Evaluation of the Impact of e-Services on Enterprise Broadband Demand in the German Market

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Abstract: The worldwide broadband penetration and internet usage are increasing. However, often the research regarding the demand for a better broadband availability and higher broadband connection speeds focuses on private households, whereas the need for higher bandwidths of enterprises is mostly unconsidered. Although some market overviews also consider the broadband requirements of enterprises, the research lacks a study with a clear focus on the broadband market of enterprises in Germany. To increase the research-based knowledge about the needs of enterprises regarding the usage of broadband connections, a survey of enterprises in Germany (with focus on the Rhine-Main area) has been performed. To strengthen the insight about the impact factors for the use of higher broadband connection speeds, elements like e.g. the expected performance or price-performance ratio will be analyzed by means of the "Unified Theory of Acceptance and Use of Technology 2". The first results of the survey indicate that the main drivers for internet usage of enterprises are the availability of higher connection speeds in combination with better price-performance-ratios.

1 INTRODUCTION

On the base of an upcoming digitization of workflows and an increasing linkage between different enterprise locations and between enterprises and customers in the virtual world, the broadband provision and the availability of high broadband connection speeds get more and more important for enterprises in the business and industry sector (vbw 2018). Since the availability of broadband accesses is a key factor for enterprise and private household settlement, the broadband network coverage needs to be comprehensively (Briglauer, 2014; Guenach et al., 2011; ITU, 2014a; Koutroumpis, 2009; Monopolkommission, 2011; Picot and Wernick, 2007).

Due to the high economic significance of a sufficient broadband provision for enterprises, a situation analysis about the current broadband provision of enterprises is necessary. In this context, an online survey was conducted to find out how the current broadband needs of companies in Germany (with focus on the Rhine-Main area) will be met and what the future broadband needs of companies will look like. In addition, information about the usage of broadband internet services and the potential willingness to pay for higher bandwidths will be also collected by the survey. The main aim is to identify if enterprises “suffer” of low broadband connection speeds or an insufficient broadband network coverage in their delivery of their services and products.

Therefore, the paper is structured as follows. After the introduction, the second section covers the literature review. Here, the first subsection contains an in-depth definition of broadband. The second subsection of the literature review considers the differences between the broadband demand of enterprises and private customers. The following subsection builds the theoretical base of the model by considering the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and their model adjustments, which would be needed for the development of the three research hypotheses of this study. In the fourth subsection of the literature review indicators and drivers of broadband demand for private customers and enterprises are discussed. Based on the structure of these four subsections, the next section presents the methodology and research

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approach of the study. Section 4 contains the data analysis and the main results of the survey. In the fifth section, the results will be discussed briefly and the further research options will be introduced.

2 LITERATURE REVIEW

2.1 Definition of Broadband

In general, "broadband" is defined as an uninterrupted access to a great number of services to achieve a specific fast connection speed (Picot and Wernick, 2007). Here, a specific connection is named broadband when the connection reaches a faster speed than the delivered one of the Integrated Services Digital Network (ISDN) technology. In the past, broadband is stated if connection speeds of 256 kbps and more are delivered by the internet access (OECD, 2002, ITU, 2006, p. 21). Due to the increase of broadband demand, the minimal connection speed for the identification of broadband would be adjusted from 1/2 Mbps to 4 Mbps over time (FCC 2010; ITU, 2003, p. 9; Jensen et al., 2006; Kim et al., 2003). In the last definition of broadband, the minimal broadband connection speed is raised up to 25 Mbps in downstream (FCC 2015). The adjustment of the minimal broadband connection takes care about the necessities of a network-based and digital world.

Besides high connection speeds other quality parameters like e.g., the symmetry of download and upload streams, the reliability and security of the connection, the low latency, are also important factors for broadband services.

2.2 Challenges

Following the reports of the International Telecommunication Union (ITU) (ITU, 2014b) and Organisation for Economic Cooperation and Development (OECD) (OECD, 2007; OECD, 2013), the perspective focuses on most of the consideration how much of the private households or inhabitants are connected to broadband internet.

Although residential customers represent 80% of end-users or devices for the use of broadband Internet (Cisco, 2014), the importance of business use and demand for broadband connections should not be overlooked. If one considers the development of the introduction of broadband connection speeds in excess of 100 Mbit/s, it can be seen in Germany, for example, that only a few private consumers (“heavy users”) and especially business customers require this type of access. (Deist et al., 2016, p. 22). This is not surprising given that businesses generally have higher broadband demand and willingness to pay than residential customers (BEREC, 2016). Companies usually have a strong need to send and receive large amounts of data over the Internet. In addition, access technology is not relevant from the customer's point of view, but the decisive factor is whether the broadband infrastructure is able to meet the customer's demand for (high) broadband connection speeds (Götz 2009).

