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INFLUENCE OF ROGERS' TECHNOLOGICAL ATTRIBUTES ON INTERNET DIFFUSION DYNAMICS: THE CASE OF PIEDMONT REGION

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ABSTRACT

The spread of Internet technology tends to be slow especially among elderly people in many European countries. This situation appears even more critical if the demographic trends are considered in a context where the aging phenomenon will represent a significant challenge in the next future. This paper aims to investigate the relationship between age and Internet diffusion dynamics in Piedmont Region (Italy), mainly focusing on how people perceive the technological attributes and features of Internet technology. To achieve this objective a specific survey has been undertaken among Piedmont citizens. The questionnaire's responses show a low propensity exhibited by old age people towards the adoption of Internet. In particular, it emerges that the subjective perceptions of technological attributes and features of Internet - that significantly differ between users and not-users - may exert a great influence on its diffusion dynamics.

KEYWORDS

Internet, aging, technological attribute, diffusion of innovation, subjective perceptions.

1. INTRODUCTION

Nowadays, the low Internet penetration rates amongst elderly people in many European countries could represent a clear indicator of their reluctance towards the adoption of a new technology.
In Italy, for instance, the percentage of individuals aged 65-74 who have never used Internet accounts for 83% and, it reaches the 94% if we consider the individuals of 75 years old and over (Eurostat, 2010).
In this context characterized by a high old-dependency ratio (Figure 1), it seems to be worthwhile to investigate how people at risk of digital exclusion, in particular old age people, perceive the attributes and features of a determined technological innovation.

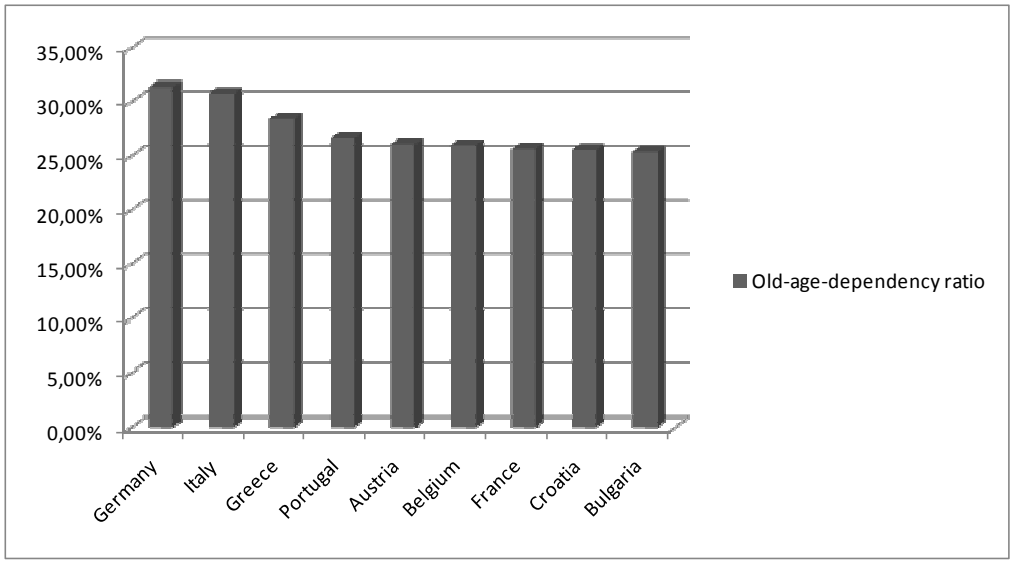


Fig. 1. Old-age dependency ratio in several European countries (source: Eurostat, 2010)

In this paper, we will investigate the relationship between age and Internet diffusion dynamics in order to figure out:

- how the subjective perceptions of the attributes and features of Internet may significantly differ among users and not-users belonging to specific age-cohorts;
- what are the consequences arising from the different perceptions by age group of technological attributes on the technological diffusion.

