sequence of such incidents as featured in the case histories based on the interviews and the archival sources. In a stepwise cross-case analysis, I then categorized the observed incidents into comparable categories of events or expansion steps and determined the sequence of these events.
for each case (compare, Sabherwal and Robey, 1993). The categories of expansion steps are inducted from the accounts of the respondents. They are surprisingly similar to the four stages of the establishment chain as originally defined by Johanson and Wiedersheim-Paul (1975), although they encompass more diverse operation methods: export (E), licensing, franchising and other cooperative agreements with local firms (C), representative offices and sales offices (O) and production site (P). This resulted in 13 sequences of events (see table 3), which are different with respect to the events in the sequence, the order of events in the sequence and the number of events in the sequence. In contrast to prior studies this approach allows for more than one event per category, which means that some categories were 'repeated' in the sequence (as in sequence 12, "E-P-P-P", which reflects the stepwise extension of the ownership share in a production site).

***INSERT TABLE 3 ABOUT HERE***

Distance matrix & Cluster analysis

The next stage of analysis involved the calculation of distances between all pairs of sequences following the methodology of Sabherwal and Robey (1993). Comparing every pair of sequences, I computed distance scores accordingly: substitution of events are attributed a cost of 1.0 and deletions and insertions 0.5. The smallest possible distance score is entered in the matrix\(^1\). Table 4 presents the complete distance matrix.

***INSERT TABLE 4 ABOUT HERE***

\(^1\) For example, the distance score comparing the sequence "E-C-O-P" to the sequence "E-O-P" is computed as 0.5 for one deletion (of the second event) instead of computing two substitutions (of event 2 and 3) and one deletion (of event 4), which would make a total distance score of 2.5.
The distance matrix is entered in a clustering or multidimensional scaling procedure in order to identify typical patterns of sequences (Abbott, 1990; Sabherwal and Robey, 1993). I first performed Quick Clustering (SPSS 10.0), which provides ANOVA tests on the fit of individual data into a prespecified number of clusters, maximizing the differences among cases in different clusters. A solution of three clusters, containing 6, 5 and 2 cases respectively, appeared to result in optimal significant group membership for all thirteen cases. With Hierarchical Cluster Analysis (HCA, SPSS 10.0), which starts with one case and iteratively adds cases to clusters and combines these until only one is left or a prespecified number of clusters is reached, I tested whether cases appeared in the same three clusters as identified by the Quick Clustering procedure and the results supported this solution.

As a further test for the reliability of the clusters found with HCA, multidimensional scaling (MDS) was performed. MDS assigns observations to specific locations in a two or more-dimensional conceptual space and is therefore a helpful tool in interpreting the dimensions that underlie the differences in the sequences. A visual representation of a two-dimensional solution is presented in Figure 1.

***INSERT FIGURE 1 ABOUT HERE***

Three typical sequences of foreign expansion emerge from the cluster and MDS analyses. A first cluster contains Amstel and Zywiec, both started as minority acquisitions of brewing company Heineken, which over time and stepwise extended its share in the Hungarian and Polish companies. The second cluster consists of six cases (Seminis, both Green affiliates, Black, DSM and Ovita-Nutricia), which have all used
local business relations, in case of Ovita-Nutricia even an equity Joint Venture partner, in order to build up local activities. Finally, cluster three groups five cases (DSM, Chemo, Van Melle, Douwe Egberts, Organon and Power). With the exception of DE, which used an exclusive local distributor in its early period in Russia, all these companies have expanded through successive internal company initiatives, i.e. without establishing some form of formal cooperation with local business partners.