Companies (compared to private households) tend to be more willing to pay for broadband access at high speeds. In this respect, network operators believe that business customers have a significantly higher revenue potential per line (compared to residential customers). However, in the most cases the available broadband connection speeds are not sufficient to satisfy the enterprise broadband needs. This study is intended to contribute to clarifying the question of the extent to which the broadband demand of companies in Germany, and in particular in the Rhine-Main region, is sufficiently satisfied.

2.3 Research Model – Adjusted Model with Elements of the Unified Theory of Acceptance and Use of Technology 2

To increase the comprehension about the enterprises’ needs regarding the usage of broadband internet services and the requirement of higher broadband connection speeds, an adjusted approach of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) will be used.

Besides the concepts of expected performance, expected effort, social influence and facilitating conditions are already treated by the known UTAUT, the UTAUT2 adds the concepts of hedonic motivation, price value, and habit (Lin et al., 2013; Venkatesh et al., 2003; Venkatesh et al., 2012). In the own developed and adjusted model, the concepts of price value and expected performance will be in the main consideration. Although Venkatesh et al. (2012) has used these two concepts in connection with the intention to behave, they cannot be directly incorporated into our model. The core problem is that businesses have a demand for higher broadband speeds, which they need to maintain their status in everyday business life. There is no relationship between (a) performance expectations and (b) price value as well as a behavioral intention to use higher broadband connection speeds. As enterprises need the higher broadband connection speeds to provide their services, there is no intention to use them, but rather

a need to use them. Therefore, the authors do relate performance expectancy and price value to the behavioral need to use higher bandwidths.

In this context, the authors assume that if current broadband access provides acceptable performance for enterprises and meets their needs, the need to introduce higher bandwidths will be reduced. Regarding the price value, it can be estimated that if the enterprises perceive an acceptable price-performance ratio, the demand for the adoption of higher bandwidths will be reduced too.

In this regard, the usage of specific broadband internet services could also induce demand for higher broadband connection speeds. To examine this relationship, an external variable "importance of network-based/access-based services" will be used. In considering the UTAUT2, Venkatesh et al. (2012) argue that external variables could be used as influence factors for the behavioral intention to use. In order to adapt the approach to this research, the external variable of the importance of network-based/access-based services is related taking into account the behavioral necessity of using a higher bandwidth. The variable represents the importance for enterprises of the different internet services presented in the next paragraph. These specific internet services often need high broadband connection speeds and therefore, a demand for a higher bandwidth exist.

Based on this the hypotheses for this paper are:

H1: A positive assessment of the performance of the current broadband access by enterprises has a negative impact on the demand for higher bandwidth.

H2: A positive assessment of the price-performance-ratio of the current broadband access negatively affects the demand for a higher bandwidth.

H3: An increasing importance of internet services has a positive impact on the demand for higher bandwidths.

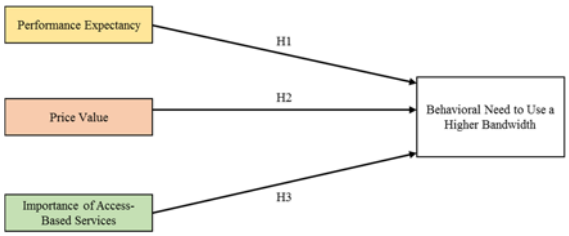

Figure 1: Conceptual Model.

Following the hypotheses, Figure 1 visualizes the conceptual model for this research work, which is an adapted model based on the UTAUT2. In the later section "data analysis" the relation of performance expectancy, price value and importance of access-based services will be tested in two different ways. On the one hand, each hypothesis is tested by a specific regression analysis to analyze the relationship between these independent variables and the need to use higher bandwidths. In this analysis, the individual relationship is tested for its significance in terms of the impact on the behavioral needs of enterprises to use higher broadband connection speeds for the provision of their own services and products. On the other hand, all the variables of the concepts will be combined in one regression analysis to figure out, which of the concepts and variables will be dominantly for the use of higher bandwidths and to figure out how the different variables also affect each other. To better comprehend the results in the data analysis, each concept is dressed by a specific color code, like performance expectancy in yellow, price value in red and internet services in green (see Tables 4 to 9).

