

Wenzel, Stefan

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Characteristics Enabling Online Purchase And Their Portability To  
Enterprise Application Software

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# **APP'IFICATION OF ENTERPRISE SOFTWARE - EVALUATING MOBILE APP CHARACTERISTICS ENABLING ONLINE PURCHASE AND THEIR PORTABILITY TO ENTERPRISE APPLICATION SOFTWARE**

*Whitepaper*

Stefan Wenzel<sup>1,2</sup>, [stefan.wenzel@sap.com](mailto:stefan.wenzel@sap.com)

<sup>1</sup>SAP AG, Walldorf, Germany

<sup>2</sup>Otto-Friedrich-Universität Bamberg, Bamberg, Germany

## **Abstract**

*Enterprise application software vendors seek to re-produce the success story of consumer mobile apps in their domain. Like private users, business users ask for flexible, consumer-grade applications for their daily work. However, enterprise software applications do not meet those expectations and are not ready for the “App Store Model”. Therefore, IT departments are facing new challenges with consumerization and “shadow IT”. Practitioners and researchers expect to counteract these issues if enterprise software was more flexible and consumer-like – in other words, if enterprise software was app’ified. Therefore, this study investigates typical “app characteristics” from the business users’ perspective. Special focus is on the characteristics that are relevant for online purchases. Furthermore, it is evaluated if app characteristics can be applied to enterprise application software. To study the “app phenomenon”, a self-completion questionnaire and mainly quantitative data analyses have been used. The results are addressed to both IS researchers and practitioners. For IS research this study offers insights into the under-investigated topic of apps as an own concept. Enterprise software vendors and IT departments can use the results to design enterprise software which targets an employee-driven adoption using online channels or to assess existing applications and app store initiatives.*

**Keywords:** App Store, Mobile Apps, App’ification, Enterprise Software, Consumerization of IT

## 1 Introduction

In the consumer segment, mobile apps have been extremely successful and are pervasive in many areas of our private life: Apple alone reported a total of almost 40 billion app downloads by the end of 2012 (Rapaport 2013) and Gartner expects more than 70 billion app downloads by 2014 – every year (Pettey 2011). Given those numbers, it is not surprising that IT companies seek to re-produce this success story in the business segment. Multiple enterprise software vendors have started their own “app stores” or online sales channels, often combined with a platform offering and an ecosystem of independent software vendors (e.g., [pinpoint.microsoft.com](http://pinpoint.microsoft.com), [www.sapstore.com](http://www.sapstore.com), [appexchange.salesforce.com](http://appexchange.salesforce.com)). Though these initiatives are gaining traction, they are still at an early stage: the number of downloads and applications that are available as well as the maturity of the e-commerce process are not on a par with the consumer counterpart. For example, many applications cannot be bought and downloaded online; users have to request a quote by filling web forms and then, individual application providers will follow-up “offline” (Bayer 2012; Salesforce.com 2013).

According to Novelli & Wenzel (2013) today's enterprise application software<sup>1</sup> (hereafter also abbreviated to “enterprise software”) is often not ready to be purchased online (especially not by business users) due to its prevailing monolithic nature and high complexity resulting in the need for personal consultation. They further refer to “app'ified” enterprise software if the respective application's characteristics comply with requirements of the “transactional” online sales channel and if companies would prefer to transact the acquisition of such an application online. For the purpose of this study the metaphor “app'ification” is used to describe the act of applying a combination of characteristics associated with “mobile apps” to a different context (here: enterprise software).

The phenomenon of IT innovations originating in consumer markets and subsequently diffusing into the enterprise market is referred to as “Consumerization of IT” (Weiß & Leimeister 2012; Harris et al. 2012). One consequence is that business users rate corporate IT with private evaluation criteria. However, corporate IT and today's enterprise applications often do not meet those expectations (Weiß & Leimeister 2012) resulting in dissatisfaction or shadow IT (Beimborn & Palitza 2013; Jones et al. 2004). Hence, IT departments are looking for new governance models (e.g., “bring your own device”, BYOD (Luftman & Derksen 2012)) to satisfy the need for employee-driven IT adoption and consumer-grade technologies. It is expected that these new governance models – combined with the availability of consumer-grade enterprise apps and enterprise app stores – can effectively reduce shadow IT and ultimately meet the business users' expectations (Beimborn & Palitza 2013).

