Innovation diffusion: The need for more accurate consumer insight. Illustration of the PSAP scale as a segmentation instrument

Received (in revised form): 5th January, 2004

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Abstract In spite of promising forecasts, successful diffusion and adoption rates are no longer self-evident in the information and communication technologies (ICT) market. Wireless Application Protocol (WAP) for example, is only one of the innovations that failed in that market. For most such failures, an inefficient marketing and introduction strategy — due to a lack of preliminary insight in adoption potential and adopter segments – is often referred to as being the cause. For upcoming innovations, such as digital television (DTV) and Universal Mobile Telecommunications System (UMTS)), it will be of major importance to have an accurate preliminary market insight and segmentation in order to develop more effective and segment-tailored introduction strategies. On the 'supply side' as well as the 'demand side', this need for insight is emphasised.

In the search for a method to obtain that insight before the actual introduction of the innovation, the authors established that none of the existing forecasting and segmentation methods are really appropriate. Therefore, they developed the Product Specific Adoption Potential (PSAP) scale: a segmentation tool that enables an adequate prior-to-launch profiling of the different potential adopter segments.

Illustrations are based on a case (*N*: 836) in which the PSAP scale was used to make an innovation segmentation for UMTS in Belgium. (UMTS is the third and most recent generation (3G) of mobile telephony.)

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'We can also now focus marketing effort on targeting innovators. Once we have singled them out and understood what drives them, we can write and design our communications specifically to recruit them. We can also choose whatever media are best to reach them with greatest efficiency. In short, in the late 1990s, we have the capability to focus on innovators. But we still have to know who they are.'[1]

INTRODUCTION

Crucial for an innovation to become a success is an effective introduction strategy in which the appropriate marketing and communication decisions are taken about which groups to target, when to target them, the applications to be offered and the information to be communicated.[2,3] As the quote above illustrates, such a

strategy is based on efficient segmentation and targeting. The different adopter segments need to be 'singled out' and 'understood' beforehand. Communication and marketing efforts need to be designed to target them. To enable such an innovation segmentation to be made, the Product Specific Adoption Potential (PSAP) scale is suggested as a prior-to-launch segmentation tool.

The first part of this paper outlines the information and communication technologies (ICT) market situation. In this fast-evolving market, some traditional assumptions on 'diffusion of innovations' become obsolete and unreliable, and preliminary market insight becomes more and more important. The second part gives an overview of the existing methods to obtain such insight. Since none of them satisfies as a tool for preliminary innovation segmentation, the PSAP scale is presented as a new method to do this. The third and final part focuses on the three research questions of this paper. The first question focuses on 'innovativeness' as an adoption determinant. To measure this concept, it is demonstrated that different innovativeness levels need to be covered. Questions two and three are the core questions of this paper. Based on a case study (N: 836) in which the PSAP scale is used to make an innovation segmentation for Universal Mobile Telecommunications System (UMTS), the PSAP scale is proved to be a more precise segmentation tool in comparison to an established tool such as the domain specific innovativeness (DSI) scale of Goldsmith and Hofacker, and largely consistent with current assumptions on adoption determinants.

THE NEED FOR INSIGHT IN THE ICT ENVIRONMENT

Examination of the ICT environment, 'information society'[4,5] or 'postindustrialistic society',[6] shows that this society can be characterised by the increasing importance of, and need for, consumer insight. This is as apparent on the 'supply side' as on the 'demand side' of this society or market.

During the past 25 years, the ICT market underwent an evolution of convergence[7,8] and an exponentially increasing rate of innovation development (cf. Moore's Law).[9,10] Computers, for example, evolved from mainframes to 386 and 486 generations to several Pentium generations, of which the most recent is already 'old-fashioned'. Also the markets for mobile telephony (450MHz, 900 MHz, 1,800 MHz, GPRS, UMTS), floppy disks, games consoles, etc illustrate the faster speed at which the different generations of ICT innovations succeed each other. Besides this fast development making it difficult for some to keep pace, these products also converged towards each other. Digital television, for example, turns the traditional television into a multimedia terminal. Including several online and entertainment applications, the latest generation of mobile phones offers 'traditional internet and (gaming) computer applications'. And the latest games consoles also serve as a DVD player, MP3 player or modem. Illustrations of this evolution on the supply side are numerous: WAP, digital television, MP3, UMTS, I-mode, gprs, wifi, X-Box, …. The ICT market evolved into a market of feature-rich technologies, with shortened life cycles.[11–13] Due to this evolution, consumer attitudes also changed. On one side for example, realisation of this fast technological evolution causes certain customers to 'leapfrog',[14,15] ie postponing or refusing to adopt an innovation because they expect a newer and better generation soon. On the other hand, this fast development of multi-featured