2. STATE OF THE ART

The topics of the present project lie at the intersection of different strands of literature.
In the first strand of literature concerning the diffusion of innovation, the most considerable contribution must be attributed to Rogers. According to the author, technologies can be characterized by five perceived attributes which include relative advantage, compatibility, complexity, trialability and observability and, are able to explain from 49 to 87 percent of the variance in the rate of adoption of an innovation (Rogers, 2003).
Some scholars have considered these technological attributes to examine the subjective perceptions of the features of several technologies, such as Wi-Fi technology (Lu et al., 2009), distance education system (Dooley and Murphrey, 2000), Internet banking (Chang, 2003), etc. However, little has been written about the relationship between age and Internet diffusion dynamics taking into account the perceived technological attributes by different age cohort in an aging society.
In the second stream of literature particular attention is given to the psychological aspects of ageing on the acceptance and use of a new technology. As a matter of fact, several scholars affirm that older individuals exhibit a lower acceptance of IT (e.g. PC, use of information systems or software packages at work) and a lower use of the technology over the long term (Hall and Mansfield, 1975). Different reasons have been advocated to explain this phenomenon, leading to attributes depending on age which include individual values and needs, capability and willingness to process complex information within an unfamiliar cognitive domain and capability to process visual information.
Other scholars focus on theories and models which analyse the main determinants of the information systems' use from a psychological perspective. In this context, Technology Acceptance Model (Davis, 1989) and the Theory of Planned Behavior (Ajzen, 1985) play an important role.
In particular, the Technology Acceptance Model emphasizes the importance of perceived usefulness and perceived ease of use such as the main factors that allow to predict individual adoption and use of new

Information Technologies. The Theory of Planned Behavior considers the factors which influence and predict the intention to perform a determined behavior. These theories have been recently used by some researchers in order to develop technology adoption models in households (Venkatesh et al., 2008), where age is considered a fundamental determinant of technology adoption and use.
Finally, some studies on the differences between younger and older people in the working environment show that different forces drive younger individuals to use a new technology in comparison to older ones (Venkatesh, 2003) (Morris, 2005): for younger individuals initial expectations about their potential personal gain related to using the new technology (e.g. extrinsic rewards, increased opportunities for career advancement at work) usually matter more than their initial confidence in possessing the knowledge necessary to appropriately use the technology. This implies that when younger workers have high incentives to use IT for personal gain, positive initial expectations may have a greater effect on the benefits achieved than in the case of older persons. Indeed, when deciding to use a new technology older individuals tend to give more weight to the perceived confidence (Morris, 2000).

3. METHODOLOGY

In order to investigate the relationship between age and Internet diffusion dynamics, the case of Piedmont Region has been considered.
Piedmont is one of the largest Italian regions with a relatively high old-age dependency ratio. More specifically, the number of elderly people aged 65 and over compared to the number of people of working age (15 to 64) reached the 40,87% in 2010 (Istat, 2010). A specific survey has been devised, prepared and undertaken by Istituto Superiore Mario Boella with the collaboration of Politecnico di Torino in order to obtain the values of Rogers' technological attributes about how Piedmont citizens perceive the use of Internet technology.
The questionnaire about technological diffusion in Piedmont Region has been submitted both online and via telephone interviews to a sample of 180 Piedmont citizens (with a confidence level of 95%) through LimeSurvey, a free and open source survey software tool.
The demographic profile of survey's respondents divided by age group, gender and educational level is shown below (Table 1).

Table 1. Demographic profile of survey's respondents

		Frequency	Percent
Age groups	14-19	20	11,11%
	20-29	37	20,56%
	30-39	33	18,33%
	40-49	25	13,89%
	50-59	29	16,11%
	over 60	36	20,00%
	Total	180	100,00%
Gender	Male	86	47,78%
	Female	94	52,22%
Educational level	No education	2	1,11%
	Primary/Middle Schools	42	23,33%
	High School Diploma	69	38,33%
	Bachelor Degree/Master/PhD	67	37,22%

The choice of six different age groups has been made in order to have a deeper understanding of Internet diffusion dynamics within the various age-cohorts.

