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# **A benefit segmentation approach for innovation-oriented university-business collaboration**

Tobias Kesting, Wolfgang Gerstlberger and Thomas Baaken

**Abstract:** Increasing competition in the light of globalisation imposes challenges on both academia and businesses. Universities have to compete for additional financial means, while companies, particular in high technology business environments, are facing a stronger pressure to innovate. Universities seek to deal with this situation by academic engagement, hereby providing external research support for businesses. Relying on the market segmentation approach, promoting beneficial exchange relations between academia and businesses enables the integration of both perspectives and may contribute to solving current challenges. Transferring the segmentation approach and the customer benefit perspective to university-business collaboration (UBC), this paper develops a multi-step segmentation framework aimed at identifying research customer segments in technical textile industries in Western Europe. This novel view helps to promote UBC and benefits both actors and society.

**Keywords:** university-business collaboration; academic engagement; universities; industrial enterprises; textile industries; market segmentation; benefit segmentation; innovation collaboration; inter-organisational collaboration; R&D; small and medium-sized enterprises

## **Biographical notes:**

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Thomas Baaken is a professor for marketing (specialising in industrial marketing, technology and innovation marketing as well as market research) at Münster University of Applied Sciences (MUAS). He holds a doctoral degree from FU Berlin and gained his habilitation for business administration (focus: marketing) from the IHI Zittau (now part of TU Dresden). He is the director of the Science-to-Business Marketing Research Centre (S2BMRC) at MUAS. The centre activities focus on applying marketing and technology management models and instruments to research commercialisation as well as developing and testing new models and instruments. His research areas are science-to-business marketing, knowledge and technology transfer, research communication and commercialisation and partner relationship management in university-business collaboration.

## **1 Introduction and objectives**

Inevitably fiercer competition in many sectors has been raising the need for continuous innovation (Martini et al., 2013; Michl et al., 2013) for both businesses and research organisations. The latter term serves as an umbrella term for universities and non-university research institutes (European Union, 2015). Environmental dynamics and influences (e.g. the Bologna process) have resulted in increased competition for financial means in academia and in a shortage of public funding. Hence, universities must intensify their efforts to access further financial supports for conducting sustainable research activities and ensuring their long-term existence (Kesting and Wurth, 2015; Lambert, 2003).

Increasing external orientation of universities is nurtured by the establishment of the so-called 'Third Mission' as the third core task in addition to teaching and research (Martinelli et al., 2008; Perkmann et al., 2013). This mission derives from the increased societal responsibility universities are expected to take on. Thus, universities are to forge stronger linkages to potential users of knowledge, as the dissemination of knowledge is crucial for a university's societal engagement, in particular its contribution to economic growth (Audretsch et al., 2002; Perkmann et al., 2013; Rothaermel and Ku, 2008).

Especially small and medium-sized enterprises (SMEs) rely on practically applicable knowledge from academia to deal with the pressure to innovate (Lambert, 2003; Metcalfe, 2000) in the light of globalisation impacts and rapid technological progress. Such academic engagement may take on many forms (e.g. contract and collaborative research) and bears considerable support potential for both actor groups to better deal with the challenges in their respective environments (Perkmann et al., 2013).

Particularly with respect to how university-business collaboration (UBC) is initiated, implemented and further developed, market orientation and marketing issues have been largely neglected so far. This concerns concrete measures to achieve third-party funding, in particular analysis of and communication towards potential business partners to ensure matching (Mindruta, 2013; Ylijoki, 2003). We consider this gap by providing a multi-step segmentation framework for UBC in technical textile industries to thus empirically identify characteristic research customer segments in these industries. As a starting point for the framework we transfer the concept of market segmentation to UBC. The contribution of this novel approach lies in fostering UBC in both theory and practical applicability, hereby integrating the perspectives of both academics and business practitioners as well as societal issues and implications. Such focus plays an essential role in alleviating the challenge for universities to identify appropriate companies for collaboration and vice versa. Following this premise and the idea of explicit customer segmentation in UBC, our main research question is:

***How can a basic segmentation framework for research customers be applied to textile-related industries?*** The sub-questions to be dealt with are: (i) Which company-related characteristics primarily influence the probability of collaboration? (ii) Which are the most important benefits perceived by companies with collaboration experience? (iii) How can companies with collaboration experience be differentiated into benefit-based customer segments?

We structure our paper as follows: Section 2 provides the theoretical and conceptual background for our study. Section 3 outlines the empirical procedure and is followed by the findings and discussion sections. The paper finishes with a conclusion featuring limitations and future research directions.

## **2 Theoretical and conceptual background**

### *2.1 Basics of UBC*

In consideration of the multitude of approaches to conceptualising UBC, we base our understanding on recent literature featuring newer terminology – namely entrepreneurial universities (systemic view) as well as academic entrepreneurship and academic engagement (process-oriented view).

