WORLD ECONOMIC FORUM

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Industry Agenda

Rethinking Personal Data: Trust and Context in User-Centred Data Ecosystems

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Executive Summary

An information differential exists between institutions and individuals, creating a crisis of trust that results from uses of data being inconsistent with user expectations and preferences. Context-aware data usage is a key element in restoring this trust, and is increasingly relevant as the personal data ecosystem increases in scale and complexity. Context-sensitive governance can increase the flexibility, relevance and effectiveness of personal data regulations by allowing policies to adapt as situations and norms change.

Individuals also view context as highly relevant to their perceptions of personal data. Engaging individuals in a way that allows them to make empowered and context-relevant decisions is key to strengthening trust. However, bottom-up evidence on how individuals define context remains scarce.

As part of its multi-year Rethinking Personal Data initiative, the World Economic Forum, in partnership with Microsoft, collaborated to understand the impact of context on individuals' attitudes towards personal data, and how to practically leverage this information to develop context-aware systems that can empower individuals. The research undertaken identified seven variables, both objective and subjective, that influence individuals' perception of a given personal data-use scenario. The study also examined individual demographic variables such as age and technological sophistication. Individuals were found to be particularly sensitive to four of the factors: collection method, data usage, trust in service provider and value exchange. Additionally, cultural and geographical factors influenced the relative importance of each variable.

With a better understanding of the elements of context, data governance systems can be more user-centred and reflective of individual preferences. For example, "recommender systems" can help individuals with context-sensitive data settings by either allowing for expressed preferences on certain data settings or by making a recommendation on the individual's behalf.

As these systems develop, technology and policy need to evolve in tandem. Supportive policy frameworks can allow greater flexibility in data use by respecting individuals' preferences and the changing context of data scenarios. While it is challenging to incorporate subjective factors such as the identified context elements into policy frameworks, technological developments can help. Ultimately, incorporating context into data governance systems can improve transparency by relating information and choices to individuals in a more relevant, actionable and easy-to-understand fashion.

In order to reach these objectives, additional multistakeholder dialogue is needed, encompassing technologists, civil society, policy-makers and the private sector. Beginning this dialogue and developing context-based solutions are crucial to building trust and maximizing the potential of the personal data economy.

Introduction

An asymmetry of power exists today between institutions and individuals – created by an imbalance in the amount of information about individuals held by, or that is accessible to, industry and governments, and the lack of knowledge and ability of the same individuals to control the use of that information. While people are generally willing to share personal information in exchange for valued services, recent surveys indicate growing unease in how personal data are being used. A study by the telecommunications operator Orange showed that 78% of consumers find it hard to trust companies in the way they use such data.[1] A crisis of trust is developing, stemming from the use of personal data in ways that are inconsistent with individuals' preferences or expectations. To thrive, the growing number of economies that depend on the potential of "big data" must earn the trust of individuals, and be centred on empowering those individuals by respecting their needs.

In the world of big data, where new and unanticipated uses of such data drive innovation and economic growth, respecting the impact of context on individuals' perceptions and expectations is crucial to engendering user trust.[2] The context in which data is used matters – acceptable use is not binary, but is nuanced, personal, evolving over time and reflecting differences in cultural and social norms.[3] There are no absolutes.

In today's hyperconnected and dynamically changing world, new approaches are needed to engage and empower users to make appropriate and informed choices about the use of their data in different circumstances. This requires a combination of technology and policy framework that can consider individual user preferences and commonly accepted data-use policies, as well as accommodate evolving norms. Users choosing to engage in this process must be empowered to address or negotiate data-use exceptions in an informed manner. These context-aware frameworks can enhance trustworthiness of the personal data ecosystems, leading to more meaningful interactions between individuals and institutions.

Yet despite the growing recognition of the importance of understanding context from individuals' point of view,[4] little work has been done to further refine the meaning of context or how it can be practically incorporated into policy-making. To address the concerns of growing numbers of public and private stakeholders, a collaborative global research initiative was established between the World Economic Forum and Microsoft. The intent of this study was to examine how individuals define context, focusing on the factors that affect their sensitivity to how data related to them is used by service providers. The project studied how these factors vary across different countries; how they can aid in designing context-aware systems; and how these systems can be integrated into user-experience designs for interactions that are more meaningful and consistent with complex individual preferences. [5]

Additional analysis was also done on the policy implications for how such context-aware systems can play a key role in establishing *user-centred personal data ecosystems*, where all ecosystem stakeholders are focused on empowering individuals in their interactions and their control of how the data related to them is used.[6] Such ecosystems would typically be driven by values or frameworks of trust that define, among other things, principles or rules on appropriate uses of data.

The Importance of Context

Individuals' perspectives on personal data are not binary; complexities and nuances must be understood to empower and assist people to make meaningful decisions. Understanding how individuals integrate personal values, risks, benefits and commonly accepted norms is fundamental for arriving at a balanced and equitable personal data ecosystem. Evidence is needed on the interplay and impact of these factors (and others to be identified) on how individuals think about the access, use and sharing of their data on a holistic basis rather than exclusively within a narrow domain, e.g. use of data in advertising or financial services. Exploring how this relates to individuals' views of technology in general can produce insights into other questions, such as how adoption of technology or being savvy in its use may influence their mental models. In today's borderless digital world, regional differences in people's attitudes and behaviours towards personal data, and in their trust in the digital world, must also be established and considered.

