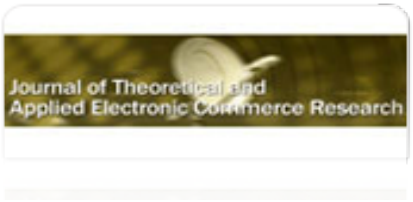

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Determinants of Consumers' Perceived Trust in IT-Ecosystems

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Abstract

Digital ecosystems, or IT-ecosystems (ITEs), are composed of multiple and independent entities such as individuals, organizations, services, software, and applications. Together, these elements create a number of new independent systems that operate and communicate with their own infrastructure (man to machine; machine to machine; person to person), sharing one or several missions. A better understanding of how ITEs and their interconnected components create benefits and added value for different types of consumers is of particular importance to the establishment of digital environments and to managing their resources. Considering different components of perceived trust in ITEs, we rely in this paper on a multi-dimensional framework of trust effects that includes system-centric as well as user-centric determinants of trust. Based on our conceptual model, we develop two sets of propositions. The first ones address technological drivers of trust in ITEs, whereas the second set of propositions considers individual as well as social drivers of trust. The model and propositions are discussed with reference to preliminary empirical results as well as to future research steps and business implications.

Keywords: Trust, Trustworthiness, IT-ecosystems, Digital environment, Man-machine-interaction

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Introduction

In recent years, the topic of perceived trust has gained growing interest in the context of research dedicated to examining consumers' acceptance and adoption of innovative technologies in our rapidly changing digital environment. Existing studies [22], [64] indicate that perceived trust in the reliability of technical elements and structures, as well as the fairness of other internet user, is one major determinant of sustainable internet usage among individuals.

With the emergence and increasing use-density of new technologies like the mobile internet, for example, different areas of the human living environment grow digitally together. This implies novel challenges for trust-related research. Furthermore, up-and-coming technologies like RFID and future trends like ubiquitous computing, ambient intelligence, and the connected (smart) home scenario have gained special attention in both research and business practice. Consequently, a need has developed to create a multi-disciplinary framework for better understanding and managing mechanisms associated with consumer-centered trust-building, expansion, and savings.

Against this backdrop, in our study, we will focus on examining users' trust in the digital components of an IT-ecosystem (ITE). Because we live in a continuously virtualized environment composed of individuals, organizations, services, and software applications, it is important to rely on theoretically and empirically verified models focusing on the interactions and inter-relationships among entities embedded within an ITE. Like biological ecosystems understood as a community of independent, partly cooperating, partly competitive components that is changing steadily, an ITE lies between the conflicting priorities of autonomy versus controllability. A perfectly operating ecosystem requires controlled management and must balance its strengths, several missions, and the interactions of the entities within the ITE.

Our paper includes three main sections. First, considering different components of perceived trust in ITEs, this paper aims to develop a multi-dimensional conceptualization of trust effects, including both system-centric and user-centric determinants of trust. Second, based on our conceptual model, two sets of propositions are developed and explored. The first one is dedicated to technological drivers of trust in ITEs, whereas the second set of propositions refers to users' individual and social drivers of trust. Third, the model and propositions are discussed with reference to preliminary empirical results, future research steps and business implications.

1 Construct Definition and Literature Review

Digital ecosystems, or IT-ecosystems (ITEs), are composed of multiple, independent entities: individuals, organizations, services, software, and applications. These elements create a number of new independent systems that operate and communicate with their own infrastructure (man to machine; machine to machine; person to person) sharing one or several missions. As self-organizing environments that continue to re-combine or further develop their digital components, ITEs are highly complex entities to study and manage. A better understanding of how ITEs and their interconnected components create benefits and added value for different types of consumers is of particular importance to supporting the establishment of digital environments and managing their resources. Therefore, considering and conceptualizing trust, acceptance, autonomy and controllability as crucial prerequisites at the intersection of marketing and technology, ITEs can become an information-based ecological system for consumers.

1.1 Components of Trust in ITEs

In the use of ITEs, the concept of perceived trust is key. Almost every aspect of personal interaction with information technology is based on trust in one way or another. A review of the existing literature reveals several formal definitions of trust: "*...trust is a term with many meanings*" [112]. The term is used in numerous interdisciplinary contexts. Therein, it has not always been treated as a distinct theoretical notion but has often been used to explain other notions or constructs. Particularly in this context, it must be pointed out that trust can be considered a substitute for risk because trust may represent a risk for the individual who trusts, the trustor [16].

Analogous to this concept of reciprocity, Grandison & Sloman (2000) define trust as follows: "*Trust is the firm belief in the competence of an entity to act dependably, securely, and reliably within a specified context.*" Similarly, Baier (1986) considers trust as "*… the belief that others will, so far as they can, look after our interests, that they will not take advantage or harm us. Therefore, trust involves personal vulnerability caused by uncertainty about the future behavior of others, we cannot be sure, but we believe that they will be benign, or at least not malign, and act accordingly in a way which may possibly put us at risk.*" The central component of uncertainty embedded in the construct of trust is central to the definition by Gambetta (1988): "*Trust as the subjective probability with which an actor assesses that another actor or group of actors will perform a particular action, both before she or he can monitor such action.*"

If we compare the existing definitions, we recognize that specific aspects can be regarded as constituent elements of trust: benevolence, caring, concern, competence, goodwill, good intentions and honesty [80]. To distill various

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components of this abstract construct, we present some general and specific definitions of trust from different research disciplines in *Table 1*.

Table 1: Definitions of trust

Author(s)	Definition
Baier (1986)	"Trust involves the belief that others will, so far as they can, look after our interests, that they will not take advantage or harm us. Therefore, trust involves personal vulnerability caused by uncertainty about the future behavior of others, we cannot be sure, but we believe that they will be benign, or at least not malign, and act accordingly in a way which may possible put us at risk."
Barber (1983)	Trust "as expectation of the persistence of the moral social order. …The first…as the expectation of technically competent role performance. … The second meaning of trust … concerns expectations of fiduciary obligation and responsibility to demonstrate a special concern for others´ interests above their own"
Barney/Hanson (1994)	"Trust is the mutual confidence that one's vulnerability will not be exploited in an exchange"
Boon/Holmes (1991)	Trust as a state involving confident positive expectations about another's motives with respect to oneself in situations entailing risk.
Rousseau et al. (1998)	"Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another.."
Gambetta (1988)	Trust is one actor's subjective belief regarding the probability that another actor or group of actors will perform a particular action both before she or he can monitor such action (or independently of his or her capacity to ever monitor it) and in a context in which it affects his or her own action.
Grandison/Sloman (2000)	"[Trust is] the firm belief in the competence of an entity to act dependably, securely, and reliably within a specified context."
Deutsch (1958)	An individual may be said to trust that an event will occur if he expects its occurrence and his expectation leads to behavior that he perceives to have greater negative motivational consequences if the expectation is not confirmed than the positive motivational consequences if it is confirmed.
Kreitner/Kinicki (1995)	Reciprocal faith in others´ intentions and behavior.
Lewis/Weigert (1985)	Trust exists in a social system insofar as the members of that system act according to and are secure in the expected futures constituted by the presence of each other or their symbolic representations.
Mui et al., 2002	"[Trust is] a subjective expectation an agent has about another's future behavior based on the history of their encounters."
Mayer et al., 1995	Trust is a willingness to be vulnerable to the actions of another person or people.
Olmedilla et al., 2005	"Trust of a party A to a party B for a service X is the measurable belief of A in that B behaves dependably for a specified period within a specified context (in relation to service X)."
Rotter (1967)	An individual's or group's expectation that the word, promise, or verbal or written statement of another individual or group can be relied upon.