Concluding the elaborations above, it is important to understand the underlying drivers of apps to better serve the needs of the business users – for both, enterprise software vendors and corporate IT departments. Academic research so far has not paid much attention to this topic (despite selected publications (Novelli & Wenzel 2013; Sodhi et al. 2012)). Merely authors of popular science and analysts have recently investigated this subject (Kosner 2012; Sidwell 2013; Ellison 2010) or have put it on the agenda of important IT topics (e.g., Gartner has predicted “App Stores for Enterprises” and the rise of “Apps over Applications” as two of the ten most important strategic technology trends in 2012, 2013 and 2014 (Pettey 2011; Pettey 2012; Rivera 2013)). Accordingly, this paper contributes to fill the gap in Information Systems Research (ISR) concerning the app phenomenon.

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<sup>1</sup> In this publication enterprise application software is used for end user-oriented software applications supporting single or multiple business tasks up to entire business processes. Examples are applications in the area of Enterprise Resource Planning (ERP), Human Capital Management (HCM) or business analytics software.

Two main research objectives are in the focus of this work. First, the key app characteristics are evaluated. The characteristics have been chosen when they meet the two following requirements: they are enabling the online app acquisition and at the same time they are relevant to business users. Here, online acquisition is defined as the entire process from informing and evaluating (or trying) to buying, deploying (downloading and activating) and the initial use of an app (derived from (Verville & Haltingen 2003)). The characteristics are evaluated from the business users' perspective because – in contrast to traditional enterprise software where the buying process is governed by corporate IT – the adoption of apps is mainly employee-driven. The second objective of this work is to investigate if these characteristics can be applied to enterprise software or, in other words, if it would be useful from the business users perspective to “app’ify” enterprise software. Since this study partially complements and extends the qualitative research from Novelli & Wenzel (2013), a self-completion questionnaire and mainly quantitative data analysis have been selected to pursue the research objectives.

The study's findings confirm the importance of app characteristics, e.g., “ease of use”, “focused functionality”, “ability for immediate usage after purchase”, “ability to use without instructions” and hedonistic aspects like “visually appealing design”. Further, the results show that in principle, these characteristics would also be useful for enterprise software and that current enterprise software underperforms in this respect. However it can also be said that the priorities of apps for private use differ from those for professional use. The outcomes can be used by software vendors to design enterprise software which targets an employee-driven adoption using online channels or to assess their current app store activities with these findings. IT departments might use the results to select enterprise software to better deal with issues related to shadow IT or to consider those characteristics when developing their own custom apps in-house.

## 2 Related Work

Apps as a type of software product or app'ification of enterprise software have not been examined in detail so far. However, contributions from multiple streams of research help to explain the subject or might benefit from its results – in ISR but also in research for Industrial Marketing.

App'ification as a concept can partly be explained by IT consumerization. As described earlier, this metaphor describes the rise of IT innovations in consumer segments diffusing into (or often infiltrating) corporate markets. To support the practical relevance of this phenomena, Harris et al. (2012) describe a survey sponsored by Accenture in 2011 among 4017 employees: 52% responded that they would at least sometimes use their personal consumer device for work related activities, 36% stated that they would not worry about IT policies in place and just use the technology they need to perform their work and 45% agreed to the statement, that private devices and software applications are more useful than the ones provided by corporate IT. Weiß & Leimeister (2012) describe the opportunities as well as the risks of this trend for corporate IT including IT governance and the management of information systems, information exchange and information technology. The uncontrolled infusion of such technologies, however, threatens typical IT targets, such as security, integrity or integration. Further, Weiß & Leimeister (2012) state that the role of apps in corporate IT is a trend that requires further investigation.

A formal definition of apps or an extensive list of distinguishing characteristics of apps over “typical” applications could not be identified. However, there are some research articles looking at “app'ification” from different perspectives. Sodhi et al. (2012) evaluate the app'ification of web applications. They describe four major app characteristics: focused/specialized functionality, harnessing (mobile) device capabilities, simplification of workflows, and greater user intimacy through design. Based on those characteristics they derive software design and architectural recommendations to app'ify web applications. Novelli & Wenzel (2013) have qualitatively investigated the adoption of an online channel for acquiring enterprise software by an organization.

Ultimately, they identified drivers and barriers for using an online channel to buy enterprise software. The authors grouped the influencing factors into “solution attributes”, “customer attributes” and “transaction attributes”. The “solution attributes” are the ones with the biggest impact as they influence the others but not vice versa. Table 1 shows the “solution attributes” (left) and the respective app'ified instances of those attributes (right). The characteristics identified by Novelli & Wenzel (2013) and Sodhi et al. (2012) have been used as a basis to derive the hypotheses; though they could not be used for the purpose of this study as they stand: the criteria had to be interpreted from a business user's perspective since Novelli & Wenzel have defined their criteria from an organizational point of view. Some criteria had to be dropped entirely because they did not make sense on an individual level (cf. section 3.1).