technologies also contains the risk of overwhelming people by offering too much too soon.[16,17] Successful introduction of an innovation comes down to having a segment-specific preliminary insight, and to entering a segment with the 'most appealing' killer application. Once the innovation is adopted and people are familiar with it other features and applications can be offered. This evolution not only leads to shortened product life cycles, but is also related to an increasing number of failing innovations. WAP, the RCA Video Disc, 3DO, IBM's PC Junior, Philips CDI are all illustrations of 'hyped up universal solutions to the home of the future',[18] or innovations that failed or exhibited disappointing adoption rates despite the promising forecasts they were introduced with. Explaining these failures, people often come up with 'badly judged marketing decisions' or 'inefficient communications',[19–21] indicating that marketing or communications departments often did not have a clue about the way to market or communicate the innovation towards different segments. Some even emphasise 'the need to effectively communicate with consumers in order to increase adoption rates' as the major challenge for new technologies managers.[22] Others explain failure by the inclination to offer 'too much too soon',[23] indicating there was insufficient insight into the different adopter segments, their adoption potential and their interest in various applications. As a consequence, many potential adopters did not adopt because they were overwhelmed by an offer that was too big, or that contained too many (sophisticated) applications that were not appealing to them. Dodgson[24] remarks that this latter inclination needs to be tempered by sufficient user insight to make sure that the initial offer still appeals to the majority of the market.

On the demand side consumers have become more exacting, more fragmented[25] and less predictable.[26] Traditional assumptions about 'earlier adopters' being typically male, younger, more highly educated, having a higher income and a larger family size, owning relatively more ICTs and using these at a higher frequency[27–30] etc are no longer typical or consistent in the ITC environment.[31–34] Segment profiles based on demographics, media usage and media ownership — traditionally assumed to be applicable to several products and product categories — are not that reliable anymore. Therefore, in line with authors stating 'attitudinal variables' to be more powerful predictors of innovative adoption behaviour when compared to the above-mentioned demographic and media-related variables,[35,36] many emphasised the importance of predictors or adoption determinants such as 'social influence',[37,38] 'network externalities',[39,40] 'perceived complexity',[41,42] 'perceived trialability',[43,44] 'perceived compatibility',[45,46] 'relative advantage',[47,48] 'willingness to pay',[49,50] 'optimism',[51,52] 'tangibles',[53,54] and 'image'.[55,56] In addition, however, perceptions of these factors are not always that consistent anymore, a theory put forward in previous research.[57–59]

Briefly, the increasing number of failing innovations make clear that the traditional bell-shaped adoption pattern of 2.5 per cent innovators, 13.5 per cent early adopters, 34 per cent early and late majority and 16 per cent laggards is not that evident anymore. For more and more innovations, diffusion suddenly stops and adoption stays limited to some innovators and early adopters. It has also become clear that a profound preliminary consumer insight in adoption potential and the potential adopter segments has become an absolute necessity to make 'better judged marketing decisions' or to

design a more effective gradual introduction strategy — a strategy in which the introduction of the innovation is tailored to the market and in which the innovation has the best chance of penetrating deeply into that market.

EXISTING METHODS DO NOT SATISFY

The above shows that a mix of forecasting and segmentation is required. Forecasting is needed because, when the product is not yet on the market, predictions need to be made about the course of the adoption curve, segment sizes and adoption potential. Segmentation is needed to obtain detailed profiles of innovators up to laggards for a specific innovation. As discussed above, traditional assumptions on the generalisable profiles of these adopter segments have become unreliable and inconsistent. Making a preliminary market segmentation on these demographic and media-related variables, but also on more attitudinal or perceived adoption determinants, is consequently not a good option. Meanwhile, since the list of adoption determinants has become so extensive, it has also become very unlikely that a segmentation tool or mathematical diffusion model can adequately and simultaneously cover for all these determinants.[60]

Besides these segmentation criteria, literature also reveals many other methods for obtaining segmentation forecasts for innovations. These can roughly be divided into four traditions (qualitative methods, bibliometrics and analogies, modelling or econometrics and scaling). None of them however, seem to be able to provide the requisite consumer insights prior to launch.

Since qualitative methods (such as Delphi) have too small an empirical basis, and their focus is on expert opinions rather than on consumer insight, they are inadequate for making reliable generalisations at the consumer level. The reliability of the second tradition is often questioned because it produces forecasts based on an input from other contexts, atypical for the innovation under investigation. Bibliometrics[61] is a tradition in which forecasting research is done on a non-statistical bibliographic/literature base. Analogies use experiences with or data time series of analogue products[62,63] to produce forecasts — based on previous experiences and introductions elsewhere, conclusions are drawn in order to launch a new product. For example, study on the NTT DoCoMo case (3G) showed that because of the specific Japanese societal and business context it would be naïve to export the strategy to Western Europe.[64] In contrast to the two previous traditions that rarely result in a concrete forecast of adoption curve and segments, econometrics/modelling and scaling do result in such forecasts. Yet, they also are unsuitable for making preliminary segmentation forecasts. Econometrics (eg the generalised Bass Model[65]) are not usable prior to launch, because they need an input of data, for some variables, over a period of at least a couple of months from introduction. Evidently, these data are not available prior to launch. The method that best suits this study's needs is that of scaling. One of the most frequently used scales within this tradition is the DSI scale of Goldsmith and Hofacker (Table 1).[66] This is a scale that consists of six items, measuring innovativeness as personality trait, which has long been supposed to be the most important adoption determinant, and consequently also segmentation criterion.[67,68]

As the name of the scale suggests, the dots need to be filled in with the name

Table 1: DSI scale of Goldsmith and Hofacker[69]