The questions addressed to Piedmont citizens aim at investigating their technological perceptions towards Internet adoption and use. It is been used a Likert scale ranging from 1 (strongly disagree) to 10 (strongly agree) to indicate, respectively, a state of disagreement or agreement with the survey's statements.
The measures on which we have focused through the survey are presented in the appendix (Table 2).
It seems to appropriate to specify that we have not taken into account the technological attribute that Rogers defines as 'compatibility' because of the difficulty encountered in setting up items as clear as possible for Piedmont citizens.
Once collected data from the questionnaire, item responses have been analysed using factor analysis (Table 3 contained in the appendix) enabling, also, to verify whether the identified items could be aggregated into Rogers' perceived technological attributes. For this purpose, we have employed a level of 0.5 for the Kaiser-Meyer-Olkin measure of sampling adequacy.
Furthermore, in order to control the internal consistency of the measure we have used Cronbach's alpha with a reliability threshold of 0.5.

4. SURVEY'S RESULTS

As far as Internet technology is considered, analysing the composition of Rogers' adoption categories by age group it emerges that 'innovators' include mainly the younger cohorts. In particular, Piedmont citizens aged 30-39 represent a large proportion of the first Rogers' adoption category probably due to a higher value of their innovation propensity compared to other age groups. Furthermore, we can observe that there is a small percentage of elderly people among 'early adopters' and 'early majority'. In addition, not-users of Internet technology account for a high percentage (60.76%) among over 60 Piedmont citizens.
This situation depicts a low propensity exhibited by old age people towards the adoption of a new technology compared to the younger age cohorts.

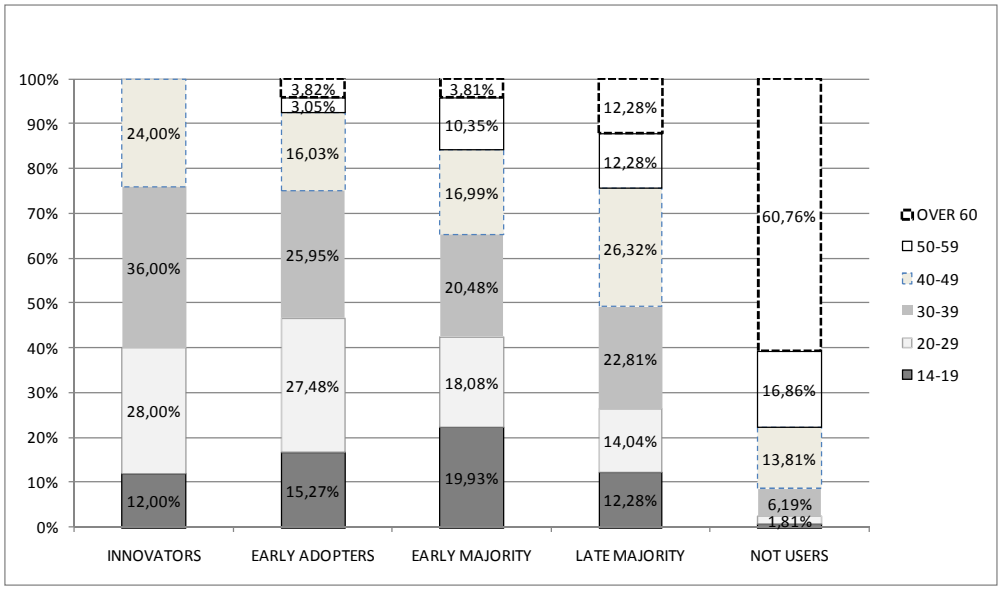


Fig. 2. Distribution of Rogers' categories by age group in Piedmont (source: Piedmont Observatory, 2010)

In order to study the influence that the subjective perceptions of Piedmont citizens may exert on Internet diffusion dynamics, the average values of survey's items with an acceptable threshold of factor loading (0.5) have been taken into account for each specific technological attribute (relative advantage, trialability, etc.).
Analysing survey's responses of Piedmont Internet users on a scale ranging from 1(minimum value) to 10 (maximum value), it emerges that Piedmont citizens by each age-group could have adopted Internet because of middle-high values of perceived usefulness, ease of use and 'observability' of the technology itself (the

latter technological attribute stands for the opportunity to have seen in its own social network other people while use the considered technology).