<b>Solution attributes influencing online purchase of Enterprise SW</b>	<b>Ideal type of app'ified Enterprise SW</b>
Scope	Focused scope / functionality
Implementation	Instant usage
On-Demand Delivery	Cloud infrastructure
Number of users	Low number of users
Evaluability	Trial available
Price Level	Low entry price / starter package available
Customization	No customization / enhancements
Criticality	Low criticality

*Table 1. App'ification criteria according to Novelli & Wenzel (2013).*

The Technology Acceptance Model (TAM; Davis 1989), the most prominent model in ISR to investigate and explain users' acceptance of technologies, would also be suited to investigate the high user acceptance of mobile apps. In its original version, the TAM proposed two main variables influencing the “attitude towards using” a technology, that is “perceived ease of use” and “perceived usefulness”. While the TAM has not been used so far to investigate mobile apps or apps, it was used to analyze other fields of mobile technology. Cyr et al. (2006) enhanced the TAM by incorporating the constructs “enjoyment” and “design aesthetics” in the context of loyalty towards mobile commerce services. Other studies in the mobile domain have also enhanced the TAM with hedonistic variables (such as “design aesthetics” or “entertainment”) in addition to the utilitarian concepts of “ease of use” and “usefulness”, e.g., to explain customer experience and brand equity in the mobile domain (Sheng & Teo 2012) or acceptance of “internet handheld devices” (Bruner & Kumar 2005). Enhancements including hedonistic concepts (i.e., experience) have also been made by Venkatesh & Davis (Venkatesh & Davis 1994; Venkatesh 2000) and are present in the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al. 2003). To evaluate apps, hedonistic characteristics have also been considered in this study. However, it was not chosen to study app characteristics using the TAM at this stage of research because the authors are convinced that the concepts provided by the TAM do explain technology acceptance in general, but do not recognize the peculiar technological context in a way that tangible design recommendations can be derived. Further, it would be very complicated to assess a concept such as “perceived usefulness” for apps as a type of software, neglecting the actual usage scenario or domain of application. In future research, however, the researched categories may well be examined using the TAM or one of its extensions.

Service-oriented architectures (SOA) describe modular information systems' architectures with the target of higher flexibility and adaptability. Much attention has been paid to this topic, but literature reviews uncover a lack of business orientation in SOA research (Viering et al. 2009; Joachim 2011; Kontogiannis et al. 2008). An app is in essence a highly modular software application packaged as a purchasable product. Therefore, this study might be used by SOA researchers to add the market and product perspective to the predominantly technical oriented discussion.

Last, the findings can contribute to analyze organizational buying behavior, since few publications have investigated software purchases so far. Haltingen & Verville (2002; 2003) studied the purchase of ERP systems and classified influencing factors grouped into environmental, organizational, interpersonal, and individual factors. In addition, they analyzed the acquisition process and defined phases from planning, information search over selection, evaluation, and choice to negotiation. In this study, the understanding of software purchases and the purchase process was guided by their work.

### 3 Hypotheses and Research Methodology

#### 3.1 Formulating Hypotheses

Three groups of hypotheses have been derived from the research objectives (cf. Table 2). The first group consists of three general app hypotheses to confirm certain input assumptions. The second group includes hypotheses on app characteristics, i.e., those enabling online purchase. These have been derived in an iterative interpretative process from the works of Novelli & Wenzel (2013) and Sodhi et al. (2012) considering findings in TAM research (cf. section 2). The third group of hypotheses targets to evaluate the transferability of the investigated app characteristics to the domain of enterprise software.

<b>General assumptions on apps</b>	
H1	Apps can be purchased online.
H2	Apps can be used on mobile devices.
H3	Apps can be used on the desktop computers.
<b>App characteristics enabling online acquisition</b>	
H4	Apps are focused on specific functionality.
H5	Apps are tailored to mobile devices.
H6	Apps can be used without instructions.
H7	Apps can be used immediately after purchase.
H8	Apps have a low price.
H9	Apps are easy to use.
H10	Apps have a visually appealing design.
H11	Apps can be tested before purchase.
H12	Apps cannot be enhanced with further functionality.
<b>App'ification of enterprise software</b>	
H13	Frequent usage of private apps increases usage of professional apps.
H14	Business users are not satisfied with their involvement in the buying process.
H15	Consumer app characteristics can be desired for enterprise software.
H16	Current enterprise software is not "app'ified".

Table 2. Overview hypotheses.