1.	In general, I am among the first (last) in my circle of friends to buy a new . . . when it appears.
2.	If I heard that a new . . . was available in the store, I would (not) be interested enough to buy it.
3.	Compared to my friends I own a few of (a lot of) . . .
4.	In general, I am the last (first) in my circle of friends to know the titles/brands of the latest . . ..
5.	I will not buy a new . . . if I haven't heard/tried it yet. (I will buy a new . . . if I haven't heard/tried it yet.)
6.	I (do not) like to buy . . . before other people do.

of a domain or broad product category, eg ICT. By answering these Likert-statements on a five-point scale (1 = I completely agree, … 5 = I certainly disagree), respondents end up with an innovativeness score for the domain ICT between 6 (6 × 1) and 30 (6 × 5) (after scaling items in same direction). This serves as an input for a segmentation into five adopter segments, from innovators up to laggards (using 'arbitrary cut-offs' or using a 'percentile based split-up', sticking to the fixed ratio of 2.5 per cent innovators, 13.5 per cent early adopters).

Without going deeper into the way this segmentation is made, or into remarks on the reliability and validity of this scale,[70] the main question is about the usability of this scale because the authors assume it is neither specific nor accurate enough. First, as the name of the scale suggests, the focus is on domain innovativeness or the degree of innovativeness towards a certain domain or product category. Some authors however, distinguish this domain innovativeness from a more global degree of innovativeness, and from a more product-specific degree of innovativeness, an innovativeness towards a specific product within a certain domain or category. The authors certainly do not question the value of 'innovativeness' as an adoption determinant, but do wonder if innovativeness as a personality trait and segmentation criterion could not be better predicted or measured by accounting for the different levels of innovativeness (instead of only one level, eg the domain level).

> Q1: 'Is it possible to measure innovativeness more accurately by accounting for different levels of innovativeness?

Secondly, it needs to be kept in mind that the DSI scale-based segmentation still results in innovation segments for a domain or broad category, and not for a specific product. A naïve interpretation (as is often the case in practice), could lead to the conclusion that an innovator for the ICT domain is automatically also an innovator for every product within that domain. Following this reasoning, exactly the same people would be targeted as innovators for 3G as for digital television (DTV). Evidently this makes no sense. In general, an ICT-domain innovator will indeed be innovative for most products within that domain, but the domain profiles are too vague to be reliable for every product within that domain. Filling in the concrete product on the other hand (on the dots of the DSI items) is absurd bearing in mind that the questions are asked before the product is on the market.

PSAP SCALE

Since traditional segmentation criteria have become unreliable due to inconsistency and existing methods cannot be used in advance, are not

precise enough or are simply impractical, because they have to cover for a too extensive number of determinants, the authors developed the PSAP scale as a tool for preliminary segmentation forecasting. The scale consists of only three questions, which makes it easy to implement in large-scale survey research. The three questions gauge for hypothetical adoption intentions, by which they also meet the need for more 'attitudinal' segmentation criteria. 'Product specific' refers to the ability to come up with a forecast and a segmentation that is more accurate for a specific product than the DSI result (see Q2 below). With 'Adoption potential' the emphasisis is that the scale measures a broader concept than 'innovativeness' (see Q3 below).

A first obstacle in the attempt to make a forecast is that users must be asked about an innovation before it is on the market. To make sure that every respondent has an equal, objective and clear picture in mind about the innovation, the authors opted for a survey by means of a personal interview. In this interview the respondent receives a document explaining what the new product is and what can be expected from it. Interviewers are trained to discuss this information with the respondent, in order to make sure that all respondents have an equal and correct notion of the product. Once the interviewer is sure of this, the first PSAP question can be asked:

> 'Suppose … were available to you now. As you have it in mind right now, up to what degree would you be interested in adopting/purchasing this?'

To answer this question the respondent has five possibilities:

1 'I will subscribe/adopt immediately';
2 'Big chance I subscribe/adopt';
3 'Let's wait and see, maybe later';
4 'I don't think I will subscribe/adopt';
5 'I certainly won't subscribe/adopt'.

The answer to this question gives an impression of the global interest or attitude at first sight. The second and third PSAP questions are used to refine this impression.

After the respondent has answered this first question, the interviewer starts discussing the innovation again with the respondent: in depth this time, paying attention to the possible applications and features, the willingness and ability to pay for these applications, but also possible adoption determinants and thresholds such as price, usability, design, complexity, social pressure. For the respondent this creates a concrete impression of the innovation, and it indirectly forces them to think about (and evaluate) the innovation in all its facets. It also gives the interviewer an idea of what may appeal to the respondent, and what may be possible drivers or thresholds. After this, the respondent receives the second and third, more specific, PSAP questions. Based on the preceding discussion and answers, these questions are formulated by the interviewer.

> 'Suppose … were available to you now, in its most optimal conditions for you: only the applications/features/services you are interested in, and at a price that isn't exceeding the price you are willing to pay for it. Up to what degree would you be interested in adopting it or subscribing to it?'

> 'Suppose … were available to you now, in only suboptimal conditions for you: a bit too expensive, or an offer that also contains applications you are not interested in. … Up to what degree would you be interested in adopting it or subscribing to it?'