Throughout 2012 and 2013, Microsoft sponsored a series of research studies, divided into two stages, to address these questions. The first involved qualitative studies in Canada, the People's Republic of China (China), Germany and the United States (US) to develop insights on users' mental models of their personal data. The countries were chosen to cover a broad spectrum of approaches to privacy/data protection regulations and cultural norms. The second stage provided quantitative analysis to validate the initial insights and, in addition to the original countries, included Australia, India, Sweden, and the United Kingdom (UK), further expanding the representation of existing regulatory approaches and prevalent social/cultural attitudes on internet usage.[7]

The research identified seven distinct factors (Figure 1) that individuals consider when determining if a given use of data is acceptable; in this report, they are defined collectively as the *data context*. Categorized into two subgroups of objective and subjective variables, the seven examined were:

Objective variables:

1. *Type of data* – what type of data is involved? (e.g. financial, medical, location)
2. *Type of entity* – who is accessing the data? (e.g. retailer, employer, government)
3. *Device type* – what kind of device is used for the transaction? (e.g. mobile phone, desktop)
4. *Collection method* – how is the data collected? (e.g. actively provided by the user, passively collected or generated without user awareness)
5. *Data usage* – what is the level of user involvement in using data? (e.g. from explicit consent and active engagement to being unaware and using automation)

Subjective variables:

6. *Trust in service provider*[8] – what relationship, if any, do users have with the service provider they are interacting with?
7. *Value exchange* – how do users perceive the benefits they receive from the use of their data? (e.g. personal benefits, benefits to the community)

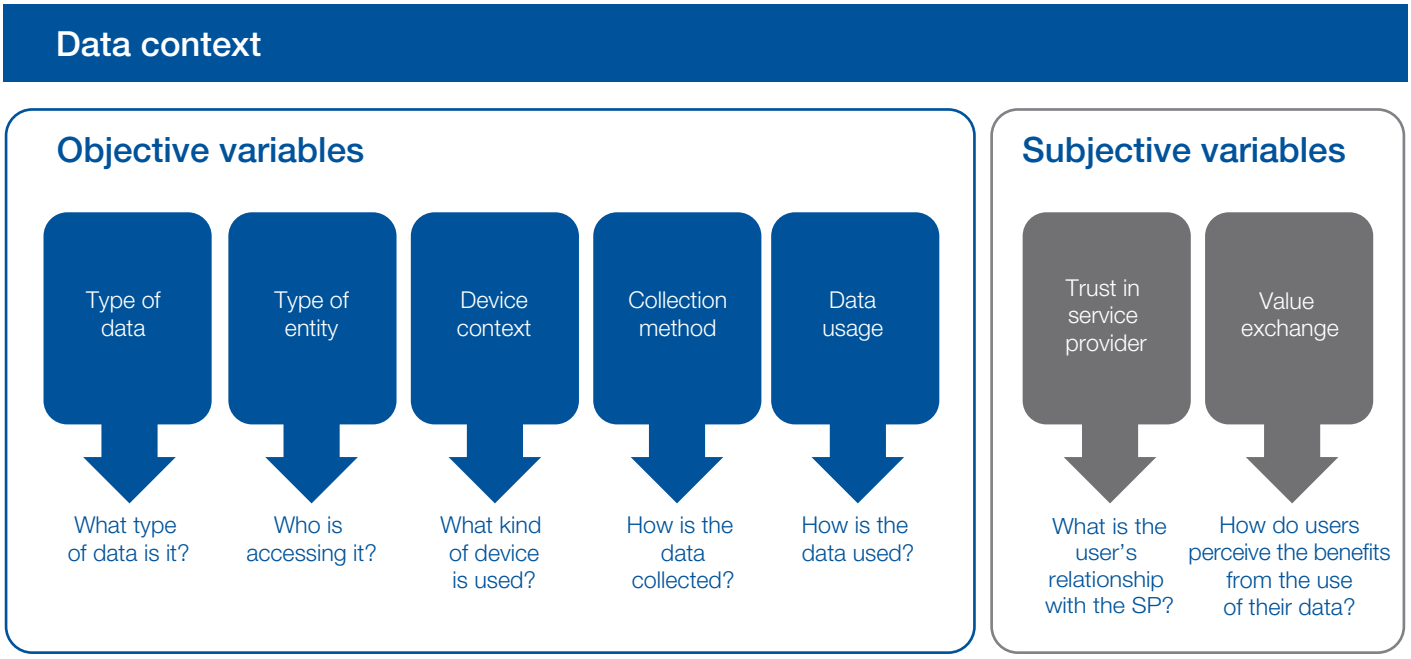
The subjective variables show that data context is very much defined by personal preferences. Note that neither trust in service provider nor value exchange is sufficient, on its own, to determine if the use of data is acceptable to the individual. Both of these variables play major roles, but they do not pre-empt other factors.

In addition to these seven variables, factors related to individuals' mental models were also identified. Some of these factors included the following:

- Attitudes to and adeptness with technology
- Awareness of the relationships and activities within the personal data ecosystem
- Perceptions of government protection

In today's data-driven ecosystems, data collected or derived by the initial service providers will most likely be shared with and used by others in the value chain. Thus, individuals do not enter into a bilateral relationship solely with the initial providers, but into a multilateral one with numerous entities whose use of the same data may be totally opaque to them. Enough information needs to be passed to these entities so they can incorporate the same contextual variables in subsequent uses of the data.

Figure 1: Factors impacting individuals' sensitivity to the use of their data



Source: Microsoft

Framework for Analysis

To illustrate how the identified factors can influence acceptability, a baseline scenario was established involving a service provider collecting location information from a mobile phone – a case with particularly low acceptability.[9] From this starting point, a series of changes could be made to select variables, and the relative impact on acceptability assessed on a country-by-country basis.