#### 3.2 Research Process

This paper employs a largely deductive, nomothetic research approach by combining a quantitative research strategy with a cross-sectional research design (Bryman & Bell 2011). The data was collected using an online self-completion questionnaire. The questionnaire was designed to address the postulated research objectives and hypotheses and was complemented with few selected, rather open-ended, qualitative questions.

Novelli & Wenzel (2013) evaluated "app'ification patterns" for enterprise software in the context of buying enterprise software online and opted for a qualitative research strategy (i.e., expert interviews

and qualitative data analysis). Consequently, this study complements their findings by trying to confirm the key app characteristics from the business users' perspective and, in addition, by expanding it with additional knowledge about those characteristics and the influence of consumer app technology on enterprise software. According to Venkatesh et al. (Venkatesh et al. 2013) this is a typical instance of combining qualitative and quantitative methods.

The questionnaire was created in two versions: in English and German. The process of designing the questionnaire and the individual questions was guided by best practices in survey design literature (Bryman & Bell 2011; Heinz & Jacob 2013; Hill & Schnell 2011). The initial version was reviewed by six test candidates in individual face-to-face reviews of 30–45 minutes each. Three of the candidates were German native speakers and three of them were English native speakers. The adjusted questionnaire was further reviewed by a professional survey analyst with focus on questionnaire mechanics, design and aspects peculiar to the online survey tool which had been chosen. A third test round was performed with 25 test respondents. In this last test round, the candidates were additionally asked to give feedback on duration, clarity, completeness and language of the online questionnaire. This resulted in minor adjustments of the sequence of questions and wording. The test candidates stated that the duration to complete the questionnaire was between 10 and 15 minutes.

The data was collected from the beginning of August until the end of September 2013. In total, 126 data sets were received and 119 respondents were considered for the final data analysis (excluding the 25 test candidates who were mentioned before). As a first step of data preparation, the received data was screened and data cleansing was applied. In this process, two data sets had to be removed due to incompleteness and data errors and another five sets did not fulfill the sample quality criteria. After selecting statistical methods based on the research objectives and the available scale level, the data was coded and analyzed using IBM SPSS Statistics and spreadsheets. Qualitative questions were analyzed using descriptive open coding techniques (Saldana 2009).

### **3.3 Sample Design**

The survey targets to evaluate important characteristics of “apps” from the business users' perspective. Business users form a population that is hard to grasp and random sampling seemed very difficult to achieve. Therefore, taking feasibility considerations into account, a non-probability sampling strategy was chosen, combining convenience with snowball sampling. The convenience sample was identified by screening the authors' and their assistants' professional networks. Then, further qualification criteria were applied (Heinz & Jacob 2013, p.80 ff.): i.e., candidate is employed, job description qualifies him as a business user of enterprise software, application of minimum quota for gender, country spread, industry spread, age and professional experience. By this method, 189 candidates were identified and contacted via e-mail. Additionally, the candidates were asked to forward the survey request to colleagues and other relevant contacts in their network (snowball sampling). The online survey tool was configured to record the sampling channel for each individual. The response rate, for the candidates identified via convenience sampling, was 43% (82 valid responses). Via snowball sampling additional 42 candidates could be recruited. Out of the latter, five candidates were removed from the sample as they did not fulfill the minimum criteria that had been defined for the convenience sampling. So, it was ensured that equal criteria were applied to both sampling methods. No personal data was recorded. Data which might conclude to an individual was anonymized during data preparation. The following demographics describe the final sample:

- Geography: 13 different countries: 91% in Europe, 5% in America, 4% in Asia
- Industry: employed in companies from 22 different industries
- Gender: 25% female, 75% male
- Age: 28% between 20–30, 56% between 31–40, 11% between 41–50, 5% above 50 years old.

- Professional experience: 6% student workers, 13% young professionals. 55% experienced professionals, 18% middle management, : 8% executive management.

### 3.4 Questionnaire Design, Scales of Measure and Statistical Methods

The questionnaire contained 19 questions: 14 content questions and five questions for survey sample demographics. Due to the limited sample size, sub-group analyses were not pursued. Four content questions used a 5-level one dimensional Likert scale (e.g., “strongly agree, agree, neutral, disagree, strongly disagree”). Five questions used other verbal scales at the ordinal level, two questions were categorical questions at the nominal level and three questions were purely qualitative. i.e., free text (Heinz & Jacob 2013).

First, the data was analyzed using cross tabulations and absolute or relative frequencies. For easier readability and qualitative interpretation, the 5-level Likert scale was grouped to a 3-level scale for tables presented (see section 4) by grouping the two values at both ends (e.g., “Strongly Agree + Agree”, “Neutral”, “Strongly Disagree + Disagree”). Due to the mostly ordinal nature of the collected data, mode and median were used to measure the location (Hadler 2005, p.47 ff.)