With regard to the hypothesis H3, it should be noted that in H3 the different internet services are tested in a separate combined regression analysis to find out which internet services are most important for enterprises in terms of their broadband demand. When considering the combined regression analysis with the other two concepts of price value and performance expectation, only the significant Internet services are considered by the test hypothesis H3.

2.4 Broadband Demand

As already introduced, the broadband demand, future bandwidth demand and the need for higher bandwidths are in the consideration of this study. In this regard, this chapter will identify, which indicators drive the demand for higher bandwidths in general and specifically for enterprises.

For more than 20 years, innovative developments in services and applications for everyday business and private life have been driven by the opening up of the telecommunications and internet markets in particular. The increasing use of internet services based on broadband internet infrastructures is making the availability of these services as an economic location factor increasingly important (Briglauer, 2014; Guenach et al., 2011; ITU, 2014a; Koutroumpis, 2009; Monopolkommission, 2011; Picot and Wernick, 2007). As the bandwidth needs of enterprises can change rapidly and the provision of broadband infrastructure requires appropriate lead times, decisions on the further development of broadband infrastructure must be taken in good time.

Therefore, broadband infrastructures will be seen as essential base for the collection of knowledge and

information and exploiting the potential of electronic markets in the upcoming digital world (Economides, 2004; Jensen et al., 2006). Telecommunications infrastructures therefore represent a key factor for companies in their choice of location, economic success and future (international) competitiveness (Belloc et al., 2012). If broadband coverage in a region is considered to be insufficient, companies would be limited in their business activities there and may avoid having their place of business there. In this respect, a complex local broadband supply can lead to a deterioration in productivity and service quality in a region.

For the ability to offer own products and services, enterprises need to use internet services like: (a) cloud-computing, (b) contract transactions, (c) digital administration, (d) e-commerce, (e) email services, (f) file-sharing, (g) financial transactions, (h) home office, (i) intranet, (j) video-conferences, (k) web-programming (Briglauer and Gugler, 2017; Buigues, 2001; BMWI, 2013; Cava-Ferreruela and Alabaz-Munoz, 2005; Falck et al., 2013; Jensen et al., 2006; Montolio and Trillas, 2013; Stordahl, 2008). The demand for higher bandwidths is growing quite strongly due to more sophisticated applications and the content-oriented development of new services (BMWI, 2013, p.20; Choudrie and Lee, 2004; Hazlett and Weisman, 2011; Jensen et al., 2006; Winzer et al., 2017; Winzer and Massarczyk, 2018).

Due to the technologically advance of broadband access technologies (copper, coax cable, fiber and mobile connections), telecommunications infrastructures allow the achievement of broadband connection speeds of 100 Mbps and more. Therefore, the network operators should be able to satisfy the bandwidth needs of the enterprises and to be able to maintain the customer relationship (BMWI, 2013, p. 20; Stopka et al., 2013, p. 59p.). In addition to the basic availability of broadband connections with speeds in excess of 100 Mbit/s, companies expect in particular (a) fair price-performance-ratio and (b) widespread availability in rural regions/locations (Distaso et al., 2006; Sawyer et al., 2003; Stopka et al., 2008). In this respect, higher demand for broadband is particularly dependent on prices and comprehensive network availability (Grosso, 2006). In addition, there are always internet services that customers want to use unconditionally ("killer applications") and in which the parameter and broadband infrastructures play a less important role (Aizu, 2002). Nonetheless, this study will estimate both parts of indicators by considering the performance expectancy, price value and importance of access-based services.

In summarizing the importance of broadband accesses, the provision of broadband accesses and high connection speeds directly influence the national competitiveness and profitability of enterprises (Cava-Ferreruela and Alabaz-Munoz, 2005; Choudrie and Lee, 2004; ITU, 2003, p. 9; Woroch, 2002).

3 METHODOLOGY

To validate the developed hypotheses, the authors have performed a survey to get information, (a) which services are used by the enterprises, (b) which broadband speeds they use and (c) how much they pay for it. The main intention is here to figure out how the named indicators influence the demand for a higher bandwidth in future.

As our university is located in the Rhine-Main area (Hesse) in Germany, the survey was mainly distributed via local multipliers located in the municipalities to reach all types of businesses (from micro to large). For the simplification of the data collection, a cross-sectional online-survey (“one-shot surveys”) have been prepared (Diekmann, 2011). Although an online survey can in principle reach a wide range of potential respondents, the absence of a high participation rate (or low dropout rate) and the completeness and accuracy of the answers cannot be guaranteed for such online surveys. In addition, the questionnaire is designed in such a way that individual questions can be skipped without ending the survey.