The baseline scenario consisted of a service provider using individuals' location information to make decisions on their behalf, without their awareness or consent and with no perceived benefit to the individuals.

The acceptability rates for this Scenario 1 were quite low across all countries in absolute terms (Figure 2), with results clustered among the Western-oriented countries (US, Germany, UK, Canada, Australia and Sweden), and Asian-oriented countries (China, India).[10] Notably, the baseline percentage of individuals within the Asian countries who found this scenario acceptable (26-27%) was over three times greater than that of individuals within the Western countries (5-8%). This points to relatively strong cultural differences in individuals' perceptions and concerns about how personal data is collected and used, possibly due to respondents' higher adeptness with technology.

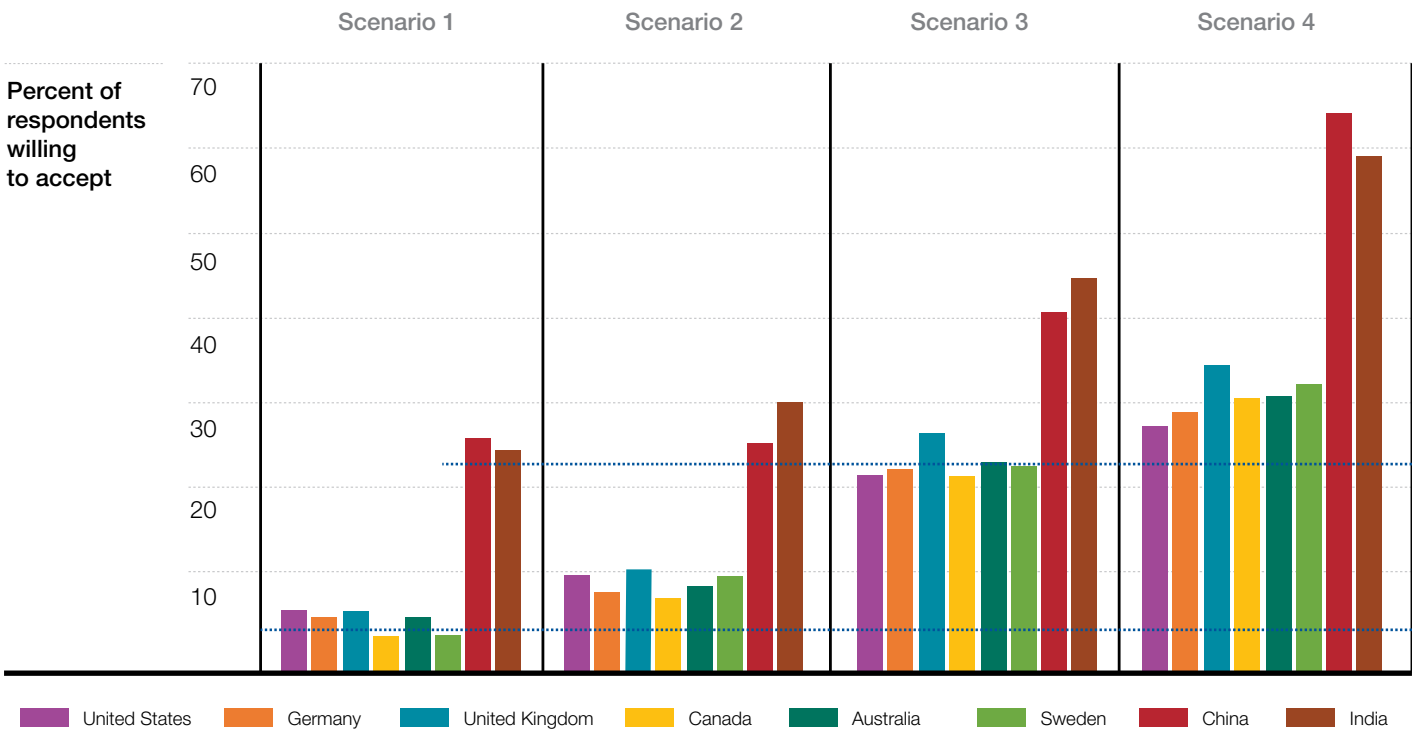
A rise in corresponding levels of acceptability occurred after changing the relationship between the individual and the service provider in how the data was being used. In Scenario 2, when the service provider offered to personalize the choices for the individual (keeping all other variables constant), the acceptability levels increased. This increase was much more pronounced in percentage terms in the Western countries, particularly Sweden.

Likewise, when trust in service provider was increased in Scenario 3 (keeping all other variables constant), it too generated a more positive impact in the Western countries, although levels of acceptability rose across all countries. The acceptability rate in Canada almost tripled from 9% to 24%. Responses from the Asian countries saw smaller gains in relative terms, but their acceptability rates nearly doubled from the baseline scenario, and overall rates remained considerably higher than in the Western countries. Over 40% of individuals in the Asian countries indicated they would find the use of location data acceptable if the service provider was "well known" to them. In Western countries, 20-30% of individuals indicated this level of acceptability.

Finally, the fourth scenario used individuals' location data for community benefit (e.g. more efficient traffic management in a city). This scenario had by far the most significant impact on perceptions of acceptability in China and India of all the factors studied; more than 60% of respondents in the two countries found community use acceptable, or about double the rate of those in the Western countries. China had the highest acceptability rate (65%), and the US the lowest (29%).

Overall, the Western countries had much higher gains in acceptability rates when comparing Scenario 4 to Scenario 1, with Canada and Sweden increasing by 5-6 times the original rates. With the higher baseline acceptability rates in the Asian countries, gains there were much more modest at just over twice the original rates. Different factors had different levels of impact in the different countries.

