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Abstract

Considerable public resources are devoted to the establishment and operation of business incubators (BIs), which are seen as catalysts for the promotion of entrepreneurship, innovation activities and regional development. Despite the vast amount of research that has focused on the outcomes or effectiveness of incubator initiatives and how to measure incubator performance, there is still little understanding of how to determine incubators that are more effective than others. Based on data from 410 graduate firms, this paper applies the multi-criteria outranking technique PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) and compares the long-term effectiveness of five technology-oriented BIs in Germany. This is the first time that outranking procedures are used in incubator evaluations. In particular, we investigate whether PROMETHEE is a well-suited methodological approach for the evaluation and comparisons in the specific context of business incubation.

Keywords: Business Incubators; Evaluation; Performance Measures; PROMETHEE; Outranking

JEL Classification: C44, D81, L26, O38

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Zusammenfassung

Noch immer werden öffentliche Gelder in beträchtlichem Ausmaß in die Errichtung und den Betrieb von Technologie- und Gründerzentren (TGZ) investiert. Diese Instrumente der, in erster Linie kommunalen, Wirtschafts- und Innovationsförderung zielen darauf, Existenzgründungen zu unterstützen, Innovationsaktivitäten zu befördern und die Regionalentwicklung nachhaltig positiv zu beeinflussen. Ungeachtet der Vielzahl an Studien, welche die Effektivität dieser Zentren untersuchen, existieren kaum Ansätze, wie die TGZ bzw. deren Effektivität miteinander verglichen werden können. Hier setzt das vorliegende Papier an, indem basierend auf Daten zu 410 ehemalig geförderten Unternehmen die Outranking-Methode PROMETHEE (Preference Ranking Method for Enrichment Evaluation) angewendet wird. Ziel ist es dabei, die langfristige Effektivität von fünf Technologie- und Gründerzentren (der Neuen Bundesländer), unter Berücksichtigung einer Reihe relevanter Indikatoren, zu vergleichen. Diese Methode bzw. Gruppe von Methoden ist bislang in diesem Kontext noch nicht verwendet worden. Insbesondere wird daher auch der Frage nachgegangen, inwiefern PROMETHEE grundsätzlich geeignet ist und welche Voraussetzungen erfüllt sein müssen, um eine Evaluierung von Technologie- und Gründerzentren durchzuführen.

Schlagworte: Technologiezentren; Gründerzentren; Outranking; PROMETHEE; Evaluierung; Erfolg; Effektivität

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1 Introduction

Among the broad range of policy measures that focus on the promotion of entrepreneurship, innovative start-ups and the support of small and medium-sized enterprises (SMEs) (see *Audretsch* 2002; *Commission of the European Communities* 2005; *Storey and Tether* 1998), business incubators (BIs) and science parks in particular have been subject to intense academic and worldwide policy discussions. More recently, there is a considerably growing perception among researchers as well as increasing awareness of policy-makers and practitioners for more rigorous evaluations (*Bigliardi et al.* 2006). The total number of incubators, science parks and similar policy initiatives is rapidly expanding, and therefore, evaluation efforts are clearly of major importance not only to provide crucial information on the effectiveness of these mostly publicity funded programs, but also to give advice for stakeholders that are concerned with the establishment and operation of BIs.

Previous evaluation studies have approached the question of BIs' effectiveness from a multiplicity of perspectives, based on plurality of assessment criteria reflecting the performance of incubator organizations (see *Hackett and Dilts* 2004; *Siegel, Westhead and Wright* 2003; *Tamásy* 2007 for overviews). Thereby, most research focuses on the effectiveness of single incubators/science parks, a group of incubators/science parks (e.g. within one country or region) or specific types of incubators/science parks. However, what has been largely disregarded in prior evaluation efforts are explicit comparisons within a specific population of incubator organizations. Therefore, the central intention of this article is to shed some light on the question of how to identify the most effective incubator within a specific BI population. For this purpose, the "Preference Ranking Organization Method for Enrichment Evaluation" (PROMETHEE) is applied to a comparison of five technology-oriented BIs in Germany.

In the past, the neglect of a comparison of BIs effectiveness is mostly justified by the arguments that the business incubation industry is heterogeneous (*Allen and McCluskey* 1990; *Hannon and Chaplin* 2003) and that incubators are idiosyncratic with respect to, for instance, their regional context, underlying objectives or support components. This strand of research basically claims that BIs are too different to be comparable (see *Bergek and Norrman* 2008 for a recent discussion). However, in this article we argue, that despite apparent idiosyncrasies, a performance comparison of BIs should be possible given that the superior economic objectives of BIs and the basic ingredients of business incubation (e.g. limitation of incubation time, business assistance) are widely shared between most incubator organizations (*Bergek and Norrman* 2008; *Hannon* 2005). With respect to the German BI population, there are four major goals that all incubators have in common: promotion and support of new ventures, employment creation within a region, increasing the speed of technology transfer and facilitation of innovation activity. Therefore, assuming a sufficient homogeneity of the major goal categories of German BIs, the primary objective of this paper is to approach the unexplored area of BI performance comparisons.

To the best of our knowledge, this is the first time that outranking methods in general, and PROMETHEE in particular, are applied to the specific context of evaluation and comparison of incubator organizations. Since its initial development (e.g. *Brans and Vincke* 1985; *Brans, Vincke and Mareschal* 1986), by now the PROMETHEE approach constitutes a rather popular technique of multi-criteria decision making (see *de Keyser and Peeters* 1996 and *Macharis et al.* 2004 for an overview) that has been successfully applied in many fields, including supplier selection (*de Boer, van der Wegen and Telgen* 1998; *Dulmin and Mininno* 2003), outsourcing management (*Araz, Ozfirat and Ozkarahan* 2007), waste management (*Briggs et al.* 1990; *Rousis et al.* 2008), resources planning (*Abu-Taleb and Mareschal* 1995), or decision making in stock trading (*Albadvi, Chaharsooghi and Esfahanipour* 2007). One reason for its popularity among researchers and practitioners is the relative simplicity in conception and application compared to other methods for multi-criteria analysis. In case of incubator evaluation, public authorities, like for instance politicians and municipalities, might easily understand the underlying methodology regardless the knowledge they may have about it. Hence, it avoids a 'black box' effect because it allows for a participative role of the relevant decision makers. Particularly, in the field of BI evaluation where there is no clear understanding what the most appropriate measures of success are, multi-criteria outranking procedures, and especially the PROMETHEE method, may constitute powerful tools.

The paper is structured as follows. The subsequent section discusses core problems of BI evaluation studies and gives a short overview over performance criteria that are discussed in the literature. Section three briefly introduces the concept of outranking and presents the fundamentals of the PROMETHEE approach. Section four describes the data collection process and the basic characteristics of the five BIs. In a second step the evaluation criteria and their specification according to the requirements of PROMETHEE are described. The fifth section contains the application of PROMETHEE, presents the central findings as well as the results of a sensitivity analysis. The concluding Section 6 includes a discussion of the results and gives policy implications.