As shown in *Table 1*, there is a wealth of research dedicated to the definition and conceptualization of trust and its prerequisites, conditions and consequences [4]. Several considerations are visible in these definitions, but as mentioned before in reference to ITEs, trust is considered so vital that a multi-disciplinary approach is necessary. Particularly for the sake of our research on trust in the context of ITEs, the viewpoints of sociologists, psychologists, economists, and computer scientists are of interest [23], [78]:

- *Sociologists* tend to see trust as structural in nature [39], [67].
- *Economists* view trust as a rational choice mechanism with a focus on the actor's reputation and its effect on transactions [21], [45], [112].
- *Psychologists* see trust as a personal attribute [33], [96].
- *Social psychologists* are more likely to view trust as an interpersonal phenomenon [28], [51].
- *Technologists* focus on the adoption of new technology [36], [38], [84].
- *Computer scientist*s mainly refer to the trustworthiness of information or specific services [4], [88].

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In an attempt to structure existing definitions, structural approaches, antecedents, and consequences of trust, we will rely on six key constructs of trust as defined by McKnight & Chervany (1996). These six trust-related constructs are 1) system trust, 2) dispositional trust, 3) situational trust, 4) trusting beliefs, 5) trusting intentions, and 6) trusting behavior. They form a group of trust dimensions that are conceptually distinguishable but are interrelated to each other in specified ways [78].

Especially as we consider the interdependency between trust and the adoption of ITEs, distinguishing between I) technology-driven and II) user-driven components of trust, these six constructs include the most important elements of perceived trust as represented in our conceptual framework and our propositions. For the purpose of our study, we categorize the six trust-related constructs into one of two groups:

1.1.1 Technology-driven Components of Trust in ITEs

The first set of trust-related constructs encompasses system trust, dispositional trust, and the situational component of trust. In general, these components of trust have to do with institutional phenomena and impersonal structures [67], [70], [98] and specific situations [6], [39], [67]. They are conceptualized as cross-situational or cross-personal [47] [115]. In our context, they are related to the technological characteristics that influence an individual's trust in ITEs.

- **System Trust:** Defined as the extent to which an individual believes that proper impersonal structures like structural assurances (e.g., regulations, guarantees, or contracts) and situational normality (which reduces uncertainty) enable an individual to anticipate a successful future endeavor, an individual's willingness to trust the components of an ITE is an important technology-driven element of trust in ITEs [67], [70], [78], [98].

- **Dispositional Trust:** Based on a cross-situational, cross-personal conceptualization of trust, dispositional trust refers to generalized expectations and a consistent tendency to trust an ITE across a broad spectrum of situations and persons [47], [78], [115].

- **Situational Decision to Trust**: This component of trust has to do with the extent to which an individual intends to trust every time a particular situation arises; the situational component of trust entails the user's decision to trust the ITE without taking into account the specific attributes of the other party involved [78], [95].

1.1.2 User-driven Components of Trust in ITEs

The second set of trust-related constructs – trusting beliefs, trusting intentions, and trusting behavior – is widely studied in social psychology and is based on the theory of reasoned action [2]: Certain beliefs and attitudes lead to behavioral intentions that become manifest in actual behavior. According to this belief-attitude-intention-behavior pattern in our context, an individual with trusting belief in another person or component is more willing to depend on that person or component and will behave in ways that manifest that reliance [25], [30], [78]. In our study, these components of trust relate to the individual and social aspects that influence a user's perceived trust in ITEs.

- **Trusting Beliefs:** Including cognitive beliefs/intentions and belief-related confidence in the other ITE components' traits and intentions, trusting beliefs indicate the extent to which an individual believes and feels confident that the other component is trustworthy and willing to act in the individual's best interests in a given situation [78], [80].

- **Trusting Intentions:** The intentional component of user-centric trust in ITEs can be defined as the extent to which an individual is willing to depend on the other ITE component in a given situation with a feeling of relative security, even when negative consequences are possible [78].

- **Trusting Behavior:** Supported by trusting intentions, the behavioral component of user-centric trust in ITEs is the extent to which the individual voluntarily feels secure in depending on the other components of the ITE, even when negative consequences are possible [67], [78].

In our study, we will concentrate on two sets of propositions with regard to technology-driven and user-driven components of trust in ITEs based on a multidimensional model as presented in the following paragraph. In the current stage of the study and for the purposes of this paper, the propositions consider trust in ITEs on a global level and are not specific to the different components of trust presented in our conceptual model.

2 Conceptualization and Propositions: Technological and User-centric Components of Trust in ITEs

The primary goal of this paper is to examine a multidimensional framework that may help us to achieve a better understanding of the drivers of trust in ITEs. With reference to the six elements of perceived trust as described above,

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we suggest that the crucial role of trust can be described by considering technology-driven and consumer-centered determinants. *Figure 1* shows the proposed conceptual model for investigating if and to what extent the construct of perceived trust in an ITE is related to technological and/or individual as well as social consumer-specific characteristics.