The survey was distributed during the period May to July 2018. In total, 364 companies were interested in the survey and 123 enterprises have started/passed the questionnaire. There are 81 fully completed questionnaires, which corresponds to a high response rate of 22.25%. Against the background of approx. 566,000 companies in Hesse (Hessen Statistisches Landesamt 2018), the number of 81 participating companies is naturally to be classified as too low.

In the first part of the survey, the enterprises were asked about their industry, enterprise size and degree of internet usage in general. The second part covers questions about the internet provider and broadband access. The third part include questions about the importance of different Internet services. The following fourth part of the survey deals with the question to what extent the current broadband situation satisfies the needs of the company. These are supplemented in the fifth part by questions on service quality and fault frequency. The last part regards

questions about the price of the current broadband access and the willingness to pay for a better broadband access.

The data collected were analyzed using quantitative research methods and the SPSS statistical program. To examine the reliability and validity of the data, the estimation of the Cronbach Alpha and an Exploratory Factor Analysis were performed.

The importance of access-based internet services in the respective enterprise was queried with the 5-Point-Likert-scale (scale: unimportant to important). The considered internet services include: (a) email, (b) e-commerce, (c) file-sharing, (d) home office, (e) cloud computing, (f) information generation, (g) intranet, (h) financial transactions, (i) contract transactions, (j) digital administration, (k) web-programming, and (l) video conferences. To measure the performance expectancy, the enterprises were asked to estimate if the current broadband access would be sufficiently in the provision of bandwidth in the future of the enterprise (5-Point-Likert-scale: fully disagree to fully agree). Furthermore, the scope of disturbances and the overall evaluation of the current broadband access gives an overview about the performance of the used broadband access (5-Point-Likert-scale: imperfect performance to excellent performance) (Likert 1932). Last the price value is evaluated by using questions regarding the price-performance-ratio and willing to pay for a better broadband connection (5-Point-Likert-scale: fully disagree to fully agree).

As introduced above, the used approach for assessment the hypotheses deviate from the original model of the UTAUT2.

4 DATA ANALYSIS AND RESULTS

4.1 Result Conditions

The following discussion assumes that the participants of the survey answer in the position of business customers. In the following, the descriptive results precede the analysis of the validity and reliability tests. After the validation of the used concepts, the results of the correlation analysis will be briefly discussed. Accordingly, the results of the ordinary least square regressions of the hypothesis testing will be displayed

4.2 Descriptive Results

First of all, the classification of the companies involved will be discussed. Here, 23.5% of the responding enterprises are directed in the IT section, whereas 17.3% of the enterprises are situated in provision of services. The other participating enterprises are nearly equal distributed to the other 11 industry sectors.

Regarding the classification of the size of the enterprises in Table 1, it can be seen that micro enterprises and small enterprises take the biggest shares of the responding enterprises with 38.5% and 37.2% respectively. Considering the distribution of the number of employees in the enterprises, the distribution of micro and small enterprises in the study fits roughly with the overall distribution in Germany. However, regarding the distribution and relation of the enterprises in Germany with the share of the responding enterprises, it can be seen that the share of micro enterprises in the survey are underrepresented. Small, medium and large enterprises are overrepresented in their own survey (compared to their share of the total German distribution).

Table 1: Size of the Enterprises (EM = Employees) (Destatis 2018).

Size	Percentages in the Survey	Percentages in Germany
Micro Enterprises (below 10 EM)	38.5%	89.5%
Small Enterprises (10 to 49 EM)	37.2%	8.3%
Middle Class Enterprises (50 to 249 EM)	17.9%	1.8%
Large Enterprises (250 EM and more)	6.4%	0.4%

Since larger companies require more effort in synchronizing the tasks of employees and linking different parts of the company, it can be assumed that the larger companies there are, the higher broadband connection speeds would be required (vbw 2018). Overall, 60.5% of the responding enterprises indicate a high degree of internet usage in their enterprise.