2 Performance Measurement of BIs and Implications for Assessment Frameworks

The basic ingredients of incubation processes have been listed and discussed in numerous studies (for example *Carroll* 1986; *Smilor* 1987; *Allen and McCluskey* 1990; *Mian* 1996; *Westhead and Batstone* 1998; *Thierstein and Wilhelm* 2001; *European Commission* 2002; *Abduh et al.* 2007; *Hytti and Mäki* 2007; *Schwartz and Hornych* 2008). In principle, business incubators offer three core support components. To summarize, first, BIs provide spatially concentrated, mostly low-priced and flexible rental space (office and manufacturing space, laboratories etc.). Collectively shared facilities and services (conference rooms, secretarial support, IT and presentation infrastructure etc.), charged through allowance or a moderate user fee, constitute the second element. Just like inexpensive rental space, these measure focus predominantly on the reduction of early-stage fixed costs, leading to economies of scale by means of shared operational costs. The third component comprises a variety of managerial services and business assistance, in fields such as marketing, accounting, human resources or legal matters. This also includes access to a wide network of specialized service providers, financial institutions (e.g. banks, venture capitalists), public and private research facilities (e.g. universities) and political institutions. The incubator takes the position of an intermediary, helping the tenants to establish formal or informal contacts and to gain access to resources and knowledge.

The first Sub-section 2.1 gives a short, and certainly not exhaustive, review of indicators that have been used in prior studies that try to measure the success/performance of incubation processes. Moreover, the main barriers that complicate processes of BI evaluations and comparisons are identified and discussed in Sub-section 2.2.

2.1 Review of the Literature on Performance Measures

Survival measures are one of the widely used indicators of incubator performance, since the promotion of survivability of tenant and graduate companies is one of the primary BI objectives (*McAdam and Marlow* 2007). For instance, building on survey data of UK science park firms from *Monck et al.* (1988), *Storey and Strange* (1992) investigate the survival of those firms originally interviewed by *Monck et al.* (1988) to evaluate the performance of these science parks. Using the concept of control groups, *Westhead and Storey* (1994) for UK science parks, *Ferguson and Olofsson* (2004) for science parks in Sweden compare survival/failure rates between firms located on these facilities and a control group of firms located outside those parks. Although, there are severe problems associated with survival/failure rates as variables of incubator/science park success, in particular with respect to a substantial selection bias (e.g. *Phan, Siegel and Wright* 2005), tenant firm survival is frequently used (e.g. *Aernoudt* 2004; *Aerts, Matthyssens and Vandenbempt* 2007; *European Commission* 2002; *Rothaermel and Thursby* 2005).

In recent years, there is also a growing number of studies that analyse the performance of BIs/science parks with respect to the growth of incubated firms and the respective value-added contribution of the supporting organization. Among the criteria that are most frequently employed in the evaluation literature are different measures of employment growth or jobs created (e.g. *Colombo and Delmastro* 2002; *Löfsten and Lindelöf* 2002; *Westhead and Storey* 1994), sales or profitability growth of tenant companies (*Hannon and Chaplin* 2003; *Löfsten and Lindelöf* 2002) and multiple indicators referring to innovativeness of incubatees. For example, *Colombo and Delmastro* (2002) investigate the innovative activity of firms located on/off Italien science parks based on various input and output measures (e.g. R&D intensity, patent activity). *Westhead* (1997) also uses several measures for evaluating innovative performance between tenant companies and off-park firms in UK science parks (e.g. R&D expenditures, patent or copyright applications) and *Squicciarini* (2008) examines patent activity in her evaluation of Finish science park firms.

There is also the tendency to evaluate BIs and science parks with respect to their ability to foster cooperative interactions, formal contract agreements as well as informal relationships, between the incubatees, or with respect to linkages to research organizations that are co-located (*Bøllingtoft and Ulhøi* 2005; *Rothschild and Darr* 2005; *Tötterman and Sten* 2005). These studies consider an efficient networking within the incubators as a critical success factor for incubation processes. Furthermore, incubators and science parks are evaluated in terms of promotion of networking arrangements to academic institutions, like universities or public and private R&D organizations (e.g. *Monck et al.* 1988; *Vedovello* 1997). Additionally, the degree of incubatees' satisfaction with the support elements and business assistance programmes provided by the incubator management is also considered to be an important dimension that reflects BIs effectiveness (e.g. *Abduh et al.* 2007; *Allen and McCluskey* 1990; *Hytti and Mäki* 2007; *Mian* 1996; *Westhead and Batstone* 1998).

Recently, *Hackett and Dilts* (2004; 2008) review some of the variables that are commonly used for evaluations of incubator/incubation performance and propose a taxonomy of five different incubatee outcome states in terms of survival, growth and financial performance (i.e. profitability) at the time when they *graduate* from the incubators. This taxonomy emphasizes the growing perception among researchers and practitioners that research on the success of incubated firms should not be restricted to their time in the incubators, but rather should go beyond their exit, which might provide insights regarding the overall usefulness of BIs (*Peña* 2004; *Rothaermel and Thursby* 2005). However, long-term performance evaluations including data on post-graduation firm development is rather limited, since there are deficits concerning systematically recorded data on formerly incubated firms (e.g. *Colombo and Delmastro* 2002). Some of the success criteria reviewed here are also included in the present study. The focus is clearly on performance data of formerly incubated firms.

2.2 Problems in Incubator Performance Evaluations – the Need for Multi-criteria Frameworks

Basically, there is a complex web of possible indicators available for an evaluation of a given BI. Nevertheless, the choice of appropriate criteria is far from being clear cut (*Hackett and Dilts* 2004; *Phan, Siegel and Wright* 2005). There is no consensus among researchers or policy makers regarding the most appropriate criteria to measure BIs performance. The majority of empirical studies base their assessment on one single or few indicators, given that, in many cases the available data does not allow for the consideration of multiple criteria. However, the employment of sole indicators is insufficient to capture the performance of BIs, since this may cover only one dimension of the complex support process. Moreover, this imposes boundaries to the explanatory power of the evaluation outcomes. For instance, with respect to venture survival rates as indicator for incubator success, it has also to be kept in mind that firms may induce improvements (e.g. on regional employment, improved competitiveness, acceleration of structural change), even if they fail (*Fritsch and Mueller* 2004), and therefore, survival rates alone (as any other indicator) may be unable to provide a complete picture of BI performance.

The requirement for multi-criteria analyses is further accentuated by the fact that, although the superior economic goals of BIs are widely comparable between most incubator organizations, the actual appropriateness of a particular indicator may vary between different locations (*Bergek and Norrman* 2008). For example, in so called high-tech regions where the support of technology-based firms and the commercialization of academic research might be the primary incubator objective, other success measures might be appropriate compared to incubators located in economically depressed or lagging regions, where the focus is more on general economic development processes (e.g. improvement of local business infrastructure, improvement of the general climate for entrepreneurship). These different priorities within the same superior goal categories also point to potential trade-off conflicts, meaning that some objectives might only be achieved by implicitly (or even explicitly) neglecting others. One could think of an incubator that reduces average incubation times, and therefore exhibits a high fluctuation and produces masses of graduates each year, but only few graduates survive after leaving the incubator facilities because of insufficient support during the incubation period. This implies that given the multiplicity of underlying objectives and a set of various measures that reflect different dimensions of incubator success, normally there is no single BI that can be considered effective regarding all relevant variables. According to *Bigliardi et al.* (2006, p. 499), the broad range of major BI objectives and the need to include a heterogeneous set of evaluation variables leads to a considerable complexity, which is the major cause for difficulties in developing rigorous evaluation approaches. *Bearse* (1998) suggests to develop a set of indicators that is appropriate to different kind of incubators. However, this has proven to be difficult in the past.