A chi-square test was initially applied to test whether there is a general relationship between two variables before other methods were used (Bryman & Bell 2011, p.355). To analyze correlations or relationships between two ordinal variables, Spearman's rank correlation was chosen (Bortz & Schuster 2010, p.173 ff.). To assess if there is a significant difference between two ordinal variables and to evaluate which of the two variables is “superior” Wilcoxon Signed-Rank tests were used. Wilcoxon Signed-Rank test is the non-parametric version of the related t-test and since it is based on the median and not on means it can be applied to ordinal data (Tolmie et al. 2011, p.262).

The (non-parametric) Friedman test was chosen to determine whether there are significant differences between three or more ordinal variables. Following the Friedman test, Wilcoxon Signed-Rank tests were applied for post-hoc pair-wise comparisons (Gravetter & Wallnau 2008, p.666 ff.). To avoid so called Type I or Type II errors (i.e., rejecting the null hypothesis when it is true or vice versa), caused by multiple post-hoc tests on the same data sets, a Bonferroni correction was applied to adjust the p-value, i.e., dividing the p-value by the number of post-hoc tests applied (this is equal to adjusting the alpha value) (Tolmie et al. 2011, p.123). The Wilcoxon Signed-Rank tests could further be used to generate a linear ranking of the “characteristics” of apps and enterprise software evaluated by simple forward and backward comparisons of the Wilcoxon pairs.

Kruskal-Wallis H (non-parametric) assesses if there are significant differences in three or more unrelated groups. In this work, it was used together with post-hoc pairwise comparisons according to Dunn's procedure and a Bonferroni correction for multiple comparisons (Little 2013, p.114).

## 4 Empirical Results

In this section the key results of the survey and analysis are reported. They are grouped together according to the structure of the hypotheses (cf. section 3.1).

### 4.1 General Assumptions on Apps

First, the three input assumptions were tested (cf. Table 3). Almost everyone agreed that apps can be purchased online, and a large share also agreed, that apps are for mobile devices. Interestingly, however, 52% agreed that apps could also be used on the PC in addition to the mobile device.



Apps...	Strongly Agree or Agree	Neutral	Disagree or Strongly Disagree	Median	Mode
can be purchased online	94%	5%	1%	Strongly Agree	Strongly Agree
are for mobile devices	81%	8%	11%	Strongly Agree	Strongly Agree
can be used on PCs	52%	28%	21%	Agree	Agree

Table 3. General statements on apps.

## 4.2 App Characteristics Enabling Online Acquisition

In this section the characteristics that are important for online acquisition are analyzed in detail. Table 4 shows the participants who rated the importance of nine statements on apps in the private context.

Apps ...	Very Important or Important	Neutral	Unimportant or Very Unimportant	Median	Mode
can be used imm. after purchase	97%	0%	3%	Very Important	Very Important
are easy to use	96%	2%	3%	Very Important	Very Important
can be used on mobile devices	93%	6%	1%	Very Important	Very Important
can be used without instructions	88%	8%	4%	Very Important	Very Important
have visually appealing design	79%	15%	6%	Important	Very Important
are focused on specific functions	74%	19%	7%	Important	Important
have a low price	72%	24%	4%	Important	Important
can be tested before purchase	61%	23%	16%	Important	Important
can be enhanced w. functionality	24%	38%	38%	Neutral	Neutral

Table 4. Importance of characteristics for privately used apps.

Every characteristic that was asked for seemed to be highly important or very important except “the ability to enhance an application with further functionality” (cf. Table 4) – only a minority of 24% considered this as at least important. To assess the level of independence of the tested characteristics a Spearman correlation test was performed. Out of 36, 13 characteristic pairs revealed significant correlations. The strongest three correlations are:

- “Are easy to use” correlates with “Can be used without instructions” ( $r_s = .537$ ,  $n = 118$ ,  $p < .001$ )
- “Can be used without instructions” correlations with “have a visually appealing design” ( $r_s = .351$ ,  $n = 118$ ,  $p < .001$ )
- “Can be tested before purchase” and “Can be enhanced by further functionality” ( $r_s = .397$ ,  $n = 118$ ,  $p < .001$ )

Further analyses were performed to create a ranking of the tested characteristics. First, a Friedman test was run to determine if there were significant differences in the importance of the different app characteristics. The importance of the nine characteristics was statistically significantly different,  $\chi^2(8) = 335.507$ ,  $p < .0005$ . Post-hoc analyses were used to derive a linear ranking of the nine characteristics: 36 pairwise comparisons using Wilcoxon Signed-Rank tests with a Bonferroni correction for multiple comparisons. 26 characteristics showed significant differences (either at the 0.01 or the 0.05 level), whereas ten did not. Using the 26 significantly ranked characteristic pairs, a linear rank list (cf. Table 5) could be derived. Equal rank values are a result of the ten non-significantly ranked pairs. In other words, for ten characteristic pairs the test did not determine a significant rank of one characteristic over the other.