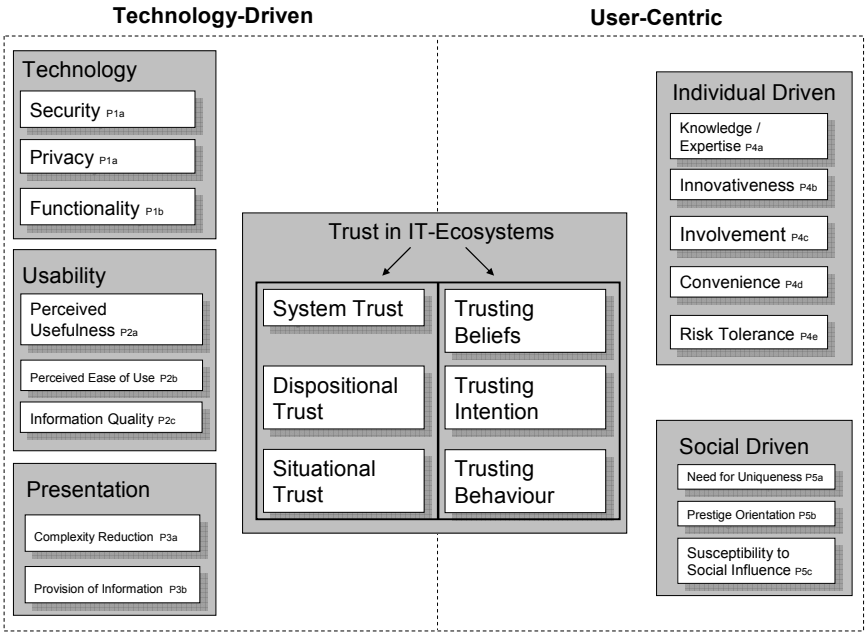

Figure 1: The Conceptual Model

2.1 Technology-driven Determinants of Trust

In determining the technological characteristics that influence consumers' perceived trust in ITEs and their components, we developed propositions focusing on three different notions: 1) The security, privacy, and functionality of the technology; 2) usability, including perceived usefulness, ease of use, and information quality; and 3) complexity reduction and the orchestration of information.

2.1.1 Technology

Security and Privacy: The importance of security issues is widely examined in the scientific literature and is associated with several aspects of using computers every day. Security mechanisms protect systems and data from being adversely affected by malicious and unauthorized parties [114]. The effect is that secured systems and data are considered to be more reliable and thus more trustworthy [5]. In e-commerce, security issues are the second-most important determinant of consumer trust. In particular, the use of secured payment mechanisms that prevent the leakage of credit card information and the use of technology that will keep a system safe from hackers play a significant role in giving the consumer a sense of security [86], [94]. In this context and within a world of smart things, some studies have indicated that privacy protection is more important than any potential benefits provided of new technologies. The sayings "*the walls have ears*" and "*if these walls could talk…*" have begun to ring true, which is disturbing to many potential consumers [14]. Particularly in everyday life situations, ITEs can cause a feeling of being watched or controlled. According to specific context issues, some researchers have advocated privacy as a preference that should be customizable by consumers based on their particular preferences [24], [58], [93]. In this vein, a high level of security will improve the probability of system trust and situational decisions to trust. Thus, safety and privacy in an ITE re a key technology drivers of the success of future services and developments and therefore are essential characteristics of ITEs.

This leads us to the following proposition:

P1a: *Guaranteeing the safety and privacy of modern ITEs and their components has a positive influence on the perceived trustworthiness and use of ITEs.*

Functionality: Concerns about the functionality of ITEs in relation to the consumer's needs must take into account the trade-off between autonomy and control. Brey (2005) points out that smart environments may help individuals to gain more control over the environment with which they are interacting. However, it may take away control as well. A world of smart components reduces controllability when the environment performs the wrong action, when it forces

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individuals to perform extra or corrective actions, when it shares information with third parties, and when it assigns monitoring and data collection to third parties [24]. Unobtrusive intrusions by smart systems may entail the installation of devices and applications that will be physically unobtrusive but could turn out to be psychologically obtrusive. Therefore, consumers may even invest their time and energy in understanding the workings of smart objects to try to outsmart them [11], [18]. In using smart objects, they require a basic trust in the services they propose to provide. On the one hand, consumers may experience cognitive dissonance when their own expectations differ from the actions of ITE-embedded smart objects. On the other hand, the better smart objects become in acting as agents, the less the user may understand the propositions and the less he may therefore trust them [18], [43], [83].

This reasoning yields the following proposition:

P1b: *The functionality of components embedded within an IT-ecosystem must be scalable by the consumer to ensure perceived trust.*

2.1.2 Usability

Perceived usefulness and perceived ease of use: A variety of research deals with the adoption and diffusion of technological innovations [104], [105]. User-centric beliefs and attitudes drive information technology usage. These perceptions change over time as users gain first-hand experience with IT usage, which, in turn, may change their subsequent IT usage behavior [56]. The concept of perceived usability can be defined as the degree to which an individual believes that using a particular system will enhance his or her job performance [26], [27]. Furthermore, perceived usefulness is most relevant in work-related settings where performance is key [104]. On the other hand, the concept of perceived ease of use can be described as the degree to which a person believes that using a particular system will be effortless [26]. For both of these two concepts, (trusting) belief is crucial. Our research model proposes that both perceived usefulness and perceived ease of use influence perceived trust in ITEs. In practice, appearance and handling (i.e., ease of use) are prerequisites for intelligent objects. For example, well-designed ITE components will be easy to access and increase individual comprehension of ITE processes. As a result, consumers will perceive the ITE and its components as a reliable partner that is not hiding anything to serve its own interests [27]. When consumers are able to understand the procedures and what is going on while they are using smart objects, the ITE is more likely to be perceived as less risky and more reliable (trustworthy) [40].

This leads us to the following conclusion:

P2a: *The perceived usefulness of the embedded components positively influences users' perceived trust in an ITE.*

P2b: *The perceived ease of use of the embedded components positively influences users' perceived trust in an ITE.*

Information quality: Working with intelligent systems means dealing with information. Information presentation and information quality are two elementary functions that make it easier for the consumer to deal with the system where it might otherwise even be impossible. A distinguishing feature of intelligent or smart systems is that they contain a knowledge component comparable to a computerized version of human knowledge [43]. In this regard, purposes, explanations and decisions made by an intelligent agent influence consumer acceptance of smart systems and improve user trust in the advice provided [43], [49]. Nevertheless, an appropriate technology stack is necessary to guarantee a high information quality level. This technology must fulfill two requirements to prevent information overload and hence reactance: distinguishing important and unimportant information from each other and making system performance transparent to its users [43], [72].

Consequently, we develop the following proposition:

P2c: *The information quality in interaction processes involving smart systems is an elementary component necessary to assure trust in an ITE.*

2.1.3 Presentation

Complexity reduction: From a consumer perspective, new technologies promote a feeling of uncertainty, especially if these innovations affect the everyday life of an individual. The principles of designing man-machine-communication interfaces attain special relevance in this context [13], [66]. Experiences in other lines of business (e.g., healthcare, as in clinical systems or aviation) can offer advice about the successful implementation and acceptance of complex technologies like ITEs [52]. In addition, the principles of effective (ecological) interface design must be taken into account during product development to accomplish the following goals [59], [107]: first, reducing the complexity of innovative systems and secondly improving trust by achieving intuitive serviceability.