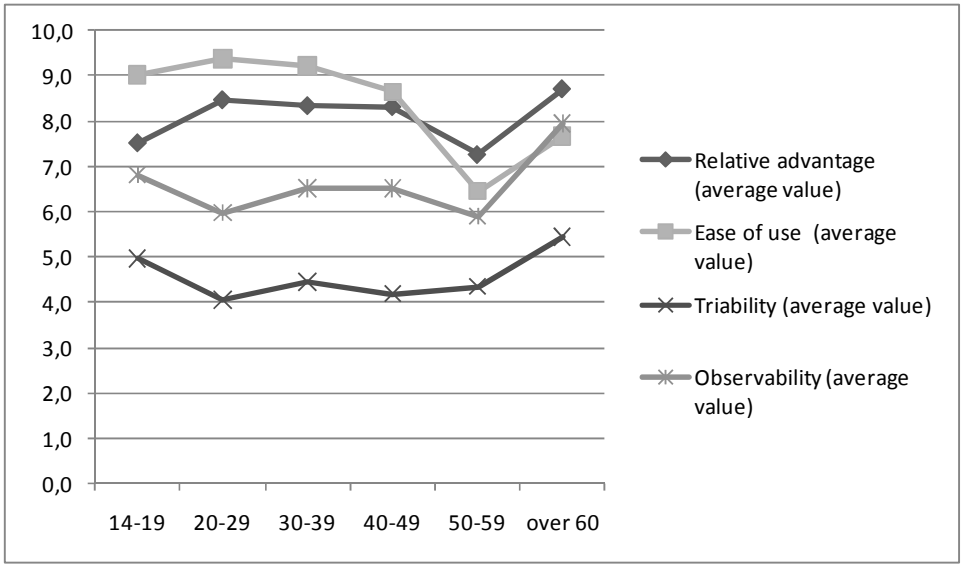


Fig. 3. Average values of technological perceived attributes of Internet technology among Piedmont users by age group (source: survey conducted by Istituto Superiore Mario Boella in collaboration with Politecnico di Torino, 2010)

Other observations could be made if we consider the different types of activities and uses that over 60 Piedmont Internet users perform in their daily life. As showed below (Figure 4), a percentage of almost 80% of over 60 citizens have stated to surf the Internet mainly in order to search information of their own interest. Furthermore, about 40% of senior citizens affirm that they use the Web to communicate with other people using social networks, instant messaging tools and chat instruments.