Even though, there would exist a generally accepted set of evaluation criteria, there is another problem because in most cases it is not possible or meaningful to define adequate target values for particular indicators. For instance, it is difficult to specify what survival rates after the graduation from the BIs are acceptable, how much graduates incubators should generate per year, or which growth rates (e.g. in terms of employment) are satisfying. For BIs there hardly exist sufficiently specified and quantifiable evaluation criteria. Neither incubator organizations, and their management respectively, nor local decision makers define such criteria. If anything, these are vague verbalized and therefore difficult to control retrospectively or on an ongoing basis. Although, first steps to develop an appropriate benchmarking framework for BI evaluations have been undertaken by the *European Commission* (2002), both researchers and local decision makers simply do not know the most suitable indicators and their respective target values. Considering this problem in particular, one major advantage of the PROMETHEE outranking method applied in this investigation shows up. For the evaluation, those benchmarking values need not to be defined, because the PROMETHEE algorithm takes into account the performance differences between the BIs, and does not measure the degree of goal-achievement with respect to specific target values.

The selection of performance measures is largely dependent on the actual unit of analysis. *Hackett and Dilts* (2004, p. 73) differentiate between six different units of analysis when measuring the success of BIs: i.) the community in which the incubator operates, ii.) the incubator as enterprise, iii.) incubator manager, iv.) incubatee firms, v.) incubatee management teams, and vi.) the innovations being incubated. Two broad categories can be derived: On the one hand, indicators are needed that reflect the success of BIs as organizations, their development and growth, their effectiveness to provide value-added support or their long-term contribution to regional development objectives (*incubator-level*). On the other hand, variables have to be considered that measure the success of the incubated ventures (especially after they graduate), and the impact of BI support on these development paths (*incubator-incubatee level*) (*Hackett and Dilts* 2004; *Voisey et al.* 2006). Although, there is a tendency in empirical studies to focus on the incubator-incubatee level, we argue that the assessment of BIs performance must necessarily include both of these evaluation levels.

These explanations clearly highlight the need for multidimensional evaluations of BIs that i.) do not base their judgements on one single or only few indicators, and ii.) that perform a combined examination of both the incubator level and the incubator-incubatee level. If available, a broad range of indicators should be used. Following this approach would not only reduce the danger of excluding valuable information, but also increases the explanatory power of the evaluation results. The present study fulfils both conditions, using a total of 12 evaluation criteria that cover the incubator as well as the incubator-incubatee dimension. However, comparing and ranking BIs' performance whilst taking into account multiple criteria is not straightforward.

3 Introducing Outranking Methods and the PROMETHEE Algorithm

3.1 Outranking Procedures

Given the insufficiency of applying one single performance criterion, we convincingly argue that evaluating the performance of a specific BI population can be treated as a multi-criteria decision problem. By definition, multi-criteria decision making refers to screening, prioritizing, ranking or selecting a set of alternatives taking account of usually independent and incommensurate or even conflicting decision criteria (*Belton and Stewart* 2002; *Vincke* 1992). However, it is this peculiarity of having to consider contradictory and incomparable criteria what in general makes evaluations in a multi-criteria environment intrinsically hard to solve. The evaluation procedure may become even more complicated if pertinent data on these criteria is unobtainable, incomplete or imprecise, contributing to uncertainty in decision making (*Chen and Hwang* 1992; *De Boer, van der Wegen and Telgen* 1998). In this context analytical decision support tools provide useful assistance to the decision-maker (DM), when resolving complex and often ill-defined multidimensional decision problems. The literature classifies several methodologies for multi-criteria decision aiding (see e.g. *Bana e Costa* 1990; *Vincke* 1992). At the core of the more classical approaches of decision support (e.g. AHP, MAUT) lies the idea that any given decision making situation can be modeled as an optimization problem. The proposed premises of rationality and perfect information, then, enable the DM to choose *the* optimum solution, that is the alternative that maximizes his utility.

A rather different approach is given by the concept of outranking. The point of departure of outranking procedures is the explicit recognition of the fact that most of the classical decision support tools are not capable to handle uncertainty or ill-determination (*Kangas, Kangas and Pykäläinen* 2001). Outranking methods, instead, respond to the imprecision of the data on which multidimensional decision making is mostly based through introducing probability distributions, fuzzy arithmetic and threshold values (*Fenton and Wang 2006*; *Mergias et al.* 2007). Unlike classical methods, outranking techniques do not presuppose the existence of a single best alternative that is to be sought. The solution of outranking algorithms rather reflects the notion of the most *acceptable compromise* with respect to the preference structure of the DM (*Brans and Mareschal* 2005; *Guitouni and Martel* 1998). The outranking concept is moreover build upon the principle of dominating and dominated alternatives. Therefore, outranking models proceed to a pairwise comparison of the alternatives regarding their performance on each single criterion (*Roy* 1991). Dominance occurs when one alternative performs better than another one on at least one criterion and no worse than the other on all other criteria (*Kangas, Kangas and Pykäläinen* 2001). Depending on the deviations between the performances of two alternatives, the DM will allocate a preference to the superior alternative or even possibly no preference if this deviation is considered negligible.