Both questions can be answered in the same way as the first one. In a survey on 3G for example, where the discussion could have told the interviewer that €17 a month was the maximum for the respondent who is only interested in multimedia messaging services (MMS), e-banking, GPS and the reservation applications, the questions could have been formulated this way:

> 'Suppose 3G is available to you today. The package offered includes MMS, e-banking, reservation possibility and GPS, at a price of €17/month. Up to what degree would you be interested in subscribing?'
>
> 'Suppose 3G is available to you today for €22/month. This offer would include MMS, e-banking, GPS, VOD [video on demand], gaming and home automation applications. Up to what degree would you be interested in subscribing?'

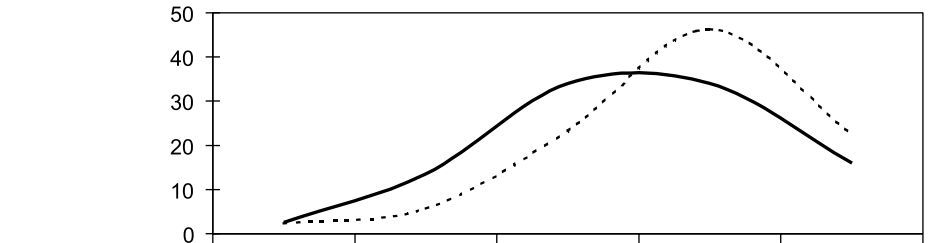
The inclusion of adoption drivers or thresholds depends on the preceding discussion with the respondent, as does the choice of the applications included in these questions. For respondents who appear to find it important what their social environment thinks of them, the 'optimal question' can be extended for example with the sentence: '…, but your friends are very negative about the product'. Or for people who appear to be complexity sensitive, sentences such as '… very easy to work with (one button)' or '… you need a manual to work with it' can be added to gauge the impact of the determinant 'perceived complexity'.

With the use of the three core questions in this example, the respondent is confronted with an optimal and a suboptimal offer (more expensive, without the preferred reservation applications, plus applications (s)he is not very interested in, ie in home automation services, VOD and gaming). Based on the answers to the three cumulative questions (Mokken-analysis proved reliability with RHO-value of 0.87 and H-index of 0.74), the respondents can be assigned to five segments (innovators up to laggards) in a logical and gradually curving way. If the respondent does not answer the first global PSAP question positively it is already certain (s)he will be situated at the back of the adoption curve. If someone, on the other hand, answers this first question positively and stays quite sure of their intention to adopt the optimal and suboptimal offer, they will be situated at the front of that curve. People still intending to adopt the suboptimal offer immediately can be considered innovators. People answering the global question and the optimal question positively but not being outspoken on the suboptimal offer will be situated somewhere between early adopters and early majority, because they do not seem that convinced. By combining all answers of every respondent on these three questions in a segmentation heuristic, every respondent is ranked in a gradual curving way according to their 'adoption potential' or their intention to adopt.

Since one of the main drivers for developing a new tool was the lack of precision or product specificity of scaling methods such as the DSI scale, the second research question is:

> Q2: 'Is the PSAP segmentation more product specific when compared to an already validated method such as the DSI segmentation?'

Having only three intention-related questions as segmentation criteria can raise the question whether that is enough to cover factors such as innovativeness, complexity and sensitivity to price which are supposed, according to the literature, to be significant adoption determinants.



	innovators	early adopters	early majority	late majority	laggards
PSAP	2.3	5.7	23.2	46.3	22.5
DSI/theory	2.5	13.5	34	34	16

Figure 1 Forecast adoption curve UMTS (based on PSAP scale) vs theory

To check whether the scale indeed measures a broader concept than just innovativeness, the third question is formulated:

> Q3: 'Is the PSAP scale covering more than just innovativeness as the adoption determinant?'

CASE STUDIES

To test the validity and reliability of this PSAP scale and the resulting segmentation, a series of case studies (digital television (2), UMTS (3), X-Box, broadband) was conducted. As an illustration for this paper the most recent study, in which an innovation segmentation is made for UMTS in Belgium, is used. Based on a sample of 836 face-to-face interviews, the three PSAP questions resulted in the forecast for 3G's adoption curve in Belgium (Figure 1). The dotted line represents the PSAP forecast; the full line is the theoretical curve. The latter is also the same as the DSI forecast based on theoretical percentages.

These curves immediately show that the adoption of UMTS does not promise to go as smoothly as some might expect. When compared to theory, there appear to be fewer innovators, early adopters and early majority, and a more bulky second part of the adoption curve. This implies that there is a risk of getting stuck with some innovators and early adopters. With segment sizes that deviate from the theoretical ratio, the PSAP scale allows for variable segment sizes, which is considered a shortcoming of the traditional diffusion concept.[71–73]

The difference in segment sizes indicates that the DSI segmentation differs from the PSAP segmentation, but does not yet give an answer to the second question. To discover whether the PSAP segmentation is more specific, the degree to which it is able to make a distinction in the interest in applications for every segment and the coverage for adoption determinants is investigated. The latter is also used to find an answer to the third research question.

In order to find an answer to the third question, a battery of 30 Likert statements was included (see below). The choice of these statements is based on literature research and preliminary qualitative research (focus groups + Kelly Grid), and is an operationalisation of adoption determinants for ICT and mobile telephones. Factor Analysis (R^2: 0.58) revealed that 18 statements could be summarised in four reliable factors: 'innovativeness' (alpha 0.89, items 1, 2,

3, 4, 6, 8, 21, 22); 'complexity' (alpha 0.75, items 23, 24, 25, 30); 'image-sensitivity' (alpha 0.69, items 12, 14, 15, 28); and 'trialability' (alpha 0.71, items 13, 27). Because the other factors scored below 0.65 on the reliability measure, the remaining 12 items were kept as separated items for further research.