The entrepreneurial university, a rather novel form of knowledge capitalisation, represents an underlying entrepreneurial ethos and spirit found among the university representatives, as well as the strategic conditions and embedment required for entrepreneurial activities (Etzkowitz, 2008). From a more systemic view, the term entrepreneurial ecosystem recently emerged in academic discourse. It represents a combination of elements which together “(...) turbocharge venture creation and growth.” (Isenberg, 2010, p. 3). Graham (2014) reflects upon university entrepreneurial ecosystems, i.e. constellations within and beyond the university, and discusses approaches for establishing an entrepreneurial agenda within universities (Graham, 2014). From a process-oriented view, more recent literature relies on the terms ‘academic entrepreneurship’ and ‘academic engagement’ (Perkmann et al., 2013; Urbano and Guerrero, 2013). The core issues of academic entrepreneurship activities are their innovativeness, the involvement of risk and the chance of financial rewards (Abreu and Grinevich, 2013). Taking on a more general view, Perkmann et al. (2013) use the term ‘academic engagement’, which they define as any knowledge-based collaboration of academics and external organisations. It is aligned with academic research and aims at accessing external funding and thus facilitating research activities (Perkmann et al., 2013). For the following reasons we base our research on UBC on a process-oriented view, namely in the sense of ‘academic engagement’: As our segmentation framework initially implies the question of how UBC can actually be initiated and implemented, academic engagement comprises a more general view that allows us to consider the multitude of UBC forms, including those without direct entrepreneurial focus. Indeed, UBC can arise in many different forms, such as e.g. contract and collaborative research and students’ final theses (D’Este and Patel, 2007; Hewitt-Dundas, 2012; Lambert, 2003). Initial UBC activities may begin shorter,

comprise less intensive, rather less entrepreneurial activities (e.g. a student's thesis in collaboration with a business) and gradually lead to a more intense collaboration in terms of content and duration (Dottore et al., 2010). Compared to direct commercialisation, academic engagement is more strongly linked to traditional research activities (Perkmann et al., 2013), hereby providing a better breeding ground for synergies and thus mutually beneficial outcomes (Mindruta, 2013).

The first critical question with regard to UBC is how university and business representatives get together to interact with each other. As this is a matter of “[t]wo-sidedness...” (Mindruta, 2013, p. 646), we have to consider both views.

Literature points to a significant potential for more UBC (Abreu and Grinevich, 2013; Perkmann et al., 2013). For better exploitation, collaboration first has to provide prospects for mutual benefit (Mindruta, 2013). Regarding academia, UBC may lead to third-party funding required for maintaining research activities and an increase in reputation (Abreu and Grinevich, 2013; Perkmann et al., 2013). With respect to the implementation of UBC from the perspective of academia, we have to consider that it is in fact the individual researcher who collaborates with businesses and decides for or against engagement (Azagra-Caro, 2007; D'Este and Patel, 2007; Mindruta, 2013). For companies, significant benefits comprise e.g. access to knowledge and technologies for innovations, process optimisation, networking opportunities or the employment of qualified university graduates (Lee, 2000; Amadi-Echendu et al., 2006; Hewitt-Dundas, 2012). Second, collaboration barriers may reduce the chances of securing beneficial outcomes. Third, transparency deficits regarding UBC may result in information deficits. Prior studies on the limits of UBC find that companies lack information on research organisations and often encounter difficulties in identifying the appropriate contact persons (Fransman, 2008; Hofer, 2007). Collaboration barriers in a more narrow sense comprise negative perceptions or even prejudices, such as the frequently mentioned ‘cultural barriers’ between academia and businesses (Arvanitis et al., 2008; Siegel et al., 2003).

Considering the limits of UBC, in particular the mentioned deficits regarding information and communication towards businesses, our research focuses on insufficient market orientation hampering the exploitation of UBC potential. Admittedly, the combination of market orientation, research and its funding is not free of controversies. Frequently mentioned concerns include the perceptions of an alleged shift from basic to applied research and a decrease in research quality and knowledge dissemination (Rosell and Agrawal, 2009). However, numerous empirically-based literature reveals evidence not supporting these

concerns at all, but instead finds contrary and synergetic impacts (e.g. Thursby and Thursby, 2011; see Wurth et al., 2015 for an overview).

According to a further unintended consequence, UBC may counteract academic freedom in such a way that business needs tend to largely influence and negatively affect the independency of research and research activities not aimed at direct practical applicability. This debate on academic freedom is a regular subject in UBC literature (Davis et al., 2011). However, given the mentioned need for increasing external research funding, UBC does not necessarily counteract the actual task of a university. In line with the social responsibility theory, academia is supposed to produce ‘public goods’ and thus contribute to societal welfare (Lee, 1996). Without financial means, many researchers would be unable to fulfil this task, as they could not afford the technical infrastructure, research equipment and personnel. In particular scientists engaged in applied research disciplines are in need of such resources (Lee, 2000; D’Este and Perkmann, 2011). In addition, UBC may be in accordance with a scientist’s own research foci (Perkmann and Schildt, 2015), entailing that UBC is partly perceived as favorable to academic freedom (Slaughter and Rhoades, 2004). Such congruence may eventually foster UBC and enable publications, ensuring that researchers benefit from synergy effects derivable from UBC (Lee, 2000).

Hence, although UBC engagement and academic freedom are not necessarily contradictory, we must acknowledge the limits; i.e. not all disciplines are suited for UBC. And not all researchers are willing to engage in UBC, just as a certain degree of blue-sky research is necessary and relevant in academia.

## *2.2 Market segmentation in UBC*

The identified insufficient degree of market orientation implies that a market actually exists, i.e. a constellation where demand meets supply and vice versa, so that exchange relations between parties may occur. Thus, we first have to clarify to what extent we can speak of a “... market for research ...” (Mindruta, 2013, p. 646) within UBC. Concerning UBC, Midruta (2013) refers to market-like exchange aimed at providing gains for the actors involved. According to this market perspective on UBC supply does exist, i.e. research competencies, capacities, results and a demand for R&D and innovation support (Lambert, 2003). In this market for research, research organisations compete for customers. It has a very heterogeneous structure as many differing sub-markets with specific competitive environments and further particularities exist. This requires market segmentation, which focuses on the heterogeneity of customer preferences (Green and Krieger, 1991) and has been

established as a fundamental issue in marketing literature (Kotler and Armstrong, 2014; Wedel and Kamakura, 2000).