5. Discussion

In the results section above, I made a start with interpreting the typical expansion processes, which result from the OM analysis. The three clusters solution and the corresponding typical expansion patterns conform to widely acknowledged and empirically supported strategies of growth: generic expansion, expansion through acquisitions and growth through interorganizational relations (Penrose, 1959; Root, 1978; Yip, 1982; Contractor and Lorange, 1988; Peng and Heath, 1996). Through OM analysis, we have therefore derived a meaningful interpretation of typical foreign expansion processes, leaving only one exception (DE’s use of a partnership) that does not fit the interpretation. This result, that companies use differentiated expansion processes, in line with different growth strategies, helps explaining the mixed findings of prior tests of the predictions of the Uppsala model (Hedlund and Kverneland, 1984; Juul and Walters, 1987) and offers a starting point for future investigations of companies’ diverse expansion strategies.

In future stages of research building on the current findings, we first need to test for the reliability of these typical expansion processes and the particular steps taken through collecting and analyzing different and a larger number of case histories on foreign
expansion, also in different settings than the current study. Furthermore, qualitative assessments of factors that explain differences between typical sequences, beyond the preliminary analysis offered in the current study, will support the formulation of testable hypotheses on the differentiated dynamics of foreign expansion. Finally, as a follow-up in future studies, the expansion process could be entered as a categorical variable into regression analyses (Wu, 2000), for instance as an explanatory variable for understanding organizational outcomes as markets share, or other success measures.

6. Conclusion: the value of OM for the analysis of processes in IB research

This paper is the first to use a systematic approach, the optimal matching procedure (cf. Abbott, 1990; Abbott and Tsay, 2000; Sabherwal and Robey, 1993), in order to analyze longitudinal and qualitative data on foreign expansion processes of firms, i.e. analyzing the sequences of expansion steps. OM is appropriate for categorizing typical sequences of events and allows us to understand differences between typical sequences. The current paper is based on qualitative data collected through in-depth interviews combined with written sources and used OM in order to inductively arrive at meaningful expansion processes of companies entering new markets. The advantages of using OM for analyzing qualitative data is that it combines the strengths of rich data collection with the rigor of systematic analysis. It is therefore specifically suitable for analyzing complex and temporal processes. Using the methodology as presented in this paper overcomes one of the weaknesses of the case survey method, namely that the selection and inclusion of cases is not dependent on the coincidental availability of existing cases (Larsson, 1993), but instead the
researcher designs the qualitative stage of the research based on conceptually meaningful criteria.

Critical for achieving the benefits of the combination of richness and rigor is that the researcher provides the reader with enough information on the steps taken in analyzing the data (in addition to the required completeness on the choices made in the distinct stages of the qualitative data collection process). Furthermore, though satisfactorily for the current study’s purposes of demonstrating the use of OM for analyzing qualitative sets of data in the field of IB, the interpretation of the resulting typical sequences needs elaboration in studies focusing on understanding particular (dynamic) problems.
Table 1: Case companies by industry and host country

<table>
<thead>
<tr>
<th>Industry</th>
<th>Hungary</th>
<th>Poland</th>
<th>Russia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horticulture</td>
<td>Green Hungary*</td>
<td>Green Poland*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seminis Hungaria Ltd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical / Electronic</td>
<td>Power*</td>
<td>Chemo*</td>
<td>DSM Eastern Europe Organon</td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>Amstel Hungary</td>
<td>Ovita-Nutricia</td>
<td>Black*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Browar Zywiec</td>
<td>Douwe Egberts CTI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Van Melle AG</td>
</tr>
</tbody>
</table>