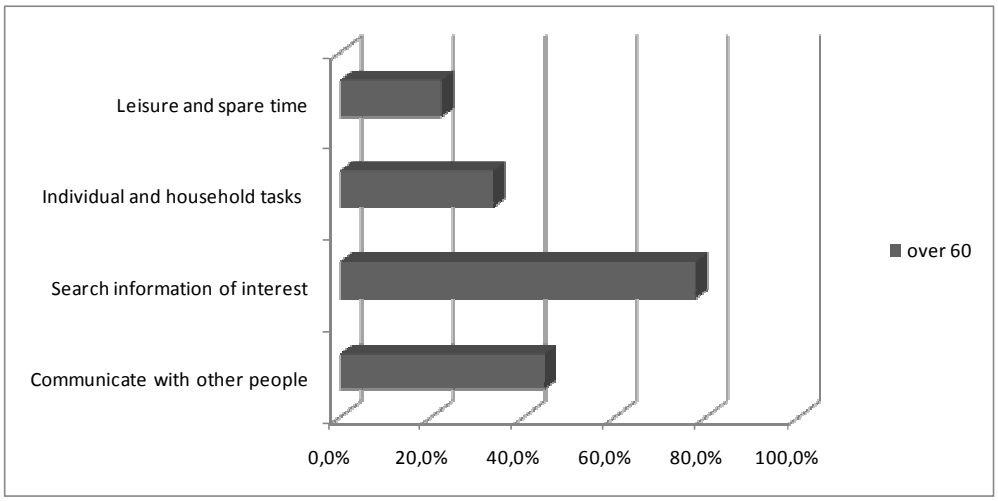


Fig. 4. Different uses by age group of Internet technology in Piedmont (source: survey conducted by Istituto Superiore Mario Boella in collaboration with Politecnico di Torino, 2010)

This result permits to highlight and stress the importance of social networks especially for the elderly who feel the need to be active and participative members of the society through the involvement in activities with friends, neighbours, and more generally groups of people not necessarily geographically close to them

(Russell et al., 2008). As pointed out by Webber (1963), the concept of "community without propinquity" exceeds the boundaries and limits of a specific geographic location and rises to a broader meaning of social networking characterized by interpersonal ties allowing socialization, support, exchange information and a sense of belonging and identity among members.
Moreover, interesting observations may arise considering how Piedmont citizens who are not still Internet users perceive the Internet technology. As showed in figure 5 we can observe how the subjective perceptions of not-users account for low-values which, also, decrease as people age.
More specifically, the interviewed elderly people perceive the Internet technology - they have never used in their life - as difficult to try (probably because they have had no chance to use the new technology in a trial-way), difficult to use (they could exhibit fear because of the novelty which the technology could represent for them) and not very useful (it is likely to consider that they are not aware about the potential and opportunities offered by several functionalities of the Web).

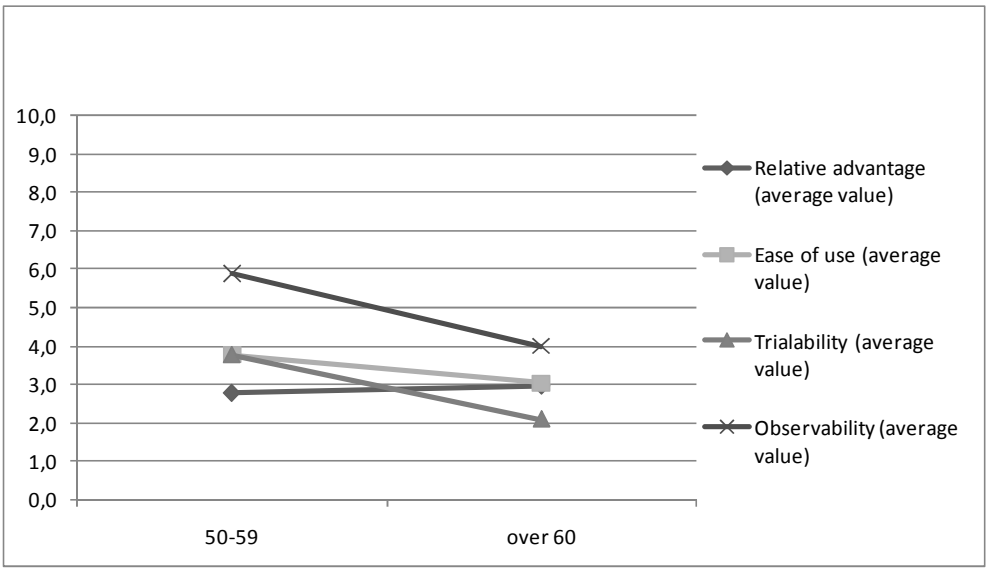


Fig. 5. Average values of technological perceived attributes of Internet technology among Piedmont not-users by age group (source: survey conducted by Istituto Superiore Mario Boella in collaboration with Politecnico di Torino, 2010)