69.6% of the enterprises are connected to broadband internet by the incumbent of the German broadband market. Regarding the quality of the broadband accesses in Table 2, approx. 48% of the enterprises use broadband connection speeds of less than 30 Mbps in downstream. In earlier studies, for the German market, values of about 40% of companies with broadband connections of (up to) 16 Mbit/s are mentioned, which is compatible with the figures given in Table 2 (27.3% less than 16 Mbit/s

and 47.8% less than 30 Mbit/s (vbw 2018). Despite 46.6% of the enterprises have broadband accesses with downstream connection speeds higher than 50 Mbps, the insufficient broadband provision for more than 50% of the enterprises is a worrying signal for the Rhine-Main area as economic location factor. Due to availability of further broadband internet services and a progressing digitization, it can be expected that the insufficiently provided enterprises will struggle in their business activities in the near future (vbw 2018). Considering Table 2, it is furthermore worrying that 56.8% of the enterprises use upstream broadband connection speeds below 16 Mbps. Especially the linkage between parts of the enterprises and between enterprises and customers as well as the stable maintenance of business functions could induce the need to use higher (upstream) bandwidths. Together with an increased processing of data volume, the usage of broadband connection speeds of less than 50 Mbps in downstream and upstream would be not sufficiently (vbw 2018). From this point of view, approx. 50% (downstream) and 75% (upstream) of the enterprises are insufficiently provided by broadband in the current situation.

Table 2: Distribution of Delivered Broadband Connection Speeds.

Size	Percentages in Downstream	Percentages in Upstream
Less than 2 Mbps	2.7%	21.6%
Less than 6 Mbps	8.2%	12.2%
Less than 16 Mbps	16.4%	23.0%
Less than 30 Mbps	20.5%	14.9%
Less than 50 Mbps	5.5%	2.7%
Less than 100 Mbps	21.9%	10.8%
100 Mbps and more	24.7%	14.9%

Regarding the access technology used, approx. 60% of the companies use different quality levels of copper lines, approx. 20% fiber optic lines, approx. 10% coaxial cable and the remaining 10% other technologies (mainly mobile). With a view to the future, only 20% of companies with broadband connections of 100 (up to 1,000) Mbit/s are securely positioned. Therefore, it is not surprising that about 70% of the companies assume that their current broadband speeds will not be sufficient to provide the services and products of the future. For this reason, it is not surprising that 77.6% of the companies surveyed would prefer to use higher bandwidths immediately, which is in line with previous studies (vbw 2018).

Besides the demand for higher bandwidths, the quality of the used broadband access depends also how often the service is not available. In this regard, 44.3% of the enterprises have answered that they experience failures in the internet connection at least once a month or more. Although once a month sounds less dramatic, the duration of the failures could be a critical problem. Since 54.4% of the failures last at least 8 hours, which possibly indicate that the employees are not able to use the internet and to work with the customers. Depending on the size and the sector of the company, the economic damage of a lost working day could be quite high.

In Table 3, the different internet services and their importance for the enterprise are presented, where only the enterprises' ratings "very important" and "rather important" has be taken into account. In general, nearly all the responding enterprises specify that email is the most important service, which would fit with previous studies in this field, which also mentioned that email is the most used broadband internet service (96%) (vbw, 2018). In addition, the following (next) most important services were mentioned by the companies: (a) to get information, (b) to manage the enterprise, (c) to enable the ability for home office for employees, and (d) to process financial transactions. In comparison to the results of previous studies (e.g. information generation 92%), the activities are rated less important in this study (vbw 2018). As most companies in the survey are micro or small enterprises, communication between employees is likely to be personal. Video conferences and file-sharing between different employees in different locations or exterior use can be normally found in middle class or large enterprises. In this regard, the rating that only the half of the enterprises rate video conferences and file-sharing as important broadband internet services for the own enterprise can be understood. However, relating the results of home office and video conferences concerning the vbw (2018) study, more enterprises are using video conferences for their communication to business partner and customers as well as offering home office to employees.

Table 3: Importance of Internet Services.

Internet Services	Importance
Email	98.7% important
Information Generation	77.9% important
Digital Administration	74.7% important
Home Office	65.3% important
Financial Transactions	61.3% important
Video Conferences	52.0% important
File-Sharing	51.4% important
Intranet	48.6% important
Cloud-Computing	44.2% important
Contract Transactions	39.2% important
E-Commerce	33.3% important
Web-Programming	29.7% important

Although cloud-computing would be often named in regard of an increased usage by enterprises, in this survey only round about two fifths rate cloud-computing as important for their business activities, which roughly corresponds to the results of other studies (approx. 50%) (vbw 2018).

In the last step, the enterprise perceptions regarding the price-performance ratio, willingness to pay and degree of satisfaction will be illustrated. Overall, 80.8% of the enterprises are not satisfied considering the price-performance ratio of their broadband access. Due to this high level of dissatisfaction, companies are increasingly willing to change network operators as far as this is technically possible. The dissatisfaction is directly related to the fear of the companies that they may not be able to carry out their business activities in full scope due to insufficient internet connections (vbw, 2018). The shortcomings can lead to e-mails (e.g. with large file attachments) not being processed at all or only very slowly, or video conferences with customers'/business partners not being possible, which would have a negative effect on customer relations (vbw 2018). Furthermore, some of the enterprises are dissatisfied through high differences between the paid and delivered broadband connection speeds (vbw, 2018).