Apps ...	Rank by importance (1 is highest)
are easy to use	1
can be used immediately after purchase	1
can be used without instructions	2
can be used on mobile devices	2
are focused on specific functions	3
have visually appealing design	3
have a low price	3
can be tested before purchase	4
can be enhanced with further functionality	5

Table 5. Ranks of app characteristics (privately used).

Respondents had further been asked to mention additional characteristics which they rate important when evaluating an app. Most candidates mentioned characteristics that match with those that were already asked directly, however, the respondents obviously did not feel comfortable with the terminology or used the free text field to additionally emphasize their assessment: e.g., multiple respondents mentioned a “clearly delimited scope”, “task-oriented design” or “clear value add” as typical app characteristics. These answers largely overlap with the intention of the characteristic “apps are focused on specific functionality”. Applying qualitative data analysis techniques, i.e., iterative coding, the answers could be grouped as shown in Table 6.

Category	#Mentions
User Experience	15
Productization	13
Responsiveness	10
Ubiquitousness	7
Security	5
Use Case	5
Business Model	2
Integration	2
Other	1

Table 6. Additional app characteristics (categorized).

Most attention was given to “User Experience” related characteristics (e.g., “efficient design”, “walk-up-and-use”). The second most mentioned characteristics can be summarized under the term “Productization”. They largely relate to the maturity of the product in terms of quality, stability, support and global availability. The third category refers to the “responsiveness” of the app: much focus was given to the interactive nature of app use cases and hence, the importance of high performance and responsiveness (“everything needs to happen in a few seconds”). Another interesting group of mentioned characteristics can be described with “ubiquitousness”. This refers to the request that apps should be available on any device (smartphone, tablet and desktop) and in any context (offline and online).

A further question was targeted to assess the aspect of “focused functionality” in detail. Participants were asked to assess the number of core functions that an app should provide. A single function was described using the examples “manage appointments” or “manage e-mails”. The majority of candidates voted for one to two functions (61.7%), i.e., a delimited and focused scope. 34.6% opted for three to five core functions and only 3.7% for more than five core functions.

### 4.3 App'ification of Enterprise Software

To investigate app'ification of enterprise software, it was first assessed if the number of apps used privately is related to the use of professional apps (cf. Table 7).

	None	1-3	4-5	>5
Privately	9%	29%	33%	29%
Professionally	44%	41%	9%	6%

Table 7. *Number of apps regularly used privately / professionally.*

A Spearman's rank-order correlation was run to evaluate the relationship. The preliminary analysis indicated the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was a significant moderate, positive monotonic correlation between the number of apps that are used privately and professionally ( $r_s = .398$ ,  $n = 119$ ,  $p < .001$ ).

Next, the satisfaction of users with their involvement in the buying process was analyzed (Table 8). Typical roles, usually involved in the organizational buying process, were offered for selection (Webster & Wind 1972). A Kruskal-Wallis test was run to determine if there were differences in the level of satisfaction of involvement between the different roles in the buying process. Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction. The satisfaction level with regards to the involvement was significantly different between the different roles in the buying process,  $\chi^2(2) = 6.203$ ,  $p = .045$ . Post-hoc analysis showed significant differences in the satisfaction between end users and deciders ( $p = .040$ ) but not between influencers and deciders or influencers and end users. Assessing the data qualitatively indicates that deciders feel adequately involved (91%), whereas only 58% of the end users assess their involvement as adequate.

	I would like to be less involved	I am adequately involved	I would like to be more involved	N
End user	5%	58%	37%	(83)
Decider	9%	91%	0%	(11)
Influencer	4%	67%	29%	(24)

Table 8. *Satisfaction with involvement in the buying process.*

Apps ...	Very Important or Important	Neutral	Unimportant or Very Unimportant	Median	Mode
are easy to use	79%	13%	8%	Important	Important
can be used without instructions	65%	22%	14%	Important	Important
can be used immediately after purchase	64%	19%	13%	Important	Important
can be tested before purchase	63%	24%	10%	Important	Important
can be enhanced by further functionality	63%	27%	8%	Important	Important
have visually appealing design	62%	26%	12%	Important	Important
are focused on specific functions	62%	22%	15%	Important	Important
can be used on mobile devices	61%	23%	15%	Important	Very Important
have a low price	30%	40%	26%	Neutral	Neutral