Market segmentation comprises three steps – segmenting (S), targeting (T) and positioning (P). This so-called ‘S-T-P approach’ first aims at dividing up a total market and identifying clearly separable market segments (segmenting). Then follows the choice of the most attractive ones (targeting); i.e. suppliers should target segments promising the greatest sustainable customer values (Armstrong et al., 2009; Kotler and Armstrong, 2014). Finally, suppliers should elaborate strategies (positioning) for successful market cultivation within the chosen segments (Kesting and Rennhak, 2011; Kotler and Armstrong, 2014). Segmentation thus helps to analyse the structure to better understand specific markets, and it can be carried out in numerous forms (Kotler and Armstrong, 2014).

By linking both suppliers and customers, segmentation applies to the UBC research market context, provides the basis for and justifies our focus on both university and business perspectives. One particular form, the benefit segmentation approach, is well-suited to the market-oriented premise of our paper. Together with buying behaviour aspects, benefits are often regarded as the best basis for segmenting industrial markets (Kotler and Armstrong, 2011). Benefit segmentation was first discussed in the literature in the 1960s and relies on behavioural issues (Beldo, 1966; Wedel and Kamakura, 2000; Yankelovich, 1964). It takes the expected or perceived benefit as a starting point for the identification of segments, seeking to create ‘true’ market segments. The specific purpose of this approach is to identify segment-specific exploitable market potentials that can provide a basis for a strategically well-grounded marketing concept. This concept can in turn use segment-appropriate market cultivation to enable a better realisation of the main objectives (Frank et al., 1972; Haley, 1968).

In our context, benefit segmentation is in line with the claim for mutuality in UBC (Mindruta, 2013). Researchers striving to establish collaboration with businesses must take into consideration the desires and benefits of potential customers so that eventually both actors will benefit. Numerous UBC studies deal with collaboration motives or motivations (e.g. Arvanitis et al., 2008; Hofer, 2007). However, the actually perceived benefit is more precise than mere motives (‘benefit expectations’). Rather few studies focus on benefit (Abramson et al., 1997; Lee, 2000). In addition, empirical research seldom puts emphasis on market orientation issues (Ylijoki, 2003). Thus, market segmentation aspects have largely been neglected in UBC research so far. Additionally, as genuine market segmentation features a target group focus rather than a product focus, customers should form the basis for



segmentation activities. However, case studies on segmentation practice in markets with organisational customers reveal that product-based segmentation issues clearly remain relevant (Dibb and Simkin, 2001). The identified current lack of UBC research featuring benefit and market orientation and emphasis on product-based rather than target group segmentation provides the basis of our survey.

### *2.3 UBC segmentation framework*

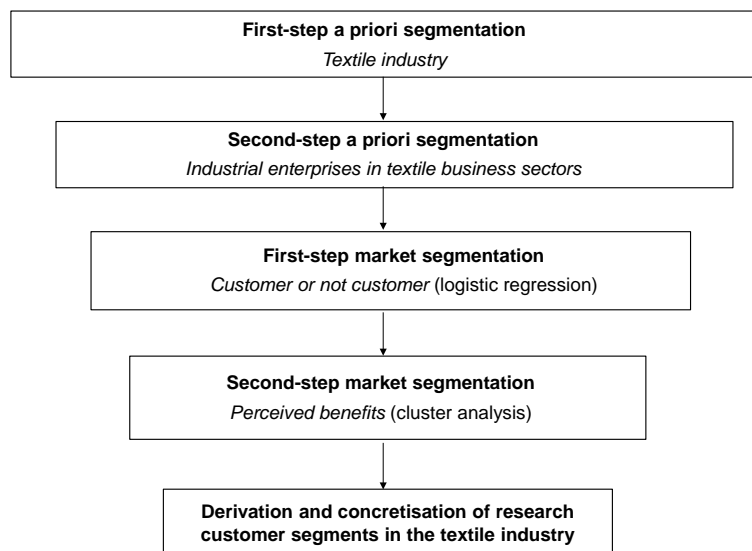
Based on theory and the subsequent considerations on UBC and market segmentation, we develop a segmentation framework for UBC in textile industries, which serves as the underlying procedure of the survey. As literature often suggests multi-step segmentation approaches for organisational customers, such as the concepts of ‘macro and micro segmentation’ (Wind and Cardozo; 1974) and the ‘Nested Approach’ (Bonoma and Shapiro, 1984; 1992), our framework also follows such a multi-step procedure.