58.6% of the enterprises pay a monthly price below 100 Euro. 64.4% of businesses would be willing to pay more each month for better/faster broadband access. Regarding the question of a possible one-off payment for better broadband access, 75.0% of companies would be willing to pay (at least) 250 Euro and 54.4% of companies would be willing to pay (at least) 500 Euro. Although this one-off payment would not cover the whole costs of an upgrade of the current or the implementation of a fiber infrastructure, a contribution margin could be made. Finally, only 19.4% of the responding enterprises rates the overall experience with their broadband access as good or very good. 25.0% of the enterprises rate their broadband access as acceptable, which, conversely, means that more than 55% of enterprises are not satisfied with their broadband access (vbw 2018).

As efficient broadband access is a very important location factor for businesses, network operators, with the involvement of public authorities, need to step up their efforts to ensure satisfactory broadband coverage.

4.3 Validity and Reliability Analysis

The results of the validity and reliability analyses are illustrated in the Tables 4 and 5. Here, the following seven aspects are included in the analysis: (1) importance of broadband internet services, (2) price-performance ratio and estimation of the willingness to pay, (3) performance expectancy regarding the delivered downstream and upstream broadband connection speeds. The further aspects are: (4) importance of broadband internet services and broadband demand, (5) price-performance ratio, estimation of the willingness to pay and broadband demand, (6) performance expectancy and broadband demand. The last concept considers all combined influencing concepts and the dependent concept of the behavioral need to use higher bandwidths.

The first three concepts regard the influencing concepts on the behavioral need to use higher bandwidths. The analysis of these three concepts should verify if these concepts are consistent. The following three concepts (4) to (6) have included the concepts of (1) to (3) and in addition the concept of the behavioral need to use higher bandwidths. The addition of the behavioral need to use higher bandwidths would be necessary to figure out if the concepts would be valid and reliable by considering the impact on the dependent variable. In the last step of the reliability and validity analysis, all concepts are considered together. This step is necessary to verify if all concepts stay valid and reliable when they are considered in relation to the behavioral need to use higher bandwidths. Furthermore, the reliability and validity analyses are necessary to estimate the truthfulness of the outcomes.

To estimate the validity of the set concepts and hypotheses, exploratory factor analyses will be performed. In the first step, the factor analysis includes the examination of the Kaiser-Meyer-Olkin value (KMO), the significance test from Bartlett, the consideration of the communalities and the examination of the cumulative variance (Field 2013; Fromm 2008; Fromm 2010; Hair et al., 1995; Schöneck and Voß, 2013). To achieve a good validity, the concepts should reach significant p values below the mark of 5% in the Bartlett-Test and KMO values above 0.7 (Field 2013; Fromm 2008; Fromm 2010; Hair et al. 1995; Schöneck and Voß, 2013). In addition, the communalities of the variables in the considered concept should exceed in average the value of 0.6. The validity of the concepts can be regarded as given if the factors reach a cumulative variance of more than 50%, which show high explanatory rates of the variances of the collected data (Field 2013; Fromm 2008; Fromm 2010; Hair et al., 1995; Schöneck and Voß, 2013).

Following the results in Table 4, in general it can be concluded that the set concepts are valid. All the concepts fit with the guidelines considering a Bartlett-Test below the mark of 5%, the communalities exceed 0.6 and all the concepts achieve good explanatory rates of their variances. In the consideration of the KMO values, only the concepts regarding prices and willingness to pay do not reach a satisfying KMO value (above 0.7), where, in a broader definition of the KMO, values above 0.5 are also to be classified as still acceptable ((Field 2013; Fromm 2008; Fromm 2010; Hair et al., 1995; Schöneck and Voß, 2013). The other concepts reach good KMO values higher than 0.7. Overall, the concepts reach good validity scores.

Table 4: Validity Analysis.