Table 9. *Importance of characteristics for enterprise software.*

Subsequently, it was evaluated if the researched characteristics are desired for enterprise software (cf. Table 9). Again, a Friedman test was applied to show significant differences in the importance of the characteristics. Then, pairwise comparisons (based on the Wilcoxon Signed-Rank test with Bonferroni correction) were used to create a rank of the characteristics. However, since post-hoc analysis revealed only 11 significant differences (at the 0.01 or 0.05 level), whereas 25 did not, the characteristics could be assigned to three ranks only. "Ease of use" was ranked first, "low price" last while all other characteristics shared the second rank.

Afterwards, the actual enterprise software in use was examined based on the app characteristics and compared with required characteristics. Therefore, a Wilcoxon Signed-Rank test was applied to assess whether there was a difference in the desired characteristics of enterprise software versus how the respondents rated their current enterprise software in use (cf. Table 10). Seven out of nine variable pairs showed a significant difference, only the two characteristics "focus on specific functionality" and "can be enhanced by further functionality" did not show any significant difference. For all other characteristics, the actual software was rated worse than the desired characteristics.

variable pairs (desired characteristics – rating of actual characteristics of enterprise software)	z based on positive ranks	z based on negative ranks	p
have a low price**	-4.253		< .001
can be enhanced by further functionality		-.342c	.733
can be used immediately after purchase*	-3.265		.001
can be used on mobile devices**	-5.296		< .001
can be tested before purchase**	-3.836		< .001
have a visually appealing design**	-4.862		< .001
can be used without instructions**	-5.808		< .001
are easy to use**	-5.116		< .001
are focused on specific functionality		-.312c	.755

\*\* significant difference at the 0.01 level.

\* significant difference at the 0.05 level.

*Table 10. Wilcoxon Signed-Ranks/paired difference test to assess differences between actual enterprise software in use versus desired characteristics for enterprise software.*

Apps / Enterprise Software ...	z	p	higher importance
can be used immediately after purchase**	-6.187 <sup>a</sup>	<.001	private apps
have a low price**	-5.787 <sup>a</sup>	<.001**	private apps
can be used on mobile devices**	-5.737 <sup>a</sup>	<.001**	private apps
can be used without instructions**	-5.361 <sup>a</sup>	<.001**	private apps
are easy to use**	-5.247 <sup>a</sup>	<.001**	private apps
are focused on specific functions**	-4.572 <sup>a</sup>	<.001**	private apps
have visually appealing design**	-4.299 <sup>a</sup>	<.001**	private apps
can be enh. by further functionality**	-6.409 <sup>b</sup>	<.001**	enterprise software
can be tested before purchase	-.970 <sup>b</sup>	0.332	enterprise software

a. based on negative ranks

b. based on positive ranks

*Table 11. Wilcoxon Signed-Rank test for pairwise comparisons to reveal differences in importance between characteristics for enterprise software versus private apps.*

Last, the differences in the importance of the researched characteristics between enterprise software (required characteristics) versus private apps were analyzed. Therefore again, a Wilcoxon Signed-

Rank test for pairwise comparisons (cf. Table 11) was used. The importance for most characteristics was significantly rated higher for private apps, except the ability to “enhance by further functionality”.

## 5 Discussion of Results

### 5.1 Interpretation of Results

Initially, basic assumptions regarding the nature of apps were examined. It can be concluded that apps are perceived as a type of application that is tailored for online purchase. A further important finding was that the majority of candidates indeed view apps as a phenomenon domiciled in the mobile domain, but more than half do also agree to the applicability to the desktop. This indicates that the concept can be applied to non-mobile domains as well. It is further supported by the answers that were given in the additional qualitative questions, where multiple respondents expressed the importance of device independence of an app. Hence, it can be concluded that the hypotheses H1, H2, and H3 can be confirmed.