Figure 2: How acceptability of data use varies for different scenarios, in different countries



Contextual variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Type of data	Current location			
Type of entity	A service provider			
Device type	Mobile device			
Collection method	Passively collected			
Data usage	Make automatic decision for me	Personalize my choices		
Trust in service provider	Is unfamiliar to me		Is well known to me	
Value exchange	Is of no benefit to me			Community benefit

Source: Microsoft

The Impact of Contextual Factors

From the individual's perspective, what constitutes the acceptable use of one's data is nuanced, personal and dependent on social and cultural norms. Quantitative analysis can help to understand this richness in greater detail. When analysed across all the scenarios tested across all countries, the four variables with the most impact are collection method, data usage, trust in service provider and value exchange (Figure 3). The impact of contextual variables on the acceptability of data usage in the scenarios and among the countries are further highlighted in Figure 4.

Except for respondents in Sweden, collection method had the largest impact of all the variables examined. Similar to other research demonstrating that individuals want to have a sense of control over how data is collected, it is interesting to note the strength of this desire despite results showing inconsistent behaviour, perhaps due to the relative lack of available tools for individuals to effectively manage this attribute.

In Sweden, the research findings indicated data usage was the factor with the highest relative impact. When data is actively collected, users prefer scenarios where use of the data is consistent with what they originally agreed. Conversely, when data is passively collected, individuals prefer situations that provide them with personalized options from which they can choose, as opposed to those where they delegate control to other parties that make automatic decisions on their behalf. For respondents from the Western countries, the proportional impact of this factor was greater than for individuals from the Asian countries.

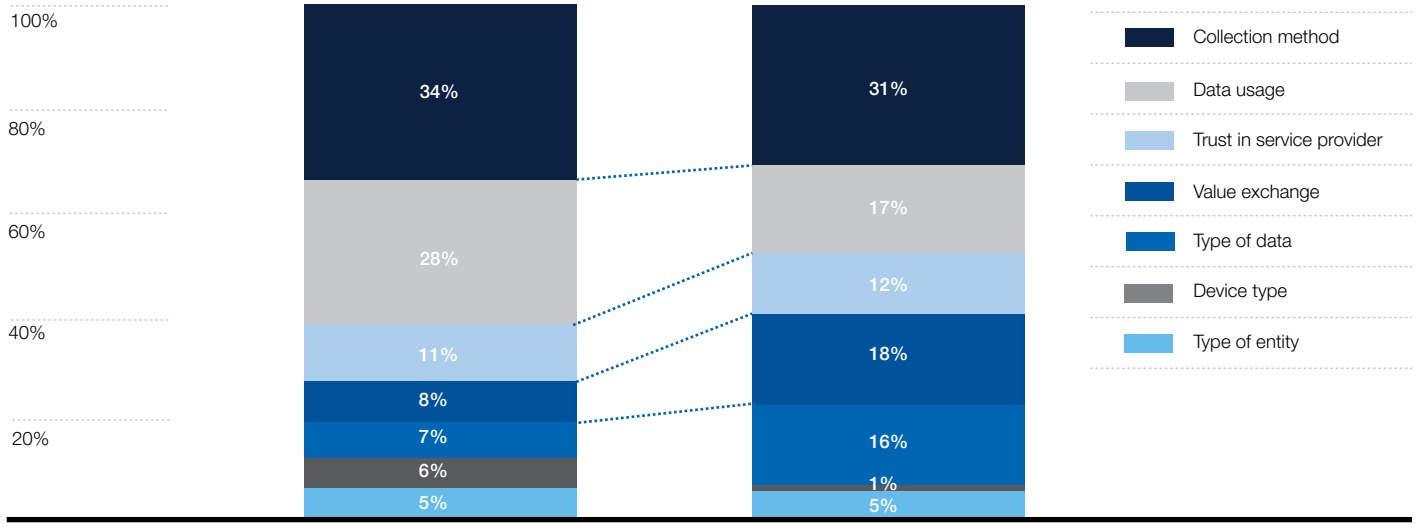
Trust was the third most important variable determining acceptable use of data in the Western countries. From the earlier qualitative research, trust is defined as a combination of the type of relationship individuals have with a service provider, and whether it can be held accountable for its actions. For example, in some countries, individuals indicated that when they pay for a service, they find service providers more trustworthy, nudging the corresponding uses of data to higher acceptability. This effect was strongest among respondents in Germany, where receiving services for free was seen as a negative factor in acceptability. In contrast, individuals from China viewed free services as a positive factor.

For situations involving passive data collection and where individuals perceived no additional benefit (causing low acceptability), the trust variable had a significant positive impact for all countries. However, the study indicated the effect was smaller for China, India, Sweden and the US, and larger for Canada.

Although value exchange had a smaller impact in the Western countries, it had the second largest impact in China. In addition, the research uncovered preliminary evidence that individuals tend to frame their interactions from the perspective of a perceived value exchange.

When the value exchange was to deliver benefits to individuals, either in saving time and/or money, or enabling something of unique value, the acceptability rate was highest for all countries. In the Asian countries, providing a benefit to the community makes a positive contribution to a scenario's acceptability; in Western countries, this is a negative contribution when analysed across all scenarios. This may reflect differences in cultural values between the two country clusters: one which emphasizes communal good and lack of individual control (Asian countries), the other which emphasizes individual values and control (Western countries).