Research Concepts	KMO & Bartlett	Cumulative Variance & Communalities
Importance Internet Services	0.748 p<0.05	64.254% Ø Com.>0.6
Price Value	0.501 p<0.05	63.782% Ø Com.>0.6
Performance Expectancy	0.814 p<0.05	64.882% Ø Com.>0.6
Importance Internet Services with Broadband Demand	0.753 p<0.05	66.897% Ø Com.>0.6
Price Value with Broadband Demand	0.504 p<0.05	76.163% Ø Com.>0.6
Performance Expectancy with Broadband Demand	0.850 p<0.05	62.135% Ø Com.>0.6
Combined Concepts	0.555 p<0.05	67.907% Ø Com.>0.6

After validity analysis, all named concepts need to be examined in the terms of reliability. Reliability is measured using the alpha values developed by Cronbach. In principle, the Cronbach alpha values should be higher than 0.7 in order to obtain good reliability (Cronbach, 1951; Fornell and Larcker, 1981; Hossiep, 2014).

Based on the results in Table 5, the concepts regarding the price value do not reach a Cronbach's Alpha value higher than 0.7. However, in a broader definition, the Cronbach' Alpha values of 0.6 could identify an acceptable reliability (Cronbach, 1951; Fornell and Larcker, 1981; Hossiep, 2014). The other examined concepts are reliable.

Table 5: Reliability Analysis.

Research Concepts	Cronbach's Alpha
Importance Internet Services	0.812
Price Value	0.653
Performance Expectancy	0.796
Importance Internet Services with Broadband Demand	0.801
Price Value with Broadband Demand	0.624
Performance Expectancy with Broadband Demand	0.741
Combined Concepts	0.801

4.4 Correlation Analysis

The correlation analysis measures the degree of the relationship between two individual variables. It is not, however, the degree of dependence, but the measure of the linear proportionality. A correlation of 1.000 shows a 'perfect' relationship. A correlation coefficient higher than 0.500 is classified as a good correlation. Below 0.300, the correlation coefficients are weak (Brosius, 1998; Hagl, 2008). For the sake of brevity, the authors focus on the significant correlations between the behavioral need for higher bandwidths and the variables of three developed concepts.

Table 6 shows the variables that have a significant correlation and will be further considered in the following. All the variables with insignificant correlation values will be excluded in the further considerations.

The results in Table 6 show that the "Behavioral Need for a Higher Bandwidth" correlates most strongly with whether the downstream and upstream speeds of one's own access are sufficient to meet future business needs (correlation coefficients: -0.650 downstream, 0.676 for upstream). The negative sign here means that companies with satisfactory broadband connections have no need to use higher bandwidths, while companies with insufficient broadband connections have a need for higher bandwidths. In addition, there is a high correlation (-0.669) with "overall satisfaction with own broadband access", i.e. if a company is dissatisfied with its broadband access, there is a need to use higher bandwidths. In view of the other significant correlations, the importance of Internet services, the price/performance ratio of broadband access, the rate of connection failures and the contractually agreed speeds of current access correlate weakly with the need to use higher bandwidths.

4.5 Regression Analysis

In this paper, the regression analysis follows the method of an ordinary least square regression. The intension is to verify if the dependent variable behavioral need to use higher bandwidths will be affected by the developed three concepts of independent variables (Brosius 2007, p. 255). In this regard, it will be examined, in which degree the predictor variables can explain the generated values of the dependent variable (Schäfer 2010, p. 121).

In the application of the regression analysis, four major indicators need to be considered. Firstly, the r-square will be determined to quantify the explanatory power of the whole regression model. The r-square is the share of the dependent variable, which can be explained by the independent variables. Following Chin (1998, p. 323) and Cohen (1988), the value should be at least 33%.

Secondly, the analysis of the variances (ANOVA) need to verify the model fit. The resulting values should be significant ($p<0.05$) and higher than 3, which is the case here with which the model can be rated as good.

Table 6: Significant Correlations with the Behavioral Need for Higher Bandwidths.

Variables	Correlation Coefficient
Downstream Speed	-0.340
Upstream Speed	-0.332
Expected Satisfactory Downstream Speed	-0.650
Expected Satisfactory Upstream Speed	-0.676
Performance Evaluation	-0.669
Failure of Connection	0.265
Service – Contract Transactions	0.252
Service – Digital Administration	0.270
Service – Video Conferences	0.335
Price-Performance Ratio	-0.329
Willingness to Pay	0.386

Thirdly, the regression coefficients of the independent variables need to be significant ($p<0.05$). In particular, the identified estimators must match the expectations in the research hypotheses. Fourthly, the test of multicollinearities by the Variance Inflation Factor (VIF) needs to be performed to find out, whether the variables included in the regression analyses have an identical relation. In the case of existing multicollinearities, i.e. if the VIF values exceed 10 (or in a stricter definition 3), the outcomes of the regression analysis are biased (Hair et al., 1995; Lin et al., 2009; Petter et al., 2007).