Analysing survey's reponses, it is likely that subjective perceptions of individuals about the features of a new technology may exert a significant influence on technological diffusion dynamics. This consideration could explain why elderly people are less oriented to adopt a new technology compared to the younger age cohorts.
Other worthwhile observations may raise analysing the reasons given by Piedmont citizens about their not-adoption of Internet technology. Almost 40% of the interviewed elderly people wouldn't have adopted Internet mainly because they do not have a PC (there is still a problem of access to ICTs involving old age people or, simply, a lack of interest towards a new technology) and perceive the technology difficult to use. Further motivations concerning the not-adoption of Internet by older cohorts include the perception of fear towards a new technology because of possible technical problems which could occur using the technology. Moreover, it is interesting to observe that old age people, even if they do not consider the price of technology as high, are still not-users of Internet, probably because they prefer spending their spare time in other ways. For almost 20% of over 60 Piedmont citizens there is, also, the problem of lack of awareness about what Internet could allow them to do in their daily life.

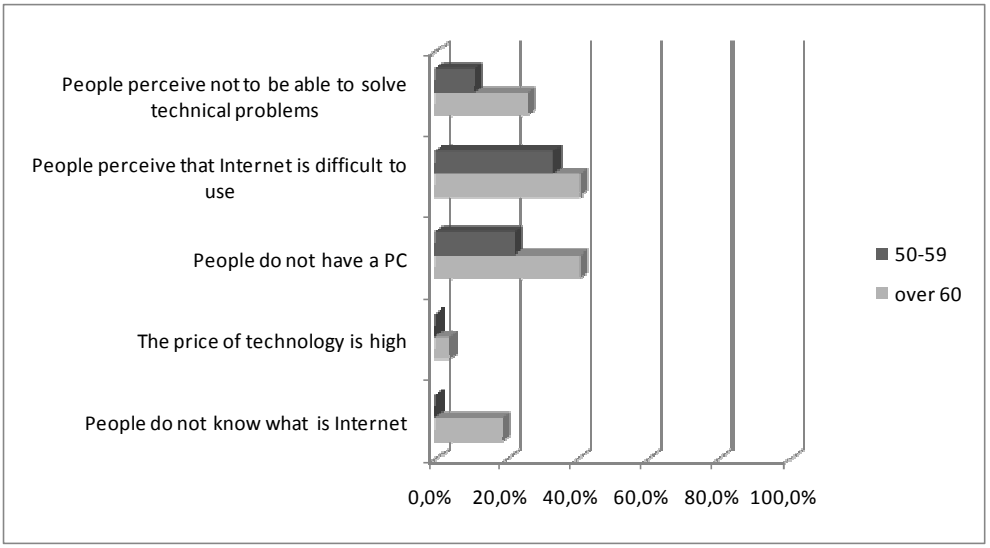


Fig. 6. Reasons advocated by Piedmont not-users about their not-use of Internet technology (source: survey conducted by Istituto Superiore Mario Boella in collaboration with Politecnico di Torino, 2010)

Considering the aforementioned observations, it emerges that specific policy interventions and actions addressed to that category at risk of digital exclusion, in particular old people, should be carried out by local policy makers in order to enable equal digital opportunities to a wider portion of population.
In the next future, it should be improved the awareness among elderly people about the potential and opportunities provided by the Web, for instance, through advertising campaigns on mass media, newspapers or magazines which could explain the benefits and advantages deriving from the use of Internet. In this context, advertising on television could be very effective because of its own peculiar repetitive messages which could capture the attention of old people which are used to watching this means of information. In this way, the willingness to adopt Internet could raise among elderly people who can enhance their interest towards the Web because of a higher awareness of the functionalities offered by the technology.
Furthermore, in order to reassure elderly people who could perceive Internet technology as difficult to be used, training courses specifically targeted at them could be provided.
Moreover, the establishment of technological and information centers located in meeting places for senior people could represent both a chance to access to Internet technology and a good opportunity to experiment the use of a new technology in a trial-way enabling the communication with other people. In such situation, old people - even if they do not have a PC at home - could be, anyway, able to use Internet technology, for instance, following a training course in their own city or attending a technological center in their favorite meeting place. Also the development of user-friendly and barrier-free web portals for elderly people could boost the adoption of Internet technology since 'senior websites' could lead to relevant information for them providing, for instance, worthwhile links to various services offered by local Public Administration and Government Offices.