Therefore, we propose that,
P3a: *Achieving complexity reduction by designing an effective (ecological) interface and serviceability improves trust in ITEs.*

Provision of information: Effectively dealing with information within intelligent systems requires an unhindered exchange of information across system boundaries. Thus, the greatest challenges are the coordination of and

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collaborations between different kinds of information in heterogeneous contexts, including the internet, networks and distributed computing infrastructure. In such an environment, characterized by wide-reaching, autonomous, diverse, and dynamic information sources, gaining access to relevant and accurate information is becoming increasingly complex [89]. Therefore it becomes important to be able to deliver information at any time, at any place, in any form and in the right context to the recipient via a high-system performance [73].

Thus, we propose that

P3b: *The organization of information within intelligent information infrastructures must ensure a high performance level and context-sensitive correctness to encourage trust in ITEs.*

2.2 User-centric Determinants of Trust

Our set of user-centric trust relations fundamentally relies on both the theory of reasoned action [2] and the theory of planned behavior [1]. Adapted to our ITE scenario, trusting beliefs lead to an intention to trust that creates positive trusting behavior at its best [78]. This individual trust-building process is influenced and determined by many different individual and social dimensions and characteristics [41]. The reason for this is that trusting beliefs are primarily formed "outside" the ITE components itself but typically arise in the same way as beliefs are formed in the adaptation process as part of product shopping or service acquisition [40]. This process is based on the interaction between the cognitive and emotional dimensions, which influence many different kinds of individual factors [57]. Besides psychological aspects, social interaction and the influence of personal communication networks play a central role in the way individuals think about and use technology. According to the social influence model of technology use [37], contextual social factors influence the perceptions and usage of communication technologies. In our conceptual model, we concentrate on the following determinants: First, 1) the individual trust-forming factors of knowledge and expertise, innovativeness, involvement, convenience, and risk tolerance, which are discussed in detail; and secondly, 2) social influences on perceived trust and the adoption of innovative technologies and ITE components that address an individual's need for uniqueness, prestige orientation, and susceptibility to social influence.

2.2.1 Individual Characteristics

Knowledge and expertise: Knowledge and experience are two elemental qualities that make it possible or easier for users to orientate themselves in new, unknown surroundings [3], [19], [32]. Usually, knowledge and experience dealing with technology are acquired when a person is interested in and frequently uses technical equipment or services. This basic understanding is an appropriate basis for optimal individual use, and the ability to transfer the acquired knowledge to new facts and, correspondingly, innovative technologies [87]. Nevertheless, the less clear, more unknown, and more incomprehensibly a new system appears in the eyes of its users, the more urgent it is to proof that the ITE deserves trust and confidence to replace missing knowledge and insufficient experience. This is required both for a positive acceptance decision and for constant user satisfaction. All this is especially true for smart objects, little electronic helpers that must also make independent decisions based on their (limited) knowledge based on trust in turn in a similar way. In addition, as with Web 2.0 technologies that enable community-building and interpersonal relationships, it is of particular importance to assess future methods of knowledge-building and knowledge transfer.

This leads us to consider the following proposition:

P4a: *Extensive user knowledge and distinctive experience dealing with known technologies positively influence the trust formation regarding new technologies and components embedded within an ITE.*

Innovativeness: An innovative person desires to create ideas that are novel and useful, is willing to adopt innovative structures, and can accept new ways of getting things done. Thus, innovativeness can be understood as being among the first group of individuals to adopt new ideas. Furthermore, innovativeness is generally positively correlated with a positive attitude toward new technologies [63]. These individuals are some of the first to purchase new technological equipment and are also ready to pay a surcharge to do so. They often have an intrinsically motivated interest in trying innovative technologies, obtain them for personal use, and believe in the functionality, quality, reliability, etc. of a new product or service earlier than other people do. The propensity to trust all these different aspects and determining factors of an innovative product (and especially a smart object) is positively related to individual innovativeness [53], [79]. These individuals feel safe innovating and perceive the innovativeness of new products to provide them with enjoyment and happiness. Accordingly, they believe in the trust achieving effect [91]. In addition, innovative consumers tend to actively use, engage in, and design open source environments (e.g., Google's Android, Apple's App Store). Thus, the opportunity to interact with the system can serve as a proxy for minimizing perceived risk and promote trust-building.

This leads us to the following proposition:

P4b: *An innovative person who is open-minded about new things shows a certain disposition to trust new technologies and components embedded within an ITE.*

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Involvement: In an environment filled with highly new, mostly unfamiliar smart objects, the adaptation of unknown working processes and living environments involves a broad range of individual drivers, with involvement itself as moderating factor [17]. In addition, the trust formation process always includes and requires personal involvement, like every kind of reasoned human action. However, it is necessary to distinguish which kind and level of product-specific or domain-specific involvement can have the most significant influence on trust formation in ITEs [48]. In general, new products, services, or processes and an innovative way of life presuppose a high level of involvement and thus an equally high level of awareness. High involvement in a particular trust-related area of an ITE may increase an individual's motivation to trust ITE in its entirety and, therefore, to develop personal trusting beliefs and behavior [61]. In addition to and in combination with this knowledge effect, a high level of involvement is an important prerequisite for trust in ITEs.

As a result, we suggest the following:

P4c: *A high level of individual involvement with innovative technology supports the process of trust formation in the context of ITEs.*

Convenience Orientation: One major aspect of smart living support systems is that they make life easier and more comfortable [18]. However, the manufacturers of smart systems must deal with the trust problem as well and must offer some kind of compensation to potential customers and smart system users. Convenience is strongly related to luck and satisfaction and can be understood as an experienceable, understandable and worthwhile "condition". It helps to arrange with aspects of new technology usage that perhaps can be perceived as complicated or problematic. A perceived lack of trustworthiness is one such a negative aspect. Nevertheless, if the user judges convenience to be more important to confidence and trust, then he will accept the system in spite of possible negative outcomes [69].