Figure 3: The impact of contextual factors



Source: Microsoft

Figure 4: Highlights of impact of contextual factors on acceptability of data uses

CONTEXTUAL FACTOR	GENERAL IMPACT	COUNTRY DIFFERENCES
Collection method	In general, scenarios with active data collection were favoured; scenarios where personal data is provided by "a person I know" or collected passively have negative impacts on user sensitivity.	Except for Sweden, "collection method" had the largest impact of all the factors considered in all countries.
Data usage	Scenarios where data is used as agreed were uniformly positive; whereas scenarios where data is used to automatically make decisions for users were uniformly negative.	In Sweden, "data usage" had the largest impact of all the factors considered. For the remaining countries, except for China and India, it had the second most significant impact on user sensitivity.
Trust in service provider	Participants favoured situations where the service provider is well-known over those where the service provider is unfamiliar.	Except for Sweden, China and India, "trust" had the third largest impact on user sensitivity of all the factors considered, although the impact in the US is relatively moderate. In China, a service provider providing free services is a positive factor.
Value exchange	Scenarios where the data is used to provide something of value or save time and/or money are regarded positively.	In China, "value exchange" had the second largest impact. Relative to other countries, it has the smallest impact in Canada. Providing a benefit to the community was also perceived positively in both China and India.
Type of data	For data that is actively provided, scenarios that involve sharing of bank account number were generally regarded negatively.	In India, "data type" had the second largest impact on user sensitivity.
Device context	Using computers for the transactions was regarded much more positive than using mobile devices.	In China and India, "device context" was not considered important.
Type of entity	No generalizations could be made about the impact of the type of entity, except thatit was a factor.	Responses were negative when the "entity" was a service provider in Australia, China and especially India.

Source: Microsoft

The Impact of Other Factors

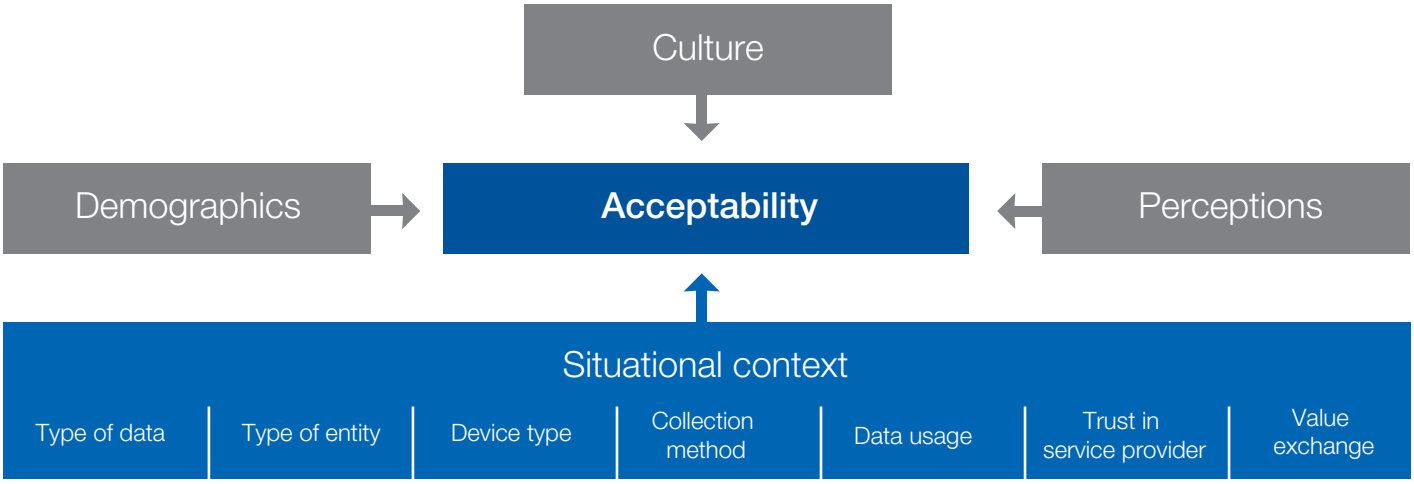
In addition to the contextual factors, the study identified a number of others that can impact cases of acceptability. These variables include the following:

- In general, early adopters of technology had a higher rate of acceptability across all use cases tested (Figure 6).
- Men (28%) were more willing to accept data-use scenarios than women (23%), and younger participants were more willing to accept data-use scenarios than older ones.
- The perception that the government provides adequate privacy protection generally had a positive effect on acceptability of data uses (Figure 7).

These findings suggest that a conceptual model is required to fully evaluate the acceptability of a given data-use scenario (Figure 5). The model would incorporate the influence of the situational context variables as well as other factors that can arise from cultural differences, demographics and personal beliefs.