Since it was precisely such high multicollinearities between the parameters upstream and downstream speed that could be observed, the parameter "upstream speed" was not further considered (in Table 7). The overall satisfaction/performance rating and the expectation as to whether the downstream connection speeds are sufficient for future broadband services have a negative impact on demand for higher bandwidths.

Table 7: Regression Analysis – Performance Expectancy.

Independent variables	Dependent: Behavioral Need for Higher Bandwidths	
ANOVA = 14.590 p<0.05	R-Square = 48.9%	
	Regression Coefficients with Significance	VIF
Downstream Speed	0.041	1.739
Expected Satisfactory Downstream Speed	-0.117**	2.771
Performance Evaluation	-0.150**	3.180
Failure of Connection	0.010	1.208

* Significant within the error probability of 10%.
** Significant within the error probability of 5%.

If downstream connection speeds were sufficient, companies would see no need for the adaption of higher bandwidths. The r-square with 48.9% identifies a properly explanatory rate and the ANOVA represents a good model fit of the regression. The VIF values are closely above 3. Multicollinearities do not bias the model.

Table 8: Regression Analysis – Price Value.

Independent variables	Dependent: Behavioral Need for Higher Bandwidths	
ANOVA = 11.506 p<0.05	R-Square = 25.3%	
	Regression Coefficients with Significance	VIF
Price-Performance Ratio	-0.125**	1.000
Willingness to Pay	0.158**	1.000

* Significant within the error probability of 10%.
** Significant within the error probability of 5%.

As shown in Table 8, there is negative relationship between the evaluation of the price-performance ratio and the demand for higher bandwidths, i.e. enterprises who perceive a dissatisfying relation between the price and the performance of the current broadband access have a stronger demand for higher bandwidths.

Table 9: Regression Analysis – Importance Internet Services.

Independent variables	Dependent: Behavioral Need for Higher Bandwidths	
ANOVA = 4.236 p<0.05	R-Square = 16.1%	
	Regression Coefficients with Significance	VIF
Contract Transactions	0.037	1.344
Digital Administration	0.038	1.325
Video Conferences	0.078**	1.139

* Significant within the error probability of 10%.
** Significant within the error probability of 5%.

The company's willingness to pay is clearly positively dependent on the need to use higher bandwidths. In other words, the higher the enterprises are willing to spend financial resources for the broadband access, the stronger is the need for higher bandwidths. The r-square of 25.3% identifies a weak explanatory rate, which is naturally, since the need for higher bandwidths is influenced by multiple variables. The test for the ANOVA indicates a good model fit. Following VIF values of one, a non-existence of multicollinearities can be concluded.

Table 9 clearly shows that only the use of the "video conferencing" service (statistically significant) indicates the need for higher broadband speeds. If enterprises have to do more video conferences with partners, other locations and customers, they have an increased need to use higher bandwidths. The other internet services are insignificantly. Considering the r-square, the value of 16.1% indicates a weak explanatory rate. Despite the ANOVA test identifies a F-value of four, which indicates a model fit, the value is close to three and therefore, the model fit is weakly acceptable. Since the VIF values are close to one, a non-existence of multicollinearities can be comprehended.

As introduced in the beginning of the paper, in the final stage, all the variables significant variables of the single analyses will be used in the combined analysis. When performing the regression analysis by implementing all the different variables, a high explanatory rate of 60.4% with significant model fit (following ANOVA test) shows that many indicators for the explanation of the variable behavioral need to use higher bandwidths are considered in the taken regression analysis. In doing so, two variables get a significant impact on the need to use higher bandwidths, (a) performance evaluation (coefficient: -0.143) and (b) video conferences (coefficient: 0.055). Given the strength of the variables, it should be noted that (a) the performance of or satisfaction with current broadband access and (b) the use of video conferencing significantly affect the need to use higher bandwidths.

5 DISCUSSION AND CONCLUSIONS

Summarizing the different analyses and considerations, the hypotheses H1 to H3 can be accepted. If the performance and price-performance of the current broadband accesses are satisfying for the enterprise, there is no need to use higher bandwidths. If some of the internet services are important enough, the need to use higher bandwidths increases. However, this relation cannot be verified for all of the different broadband internet services. Nonetheless, the existing concepts of price value and performance expectancy can be confirmed.

Despite some significant results of the survey, the authors are aware of the problem that only a small number of companies participated in the survey. In this respect, the results should be checked by a further survey (ideally with a higher number of participants).

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