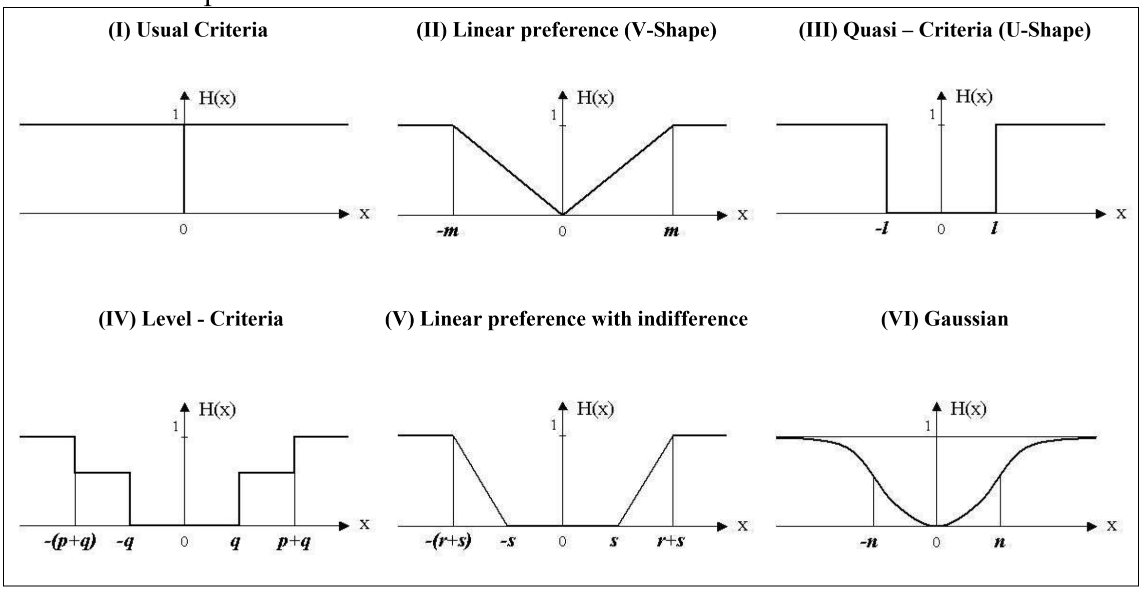
In an attempt to be closer to the bounded rationality of the DM and to more realistically model his preference structure (*Roy* 1996), the outranking school has extended the preference framework of classical decision support tools based on strict preference and indifference to introduce two additional relations, namely those of weak preference and incomparability. A particularly interesting feature of outranking models is the possibility for two alternatives to be classified as 'incomparable' or 'difficult to compare'. A relation of incomparability typically arises when the performances of two alternatives differ widely on a number of criteria with some criteria favoring one and some the other (*Brans and Mareschal* 2005). Incomparability is not the same as indifference and might be associated with missing information at the time the assessment of the alternatives was made (*Bouyssou and Perny* 1992). Given a real-world problem, the number of incomparable alternatives can be rather large. In these situations it is impossible to judge on any preference relation between two alternatives without additional information about the DM's preference structure. Such information may consist in subjective weights the DM assigns to each criterion in order to reflect the relative importance of a particular criterion to his decision (*Brans* 1996). However, accepting the possibility of incomparable alternatives within the mathematical structure of outranking allows analyses of multidimensional decision problems to continue without imposing a judgment of indifference which cannot be supported nor dropping an alternative entirely because of a lack of information. An outranking relation is finally given if the gathered preference information provides enough arguments to decide that one alternative is at least as good as another one, while there is no essential reason to refute that statement (*Belton and Stewart* 2002; *Brans and Mareschal* 2005).

3.2 The PROMETHEE Method

The PROMETHEE algorithm (**P**reference **R**anking **O**rganization **Meth**od for **E**nrichment **E**valuation) belongs to the wider family of outranking methods (*Brans and Vincke* 1985; *Brans, Vincke and Mareschal* 1986). It has been adopted for the purpose of this study because of its simplicity and its capacity to approximate the manner in which decision makers naturally form preferences when facing a multidimensional decision context. This method provides direct interpretation of parameters and a sensitivity analysis of the results (*Al-Rashdan et al.* 1999; *Goumas and Lygerou* 2000). The PROMETHEE algorithm starts with structuring the decision context (*Bana e Costa* 1997). This structuring enables the identification of a finite set $A=\{a_1,\ldots,a_i,\ldots a_m\}$ of alternatives to be evaluated and compared as well as the establishment of a set $F=\{f_1,\ldots,f_j,\ldots f_n\}$ of relevant criteria by which the evaluation will be carried out (*Bouyssou* 1990; *Brans and Vincke* 1985; *Roy* 1990). Both the alternatives and criteria can be expressed as $m \times n$ evaluation matrix, in which each row describes an alternative and each column describes the performance of the alternatives regarding each criterion (*Brans and Mareschal* 2005; *Roy* 1991). On the basis of the evaluation matrix, the alternatives are compared in pairs in order to determine how one is to be ranked relative to the other.

Therefore, a preference function $H_j(a_i, a_i')$ is introduced, which translates the deviation $x = f_j(a_i) - f_j(a_i')$ between the evaluations obtained by two alternatives a_i and a_i' on a single criterion f_j into a preference degree ranging from 0 to 1. The preference degree represents an increasing function of the observed performance deviation, which indicates that the larger the deviation, the larger the DM's preference for the superior alternative (*Brans and Vincke* 1985; *Brans and Mareschal* 2005). As illustrated in Figure 1, six basic types of preference functions H_j represented by specific shapes have been proposed by *Brans and Vincke* (1985) and *Brans, Vincke and Mareschal* (1986) that might cover most of the decision problems.

Figure 1
PROMETHEE preference functions



Source: Illustration IWH; based on *Brans and Vincke* (1985) and *Brans, Vincke and Mareschal* (1986).

The particular shape of the preference functions is dependent on two thresholds, in general denoted as Q_j and P_j. The indifference threshold Q_j indicates the largest performance deviation beneath which the DM is indifferent between two compared alternatives, while preference threshold P_j represents the smallest deviation which is considered as sufficient to generate a full preference (*Kangas, Kangas and Pykäläinen* 2001). Considering criterion V (Linear preference with indifference), for instance, Q_j is given by s and P_j is given by $(r+s)$.

Having defined a particular preference function for each single criterion, a multi-criteria preference index Π is calculated (see Equation 1):

$$\Pi(a_i, a_i') = \sum_{j=1}^{n} H_j(a_i, a_i')w_j \text{ and } \sum_{j=1}^{n} w_j = 1 \qquad (1)$$

The weighting factor w_j expresses the relative importance of the particular criterion f_j with $0 < w_j \leq 1$, so that $\Pi(a_i, a_i')$ also varies from 0 to 1. $\Pi(a_i, a_i')$ determines to what degree a_i is preferred to a_i' when considering simultaneously all criteria (*Albadvi, Chaharsooghi and Esfahanipour* 2007; *Brans, Vincke and Mareschal* 1986). On the basis of preference indices, the PROMETHEE algorithm proceeds with the computation of two preference flows for each alternative. The positive preference flow or 'outgoing flow' Φ^+ measures the outranking character of alternative a_i and indicates the degree to which a_i dominates the other alternatives (see Equation 2). Accordingly, the negative preference flow or 'incoming flow' Φ^- measures the outranked character of alternative a_i, thereby pointing to the degree to which a_i is dominated by the other alternatives (see Equation 3). While Φ^+ indicates the overall strength, Φ^- indicates the overall weakness of one particular alternative.

$$\Phi^+(a_i) = \sum_{\substack{i'=1 \\ i' \neq i}}^{m} \Pi(a_i, a_i') \qquad (2)$$

$$\Phi^-(a_i) = \sum_{\substack{i'=1 \\ i' \neq i}}^{m} \Pi(a_i', a_i) \qquad (3)$$

Determining incoming and outgoing flows for each alternative allows deducing a ranking of the alternatives. The PROMETHEE algorithm suggests two ways of how to specify a ranking order, that is a so-called *partial preorder* and a *complete preorder* (*Brans, Vincke and Mareschal* 1986). As a basic principle of the PROMETHEE I partial preorder, the higher the 'outgoing flow' and the lower the 'incoming flow', the better the alternative. Hence, alternative a_i outranks alternative a_i', if $\Phi^+(a_i) \geq \Phi^+(a_i')$ and $\Phi^-(a_i) \leq \Phi^-(a_i')$. Indifference among a_i and a_i' is given, if both preference flows are equal. However, in some cases the preference flows do not produce consistent information. It might be that 'outgoing flows' indicate a_i to be better than a_i', while the 'incoming flows' refer to the reverse. The particular alternatives are, then, suggested to be incomparable.