* Concealed identity, on request of participating companies
<table>
<thead>
<tr>
<th>Company</th>
<th>First local activities mother company:</th>
<th>Year of establishment:</th>
<th>Acquisition; share of Dutch parent:</th>
<th>Size of subsidiary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amstel Hungary</td>
<td>1991</td>
<td>1991</td>
<td>50% at start; fully owned since 1997</td>
<td>around 300 employees</td>
</tr>
<tr>
<td>Black</td>
<td>1993</td>
<td>1993</td>
<td>40%</td>
<td>12 employees, including people 'on leave'</td>
</tr>
<tr>
<td>Chemo</td>
<td>around 1980</td>
<td>1992</td>
<td>Greenfield; fully owned</td>
<td>6 employees</td>
</tr>
<tr>
<td>Douwe Egberts</td>
<td>1994</td>
<td>1995</td>
<td>Greenfield; fully owned</td>
<td>25 employees</td>
</tr>
<tr>
<td>DSM Eastern</td>
<td>1991</td>
<td>1991</td>
<td>Greenfield; Fully owned</td>
<td>6 employees</td>
</tr>
<tr>
<td>Europe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Hungary</td>
<td>around 1930</td>
<td>1987 / 1990</td>
<td>Greenfield; fully owned</td>
<td>around 50 employees</td>
</tr>
<tr>
<td>Green Poland</td>
<td>before 1900</td>
<td>1985 / 1994</td>
<td>Greenfield; fully owned</td>
<td>28 employees</td>
</tr>
<tr>
<td>Organon</td>
<td>1989</td>
<td>1993</td>
<td>Greenfield; fully owned</td>
<td>around 100 employees</td>
</tr>
<tr>
<td>Ovita-Nutricia</td>
<td>1991</td>
<td>1993</td>
<td>Greenfield; share of Dutch parent: 50%</td>
<td>&gt; 100 employees</td>
</tr>
<tr>
<td>Power</td>
<td>1975</td>
<td>1989</td>
<td>Greenfield; fully owned</td>
<td>9 employees</td>
</tr>
<tr>
<td>Seminis Hungaria</td>
<td>before 1940</td>
<td>1984 / 1992</td>
<td>Greenfield; first JV; fully owned since 1992</td>
<td>around 30 employees</td>
</tr>
<tr>
<td>Van Melle</td>
<td>1993</td>
<td>1993</td>
<td>Greenfield; fully owned</td>
<td>130 employees</td>
</tr>
<tr>
<td>Browar Zywiec</td>
<td>1992</td>
<td>1993</td>
<td>Acquisition; share of Dutch parent: 24% at start; to 75% in 1998</td>
<td>around 1500 employees</td>
</tr>
</tbody>
</table>
### Table 3: Sequences of events by case

<table>
<thead>
<tr>
<th>Case</th>
<th>Sequence of Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Seminis Hungaria</td>
<td>E, C, O, P, P</td>
</tr>
<tr>
<td>2. Green Hungary</td>
<td>E, C, O, P</td>
</tr>
<tr>
<td>4. Black</td>
<td>E, C, O, P</td>
</tr>
<tr>
<td>5. Douwe Egberts (DE)</td>
<td>E, C, O, O</td>
</tr>
<tr>
<td>6. DSM</td>
<td>E, C, O</td>
</tr>
<tr>
<td>7. Van Melle</td>
<td>E, O, O, P</td>
</tr>
<tr>
<td>8. Chemo</td>
<td>E, O, O, O</td>
</tr>
<tr>
<td>9. Organon</td>
<td>E, O, O</td>
</tr>
<tr>
<td>10. Power</td>
<td>E, O</td>
</tr>
<tr>
<td>11. Ovita-Nutricia (ON)</td>
<td>C, P</td>
</tr>
<tr>
<td>12. Amstel Hungary</td>
<td>E, P, P, P</td>
</tr>
</tbody>
</table>
### Table 4: Matrix of distances between pairs of sequences

<table>
<thead>
<tr>
<th></th>
<th>Seminis H</th>
<th>Green H</th>
<th>Green P</th>
<th>Black</th>
<th>DE</th>
<th>DSM</th>
<th>Van Melle</th>
<th>Chemo</th>
<th>Organon</th>
<th>Power</th>
<th>ON</th>
<th>Amstel H</th>
<th>Zywiec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Seminis H</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Green H</td>
<td>.5</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Green P</td>
<td>.5</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Black</td>
<td>.5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
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FIGURE 1: Two-dimensional configuration of thirteen expansion processes, a three-cluster solution*

* Distances d1 to d13 correspond to the listing of cases as in tables 3 and 4
References