The framework starts with an a priori segmentation, which considers certain criteria for differing customer needs (Green and Krieger, 1991; Lilien et al., 2007). This follows the basic premise of market segmentation: Specific industries feature customers with specific characteristics. As segmentation requires focusing on specific parts of a ‘total market’, we thus concentrate on a specific environment, namely companies from technical textile and textile-related industry sectors, for readability, henceforth labelled textile industries. Research support is particularly interesting to these companies, as continuous technological change and the relocation of production steps to low-wage countries are major concerns in textile industries (OECD, 2004). Hence, the rule that innovation is a crucial source of competitive advantage applies to a high degree to these knowledge-intensive, largely technology- and engineering-based industries (Stanislawski and Olczak, 2010). Textile-related innovations, e.g. textile-reinforced concrete, most often require both intersectoral collaboration and interdisciplinary research (Textile Research Council, 2009). This is particularly true for technical textile companies which work together with numerous other industries. Technical textile fields of activity comprise e.g. the production of textile-based materials for transport media and medical technology (Textile Research Council, 2009). These application areas are highly innovative (OECD, 2004; Textile Research Council, 2009) and primarily feature SMEs (Euratex, 2013; Eurostat, 2013; Stanislawski and Olczak, 2010). Typical academic disciplines linked to textile industries are engineering sciences, natural sciences and business sciences.

Regarding this sub-market, textile industries, we implement a second a priori segmentation step to consider differing customer prerequisites, attitudes and behaviour, hereby overcoming the diversity of the ‘total market for research service customers’. We differentiate between industrial enterprises and service and trading companies and reduce the population to companies featuring primarily or exclusively industrial production. This is necessary to avoid validity issues and difficulties in the segmentation process that would arise in case of too heterogeneous populations. E.g., the study focuses on UBC activities and collaboration benefits which are largely linked to manufacturing businesses, e.g. product/prototype development (see Section 3.1 for more details).

The third segmentation step aims at structuring the sub-market from the university researchers’ perspective by identifying the indicators for differentiating between companies with collaboration experience with research organisations and those without this experience.

The fourth segmentation step features benefit segmentation and thus considers that the evaluation of benefits requires collaboration experience. The framework, as illustrated in Fig 1, is to eventually derive and concretise basic research customer segments.



**Figure 1** Basic segmentation framework for UBC in textile industries

#### 2.4 Hypotheses development

Our hypotheses refer to the third segmentation step of the framework and aim at indicators of the UBC experience of businesses. The first hypothesis is adapted from Cassiman and Veugelers (2006) who find a positive correlation between company-internal R&D activities and the usage of external R&D support. Additionally, prior UBC studies reveal that potentially beneficial aspects of collaborating with externals are regarded as more important

by companies with internal R&D departments than by firms without internal R&D (Schartinger et al., 2001). We thus hypothesise that textile companies with R&D activities are more prone to collaborate with research organisations than companies without internal R&D:

**H1:** Textile companies with own R&D activities are more likely to have collaboration experience with external research suppliers.

Company size may also influence collaboration probability (Lambert, 2003). Several studies find that larger companies more often have UBC experience, and that those companies are more likely to collaborate with research organisations (Arvanitis et al., 2005; Capron and Cincera, 2003; Schartinger et al., 2001). Size is typically measured according to the number of employees within a company (Azagra-Caro, 2007). We rely on the ‘staff headcount’ (number of employees) classification of the SME definition established by the European Commission (EC). According to this definition, companies with less than ten employees represent micro enterprises (European Commission, 2015). Our second hypothesis is therefore as follows:

**H2:** Textile companies are more likely to have collaboration experience with external research suppliers if they are not micro enterprises.

As a third central aspect we focus on innovativeness. Findings from a German study show that almost all innovative companies receive innovation process support from external partners. A large number of innovative companies have collaboration experience with research organisations. Innovation collaboration is not necessarily limited to pure R&D projects though. It may also involve further research-based tasks, e.g. idea generation or test and inspection orders (Polt et al., 2009). In our study, innovativeness refers to self-evaluation by the survey participants regarding the degree of innovativeness of their company. We conclude:

**H3:** Textile companies are more likely to have collaboration experience with external research suppliers if they deem themselves innovative.

### **3 Data sources, collection and methods**

#### *3.1 Data sources and collection*

We conducted a web survey among companies from textile industries. Experts from these industries suggested focusing on specific UBC forms and manufacturing fields from 23 textile-related business sectors based on the internationally renowned and established Techtexsil classification of textile production activities (Techtextil, 2015). These sectors

represent the basic textile production processes. In addition to the core fields of technical textile production, such as industrial, construction and medical textiles, the population base as well features classical textile fields with nowadays advanced technological production processes, such as yarn fabrication, knitting and spinning. In total, this second-step a priori segmentation (Fig. 1) served to concretise and delimitate a population of manufacturing companies with a moderate degree of heterogeneity, in particular in terms of UBC forms and benefits. The experts helped to make sure that UBC forms, contents and benefits fit well, creating a larger population in a coherent transnational region noted for textile production and a segmentation basis which avoids additional challenges due to an increased degree of diversity among the target companies.

The selection of target companies within these 23 sectors followed the ‘concentration principle’, which is particularly suitable for special and limited studies. We applied it in such a way that the selection relied on the distinctive characteristics ‘predominantly manufacturing company’ and ‘availability of at least a general contact e-mail address’ (Hair et al., 2010). Following this, we used professional address databases and government data to retrieve contact information on 2,002 companies in Germany, Belgium and the Netherlands and sent out e-mail invitations to them. The comfortable navigation and structure of the web survey and reminder mails served as further measures to increase the return rate (Tourangeau et al., 2013). Before launching the questionnaire, we carried out a pre-test, which led to the elimination of a few items, several simplifications and an optimisation of the questionnaire structure. The sum of these steps assisted in increasing the content validity of our questionnaire (Hunt et al., 1982).