The PROMETHEE II complete preorder eliminates these incomparabilities by using the net preference flow Φ^n of alternatives. $\Phi^n(a_i)$ is given by $\Phi^n(a_i) = \Phi^+(a_i) - \Phi^-(a_i)$. Here, it is the balance between the 'outgoing flow' and the 'incoming flow', telling that the higher the difference between both, the better alternative a_i. In this sense, a_i outranks a_i', if $\Phi^n(a_i) > \Phi^n(a_i')$ and is indifferent to a_i', if $\Phi^n(a_i) = \Phi^n(a_i')$. PROMETHEE II provides a complete ranking of all alternatives from the best to the worst one (*Brans and Mareschal* 1994). The resulting information can though be more disputable because a considerable part of the relevant information gets lost when considering the difference term to calculate net preference flows. Knowing that, *Brans and Mareschal* (2005) recommend to apply both approaches in order to finalize a proper decision.

4 Data Collection and Input for PROMETHEE

4.1 Selection of Business Incubators

The central objective of this article is to perform a multidimensional comparison of the performance of five German technology-oriented business incubator organizations, and to identify a ranking order of these incubators according to the PROMETHEE outranking method outlined in the previous section. As it is increasingly being recognized in incubator/ incubation research, it is insufficient for incubator evaluations to be restricted to the initial incubation period (e.g. via cross sectional analyzes of current incubatees) (see e.g. *Hackett and Dilts* 2004; *Hannon and Chaplin* 2003; *Peña* 2004; *Rothaermel and Thursby* 2005). Therefore, input data for PROMETHEE was collected within the context of a research project that focuses on the long-term impacts of BIs on firm performance after the graduation from the BIs. Although, not all evaluation criteria (see Section 4.3) are based on graduate-specific data, in particular survival data and multiple post-graduation performance measures are used in order to account for firm development processes beyond incubation.

Table 1:
Main target groups and main objectives of the five business incubators

Incubator Organization (Year established)	**Main target group(s)**	**Main objective(s)**
Technology and Innovation Park Jena – TIPJ (1991)	Spin-offs from academic institutions/ local university; Technology-oriented new firms	Stimulation of entrepreneurship; Promotion of regional knowledge transfer; Strengthening regional cooperation
Technology and Founder Centre Halle – TGZH (1992)	Technology-oriented firms; Spin-offs from the local university	Stimulation of entrepreneurship; Promotion of regional knowledge transfer; Commercialization of academic research
Innovation and Founder Centre Rostock – RIGZ (1990)	Technology-oriented new firms; Spin-offs from the local university	Stimulation of entrepreneurship
Technology-, Innovation- and Founder Centre Neubrandenburg – TIGN (1990)	Technology-oriented firms; New firms	Stimulation of entrepreneurship; General local economic development; Formation of clusters
Technology Centre Dresden – TZD (1990)	New firms; Technology-oriented firms; Spin-offs from the local university	Stimulation of entrepreneurship; General local economic development; Promotion of regional knowledge transfer

Source: Authors personal interviews with BI management.

The aforementioned research project included a total of 410 graduate firms from the five German business incubation projects given in Table 1. Primarily, incubator selection for this study is based upon the age of the particular incubator organizations. A minimum operation time for BIs of at least 10 to 15 years is assumed to be essential to achieve reliable evaluation results (*Autio and Kauranen* 1992). All five BIs included in the investigation were established in the early 1990s and exhibit an operation time of at least 13 years, ensuring also that the incubators are sufficiently comparable in terms of age (indicating the degree of experience of the incubator management staff (*Peters, Rice and Sundararajan* 2004)). Additionally, all five incubators can be considered managed science parks with a full-time manager on site (*Westhead and Storey* 1994). As pointed out in the introduction, the superior economic objectives of the establishment of BIs in Germany are widely comparable between most incubator organizations (e.g. support of start-ups, employment creation, increasing the speed of technology transfer, facilitation of innovation activity), incubator-specific hierarchies of objectives may differ. Table 1 displays the main objective(s) and the main target group(s) of the considered BI population, according to the results of face-to-face interviews (based on a structured interview guide) conducted with the respective incubator management.

4.2 Data on Incubated Firms

The identification of all graduates from the incubators from commencement until December 31, 2006 was performed through cooperation with the incubator managements. Non-private graduates, like university institutions or offices from local development agencies, were not considered further. Overall, a dataset comprising 410 graduate firms, including independent single establishments as well as some subsidiaries, was obtained. On average, the graduate firms have left the incubator facilities since 5.3 years. The average firm age at the the reference date (December 31, 2006) is 11.6 years.

Data was collected by using firm-specific information from Creditreform primarily, which is the largest German credit rating agency and collects detailed up-to-date information on almost all firms in the German commercial register. Creditreform data are frequently used in studies on small firm growth and performance (see *Almus* 2002 for more details). From this comprehensive database we extracted the start-up date, ownership status, industry classification, exact date of deregistration of the business from the commercial register and current creditworthiness, as well as information concerning the contact details (address, phone/fax number, mail). Creditreform also provides data on employment and sales figures on an annual basis from the date the firm was founded. These data were also collected.

Because the quality of support during the initial incubation period is one important dimension to assess the success BI initiatives, additional data reflecting this aspect was collected for the surviving graduates. A standardized questionnaire was designed wherein the graduate firms that were identified as being still in business at the end of 2006 (decision based on Creditreform data according to the definition used by e.g. *Westhead and Storey* 1994) were asked to assess the value-added contribution of particular support components. Five-point-likert scales were used in order to measure the firms' perceived benefits, an approach commonly used in BI evaluations (e.g. *Löfsten* *and Lindelöf* 2002; *Westhead and Batstone* 1998). The questionnaire was sent to 216 surviving graduates in April 2007. With a second survey wave, we received a total response rate of 25%, meaning that 54 firms responded. In the analysis, four evaluation criteria ('Client satisfaction I-IV') are based on the assessments of the surveyed firms. A summary of the different stages of the data collection process is provided by Figure 2 below.

Table 2:
Summary Statistics and starting table for PROMETHEE

Evaluation Criteria f_j	Min/ Max	Unit	Criteria	Tresholds		**Business Incubator**				
				Q_j	P_j	TIPJ	TGZH	RIGZ	TIGN	TZD
Graduates per Year of Existence	Max	Number	II	-	2.7	7.1	4.8	4.4	5.3	5.7
Average Incubation Time of Graduates	Min	Months	V	12	24	45.0	32.5	41.0	36.6	56.9
Share of Start-ups	Max	Percent	II	-	34.2	60.9	45.3	71.7	64.3	37.5
Overall Survival[b]	Max	Percent	I	-	-	90.4	95.7	92.7	89.4	94.1
Share of High-Tech firms	Max	Percent	II	-	24	74.7	64.3	62.3	50.7	59.8
Client satisfaction I (rooms, rents)[a]	Max	Scale[c]	I	-	-	3.2	3.5	3.5	3.8	3.5
Client satisfaction II (shared services)[a]	Max	Scale[c]	I	-	-	2.9	3.7	3.9	3.8	3.4
Client satisfaction III (business assistance)[a]	Max	Scale[c]	I	-	-	1.3	1.4	1.4	1.3	1.3
Client satisfaction IV (networking)[a]	Max	Scale[c]	I	-	-	2.0	2.7	2.3	1.8	2.8
Post Graduation Employment Growth[a]	Max	CAGR	IV	4.4	8.8	- 1.7	0.7	6.2	2.3	7.1
Post Graduation Sales Growth[a]	Max	CAGR	IV	5.35	10.7	3.9	0.0	10.0	3.4	10.7
Creditwo[a]	Min	Index	II	-	17.3	261.7	264.0	261.6	256.4	246.7

Notes: The incubator that performs strongest on one particular criterion is highlighted in grey. [a] Only Survivors. [b] Measured in relation to all tenants since opening. [c] Median values.