The second part of the empirical results largely confirm the app'ification characteristics derived from Novelli & Wenzel (2013) and Sodhi et al. (2012). Moreover, the results enhance their findings by showing interrelationships and differences in the priority. “Ease of use” and “immediate usage after purchase” were rated as most important, “usage without instructions” and “usage on mobile devices” were rated as second important. “Immediate usage” and “usage without instructions” do also underline the instant usage characteristic of an app, i.e., users do not plan to buy or use an app early in advance but flexibly seek for an app once a need occurs. Extensibility of an app does not seem to be required at all in private usage scenarios. Since this feature positively correlates with “can be tested before purchase” it is a further indication that evaluability during purchase is complicated by this attribute. “Focused functionality”, “appealing visual design” and “low price” share the third rank of importance. Further analysis of “focused functionality” revealed the highly modular nature of apps. Qualitative answers additionally stressed the need for a “task orientation”. The limitation in scope of an app is probably one major enabler for employee-driven adoption because in case of a “task-oriented design” it can be evaluated by a single person whereas application monoliths covering multiple functions or entire processes would need to be evaluated by a group of people. In summary, the app characteristics tested in hypotheses H4 through H12 can be confirmed. Though an in-depth analysis of each characteristic might show needs for exceptions (i.e., extensibility).

The app'ification of enterprise software was evaluated from different angles. First, it was hypothesized that the private use of apps does increase the use of professional apps. Though via correlation analysis no causality can be derived directly, it can be assumed that the private use influences the professional use as the level of adoption of apps is significantly higher in the private segment and apps are obviously a trend that originated from consumer markets. Hence, hypothesis H13 can only be confirmed by subjective interpretation of the empirical results. Second, hypothesis H14 tries to show the general dissatisfaction of business users with their involvement in the buying process. Though there is a significant difference in satisfaction between end users and deciders, a general dissatisfaction of end users cannot be reasoned, since 58% of end users feel adequately involved. A more in-depth analysis on this topic would be required before further conclusions can be made.

The next step of the analysis was to investigate the desirability of the app characteristics for enterprise software (hypothesis H15). The majority of candidates confirmed the importance of all characteristics with the exception of price. Most business users are not personally accountable for cost and are consequently not as price-sensitive as they are for personal goods. Interestingly, in contrast to private apps the extensibility of enterprise software was also rated important. This might reflect the higher complexity of tasks in an organization and the more long-term orientation of investment goods in the

professional sector. Other than the mentioned exceptions, the importance of the investigated attributes was rated higher for private apps than for enterprise software. Nevertheless, qualitatively it can be concluded that an app'ification of enterprise software is desired; however single attributes gain different importance. With the exception of "extensibility" and "focused functionality", where no significant difference was found, it could further be shown that enterprise software does underperform with regards to the app characteristics. Hypothesis H16 can therefore be confirmed.

## 5.2 Limitations, Validity and Reliability

In this section selected limitations of this study are described. Reliability of the conducted research, i.e., being able to reproduce the results with the methods that were chosen (Heinz & Jacob 2013, p.34 ff.), has been considered by detailing the research process as much as possible. It has been shown in previous sections that apps are a phenomenon diffusing into other areas and are continuously changing with regards to technology and characteristics. Hence, it is unlikely that all presented results will be stable over time. Moreover, it might be an own future research attempt to capture the development of the app phenomenon in a time series analysis.

Internal validity was considered in the research design and execution. The questionnaire was tested in multiple rounds with German and English native speakers and with an expert in survey design familiar with the survey tool that was used. The additional open-ended questions were analyzed using standard qualitative data analysis methods. External validity, i.e., generalizability of the results to the entire population of business users can be questioned due to the non-probability sampling strategy that was chosen. Measures were undertaken during the recruiting process to ensure at least a close-to-representative sample of candidates. The selection of the tested characteristics based on previous qualitative studies might also be a source of criticism. However, since open-ended questions followed selected closed questions, the relevance of the quantitative questions could be validated and enhanced.

## 6 Conclusion and Outlook

In this study app characteristics that enable online purchases were examined using mainly quantitative methods complemented with selected qualitative methods and interpretations. The importance of key app characteristics for online purchases from the business users' point of view could be confirmed. Moreover, it could be shown that most of these key app characteristics would also be desired for enterprise software; however, with differences in the rank of importance due to the higher complexity of enterprise processes. Researchers could verify and enhance the findings in repetitive studies focusing on single aspects of this study's outcomes (e.g., the involvement of business users in software acquisition) or by testing the app characteristics in case studies of existing enterprise software. Furthermore, the tested characteristics could be analyzed using technology acceptance theories (e.g., TAM) to better explain and classify the characteristics and their causal effects. The employee-driven adoption of apps and the instant usage characteristics of this software type raise additional challenges in terms of flexibility of business processes, IS architectures, and IS design. Existing research in this domain might be applied to the findings (e.g., Sinz et al. 2011). Practitioners, i.e., enterprise software vendors or IT departments, can derive tangible design recommendations for new applications or assess current app store activities using the presented results. Finally, the authors conclude that apps originated from the mobile domain already today have changed the way we perceive and adopt software and that the concepts will radiate to other domains for the benefit of end users.

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