We eventually received 254 answers (12.7%). Given the considerably lower return rate of web surveys in contrast to e-mail surveys among professionals (Tourangeau et al., 2013), we deem this rate acceptable. The following findings are based on the 193 questionnaires (9.6%) that were completed sufficiently to conduct relevant analyses. A comparison with data from Euratex (2013), Eurostat (2015) and Amadeus (Orbis) shows that we can claim a good market coverage of the sample usable for our analyses. Considering recommendations regarding nonresponse bias (Armstrong and Overton, 1977; Atif et al., 2012), we also compared early and late respondents. This did not reveal any statistical differences between these two sub-samples and supports the assumption that our sample adequately reflects the market structure of the surveyed sub-market.

### *3.2 Methods*

The hypotheses developed in Section 2.3 will be tested by applying the logistic regression method ‘Enter’. It serves to identify the determinants of collaboration experience probability with external research suppliers (yes/no) focusing on a binary nonmetric dependent variable (Hair et al., 2010). Tables 1 and 2 provide an overview of the variables.

**Table 1** Dependent variable

	Variable name	N
The company has collaboration experience with external research suppliers (0 = No; 1 = Yes)	Collaboration experience	193

**Table 2** Independent variables as potential determinants of collaboration experience probability

	Variable name	N	Mean	Std. deviation
The company conducts own (internal) R&D activities (0 = No; 1 = Yes)	Conduction of own R&D activities	192		
Based on the headcount (European Commission): the company is a				
- Micro enterprise (1)	Company size	192		
- Small enterprise (2)				
- Medium-sized enterprise (3)				
- Major enterprise (4)				
Self-evaluation of company innovativeness (1 (= does not apply at all) to 10 (= fully applies))	Innovativeness	190	7.41	1.857

For assessing the goodness-of-fit of a logistic regression model we refer to the pseudo R<sup>2</sup> value of Nagelkerke and the predictive accuracy classification test of Hosmer and Lemeshow (Hair et al., 2010; Hosmer and Lemeshow, 2000).

The benefit segmentation as the second-step market segmentation (Fig. 1) is based on a cluster analysis. This analysis enables us to recognise patterns and identify a natural grouping of the companies (Hair et al., 2010). In preparing the analysis, we follow Milligan and Hirtle (2003, p. 175) who explicitly suggest not eliminating correlations between variables, as such elimination “would likely serve to distort or hide the structure in the data.” Having excluded both the observations with incomplete answers regarding perceived benefits and the outliers identified through a single-linkage procedure set up in advance, we carry out a hierarchical cluster analysis using Ward’s Method as a clustering algorithm and squared Euclidean distance as a distance measure (Hair et al., 2010).

As stated in Section 3.1, the benefit categories are mostly exclusively relevant for manufacturing businesses. They were derived and adapted from UBC literature to textile industries (e.g. Lee, 2000; Scharinger et al., 2001) and comprise benefits linked to innovation, market success and competitiveness. Our cluster analysis of these twelve benefit perception categories goes one step beyond traditional benefit segmentation as it is not

explicitly product-oriented but delinked from concrete products. It instead focuses on global benefit perception from a problem-oriented perspective.

## 4 Empirical findings

### 4.1 Descriptive findings

Most of the respondents are business managers (53.9%) and/or the proprietors (38.3%) of the companies in question. 85.4% of the companies have less than 250 employees and therefore represent SMEs according to the EC classification. A mere 14.6% of the respondents have 250 or more employees and are hence major enterprises (European Commission, 2015) (see Table 3).

**Table 3** Basic descriptive findings

Company size (headcount)	Share (%)	Own R&D activities	Innovativeness (average)	Collaboration experience	N
Micro enterprise	37.5	44.4%	6.97	20.8%	72
Small enterprise	32.3	54.1%	7.20	54.8%	60-62
Medium-sized enterprise	15.6	76.7 %	8.28	56.7%	29-30
Major enterprise	14.6	92.9%	8.14	92.9%	28
Total	100.0	59.4%	7.41	48.2%	190-193

51.8% of the companies have so far never had contact with research suppliers concerning concrete collaboration. We label them ‘non-research customers’ in the following text. As Table 3 illustrates, 48.2% of all respondents state that they already have collaboration experience with external research suppliers. Consequently, these companies can be regarded as ‘research customers’. Most of them indicate that the first contact aimed at collaboration is mostly arranged directly, i.e. either on behalf of the researcher or on behalf of the company representatives. Merely 13% of these companies respond that the contact is most often initiated by transfer intermediaries, such as university technology transfer offices (TTOs).

The research customers assessed twelve collaboration benefits (Table 4). The subsequent mean values are based on a 10-point rating scale (1= no or very low perceived benefit; 10= very high perceived benefit).

**Table 4** Perceived benefits from collaboration with research suppliers

Benefit aspect	Mean	StDev
<i>Mean values; Scale from 1-10 (1=lowest benefit value; 10= highest benefit value)</i>		
Acquisition of new knowledge	6.91	2.172
Product optimisation	6.14	2.382

Improvement of innovative ability	6.00	2.467
Development of partnerships and networks	5.86	2.628
Maintenance/improvement of competitiveness	5.74	2.457
Acquisition of new technologies	5.58	2.700
Process optimisation	4.75	2.502
Better understanding of the market	4.25	2.418
Reduction of research risk	4.10	2.612
Service optimisation	4.06	2.341
Cost reduction	3.74	2.351
(Potential) recruitment of qualified graduates/doctoral candidates	3.29	2.491

In the sense of market-oriented UBC, the benefits perceived by companies can be seen as the core issue of successful collaboration. The acquisition of new knowledge is the most relevant benefit (6.91), followed by product optimisation (6.14) and improved innovative ability (6.00).