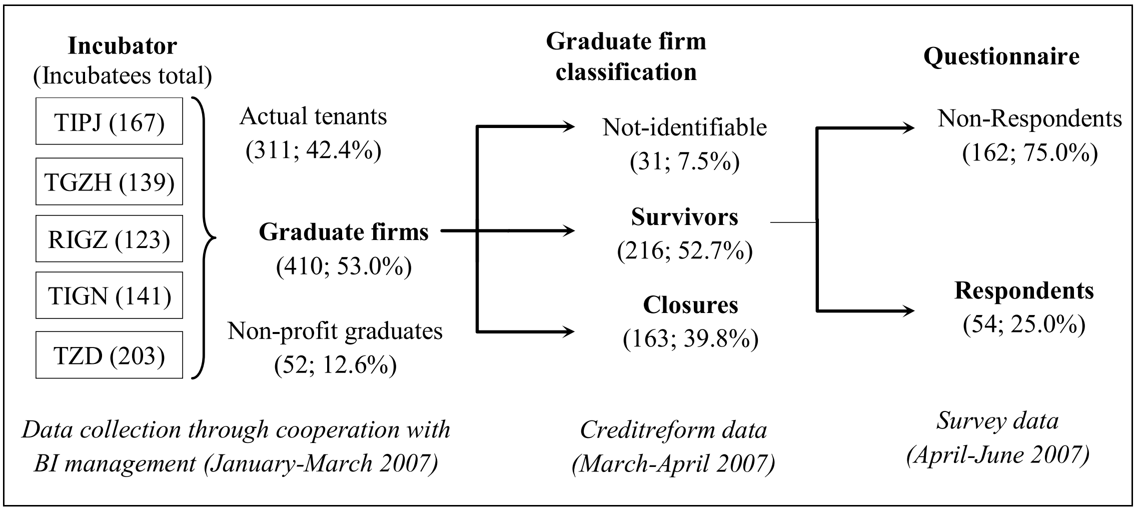
Source: Calculations IWH.

4.3 Definition of the Criteria, Preference Functions and Threshold Values

As has been detailed in Section 2, there is no generally accepted set of evaluation criteria that determine whether BIs can be characterized as being successful. Therefore, it was argued that, in order to perform comparisons between different incubator organizations, multiple criteria potentially reflecting/measuring the success of these policy initiatives must be included. Furthermore, it is important that incubatee-level indicators are considered along with incubator-incubatee-level indicators, since the neglect of one of these dimensions decreases the explanatory power of the evaluation results.

According to these requirements, overall twelve criteria were selected that seem suitable to compare the performance of BIs. These are explained below. The PROMETHEE outranking methodology that is applied in this article to compare five BIs requires the specifications of preference functions for each of the twelve evaluation criteria and, if necessary, the definition of particular threshold values (see Section 3). Based on theoretical arguments and prior empirical findings, it is also described which types of preference functions were chosen for the criteria and how the threshold values (indifference and preference) were specified. Table 2 gives an overview with respect to all relevant specifications for PROMETHEE and shows that there is no incubator performing best with respect to all or even the majority of evaluation criteria.

Figure 2
Overview over the different stages of the data collection process



Source: Illustration IWH.

4.3.1 Incubator-level Evaluation Criteria

The *average number of graduates per year* measures the overall effectiveness of the BIs with respect to the underlying incubator function and the acceleration in the entrepreneurial process (*Allen and McCluskey* 1990; *Peters, Rice and Sundararajan* 2004). Furthermore, a higher number of graduate firms reflects a 'healthy' fluctuation of new firms, meaning that more start-ups can be supported by the BIs, which contribute better to regional development objectives of BIs (e.g. *Thierstein and Wilhelm* 2001). To account for differences in incubator size and age, assuming that a larger and older incubator may produce more graduates, we employ a linear preference function (type II). The preference threshold has been chosen to be the maximum difference of the parameter values. This specification of preference thresholds is also used in *Kangas, Kangas and Pykäläinen* (2001). Another related criterion is the *average time in incubator* of graduate firms. Although, the length of incubation time is controversially discussed, it is a widely accepted performance measure in BI evaluations (e.g. *Rothaermel and Thursby* 2005; *Hytti and Mäki* 2007). Thereby, three to five years are considered to be an acceptable time span. Comparable to the argument above, shorter incubation times are considered to be indicators of the underlying incubator function. Because the incubator managements were also able to provide both the exact starting dates of the incubation period, i.e. the date the firms moved into the BIs, and the exact date of graduation from the incubators for each individual firm, precise incubation times could be considered in our analyzes. In order to capture, for instance, possible variations in BI graduation policies (some incubators might be less restrictive concerning maximum incubation times), a linear function with an indifference is used (type V), allowing for a difference in the criteria values of 12 months. Strong preference is reached, if this difference exceeds 24 months. Due to missing information regarding exact graduation dates, five firms could not be included.

Regarding the positive effects of newly founded firms (e.g. *Fritsch and Mueller* 2004), BIs act as catalysts to foster and support the formation of new ventures. Especially in less-favoured regions this motivation function is one of the main objectives of incubator initiatives (*Sternberg* 2004). For all five BIs included in this study, this is one of the major goals (see Table 1). Therefore, we calculated the *share of start-ups*, where firms with a maximum age of one year when moving in the BIs are considered to be newly founded. Overall 374 graduate firms were included in these calculations. With respect to different regional conditions (e.g. endogenous start-up potential), again a linear preference function is employed, with the maximum difference indicating strong preference. The *share of high-tech firms* is an important criterion to evaluate the technological competence or innovativeness of the tenant companies and therefore the intrinsic technological claims of German BIs. Following the definition of technology-intensive goods used in *Almus* (2002), we separate the graduate firms in high-tech and low-tech firms, according to the average R&D intensity of the corresponding industry (R&D intensity above 3.5% indicates 'high-tech'). Since this definition does not include service firms, we added knowledge-based services to the high-tech group (*Metzger, Niefert and Licht* 2008). A type II (V-Shape) function with the maximum difference indicating preference was chosen. Overall 359 firms were included.