The operationalised adoption determinants (item 1−item 30) were:

1 In general, I am among the first of my friends to buy new ICT
2 If I heard a new ICT was available, I would be interested enough to buy it
3 I immediately adopt new ICT otherwise I fall behind
4 In general, I am the first in my circle of friends to know the brands of the latest ICT
5 To buy new ICT, I follow the advice of others
6 I like to buy new ICT before other people do
7 If I first have to read a manual to find out how things work, I don't buy new products
8 In general, I follow new trends
9 Usage of mobile telephones is too expensive
10 I regularly talk to friends about the newest things concerning mobile phones
11 I pay attention to the length of my (phone) conversations and the number of SMSs
12 Design of a mobile phone is very important to me
13 I don't buy new ICT before I have tried them out
14 I am influenced by ads and commercials on ICT
15 If my peer group considers something as 'in', I'll consider buying it
16 I may be interested, but I'd rather wait until prices fall
17 I have no problems with asking friends/colleagues how my mobile phone works
18 I feel annoyed if I can't join the conversation on new ICT
19 Even if I am interested, I wouldn't buy if my peer group would be negative about it
20 I wait to buy new things until I know others have positive experiences with it
21 Compared to my friends/colleagues, I know a lot about mobile phones
22 Compared to my friends I own a lot of ICT
23 A mobile phone is an easy thing to work with
24 Calling and SMS are still ok. More applications will make mobile phones too complicated
25 The more applications on my mobile phone, the more I feel uncomfortable
26 Usability and user-friendliness are very important to me when I buy new things
27 I prefer to have some experience with something before I buy it
28 It leaves a good impression to have a nice mobile phone with a lot of a applications
29 I always choose the cheapest if I have a choice
30 More applications than those we have now on a mobile phone are very interesting.

DSI AND 'INNOVATIVENESS' (Q1)

In the item battery, the six DSI items measuring domain specific innovativeness are represented by the items 1, 2, 4, 6, 13 and 22. As can be expected, a Cronbach alpha of 0.7897 proves this to be a homogenous set of items. Deletion of item 13 (item-total correlation only 0.0638), however, significantly increases the reliability of the scale up to 0.8626. In other cases in which the DSI scale was used a similar result was found (the

Table 2: Estimates for one-factor measurement model

Variables	Estimate	Std error	Critical ratio	Std estimate
Item 8	1.148	0.064	18.076	0.740
Item 21	0.898	0.060	14.843	0.583
Item 3	1.000*			0.641
Item 2	1.135	0.058	19.691	0.829
Item 22	1.020	0.061	16.717	0.672
Item 6	0.885	0.052	17.037	0.687
Item 4	1.164	0.063	18.420	0.758
Item 1	1.267	0.065	19.442	0.814

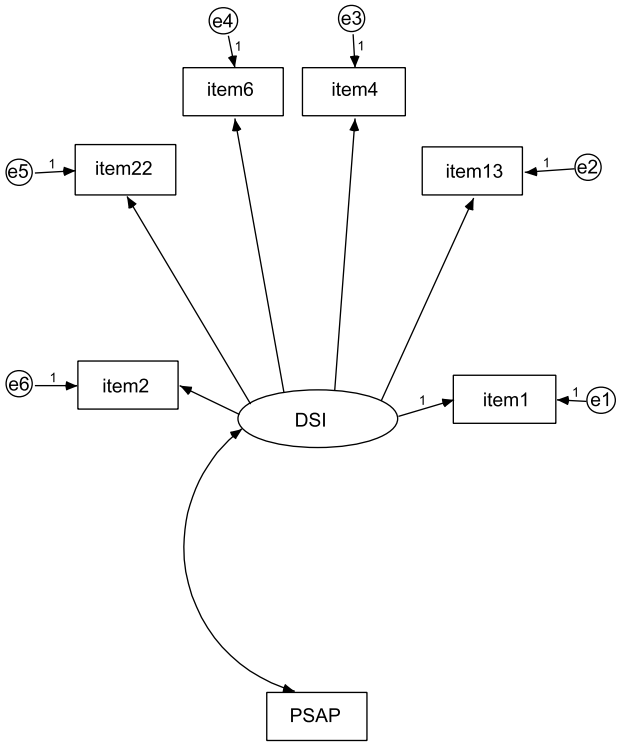
DTV case (2001) gave an increase from 0.7171 to 0.8364). This indicates that item 13 is not a good indicator for the concept 'innovativeness'. The factor analysis showed that this item correlates better with other than the innovativeness items. Together with item 27, item 13 (I don't buy new ICT before I have tried them out) constitutes a factor 'trialability', clearly distinguishable from the innovativeness factor.

Besides this evaluation of the DSI scale, the revealed innovativeness factor appeared to consist of eight items: five DSI items and three additional items 3, 8 and 21. With a Cronbach alpha of 0.8921 this proves to be an even more reliable scale for innovativeness. If these additional items measure a global innovativeness (item 8), a product innovativeness (item 21) and a domain innovativeness in the context of social pressure and influences (not to fall behind when compared to their peer group) (item 3), it may be concluded that innovativeness can be better predicted if different levels of innovativeness are accounted for. By deleting item 13, and adding items gauging for a global innovativeness and product specific-innovativeness in other words, the reliability of the innovativeness scale can be improved by more than 10 per cent.