#### 4.2 Hypotheses testing

Carrying out the logistic regression for hypothesis testing, Nagelkerke as a pseudo  $R^2$  measure has a value of 0.412, which can be regarded as acceptable (Field, 2009; Frenzen and Krafft, 2008). Concerning the predictive accuracy, the classification test (Hosmer and Lemeshow, 2000) leads to a chi-square value of 9.166 at a significance level of 0.328. A low chi-square value and a low significance level strongly imply that differences between observed and calculated frequencies do not arise more frequently than by chance (Field, 2009). The predictive accuracy (Table 5) indicates a good hit ratio of 74.1%; i.e. almost three out of four cases are classified correctly as ‘research customers’ and ‘non-research customers’, respectively (Hair et al., 2010).

**Table 5** Classification matrix

	Predicted collaboration experience		Percentage correct
	No	Yes	
Observed coll. experience			
No	77	20	69.4
Yes	29	63	78.5
Overall percentage			74.1

As illustrated in Table 6, the model shows significance for the independent variables ‘conduction of own R&D activities’ ( $p = 0.000$ ) and the ‘company size’ ( $p = 0.000$  for both small and major enterprises;  $p = 0.01$  for medium-sized enterprises), whereas ‘innovativeness of the company’ is not significant ( $p = 0.425$ ).

**Table 6** Regression model: determinants of collaboration experience probability

Variables	Coefficient ( $\beta_j$ ) & significance	Exp (B)	Sig.
Innovativeness	0.082	1.086	-
Small enterprise	1.635	5.127	*** Sig. $p \leq 0.001$
Medium-sized enterprise	1.309	3.703	** Sig. $p \leq 0.01$
Major enterprise	3.355	28.642	*** Sig. $p \leq 0.001$
Conduction of own R&D activities: Yes	1.410	4.097	*** Sig. $p \leq 0.001$
Constant	-2.701	0.067	*** Sig. $p \leq 0.001$

Pseudo-R<sup>2</sup> Nagelkerke = 0.412

Valid N = 189

Our findings show that both internal R&D activities and a large(r) company size positively influence the probability of collaboration experience with external research suppliers. These results clearly support H1 and H2.

#### 4.3 Benefit segmentation

The hierarchical cluster analysis of benefit perceptions is based on 72 cases and reveals three clusters. We label the identified clusters, i.e. market segments, as follows:

- **Cluster 1** (n = 25): Segment 1: ‘Low UBC Affinity’ (Smaller product- and research-oriented companies)
- **Cluster 2** (n = 32): Segment 2: ‘UBC Energetics’ (Larger ‘UBC-active’, research- and innovation-oriented companies)
- **Cluster 3** (n = 15): Segment 3: ‘UBC Potentials’ (‘UBC-passive’, smaller and less research-oriented companies)

The Kruskal-Wallis test leads to significant results, indicating that the three clusters are differentiable. We applied this test as a non-parametrical alternative to ANOVA, as the



sample data are not distributed normally. Tables 7 to 9 feature the most important characteristics of the three identified customer segments in textile-related research markets.

**Table 7** Segment 1: ‘Low UBC affinity’

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**Segment 1 ‘Low UBC affinity’**

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- Main benefits from collaboration: acquisition of new knowledge (7.72 mean value), improvement of competitiveness (6.36), product optimisation (6.24), improvement of innovative ability (6.20)
- 80.0% SMEs; main fields of activity: industrial textiles, machine construction, and furnishing textiles
- 84.0% conduct own R&D activities, but only slightly more than 50% with own R&D department
- Active information behaviour; main sources of information: Internet, trade journals, and colleagues/recommendations
- Particularly interested in the development of new materials, machines and components, product innovation workshops, the development of components or textile surfaces and raw material and energy efficiency
- Intensive own initiative with regard to first contact with research organisations
- Main type of collaboration partner: non-university research institutes
- Most common forms of collaboration: product/prototype development; seldom student-based forms
- Specific focus on written process components (e.g. non-disclosure agreement); post-transfer services (e.g. employee training, support) are less relevant

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**Table 8** Segment 2: “UBC energetics”

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**Segment 2 “UBC energetics”**

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- Main benefits from collaboration: acquisition of new knowledge (7.88), development of partnerships and networks (7.84), improvement of innovative ability (7.72)
- Almost 36% major enterprises; main fields of activity: industrial textiles, weaving mills, and furnishing textiles
- > 84.0% conduct own R&D activities, more than 70% with own R&D department
- Very active information behaviour; main sources of information: Internet and trade journals
- Particularly interested in the development of new materials, product innovation workshops, and process and quality optimisation
- Very intensive own initiative with regard to first contact with research organisations
- No clear focus on a specific type of research organisation
- Most common forms of collaboration: product/prototype development, students’ final theses and projects, basic research
- Frequently expect post-transfer services

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**Table 9** Segment 3: ‘UBC potentials’

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**Segment 3** ‘UBC potentials’