Consequently,
P4d: *High user-friendliness and expected convenience promote an individual's willingness to trust and use ITE components.*

Risk tolerance: On the one hand, risk tolerance has a moderating effect on people (and vice versa) because they often decide intuitively and very quickly whether or not an action is risky. As already mentioned, these judgments may be affected by previous experiences or by their level of involvement. Furthermore, the need and desire for trust increase if a situation or particular action is perceived to be more unsafe or risky [92], [103]. Moreover, risk itself is based on several dimensions, including financial, performance, or social aspects: buying or using the "wrong" smart innovation might decrease one's social status in his peer group. On the other hand, trust has a prominent effect on risk tolerance. For example, if a person has a high degree of confidence in technology in general, it can be assumed that this person emphasizes the risks involved with the use of new technologies – whether consciously or unconsciously – comparatively less strongly. In connection with ITEs, individual risk tolerance is even more important. In an environment with smart objects, the amount of permanently connected, personal data is growing continuously. Consequently, the data quality rises, information-sharing becomes easier, and everything may be stored and become available in a central place. Unfortunately, this also means that the potential risk for everyone will continue to increase above today's levels, which will also have an effect on the relationship between risk tolerance and trust.

Consequently,
P4e: *The lower the individual risk tolerance, the greater the need and desire for trust in ITEs.*

2.2.2 Social Characteristics

Need for uniqueness: Uniqueness is based on the assumption, supported by research, that the perceived exclusivity and rarity of a product or service enhances the user's desire or preference for a certain brand or product [71], [90], [106]. Furthermore, this desire also increases when the product is also perceived as expensive [44], [106]. Therefore, the more unique a product or service is perceived to be and the more expensive it is compared to usual standards, the more valuable it becomes [106]. In addition, the functional value of uniqueness also strengthens the individual's need to be unique and set himself apart from the social environment within which he or she is embedded [101]. Individuals' desire for differentiation and exclusivity can only be fulfilled when the consumption and use of a certain technology or service is prevalent in a certain group [65], [108], [109].

This leads us to develop the following proposition:

P5a: *Because of users' need for uniqueness, the exceptional exclusivity of a possible smart product or service in an ITE positively influences perceived trust in the new technologies and components embedded within an ITE.*

Prestige orientation and susceptibility to social influence: Individuals tend to conform to the majority opinion in their membership groups when forming attitudes and beliefs [34]. In this context, status plays a significant role in communicating information about their possessors and social relationships [8], [29], [31], [55]. Hence, a person may use a smart application as part of their work or, in accordance with the social standards of his/her neighborhood, live in a smart environment at home. Because products are often associated with prestigious values, social referencing

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and the construction of the self appear to be determinants of the adoption of innovative technologies. People's desire to possess smart objects can in this sense be traced back to a desire to display symbolic signs of group membership. This bandwagon effect can encourage an individual to conform to a modern lifestyle [12], [22], [29], [35], [77], [81], [82], [100], [102]. The contribution of reference theory to the analysis of prestigious behavior thus appears to be important in helping us understand the motivations underlying the acceptance of innovative technologies.

This reasoning leads us to present the following proposition:

P5b: *The user's prestige orientation and willingness to use smart technologies as status symbols positively influence perceived trust in new technologies and components embedded within an ITE.*

P5c: *The user's susceptibility to the influence of relevant others determines an individual's willingness to trust and use new technologies and components embedded within an ITE.*

Based on our conceptual model and the related propositions described above, we have tried to explore various determinants of consumers' perceived trust through an exploratory empirical study.

Table 2: Demographic profile of the sample

Variable		**n**	**%**
Age	≤ 19	48	15.8
	20-29	195	64.1
	30-39	16	5.3
	40-49	14	4.6
	≥ 50	31	10.2
Gender	Male	158	51.8
	Female	145	47.5
Education	Not graduated	5	1.6
	Lower secondary school	24	7.9
	Intermediate secondary school	18	5.9
	High-school/A-levels	203	66.6
	University degree	53	17.4
Marital status	Single	249	81.6
	Married	39	12.8
	Widowed	3	1.0
	Divorced/separated	14	4.6
Profession	Employee	68	22.0
	Worker	8	2.6
	Civil servant	18	5.9
	Self-employed	9	2.9
	Student	201	66.1
Household net income	≤ 500 EUR	31	10.2
	500 ≤ 1.000 EUR	55	18.2
	1.000 ≤ 2.000 EUR	59	19.5
	2.000 ≤ 3.000 EUR	39	12.9
	3.000 ≤ 4.000 EUR	24	7.9
	4.000 ≤ 5.000 EUR	11	3.6
	> 5.000 EUR	17	5.6
	No answer	67	22.1

3 Methodology

To measure the underlying determinants of trust in ITEs against the background of our multidimensional model, we used existing and tested measures [10], [20], [50], [54], [60], [68], [74], [99], [111] and generated further items based on exploratory interviews, with the respondents asked what value and risk drivers they associate with living in digital environments. All items were rated on five-point Likert scales (*1=strongly disagree; 5=strongly agree*) and were specifically referred to an ITE scenario and the possible usage of a mobile assistant, the key device that helps one to control and use the digital components embedded within the digital ecosystem. The first version of our questionnaire was face-validated twice using exploratory and expert interviews and pretested with 50 respondents to identify the most important ones and reduce the total number of items. For the data collection process, we decided to conduct face-to-face interviews. As a first step, all respondents received a detailed description of their lives in our smart world scenario, with a special focus on smart living, smart mobility, and smart shopping developed from an in-depth analysis of the current state-of-the art in smart environment research and practice. The study sample included male and female respondents eighteen and older. A total of 309 interviews were conducted in August 2009. A description of the sample characteristics can be found in Table 2.

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The higher percentage of younger respondents with higher education may be indicative of the fact that many students participated because they are particularly interested in innovative technologies. Even if this sample is not a representative one, with reference to the given exploratory research focus, it offers a balanced data set to use to investigate our conceptual model.

4 Results and Discussion

In conducting the data analysis, we first uncovered the various dimensions underlying the technology-driven and user-centric determinants of trust in ITEs via factor analysis using the principal component method with varimax rotation. Based on the scree plot with eigenvalues of 1 as the cutoff, the factor analysis produced a 15-factor structure that accounted for 64.2% of the variance with medium (>.5 to high factor loadings (>.8) and a Kaiser-Meyer-Olkin measure of .855. The reliability analysis yielded highly acceptable coefficients; the factors' Cronbach's alphas were from .601 to .882. As *Table 3* shows, our factor structure largely corresponds to our proposed conceptualization and the measurement scales used in our questionnaire:

Table 3: Factor structure and cluster means

Items	Factor Loadings	Means Cluster 1 *(n=106)*	Means Cluster 2 *(n=66)*	Means Cluster 3 *(n=53)*	Means Cluster 4 *(n=70)*	F	Sig
Technology-Driven							
F1 Security	***α=.601***					***2.139***	***.095***
I feel secure when I use my mobile assistant.	.847	4.11	3.88	4.00	3.96	.819	.484
I always like to be sure the product is a secure one before buying it.	.796	4.30	4.08	4.25	4.34	1.177	.319
When I use my mobile assistant, I am not taking any risks.	.587	3.44	3.05	3.17	3.51	3.394	.018
F2 Functionality	***α=.764***					***93.814***	***.000***
I have more contact with friends and relatives now that I use all functions of my mobile assistant.	.788	2.77	1.91	3.62	3.19	36.308	.000
Deepening relationships with family members and friends is easy with the functional features of my mobile assistant.	.762	2.16	1.52	2.94	2.60	26.677	.000
My mobile assistant saves time which can then be used to do important things.	.735	2.94	2.02	3.75	3.67	50.636	.000
The functional features of my mobile assistant help to reduce stress.	.660	3.25	2.38	3.96	3.64	34.109	.000
My mobile assistant has replaced the telephone as the major communication device in my family.	.644	3.31	2.32	3.92	3.64	27.591	.000
F3 Perceived Usefulness	***α=.841***					***60.991***	***.000***
Using my mobile assistant, I can more effectively manage my life.	.804	4.13	3.30	4.60	4.39	31.337	.000
Using my mobile assistant saves me time and effort in performing tasks.	.799	4.22	3.44	4.55	4.39	22.554	.000
Using my mobile assistant enhances my task effectiveness.	.759	3.66	2.86	4.34	4.13	36.075	.000
Using my mobile assistant makes it easier to do my tasks.	.740	3.98	3.26	4.45	4.40	29.466	.000
Using my mobile assistant gives me greater control	.629	3.50	2.92	4.02	3.77	13.082	.000
Using my mobile assistant offers me alternative ways to solve my everyday problem.	.619	3.50	2.74	4.02	3.91	21.897	.000
F4 Perceived Ease of Use	***α=.857***					***170.273***	***.000***
I have fun using my mobile assistant.	.863	3.25	2.02	4.47	3.81	87.912	.000
Using my mobile assistant is convenient.	.840	3.49	2.18	4.47	4.00	81.263	.000
Using my mobile assistant has become part of the daily routine in my life.	.835	2.87	1.70	4.15	3.41	78.521	.000

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I use my mobile assistant in more ways than most people do.	.807	2.67	1.64	3.83	3.16	66.497	.000
F5 Information Quality	***α=.801***					***13.066***	***.000***
Sometimes I am uncertain as to whether the information that my mobile assistant provides is trustworthy.	.895	4.15	4.36	3.55	3.80	8.375	.000
Sometimes I am concerned about whether the information provided is valuable.	.853	4.23	4.21	3.51	3.69	9.409	.000
Sometimes I am not sure if using the information provided is wise.	.795	4.11	4.26	3.28	3.73	10.371	.000
F6 Complexity Reduction	***α=.878***					***38.639***	***.000***
I needed instructions to use my mobile assistant.	.852	2.16	3.05	1.57	2.99	29.054	.000
It is easy to get my mobile assistant to do what I want it to do.	-.847	3.55	2.64	4.40	3.33	29.185	.000
Understanding all complex details from my mobile assistant was difficult.	.838	2.63	3.52	2.00	3.41	23.142	.000
I had to concentrate hard to use my mobile assistant.	.836	2.27	3.18	1.81	2.97	22.481	.000
F7 Provision of Information	***α=.621***					***60.467***	***.000***
I understand the steps involved in using my mobile assistant and the information provided.	.770	3.00	2.26	3.79	3.13	28.477	.000
Sometimes I worry about the information provided by my mobile assistant.	-.684	3.00	3.89	2.00	3.20	30.629	.000
I have the information necessary to use my mobile assistant.	.643	3.60	2.65	3.96	3.60	13.642	.000
I am very knowledgeable about using my mobile assistant.	.635	4.03	3.35	4.47	4.27	21.720	.000
User-Centric							
F8 Knowledge and Expertise	***α=.840***					***16.124***	***.000***
I am very curious about how my mobile assistant works.	.883	3.51	2.70	3.75	2.90	14.109	.000
Knowing *how* my mobile assistant works offers almost as much pleasure as knowing *that* my mobile assistant works very well.	.855	3.47	2.74	3.55	3.01	8.163	.000
As long as my mobile assistant works well, I don't really care how it works.	-.830	2.68	3.48	2.66	3.49	12.931	.000
F9 Convenience	***α=.805***					***114.590***	***.000***
Using my mobile assistant lets me feel good.	.841	2.58	1.64	3.62	3.24	61.842	.000
It is a pleasure to use my mobile assistant.	.815	2.69	1.89	3.94	3.60	60.103	.000
Above all, I enjoy the convenience in using my mobile assistant.	.722	2.65	1.73	3.30	3.34	39.732	.000
I have a good feeling to use my mobile assistant.	.719	2.19	1.67	3.19	3.10	35.101	.000
Using my mobile assistant improves the quality of decision-making.	.648	2.82	2.06	3.49	3.47	29.537	.000
F 10 Innovativeness	***α=.724***					***10.807***	***.000***
I accept challenging tasks.	.790	4.01	3.73	4.26	3.63	6.717	.000
I am challenged by ambiguities and unsolved problems.	.741	3.90	3.38	3.91	3.59	6.910	.000
I frequently devise methods of solving a problem when an answer is not apparent.	.721	3.75	3.47	4.09	3.43	6.310	.000
I seek out new ways to do things.	.719	3.41	3.09	3.85	3.27	6.910	.000
I consider myself to be creative and original in my thinking and behavior.	0.482	3.40	3.35	3.62	3.26	1.328	.265
F11 Involvement	***α=.717***					***93.402***	***.000***
My mobile assistant means nothing.	.811	1.81	2.94	1.38	1.74	50.848	.000