4.3.2 Incubatee-level Evaluation Criteria

Abduh et al. (2007) point to the importance of *clients' satisfaction* when evaluating the effectiveness of business incubator programs. Also, several studies measure the value-added contributions of BIs via the incubatees' perceived benefits (e.g. *Westhead and Batstone* 1998). For the purpose of this study, four different variables were created that are based on survey-responses of 54 surviving graduate firms from the five BIs. In detail, graduates assessments refer to the basic elements of incubator support mechanisms: i.) spatially concentrated, low priced and flexible rental space (*Client satisfaction I*), ii.) collectively shared facilities and services (*Client satisfaction II*), iii.) managerial services and business assistance (*Client satisfaction III*) and iv.) providing access to a wide network of various actors, including specialized service providers, research facilities and political institutions (*Client satisfaction IV*). It is conceivable that the better these components match the needs of the tenant companies (and therefore increase their level of satisfaction), the more the development of the firms is positively affected. We employ linear preference functions for each of the assessment criteria with the maximum difference as preference threshold (type II).

One of the core arguments in favour of BIs is seen in the compensation of resource deficits of young and newly founded (innovative) firms in the early stages of their development to ensure entrepreneurial stability, sustainable economic growth and business survival. Because incubator firm survival is one of the most important success criteria, we neglect the possibilities of the PROMETHEE approach to construct indifference or preference thresholds and choose a usual criteria function (type I). This criterion, the *overall survival rate*, is based on all 773 firms that were incubated in the BIs since their establishment. Furthermore, to account for business performance after graduation we calculated the compounded annual average growth rates (CAGR) for employment and sales figures. Both growth measures were computed using the data of all surviving graduate firms for which employment/ sales figures were available for the year of graduation and 2006. *Post-graduation employment growth* is calculated using data from 128 graduate firms, *post-graduation sales growth* is calculated using data from 80 graduate firms. These growth measures seem appropriate in this context, because the length of the time span since graduation and therefore the time-dependent character of organizational growth is explicitly considered (see e.g. *Weinzimmer, Nystrom and Freeman* 1998). We applied a compromise-approach, choosing the level-criteria function (type IV). This allows for weak preference defined via a preference threshold that, according to *Araz, Ozfirat and Ozkarahan* (2007), is determined by the maximum difference of criteria values, and an indifference threshold, which is set to the half.

Moreover, a criterion reflecting the actual *creditworthiness* and solvency of the survivor firms (for a total of 198 firms this information was available) is included. This is of vital importance because most new or small firms exhibit huge development barriers due to financial constraints. Therefore, this indicator focuses on the reduction of financial barriers by the BIs (e.g. establishing contacts with financial institutions, image effects). The respective criterion is based on an index of creditworthiness provided by Creditreform which is composed of a variety of 15 firm-specific characteristics and potential risk factors (like firm age, order situation, productivity, balance sheet information, equity capital, payment history) that are rated, weighted and combined, taking values between 100 (best possible creditworthiness) and 600. For this criterion a linear preference function (type II) is used. The preference threshold, as already being specified for other criteria, is the maximum difference of the parameter values.

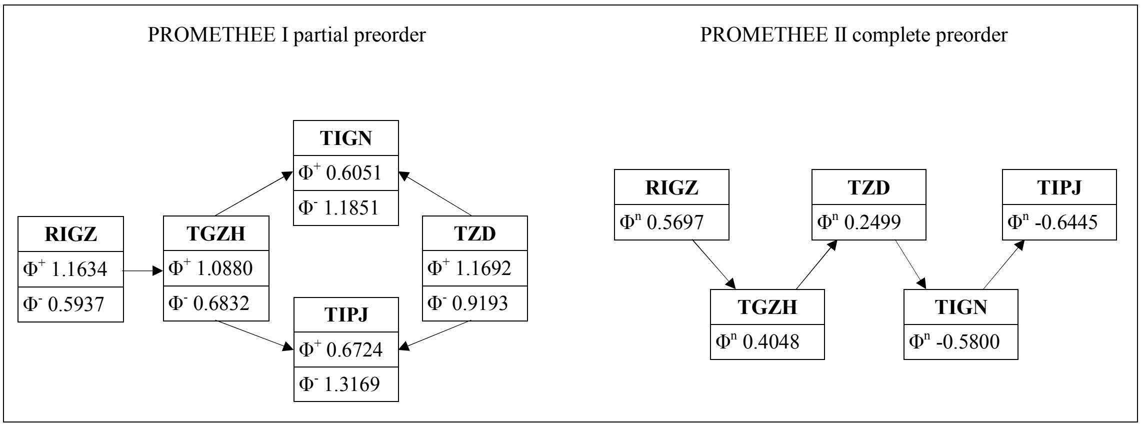
5 Applying the PROMETHEE Approach

This section presents the results of the application of the PROMETHEE technique. Whereas Sub-section 5.1 gives the ranking of the five incubator organizations according to the specifications described in the previous section, Sub-section 5.2 analyzes the sensitivity of these findings by modifying criteria weights.

5.1 Incubator Ranking

Using preference functions and threshold values detailed in Section 4.3, Figure 3 shows the PROMETHEE results of the pairwise comparisons, that is the ranking orders as well as the resulting preference flows for all five incubators. According to the 'incoming flow' Φ^-, the RIGZ and the TGZH show the lowest weakness, i.e. the degree of being dominated by the other incubators is comparably low. According to the 'outgoing flow' Φ^+, the TZD and the RIGZ exhibit the greatest strength, i.e. the degree of domination over the other incubators is relatively high. On the basis of both outgoing and incoming flow, first the dominance relations for the partial preorder of PROMETHEE I were derived. As Figure 3 shows, there exists some incomparability between the five BIs. While both the TIGN and the TIPJ are outranked by the other incubators, these two BIs are incomparable among each other. Following *Brans and Mareschal* (1990), incomparability results from the conjunction between strength and weakness (the 'outgoing flow' is not confirmed by the 'incoming flow'), meaning that the TIGN is strong on exactly those criteria, where the TIPJ is relatively weak and *vice versa*. Moreover, the RIGZ outranks the TGHZ and both incubators are incomparable to the TZD. Summing up, on the basis of the PROMETHEE I ranking order, no unambiguous decision can be made regarding which of the five incubators exhibits the best performance.

Figure 3
Business incubator ranking order according to the PROMETHEE algorithm



Source: Calculations and illustrations IWH.

Therefore, the PROMETHEE II complete preorder was computed through balancing outgoing and incoming flows (see also Figure 3). The net flow Φ^n is calculated (see Section 3.2), which leads to a suppression of incomparabilities and to a best-compromise solution. Although, PROMETHEE I might contain slightly more and also more realistic information (Macharis et al. 2004), the complete preorder particularly is useful to visualize the results from the algorithm within the context of public policy advice. Applying PROMETHEE II leads to the following outranking relation between the five German BIs: The RIGZ, which shows the second best 'outgoing flow' and the best 'incoming flow', consequentially ranks first and outranks the other incubators, followed by the TGZH and the TZD. The TIGN ranks fourth and the TIPJ has the lowest net flow and ranks last.

5.2 Sensitivity Analysis

In order to assess the robustness of the BI ranking order obtained by the PROMETHEE II algorithm, the influence of parameter variations on the final ranking results were tested.