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- Main benefits from collaboration: product optimisation (4.60), acquisition of new knowledge (4.47)
  - 80.0% SMEs; main fields of activity: industrial textiles, construction textiles and textiles for airplane construction, ship construction, automobile and aerospace
  - > 70.0% conduct own R&D activities, but only slightly more than 50% with own R&D department
  - Rather passive information behaviour; main sources of information: trade journals, fairs/exhibitions, and colleagues/recommendations
  - Particularly interested in the development of new materials, machines and components, and process and quality optimisation
  - Poor own initiative with regard to first contact with research organisations
  - Main types of collaboration partners: universities of applied sciences and universities
  - Most common forms of collaboration: product/prototype development, students’ final theses and projects
  - Often desire post-transfer services (e.g. employee training, support)
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## **5 Discussion**

Our findings from the second-step a priori segmentation support two of the three hypotheses we elaborated in Section 2.4. The logistic regression suggests that a larger company size and the conduction of own R&D activities are the most relevant factors influencing the probability of collaboration experience with external research suppliers. Non-micro enterprises with internal R&D activities turn out to be considerably more likely to have collaboration experience with research suppliers than others. These two aspects seem to be highly relevant factors when it comes to collaborating with research organisations. A critical size is thus plausible as collaboration with externals requires personnel capacity. Own R&D activities, as the second indicator for collaboration experience, seem to help with overcoming ‘cultural barriers’ (see Section 2) and to nurture better mutual understanding among science and business actors (Barnes et al., 2002). To sum up, these findings on companies with UBC experience basically confirm the results of comparable studies on companies’ collaboration experience with research organisations (Blume and Fromm, 2000; Corsten, 1987).

Acquiring new knowledge, optimising products and improving the innovative ability turn out to be the most important benefit issues for research customers. This supports the high relevance of external innovation and technological support in a market environment featuring a multitude of high technology SMEs.

Considering all this, we take a closer look at the segments identified via the benefit-based cluster analysis. We find that Segment 1 companies ('Low UBC affinity') particularly benefit from acquiring new knowledge and further innovation-based outcomes, such as improved competitiveness, innovative ability, product optimisation and new technologies. These companies feature a strong innovation and technology focus. They tend to collaborate with non-university research institutes rather than with traditional universities or universities of applied sciences. Segment 2 ('UBC energetics') and Segment 3 companies ('UBC potentials') differ with regard to the perceived benefits. The combination of the main benefits of Segment 2 features a strong inter-organisational and communication focus, which is highlighted by a strong emphasis on the development of partnerships and networks and the perceived improvement of the innovative ability. Segment 3 companies reveal a rather general combination of the perceived main benefits, namely product optimisation, acquisition of new knowledge and the development of partnerships and networks; yet all benefit perception values are on a rather low level. Both Segment 2 and Segment 3 companies are very prone to student-related collaboration forms and are therefore more accessible for universities as research suppliers, particularly regarding the integration of students in transfer activities. This supports the claim for a better integration of UBC and academic education (Rampersad, 2015). Hence, both segments feature a high UBC affinity. According to the 'Targeting' step of the S-T-P approach, Segments 2 and 3 are most attractive for universities in terms of collaboration contents and forms. Universities should therefore target these two segments, as they show the most potential for more intensive UBC. The decision to focus on Segment 2 seems plausible at first glance, but the choice to target Segment 3, instead of Segment 1, must first be explained. Following Kotler and Armstrong (2014), this can be justified with synergy effects regarding the customer structures and needs of Segments 2 and 3. Particularly with respect to resource constraints and a step-by-step procedure for entering the market, it does make sense to target Segment 3, as it is considerably more accessible for universities than Segment 1. It is hence no contradiction to implement a step-by-step segmentation procedure for such reasons (Kotler and Armstrong, 2014) and possibly target Segment 1 later.

'Positioning', the third S-T-P step, deals with the most profitable cultivation strategies regarding the prior targeted segments. This means developing segment-specific marketing mixes for each chosen segment to fully implement a genuine market segmentation. Further segment-describing variables give us indications here. Concerning contact with research suppliers, Segment 3 companies are rather passive and rarely actively initiate contact with

research suppliers. They usually have experience with few UBC forms and perceive lower benefits from collaboration with research suppliers. It is appropriate here to focus on an increase in individual benefit issues and less intensive collaboration forms with student involvement. In this respect, it is important to clarify benefit expectations in advance and try to achieve a high fulfilment of these expectations. Universities should proactively initiate contact to these companies and emphasise personal contact establishment. However, Segment 2 companies are fairly active with regard to contact initiation and information behaviour. They are interested in many research topics and have experience with many UBC forms. Thus, initial communication towards Segment 2 customers could e.g. be done via the Internet, which represents the most important source of information for these companies. Furthermore, due to their active involvement in research-based collaboration, they seem to be more open-minded and interested in many collaboration forms and contents. This openness furthermore implies considerable potential for more complex and extensive UBC forms and contents. The fact that more than two thirds of Segment 2 customers have their own R&D departments underlines this potential. Considering the premise of market-oriented UBC in the form of a service process with intensive customer integration and with respect to the complexity of research-based collaboration, regular communication is to be regarded as the key factor for cultivating both Segments 2 and 3.