5. CONCLUSIONS

This paper aims to investigate the relationship between age and Internet diffusion dynamics mainly focusing on the individual perceptions of attributes and features of the considered technology among people in an aging society. In order to achieve this objective, the case of Piedmont Region has been examined through a survey undertaken among Piedmont citizens by different age-cohort. The survey's responses show how the subjective perceptions that individuals exhibit towards Internet technology may exert a significant influence on its diffusion dynamics. In particular, concerning Internet users, it emerges that Piedmont citizens by each age-group could have adopted Internet because of middle-high values of perceived usefulness, ease of use and 'observability' of the technology itself (the latter technological attribute stands for the opportunity to

have seen in its own social network other people while use the considered technology). Conversely, as far as not-Internet users are considered, the interviewed elderly people perceive the Internet technology - they have never used in their life - as difficult to try (probably because they have had no chance to use the new technology in a trial-way), difficult to use (they could exhibit fear because of the novelty which the technology could represent for them), and not very useful (it is likely to consider that they are not aware about the potential and opportunities offered by several functionalities of the Web). Furthermore, it is possible to observe how the subjective perceptions of not-users which account for low-values decrease as people age.

Considering these observations, it emerges that specific policy interventions and actions addressed to that category at risk of digital exclusion, in particular old people, should be carried out by local policy makers in order to enable equal digital opportunities to a wider portion of population.

The effects of the implementation of specific policy actions on the technological diffusion will be presented in another paper.

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APPENDIX

Table 2. Measures investigated in the questionnaire

Construct	Item
Relative advantage	1. The use of Internet allows me to perform some daily tasks more quickly (e.g. to pay bills, to look for train timetables, to make a bank transfer, etc.)
	2. The use of Internet allows me to buy products/services more easily (e.g. to subscribe online to a magazine/newspaper, to buy a plain ticket, to buy books, etc.)
	3. The use of Internet allows me to communicate with relatives/friends/ colleagues more easily and quickly
	4. The use of Internet allows me to spend part of my spare time in a more enjoyable way and in line with my interests (e.g. to listen to music, to watch music/videos, to look for news of interest, etc.)
	5. The use of Internet allows me to perform my work activities more quickly and effectively
Ease of use	6. According to me Internet is easy to use
	7. According to me it is easy to use Internet alone without the help of relatives/ friends/colleagues
Observability	8. I have learned about Internet seeing my relatives/friends/colleagues/other people while use Internet technology
	9. Before using new functionalities/applications of Internet, I have had the opportunity to see them from relatives/friends/colleagues
Trialability	10. Before using new functionalities/applications of Internet, I have had the opportunity to try out them at house of relatives/friends/colleagues
	11. Before using new functionalities/applications of Internet I have had the opportunity to try out them in electronic stores, in Internet-points, at school, during specific courses

Table 3. Factors that describe the adoption of Internet technology

Factor	Item	Factor loadings	Proportion of variance explained	Cumulative variance explained	Cronbach's Alpha	Kaiser-Meyer-Olkin measure of sampling
Relative advantage	Item 1	0,822	49,538	49,538	0,733	0,631
	Item 2	0,784				
	Item 3	0,362				
	Item 4	0,257				
	Item 5	0,252				
Ease of use	Item 6	0,854	85,380	85,380	0,827	0,500
	Item 7	0,854				
Observability	Item 8	0,786	78,608	78,608	0,728	0,500
	Item 9	0,786				
Trialability	Item 10	0,678	67,831	67,831	0,52	0,500
	Item 11	0,678				