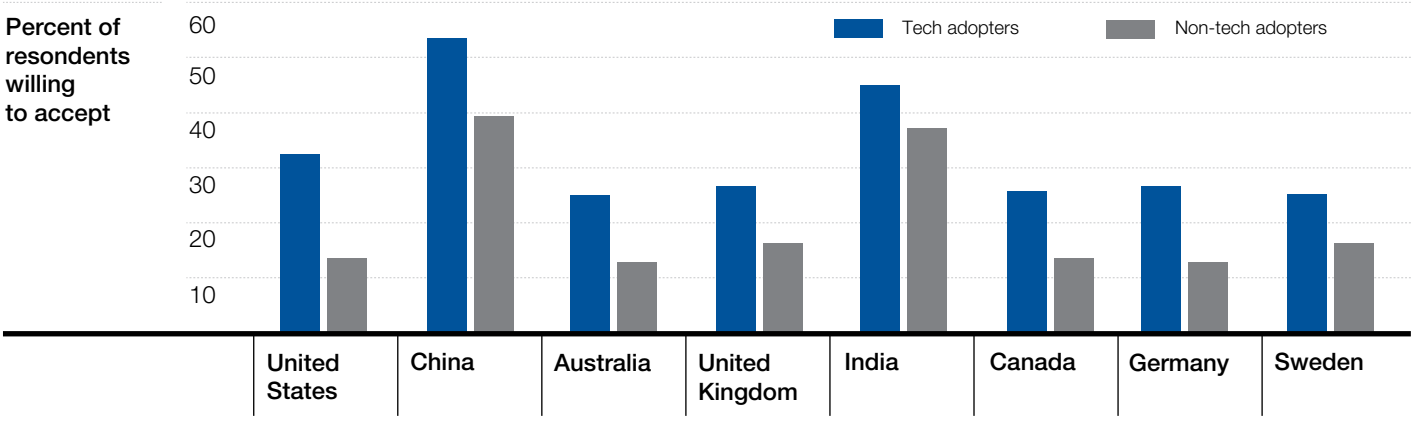
Although the conceptual model appears unwieldy, it can be greatly simplified when realized. Preliminary analyses indicate that not all variables have equal relevance or impact, and that some can be used as indicator variables (strong correlations between their values and the values of other variables in the model), eliminating the need to include the complete set of variables in practical implementations. Additional research is needed to determine the indicator variables that can simplify predicting the acceptability of any given scenario.

Figure 5: Conceptual model for determining acceptability of a given scenario



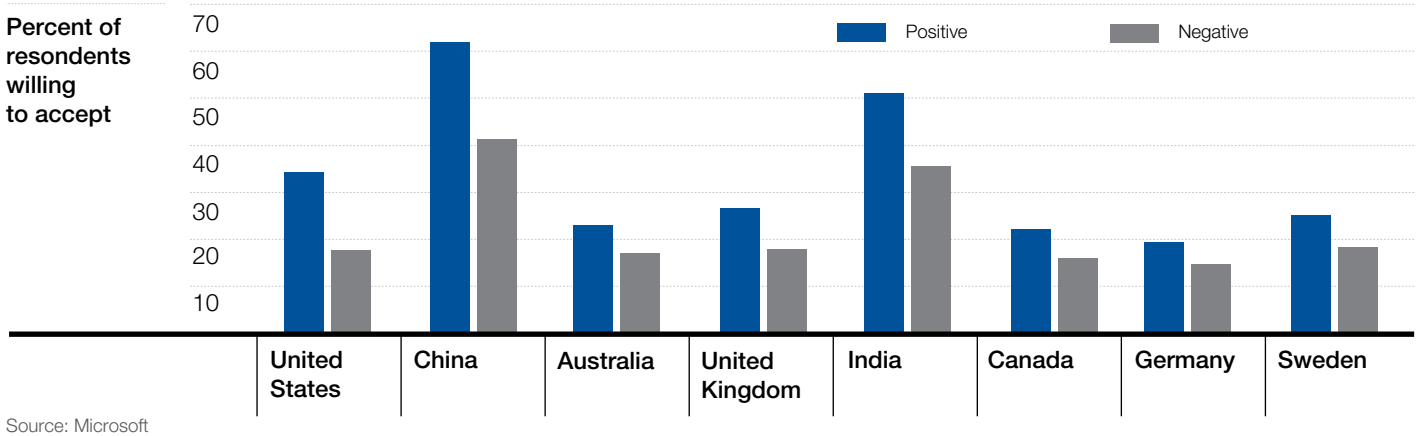
Source: Microsoft

Figure 6: Impact of technology adoption on acceptability



Source: Microsoft

Figure 7: Impact of perception of adequate government protection on rate of acceptability



Source: Microsoft

Building Context-aware Systems

How can the conceptual model be used to develop systems that are more context-aware? Such systems would enable more user-centred personal data ecosystems by respecting individual preferences in data-use scenarios; and, where individual preferences are unknown, recommend personalized settings based either on individuals' past preferences or on commonly accepted practices.

Such a "recommender system" (RS) can be deployed either on behalf of service providers to allow for a personalized user experience, or on behalf of individuals as "personal assistants" to help with context-sensitive data settings for different types of applications. In either case, these systems minimize the chance that data use will be inconsistent with user expectations, and empower individuals to engage in more meaningful interactions with service providers, thus increasing the level of trust in the overall ecosystem.

Conceptually, a service or application can query an RS and vary what it displays to the user and/or its operations, depending on the results. For example, if an application needs to verify the identity of a user, it can ask for a photo if the user is likely to decline submitting a government ID number.

An RS can assess a number of variables to help predict the acceptability of a given data-use scenario and recommend appropriate data settings, either to an application or to a user, as shown in the illustrative example (Figure 8). In the diagram, an individual accesses an application on her mobile phone. The application queries a "user agent" or "user proxy" module for additional information about the individual. This module is responsible for the following:

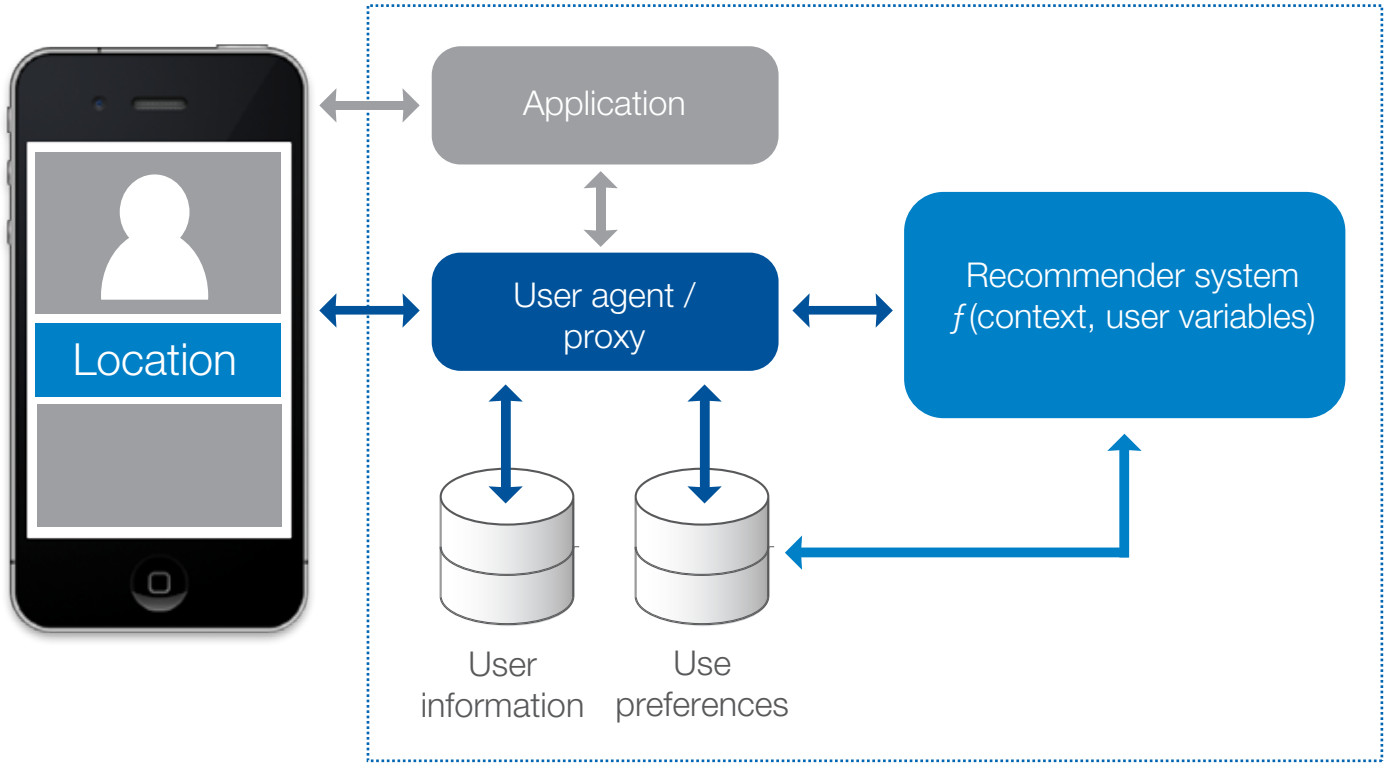
- Interacting with the user to obtain the value of the context variables needed to predict the acceptability of data use
- Accessing a "user information" database for any additional context from previous interactions
- Invoking the RS with the above information, so that it can predict acceptability of the requested data use

If the RS predicts a negative decision from the user, it can share with the proxy the additional factors that would make the scenario more acceptable. For example, as already noted, trust has a large, positive impact in situations with low acceptability. Upon receiving such information from the RS, a service-provider-based agent may request that the application give additional details about itself to increase the trust level, e.g. whether the service provider has a local branch or how positively the application is rated by the user's friends. A user-based agent can use this information to negotiate with the application for additional details before the user would be willing to accept the scenario presented.

If the RS does not receive sufficient information from the proxy to predict a decision, it can reach into a "use preferences" database to discover any previous preferences indicated by the user or any prevailing acceptable practices, and base its prediction on this information.

Regardless of how the RS arrives at its prediction or whether the prediction is positive or negative, once the user is presented with a personalized user interface and makes a decision on whether or not to accept the data-use scenario, that decision is stored in the use preferences database. The resultant decision, e.g. whether the individual finds the scenario acceptable or not, would also be used to update algorithms used by the RS. As such, the RS can conceptually reflect changing preferences at the personal level, as well as broader societal and cultural trends.

Figure 8: Illustrative example of a recommender system



Source: World Economic Forum

Designing a Context-sensitive User Experience

As described, RSs can provide applications that personalize data-access choices for each individual. To envision how the interface could work in the real world, Figure 9(a) shows a user interface similar to those commonly used today, where individuals are given the choice to either accept or decline the use of their current location information as part of accessing an application, with very limited additional information provided. A more meaningful user experience can be achieved by either providing additional input or enabling the users to negotiate on the factors that the research found to have the greatest impact on increasing acceptability (trust in service provider, value exchange and data usage).