According to Table 2 all estimates are significantly different from zero, and all indicator variables have an equal relationship with the one factor, as can be seen in the std. estimate column. Item 3 has an estimate equal to 1, since it has been used to 'set the metric'. The one-factor measurement model shows excellent fit: DELTA1: 0.991; RHO1: 0.984; DELTA2: 0.992; RHO2: 0.986. Due to sparse missing data, the full maximum likelihood parameter estimation procedure present in AMOS (the software employed in order to obtain the model) was used. According to previous research, this procedure yields unbiased estimates under the presence of missing-at-random (MAR) data.[74]

PSAP: MORE SPECIFIC? (Q2)

As mentioned earlier, the precision of the DSI scale of Goldsmith and Hofacker as a segmentation tool for specific new products is questionable. A substantial part of the DSI innovators for the domain ICT for example, will indeed be innovators for some technologies within that domain, but it would be naïve to assume that a domain innovator is always an innovator for every product within that domain. Translated to a specific product such as 3G, this means that some of the DSI innovators for the domain ICT, will indeed be innovators for the specific product 3G, while other



Path	Estim.	Std E.	CR	Std_Est
Item 1	1.000			0.832
Item 13	0.093	0.043	2.185	0.080
Item 4	0.890	0.038	23.497	0.750
Item 6	0.669	0.033	20.443	0.672
Item 22	0.752	0.039	19.272	0.641
Item 2	0.896	0.033	27.202	0.846
Cov.	0.266	0.028	9.431	0.380

Figure 2 LISREL measurement model for PSAP vs DSI segmentation

domain innovators are actually early adopters or early majority for that product. In other words, a significant, but not perfect, correlation is expected between the DSI and the PSAP segmentation. This is confirmed in a correlation of 0.38 in the measurement model in Figure 2.

The goodness of fit of this measurement model certainly satisfies (DELTA1: 0.997; RHO1: 0.994; DELTA2: 0.998; RHO2: 0.996), and as can be seen in the table again, item 13 is not a good indicator of innovativeness. Having found a correlation of 0.38 between both segmentations, both segmentations correlate significantly, but they do not match perfectly. This still does not illustrate the PSAP scale to be more product specific than the DSI scale. If the PSAP scale is expected to be more product specific, it should be able to make a better discrimination between the different adopter segments for a specific product. To be more specific, it must be able to detect the real product innovators among the domain innovators as innovators, and to restrain the less innovative ones for 3G (among the domain innovators) as early adopters or early majority. To find out which one of the two segmentations makes the most precise distinction between adopter segments, the interests of the segments in different applications of the innovation are investigated.

In the DTV case (2001) respondents had to indicate how interested they were in 17 applications. In the 3G case (2003) they did the same for 34 applications. Comparing these evaluations for both ways of segmentation (Figure 3, lines representing adopter categories, scale 1 (not interested) up to 5 (extremely interested)), the PSAP scale is concluded to be more specific than the DSI scale.