Furthermore, the study finds that initial contact between research organisations and companies typically occurs directly. Hence, such communication should take place on behalf of the researchers themselves and not through intermediary organisations. Gibb et al. (2013, p. 25) state that entrepreneurial universities typically feature “(...) a strong bottom-up development and initiative focus (...)”. As described in Section 2, the researchers themselves decide to engage in UBC and should therefore seek contact to and communication with companies. As the implementation of UBC is usually initiated at the individual researcher’s level, the applicability of the segmentation approach is not directly linked to general characteristics of a university, such as size, research engagement etc. In sum, all this strongly points to initiating the implementation of the segmentation approach by the professors and their research groups. Regarding UBC engagement in general, the size of a research group in terms of employees and resources partly influences such activities with respect to their extent and complexity. Typically, first and smaller UBC forms, e.g. student theses, are carried out on the individual level. In case of larger projects, such as contract research, two or more university institute directors may collaborate (Dottore et al., 2010). Given potential constraints concerning manpower, university TTOs can provide administrative and

coordination support services (Brescia et al., 2014) for an effective and efficient implementation of the segmentation.

The segmentation procedure fits particularly well with the role of universities as a source of highly qualified graduates and knowledge spillover (Rothaermel and Ku, 2008). One particular novelty of our approach is that it does not focus on product-related benefit issues, but regards UBC from a problem-solving approach linked to overall collaboration-related benefit issues, which are less product-specific, but include the whole collaboration relation as such. From an overall point of view and in the sense of the ‘Third Mission’, such segmentation procedure serves as a synergetic approach to better coping with the current challenges of academia and businesses.

## **6 Conclusions**

This paper transfers market segmentation to a UBC context. We propose a benefit-focused, multi-step segmentation concept for a technology- and engineering-based research market environment. In view of the predominant need for external funding to finance the resources required for conducting applied research (see Section 1), the segmentation provides a valuable approach to intensify academic engagement.

As found by Lam (2011), funding and other research resources serve as the core motivators for UBC engagement. External funding can at the same time provide valuable synergy effects, e.g. with respect to achieving research goals in the line of academic freedom and eventually gain reputation among peers. Willingness to engage in UBC is a crucial prerequisite for a better exploitation of existing potential with regard to mutual benefits of the actors, such as fostering inter-organisational linkages and applied research and to societal prosperity.

Implementing the segmentation concept requires some preparatory work. To better deal with the specific objectives of individual researchers and to help establish implementation procedures, we propose a partly decentralised approach that is supported and coordinated by TTO services. TTOs can partly take over tasks such as gathering information at a relatively early stage, technically implementing the segmentation, and establishing and maintaining the database. As UBC activities are sometimes very specific, i.e. bound to the competencies, interests and motivation of individual researchers, the building of trust and subsequent intensification of the UBC activities typically takes place on the researcher’s level. Hence, direct personal interactions between universities and businesses should still be done by the researchers themselves.

In addition, the university's top management may provide very helpful support by communicating research services to potential customers. In this respect, a transfer and context-based adaptation of student recruitment marketing and communication measures to UBC engagement, e.g. on the university website, may be a useful amendment to the bottom-up approach, directly support researchers and help to proactively inform companies about opportunities for collaboration and support activities. Research communication on behalf of the university or faculty management can be fruitful to directly support the UBC engagement of individual researchers. We recommend the implementation supported by the segmentation procedure as a template for collecting information on companies as potential collaboration partners and identifying specific benefit profiles. Following this, workshops tailored to the selected companies could be arranged. Table 10 illustrates the core responsibilities, indicated by number of asterisks, regarding the implementation of the segmentation.

**Table 10** Implementing the segmentation within universities

<b>Tasks and activities</b>	<b>Researcher/chair</b>	<b>University TTO</b>	<b>University/ faculty management</b>
Segmentation strategy elaboration	***	*	
Preparation and data collection	*	***	
Technical implementation		***	
Application	***		
Maintenance	**	***	
Direct interactions with businesses	***		
Website communication	*		***

\* = low responsibility; \*\* = medium responsibility; \*\*\* = high responsibility

The segmentation helps with initiating collaboration or with intensifying existing first collaboration steps to extend UBC activities. In other cases, e.g. if a researcher's focus is not suited to UBC or in cases where a researcher personally does not want to collaborate with businesses, the approach is not well-suited. In this respect, it is not aimed at reducing basic research without practical applicability, but instead seeks to promote applied research for a better exploitation of existing UBC potential. This paves the way for a constructive and synergetic coexistence of blue-sky and applied research (e.g. Poyago-Theotoky et al., 2002). Our research has limitations though. The findings are limited to manufacturers in textile industries. However, this limitation is plausible, as only segmentation steps in the form of a priori segmentation allows researchers to focus on a relatively homogenous sub-market and on the specific research support needs of companies in this environment. This prerequisite became even clearer in the last segmentation step (see Fig. 1), which we based on specific customer benefits specifically adapted to the prior defined sub-market. In addition, the geographical focus merely covers one area in Western Europe.

Future research on market-oriented UBC and research market segmentation should examine the inductive transferability of this multi-step approach to other sub-markets for research. For further studies, the segmentation step focusing on differentiation could integrate further relevant aspects regarding collaboration experience. Additional research could aim at refining and specifying concepts for even more detailed segmentation schemes, and could further investigate the supporting role of TTOs in this process. A concrete research direction concerns the transferability of our framework to non-industrial sectors. This would require a partial adaptation of collaboration forms and benefit issues. Future research on segmentation issues should focus on benefits of collaboration for research customers, as well as on the outcomes of differentiated segmentation approaches that seek to better exploit UBC potential. In this respect, a dyadic study could help measure the synergy effects derivable at universities, e.g. the impact of UBC on teaching quality (Perkmann et al., 2013).

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