In particular, problems arise due to the lack of knowledge about the appropriate weightings allocated to the different criteria. PROMETHEE does not provide specific guidelines for the determination of these weights. In the basis-version of the evaluation, equal weights (w_j = 1/12) were allocated to the criteria. Therefore, we investigated how sensitive the complete ranking order reacts dependent on variations of the individual criterion-weights. So called 'Stability Intervals' are applied to give the range for a single weight in which it can be varied, without causing changes in the ranking order (e.g. *Brans* 1996; *Dulmin and Mininno* 2003; *Albadvi, Chaharsooghi and Esfahanipour* 2007; *Rousis et al.* 2008). The more sensitive a particular weight, the more narrow the respective interval. Additionally, we calculated the change in the PROMETHEE II complete ranking order when the respective weight exceeds its lower interval bound/upper interval bound. Especially in the context of public policy advice, a sensitivity analysis of the criteria weights might prove to be beneficial. Weights reflect the priority the involved DMs, like for example politicians, municipalities and local development agencies, assign to each criterion. Given different aims, criteria weights may differ from one DM to another. Hence, manipulating the weights of the considered criteria in the context of a sensitivity analysis simulates diverse policy foci. Table 3 provides the results.

As can be seen from Table 3, the ranking order obtained in Section 5.1 seems to be quite robust with respect to variations of the weights allocated to the criteria. RIGZ always ranks first or second, whereas TIPJ is dominated by the other BIs in most of the scenarios. Even if individual weights change considerably (see 'Average Incubation Time of Graduates' or 'Client satisfaction II'), there is no considerable modification of the PROMETHEE II ranking observable. Taking into account the results this sensitivity analysis, it can be stated that the ranking of the five BIs is rather stable if different assumptions are made.

Table 3
Sensitivity analysis

Evaluation Criteria f_j	Stability Interval	**Change in PROMETHEE II ranking order when exceeding**	
		lower bound	upper bound
Graduates per Year of Existence	[0;0.1007]	R-H-D-N-J	R-H-D-J-N
Average Incubation Time of Graduates	[0.0344;0.2548]	H-R-D-N-J	H-R-D-N-J
Share of Start-ups	[0.0424;0.2435]	H-R-D-N-J	R-H-N-D-J
Overall Survival	[0.0064;0.1120]	R-D-H-N-J	R-H-D-J-N
Share of High-Tech firms	[0;0.0950]	R-H-D-N-J	R-H-D-J-N
Client satisfaction I	[0.0695;0.3372]	R-H-D-J-N	R-H-N-D-J
Client satisfaction II	[0.0700;0.3344]	R-H-D-J-N	R-H-N-D-J
Client satisfaction III	[0.0540;0.9999]	R-D-H-N-J	R/H-J/D/N
Client satisfaction IV	[0;0.1389]	R-H-D-N-J	R-H-D-J-N
Post Graduation Employment Growth	[0.0009;0.1368]	H-R-D-N-J	R-D-H-N-J
Post Graduation Sales Growth	[0.0186;0.1368]	H-R-D-N-J	R-D-H-N-J
Creditworthiness	[0.0430;0.1109]	R-H-D-J-N	R-D-H-N-J

Notes: R = RIGZ; H = TGZH; D = TZD; N = TIGN; J = TIPJ

Source: Calculations IWH.

6 Summary, Implications for Policy Makers and Future BI Evaluation Efforts

This article tries to shed some light on the question of how to identify the most effective incubator organization within a specific BI population. For this purpose, the PROMETHEE outranking approach from the field of multi-criteria decision making was used, which has already successfully proved its applicability and usefulness in various similar areas. On the basis of a unique data set on graduate firms from five German technology-oriented BIs, the comparison employing this method in conjunction with a sufficient number of success criteria yields evaluation results that are remarkably robust even if PROMETHEE assumptions are modified.

Although, admitting there are weaknesses regarding the method as well as the criteria used in this analysis (see the discussion below), this article shows the potential of the PROMETHEE outranking method not only for evaluation of BIs (or science parks) in particular, but also for public support programmes in general. With respect to BI evaluations, results of the application of PROMETHEE particularly might be useful as input or as starting point for a more effective allocation of public resources and subsidies. For instance, conducting such a performance comparison of a given BI population on a periodic basis (e.g. annual or bi-annual) creates a time series of evaluation results that not only provides rankings for each period, but that also provides more detailed information for policy makers regarding the dynamics of BI performance, that is how the ranking order has changed over time.

Nevertheless, in the context of business incubation research there is only vague knowledge concerning the most appropriate evaluation criteria. Even though this study uses multiple criteria to assess BIs' performance, not all dimensions could be included. For instance, data regarding innovativeness of the supported firms as well as the achievement of important regional development objectives (e.g. improvement of the general climate for entrepreneurship) were not collected, and therefore not explicitly involved in the comparison. For future work, not only we would like to strongly encourage other researchers applying outranking methods in BI assessments, particularly PROMETHEE, but we would also like to give the following two recommendations for future BI comparisons using PROMETHEE that seem important to us.

First, we strongly recommend allowing for a strong participative role of the relevant DMs. While some studies applying PROMETHEE undertake the approach of embedding experts in the relevant fields in defining relevant parameters (*Albadvi, Chaharsooghi and Esfahanipour* 2007; *Araz, Ozfirat and Ozkarahan* 2007), the choice of the preference functions just as the definition of threshold values is based on researchers decisions in our study. However, public authorities like cities, municipalities, local development agencies and other BI stakeholders should be included in the process of definition of parameters, thereby avoiding a black-box effect. At best, a large number of experts in the field of establishment, operation and evaluation of incubator organizations should be included, since preference structures may be different depending on the individual that expresses them. Is must become apparent for the DMs that it is not the method, or the algorithm in particular, which is responsible for the evaluation results, but their input and preference structures. Regardless as to whether preference functions are specified in isolation by researches themselves or by expert decisions is has to be kept in mind that there is no optimal configuration of the relevant parameters (*Kangas, Kangas and Pykäläinen* 2001). Since these specifications may strongly influence PROMETHEE results, it is reasonable to control for other possible specifications and their impact on the outranking results.

Second, the more criteria the more difficult is the specification of consistent weights for the DM. Therefore, *Roy* (1980) and *Brans and Vincke* (1985) recommend using equal weightings. However, a more appropriate method that accounts for DM's preferences would be a weighting according to the results of the 'eigenvector'-method (*Saaty* 1980). As for instance *Macharis et al.* (2004) suggest in a discussion and comparison of both outranking and Analytic Hierarchy Process (AHP), AHP features should be used for the determination of PROMETHEE weights. Using this method would ensure a fairly consistent hierarchy of the weights (see e.g. Butler et al. 1997 for other techniques of weight allocation). Again, this highlights the need for participation of DM in the process of evaluation.

To summarize, using PROMETHEE for incubator comparisons requires a set of incubators with sufficient homogeneity regarding major objectives, a set of multiple criteria that cover both incubator and incubator-incubatee dimension of BI performance and, finally, a strong participation of the local decision makers to avoid a black-box effect.

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