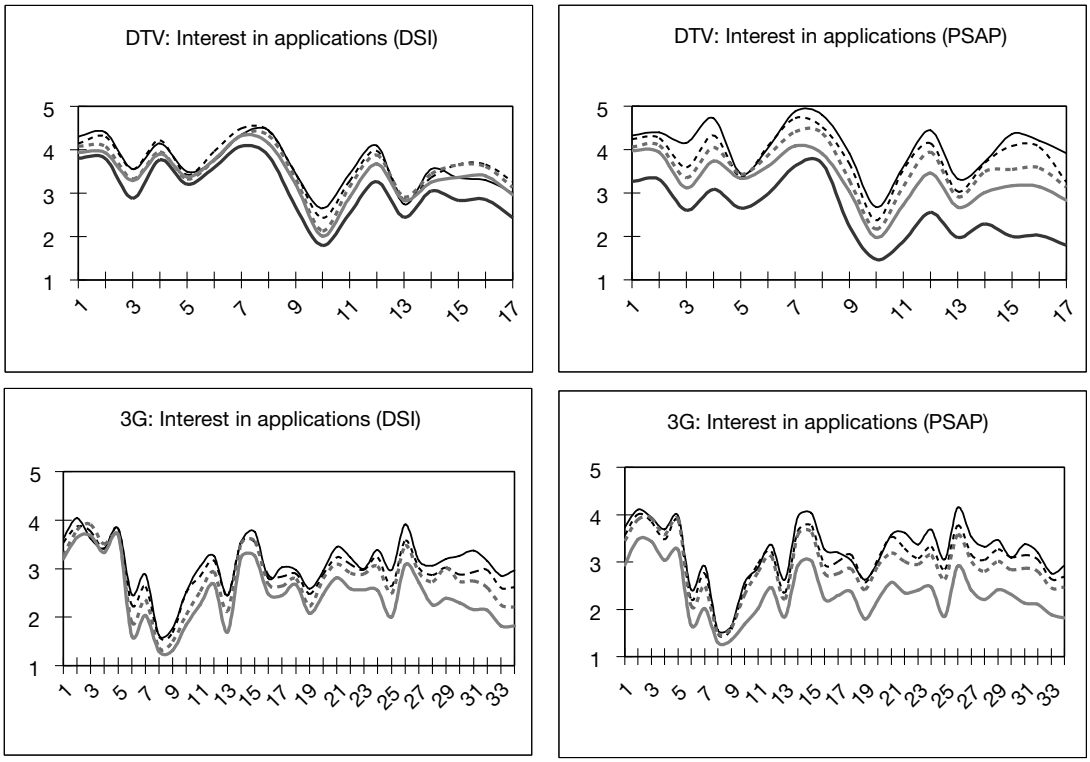


Figure 3 DSI vs PSAP segmentation for interest in applications of DTV and 3G

The PSAP scale appears to make a clearer distinction between the adopter segments for the specific products than the DSI scale does. In Figure 3 the two charts on the left side show the interests of the segments based on the DSI segmentation; the right side gives the interests of the segments in the PSAP segmentation. In all four a logical global decrease in interest from innovators to laggards is seen, but it is immediately striking that the DSI figures are more blurred, while the PSAP distinction is clearer between the adopter segments.

Using the PSAP segmentation, for DTV as well as for 3G, Kruskall Wallis and one-way ANOVA indicate a significant difference in interest between the different segments for all 51 applications (17 for DTV and 34 for 3G; all significant at the 0.01 level, except for one DTV application with $p = 0.04$). The DSI segmentation on the other hand is less differentiating. In the DTV case, there was no significant difference at all for seven applications ($p > 0.05$), four were significant at the 0.05 level, and on only six applications the differentiation was significant at the 0.01 level. Looking at the DSI segmentation for DTV (upper left) the 'innovators' are rarely seen to be clearly more interested, or the laggards less interested. In the PSAP segmentation on the contrary, innovators are clearly more interested than the rest of the market, and laggards are clearly the less interested segment for the specific product. In the 3G case this trend is less obvious. Nevertheless, the PSAP segmentation still results in 34 significant differences at the 0.01 level, in contrast with only 22 significant differences on that same significance level when using the DSI scale to make the segmentation.

Table 3: Forecast (3G) vs current adoption (2.5G)

	Innovators	Early adopters	Innovator and Early adopters	Early majority	Late majority	Laggards	Total
Not yet adopted	3 (30%)	8 (40%)	11 (36.7%)	23 (76.7%)	26 (86.7%)	29 (96.7%)	89 (74.2%)
Adopted	4 (40%)	8 (40%)	12 (40%)	5 (16.7%)	3 (10%)	0 (0%)	20 (16.7%)
Not yet adopted, but considering in near future	3 (30%)	4 (20%)	7 (23.3%)	2 (6.7%)	1 (3.3%)	1 (3.3%)	11 (9.2%)
Total	10 (100%)	20 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)	120 (100%)

Since UMTS or third generation mobile telephony is not yet available on the Belgian market, the authors were limited to the usage of adoption intentions and the interest in applications to validate the precision of the PSAP scale. The best way to validate the precision of the preliminary PSAP segmentation forecast remains, however, a confrontation with real-life adoption data. For UMTS this is still not possible, but since providers are upgrading their network capacity, several applications such as MMS, i-mode, mobile internet and digital camera features, have already been introduced. Because those forecast to be 'more innovative' for 3G by the PSAP scale are also assumed to be more innovative for these applications, some of them are expected already to have bought a new mobile phone that is compatible with these applications. Therefore, 120 respondents were contacted again in September 2003 (four months after the initial data collection), and asked if they had bought a new mobile phone during the previous three months (the period when MMS became available) that was MMS, I-mode or general packet radio service (GPRS) compatible, or had an in-built camera. Those who had not yet bought such a new mobile were asked if they planned to do so in the near future. Of each forecasted adopter category 30 members were randomly chosen. Since the innovator segment was too small (only 19 members), innovators and early adopters were considered as one segment of 'earlier adopters'.

Since the original data collection dates were April/May 2003, the period between test and retest was relatively short, about four months. Yet, there were already 20 people who had adopted a new mobile phone. Sixty per cent of them (12) were forecast as earlier adopters by the PSAP scale. Within the categories, 40 per cent of the forecast innovators and early adopters had already adopted a new model. This percentage drops to 16.7 per cent within the early majority, 10 per cent within the late majority and 0 per cent within the forecasted laggards. Also within the category of people that had not yet adopted, but were considering doing so in the near future, a similar consistent and logical decrease was found. With a significant Pearson chi (33.180, $p = 0.000$) and likelihood ratio (35.663, $p = 0.000$) this retest also serves as proof of the precision and predictive validity of the PSAP scale.