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My mobile assistant is boring.	.768	2.30	3.12	1.79	1.89	40.715	.000
My mobile assistant is worthless.	.756	2.31	3.41	1.53	1.90	65.228	.000
My mobile assistant is senseless.	.601	2.47	3.24	1.55	1.94	15.643	.000
I don't need my mobile assistant.	.585	1.70	2.11	1.21	1.64	11.877	.000
F12 Risk Tolerance	***α=.769***					***15.882***	***.000***
I was afraid that my mobile assistant would not meet my expectations.	0.89	3.56	3.33	2.77	3.73	10.377	.000
I was uncertain whether my mobile assistant worked well.	0.799	3.82	3.58	3.02	3.91	9.033	.000
I worried about the performance of my mobile assistant.	0.796	3.20	2.82	2.34	3.43	12.284	.000
F13 Need for Uniqueness	***α=.882***					***83.853***	***.000***
My mobile assistant is status-enhancing.	.883	1.70	1.56	2.92	3.10	58.593	.000
Self-actualization is an important reason for me to use my mobile assistant.	.873	1.41	1.27	2.36	2.66	48.460	.000
My mobile assistant enhances my social standing.	.814	1.71	1.53	2.68	3.06	35.292	.000
My mobile assistant makes me feel special and unique.	.787	1.53	1.26	2.19	2.73	48.303	.000
My mobile assistant expresses my personal style and who I am.	.774	1.92	1.42	3.09	2.81	50.641	.000
F14 Prestige Orientation	***α=.809***					***14.343***	***.000***
I need the approval of others.	.848	2.89	2.80	2.70	3.57	9.086	.000
I conform to others' opinions.	.840	2.74	2.67	2.66	3.61	11.120	.000
I worry about what people think of me.	.785	2.74	2.61	2.81	3.50	8.588	.000
I want to be special in others' eyes.	.717	2.69	2.68	2.75	3.41	6.890	.000
F15 Susceptibility to social influence	***α=.822***					***52.156***	***.000***
I like to know what brands and products make good impressions on others.	.755	1.83	1.74	1.81	2.93	23.984	.000
If I bought a mobile assistant within the next 12 months, I think I would be held in higher esteem by my friends.	.754	1.50	1.35	1.68	2.63	37.007	.000
I achieve a sense of belonging by purchasing the brands that others purchase.	.724	1.66	1.65	1.91	2.77	22.998	.000
If I want to be like someone, I often try to buy the brands that they buy.	.692	1.40	1.44	1.43	2.14	14.593	.000
I rarely purchase the latest fashion styles until I am sure my friends approve of them.	.661	1.82	1.74	1.87	2.84	24.539	.000
To make sure I buy the right product or brand, I often observe what others are using.	.618	2.11	2.24	1.94	2.87	9.571	.000
I do what others do.	.595	1.98	1.91	1.94	2.70	12.346	.000
My peers very much influence the choice of my shopping behavior.	.564	2.10	2.08	2.34	2.99	10.422	.000

Then, the factor scores for each respondent were saved and used in stage two, in which they were clustered into market segments using both hierarchical and non-hierarchical clustering techniques. An initial hierarchical clustering procedure was employed to obtain a candidate number of clusters and seed points for a k-means cluster analysis. To identify the appropriate number of clusters, respondents were first sorted using the hierarchical procedure. Because it produces tight minimum variance clusters and is regarded as one of the best hierarchical clustering techniques [113], Ward's method of minimum variance was chosen to determine the cluster differences at each stage and maximize homogeneity within and heterogeneity between clusters. The results strongly suggested the presence of four clusters. This four-cluster solution was validated using non-hierarchical k-means clustering.

Overall, we used the typical criteria for effective segments: groups of consumers with homogeneous needs, attitudes, and responses to marketing variables [76] that are distinctive from one another [110], are large enough to be managerially useful [76], and provide operational data that are practical, usable, and readily translatable into strategy [110]. Based on these criteria, the four-cluster solution performed the best, and it produced the most interpretable and stable result.

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We also used discriminant analysis to check the cluster groupings once the clusters were identified [46]. Using the categorical dependent variable, a priori–defined four-cluster solution, we conducted an analysis that revealed significant differences between the group characteristics. The classification results were used to determine the success of the discriminant function. As shown in *Table 4*, 94.6% of the cases were assigned to their correct groups, validating the results of the cluster analysis as indicating a useful classification of consumer subgroups based on their trust perceptions.

Table 4: Discriminant analysis

Discriminant Function	Eigenvalue	Canonical Correlation	Wilks' Lambda	χ^2	Significance
1	3.529	.883	.093	676.406	.000
2	.993	.706	.420	246.667	.000
3	.194	.403	.837	50.455	.000

	Function 1	Function 2	Function 3
Centroids (group means)			
Cluster 1	-.225	-.715	.488
Cluster 2	-2.973	.186	-.414
Cluster 3	2.481	-.948	-.600
Cluster 4	1.266	1.625	.105
Significant variable (structure matrix)			
F4 Perceived Ease of Use	.704	-.075	-.014
F9 Convenience	.571	.176	-.071
F2 Functionality	.523	.026	.074
F11 Involvement	-.518	.063	-.243
F3 Perceived Usefulness	.418	.020	.232
F7 Provision of Information	.406	-.206	.045
F15 Susceptibility to social influence	.176	.651	.187
F6 Complexity Reduction	-.231	.460	.006
F13 Need for Uniqueness	.421	.451	-.430
F14 Prestige Orientation	.084	.343	.177
F8 Knowledge and Expertise	.120	-.322	.251
F10 Innovativeness	.110	-.263	-.037
F12 Risk Tolerance	-.044	.232	.731
F5 Information Quality	-.177	-.047	.341
F1 Security	.045	.002	.277

Classification matrix revealed that 94.6% of the cases were classified correctly.

For market segmentation purposes, we profiled the cluster solutions and created a classification scheme that describes the characteristics of each cluster and explains how they might differ on relevant dimensions. To develop a profile of each market segment, more detailed information was obtained by examining the questionnaire variables cross-tabulated by cluster segment (cf. cluster means in *Table 3*). Comparisons among the four clusters were conducted on a variety of descriptive variables, including demographic and socioeconomic characteristics. Based on the variables from which they were derived, the four clusters were labeled as follows:

- ***Cluster 1 The skeptic functionalists:*** The 'skeptic functionalists', with a mean age of 25.6 years, form 34.3% of the sample, with 57.5% male and 42.5% female respondents. Typical consumers in this cluster show medium ratings for all factors. Even if they associate the usage of a mobile assistant with functional features ("*Using my mobile assistant saves me time and effort in performing tasks"* and *"Using my mobile assistant, I can more effectively manage my life")*, they are uncertain whether the information provided is trustworthy. In general, they state that they always like to be sure what benefits a certain product offers before they decide to buy it. In contrast to the members of cluster 3, the members of this cluster are interested in innovative technologies but are more hesitant and less pleasure-seeking.

- ***Cluster 2 The uninterested non-users:*** The 'uninterested non-users', with a mean age of 35.3 years, form 21.4% of the sample, with 34.8% male and 65.2% female respondents. Overall, this segment does not seem to be greatly excited about technological innovations as described in our smart living scenario. Significantly more than members of other clusters, they state that they have difficulty using the mobile assistant and uncertain if their means of usage is wise or if the information quality is trustworthy. They worry about the information provided by their mobile assistant and perceive the mobile assistant to be worthless and boring. Moreover, they are not very interested in its functional features *("I don't need my mobile*

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assistant") and avoid using it, as evidenced by their mean scores for *"Using my mobile assistant has become part of the daily routine in my life"* and *"It is a pleasure to use my mobile assistant"*, which are the lowest.