PSAP: COVERING DETERMINANTS? (Q3)

Being innovative is not enough to be likely to adopt an innovation. Besides the personality trait 'innovativeness' many other adoption determinants are

Table 4: Correlations PSAP x item battery of adoption determinants

Correlation with PSAP			
Innovat (F): –0.380**	Item 5: –0.047	Item 11: 0.098**	Item 19: –0.029
Complex (F): 0.281**	Item 7: 0.013	Item 16: –0.021	Item 20: 0.030
Image (F): –0.252**	Item 9: 0.115**	Item 17: 0.088*	Item 26: 0.015
Trialab (F): 0.019	Item 10: –0.114**	Item 18: –0.221**	Item 29: 0.164**

*: significant at 0.05 level
**: significant at 0.01 level

suggested in the literature and should be accounted for when making an innovation segmentation. Therefore, a battery of Likert statements was included in the survey as an operationalisation of the main determinants that appeared from literature research and preliminary qualitative research (see the list in the section describing the case studies). Factor analysis already revealed that 18 of these items can be summarised into four factors: innovativeness, complexity, image-sensitivity and trialability. To discover up to which degree the PSAP segmentation (based on three questions) covers these four factors and the remaining 12 single items, how they correlated with the PSAP scale was analysed (code 1 representing innovators and 5 laggards).

Concerning the four factors, two logical significant correlations were found for 'innovativeness' and 'image-sensitivity': people in the forefront of the adoption curve score higher on innovativeness and are more concerned about the look and feel of a mobile phone and the impression they make with their mobile phone. Also corresponding with earlier findings is the positive significant correlation of 0.281 with the factor 'complexity', indicating that people at the rear of the curve experience a higher complexity threshold when it comes to adoption: they feel uncomfortable sooner when ICT becomes complex or is perceived as more complex. For the factor 'trialability' no significant correlation was found.

Besides the four factors mentioned above, two frequently-mentioned determinants, 'social influences' (items 5, 10, 17, 18 and 19) and 'price sensitivity' (items 9, 11, 16 and 29), were accounted for but these were not revealed by the factor analysis. Except for item 16 (not sig.) three positive correlations were found for the price sensitivity items. This again makes sense, because it indicates that people at the front of the adoption curve are less sensitive to price than people at the rear of the curve. For 'social influence' a negative correlation with the PSAP scale could already be expected, since the items 1, 4, 22 and 21 of the innovativeness factor also partly covered a social influence component. This is confirmed in the negative correlations on items 10 and 18. The positive correlation for item 17 (0.088) reveals that people at the front of the curve have more problems admitting they do not know how to work their mobile phone. Finally, items 20 and 26 did not appear to correlate significantly with the PSAP scale.

Although significant correlations were not found for all items or determinants, three correlations with four factors and six correlations on 12 single items were found, from which it can be concluded that the PSAP scale covers for more adoption determinants than innovativeness alone.

CONCLUSION

In theory, more and more authors claim that 'corporate driven policy' of short-term vision and technology push, 'supply-side-reasoning',[75] 'field-of-dreams-thinking'[76] and only having attention for the technology itself should be left for a 'user-driven policy' of 'demand pull'.[77,78] Besides this theoretical evolution from a push towards a pull reasoning, findings in ICT practice also illustrate the need for better insight into the consumer in order to be better prepared for designing introduction strategies for ICT innovations. Since existing methods cannot obtain such insight prior to the introduction of an innovation, the PSAP scale is developed as a tool for innovation segmentation forecasting. This scale consists of only three questions, which makes it easy to implement in different kinds of research settings. This was necessary since traditional segmentation criteria become inconsistent and unreliable, and it became more and more unlikely for segmentation scales or mathematical diffusion models to cover the extensive list of adoption determinants adequately. Based on initial adoption intentions and adoption intentions towards an optimal and a suboptimal offer, the scale enables a 'prior-to-launch' segmentation forecast to be made that does not stick to fixed theoretical segment sizes. The attitudinal nature of these three questions also meets the need for more attitudinal segmentation criteria instead of the traditional segmentation variables.

To test the concurrent validity of the scale, it was compared with the DSI scale of Goldsmith and Hofacker. This comparison revealed the PSAP segmentation to be more precise and product specific than the DSI segmentation. For the latter, it was even found that the reliability of the innovativeness scale could be improved by accounting for different levels of innovativeness and by deletion of one item. Besides innovativeness, it was also found that the PSAP scale covered other adoption determinants well, such as complexity, image sensitivity, social influences and price sensitivity. Based on a retest with 120 respondents, initial proof was also found for the scale's predictive validity. With the presentation of this PSAP scale the authors hope to have contributed to the search for methods to obtain better consumer insight, into order to be better prepared for the introduction of innovations. It allows researchers and manufacturers to determine the likely sizes of adopter segments for upcoming innovations. It also allows detailed profiles of those segments to be made to give an insight into their needs and wants and the adoption drivers and thresholds. The insight into the segment-specific needs, wants and willingness-to-pay, enables determination of the right 'killer applications' for each segment, as well as the gradual order in which to offer the other applications.[78,80] The insight into drivers and thresholds can help as an input for developing more effective and segment-tailored communication and targeting, since 'the different adopter groups have to be told different stories about the benefits of the innovation'.[81] Briefly, the PSAP scale is a suitable instrument for more effective segment-based proactive targeting.[82,83] Use of the scale provides the necessary insight to 'define which types of customers to target with what offer and in what manner'.[84] If the survey is conducted anonymously, or when the profiles of the detected segment could be plotted on existing databases, one-on-one targeting may also become possible.

Unlike existing methods, this three-item scale enables a

product-specific, prior-to-launch segmentation forecast to be made for upcoming ICT innovations. The scale is consistent with prevailing assumptions on adoption determinants and offers a solution to the shortcomings of other methods.

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