- ***Cluster 3 The convenience-oriented innovators:*** The 'convenience-oriented innovators', with a mean age of 25.0 years, include 17.2% of the sample, with 63.5% male and 36.5% female respondents. More than the members of clusters 1 and 2, typical respondents in this cluster associate the usage of a mobile assistant with functional benefits, as evidenced by their ratings for "*Using my mobile assistant, I can more effectively manage my life*", "*Using my mobile assistant saves me time and effort in performing tasks*" and "*Using my mobile assistant enhances my task effectiveness*", which are the highest. Additionally, members of this segment are very innovative and enjoy the convenience of their mobile assistant*: "I have fun using my mobile assistant"* and *"Using my mobile assistant has become part of the daily routine in my life".* In general, typical consumers in this cluster are interested in innovative technologies and accept challenging tasks. They needed no instructions to understand the mobile assistant's functionality and perceive that "*It is easy to get my mobile assistant to do what I want it to do".*

- ***Cluster 4 The prestige-seekers:*** The 'prestige-seekers', with a mean age of 24.8 years, make up 22.7% of the sample, with 49.0% male and 51.0% female respondents. This group is the one that most highly rated F13 Need for Uniqueness, F14 Prestige Orientation, and F15 Susceptibility to social influence. They like to know what brands and products make a good impression on others and state that "*I need the approval of others"* and *"I want to amount to something special in others' eyes"*. They associate using the mobile assistant with status above all: *"My mobile assistant enhances my social standing"* and *"If I bought a mobile assistant within the next 12 months, I think I would be held in higher esteem by my friends"*.

In sum, our results as presented here are just the very first steps in exploring different drivers of perceived trust in ITEs and identifying groups of consumers based on their trust perceptions in an ITE scenario. However, they contribute to theory and practice in different ways:

Based on our multidimensional conceptualization of consumers' perceived trust in ITEs, the results of our factor analysis support the suggestion that there exist a variety of trust-related determinants in the context of personal interaction with and adoption of innovative technologies. On the one hand, there are aspects that are directly connected with the technology itself in terms of a) security, privacy, and functionality issues; b) its usability, including perceived usefulness, ease of use, and information quality, and c) the presentation of complex information. On the other hand, the user's personality is an important driver of or barrier to trust as related to the technological devices s/he interacts with. Apart from psychological characteristics (i.e., personal levels of knowledge and expertise, innovativeness, involvement, degree of emphasis on convenience, and individual risk tolerance), the user's social environment is an important determinant. Essentially, the greater the individual's need for uniqueness, prestige orientation, and susceptibility to social influences, the more important it will be whether relevant others approve, if a certain technology will be status-enhancing in their eyes and whether they think it is trustworthy. Our factor solution shows that in the context of trust, in exploring the diffusion and adoption of innovative technologies, it is not sufficient to consider the technological features or certain characteristics of potential adopters. Only a combination of technology-driven and user-centric determinants creates a complete picture of drivers of and barriers to trust-building as a key construct affecting almost every aspect of personal interaction with technology.

As we consider these diverse groups of consumers and their attitudes regarding the different aspects described above, we find that factors apart from *F1 Security* (F=2.139; sig=.095) show significant differences. In particular, *F4 Perceived Ease of Use* (F=170.273; sig=.000), *F9 Convenience* (F=114.590; sig=.000), *F2 Functionality* (F=93.814; sig=.000), *F11 Involvement* (F=93.402; sig=.000), and *F13 Need for Uniqueness* (F=83.853; sig=.000) contributed most to differentiating the clusters. This knowledge is important for researchers and marketers from both a segmentation perspective and a positioning point of view. To some more hesitant and security-oriented users, the benefits and risks of a certain technology are of special importance, and they must explore these questions before they consider buying that technology. Another segment states that researchers and marketers are not interested in innovative technologies at all and avoid using them if possible. A third group with very innovative and more risk-taking individuals could be the most interesting segment in introducing new technologies because they can be regarded as first movers and influencers. Finally, we identified one cluster of more status-oriented consumers who consider prestige to be their most important consideration in buying brands and products. To them, the design aspect of innovative technologies is more important than their technological features.

Even though this study is based on an experimental design and face-to-face interviews with mainly younger consumers evaluating an ITE scenario and their own possible usage of a mobile assistant as the key device in the context of smart living, smart mobility, and smart shopping, our results are as initial empirical hints a promising direction for further research and practice.

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5 Implications and Conclusions

Focusing on the link between perceived trust and ITEs, this paper has examined the crucial role of technological and user-centric drivers in determining the success factors in the orchestration and adoption of IT-ecosystems. A better understanding of users' perceived trust and associated risks in interacting with ITE components and living in a digital environment may help to improve the diffusion and adoption of innovative solutions. We hope that our study offers useful avenues for the analysis and management of the antecedents of trust perceptions and decision-making in the dynamic and high risk-domain of technology-based innovations.

From a methodological perspective, our model and our preliminary empirical results should be further developed in different ways. First, the different propositions sketched above should be developed in greater depth. Second, in developing trust-related hypotheses, we should emphasize the interplay between the different factors and the different components of trust, considering which determinant, as an independent variable, affects which component of trust. Additionally, the intricate structural relationships between the trust constructs must be analyzed. This will help us to develop a proper causal model of effects between the technological and user-centric determinants and their impact on users' willingness to trust and adopt ITEs. Starting from our experimental design, in a number of situational contexts and different ITE scenarios, the perceptions of potential or actual users may be explored to cultivate a better understanding of the highly interrelated components and outcomes of trust. Consumer attitudes regarding an ITE will naturally evolve over time and depend on the interaction within a given digital environment, which has to be the future focus of a longitudinal study of consumer attitudes, intentions and behavior before and after the use of a mobile assistant.

From a managerial standpoint, our proposed typology of different segments of users who can be distinguished based on their willingness to trust the ITE and its components is of special importance to assessments of possible market opportunities. In referring back to our insights, practitioners may be able to better understand the multidimensional origins of trust and market adoption. Even if a product has high-performance technological features, its lack of trustworthiness may be the highest barrier to market success. Therefore, we suggest including trust-related insights in the process of research, the design of technological innovations and the orchestration of ITEs. Using our multidimensional model and our typology, practitioners might be able to develop appropriate strategies based on our concepts and empirically validated principles, improving perceived value for distinct segments of users who differ in their trust orientation and individual risk perceptions in the context of ITEs. In sum, to understand all relevant aspects of different groups' positive or negative attitudes toward ITEs and ITE components may help to address individual risk barriers and ensure perceived trust.

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