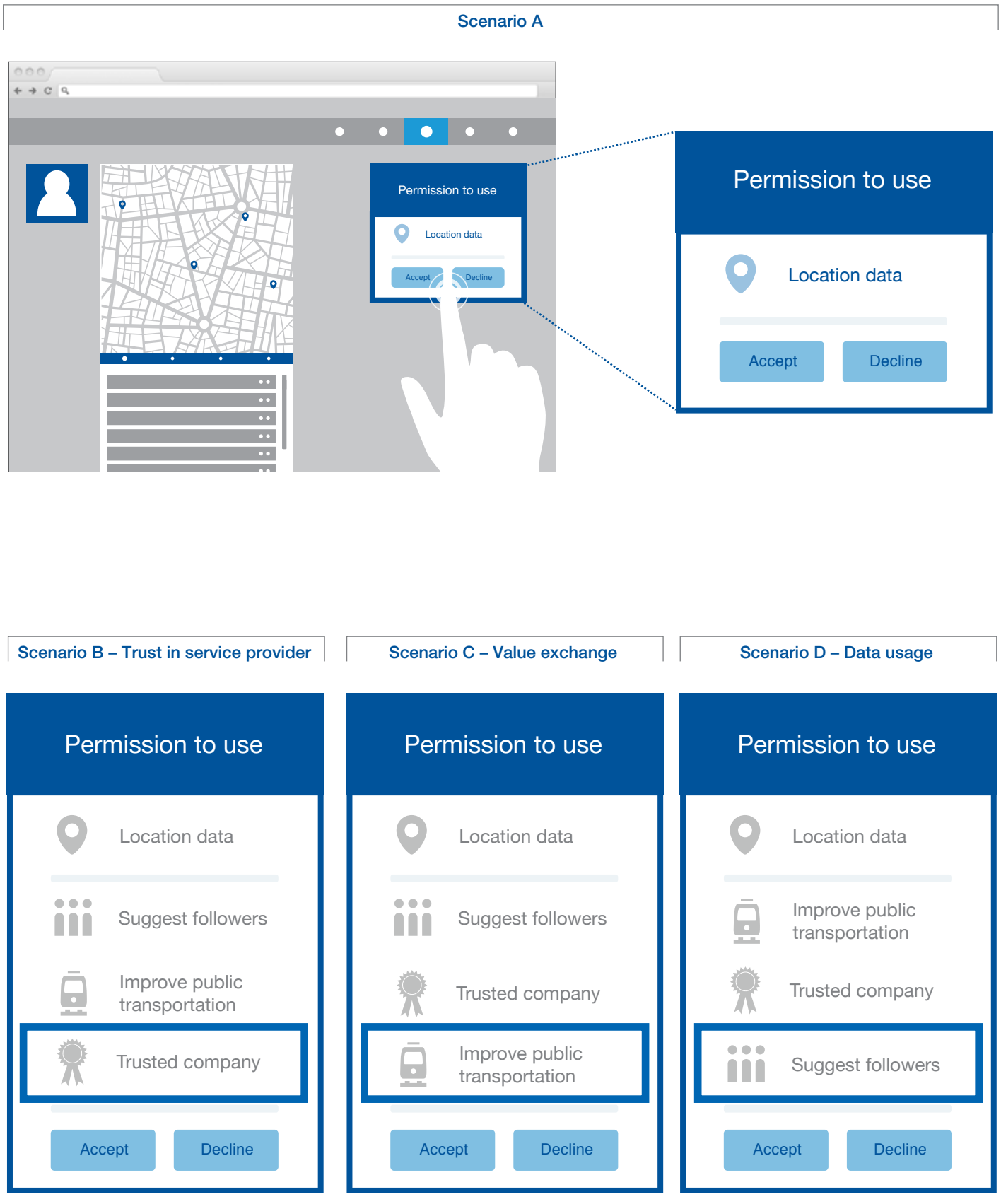
For example, a service-provider-based agent could engage with the party seeking to use the data and request more information on the factors that would have the greatest impact on user acceptability. Examples (b), (c) and (d) in Figure 9 show how this extra information can be integrated into the user interface, with additional emphasis on, respectively, trust (third-party trust seal), value exchange (improve public transportation) and data usage (suggest followers), for use where respondents indicate that these variables have the greatest impact on acceptability.

An agent acting as an assistant to users might recommend that individuals either decline to share their location data, or query the application until it is able to display at least the information about the variables to help individuals make their decisions. In both cases, integrating the context variables can help increase the probability that users will share location data, and enable the users to get more information about how that data will be used.

For individuals who may want to be more involved in how their location data is used, a variation of this user-experience design would present them with choices for each of the contextual factors. For example, under trust, individuals may be able to select whether they want to see a third-party seal or recommendations, if any, from their social networks. In any case, these types of interface design would significantly empower individuals in the use of their data. Their preferences can then be captured to improve predictions by recommender systems and in the user preferences database described earlier.

Although they did not directly apply to the interface shown here, other factors were considered in designing a personal data-management interface; these include language and semiotic differences (pictorial and typographic elements), oral or spoken interface concepts, and the potential for a visual indication of how much data a service provider has about an individual. Additional, culture-specific implications can be addressed later in the design process and can be incorporated into the interaction between the service provider and the individual.

Figure 9: User experience integrated with contextual factors



Source: Microsoft

Policy Implications

The research results discussed here show that individual preferences for data use are nuanced and contextual. With subjective variables such as trust in service provider, perceived value exchange and other attitudinal, demographic and cultural factors all playing a role, what is considered acceptable is clearly personal and will evolve over time. Binary approaches to data-use policies that treat all data equally, and that apply universally, are thus neither appropriate nor flexible enough, especially in a world of big data. Incorporating context-related nuances into regulations is difficult. However, technologies similar to those described here may provide an alternative, by helping to create policy frameworks that are driven by principles and outcomes, rather than by process or technology.

If models and algorithms, for example, can be developed to predict which applications are contextually consistent with personal preferences, they can, in theory, be used to develop context-aware systems capable of recommending data usage that respects individual values. When implemented with user-experience designs that are sensitive to the same contextual factors, users will be empowered and able to engage in more meaningful interactions to drive data usage that is consistent with their needs. Leveraging the same technology, individuals can also call on personal user agents to negotiate with applications on conditions of use until they become acceptable. Awareness that such technologies exist would encourage development of policy frameworks that incorporate the principle of context-aware data usage.

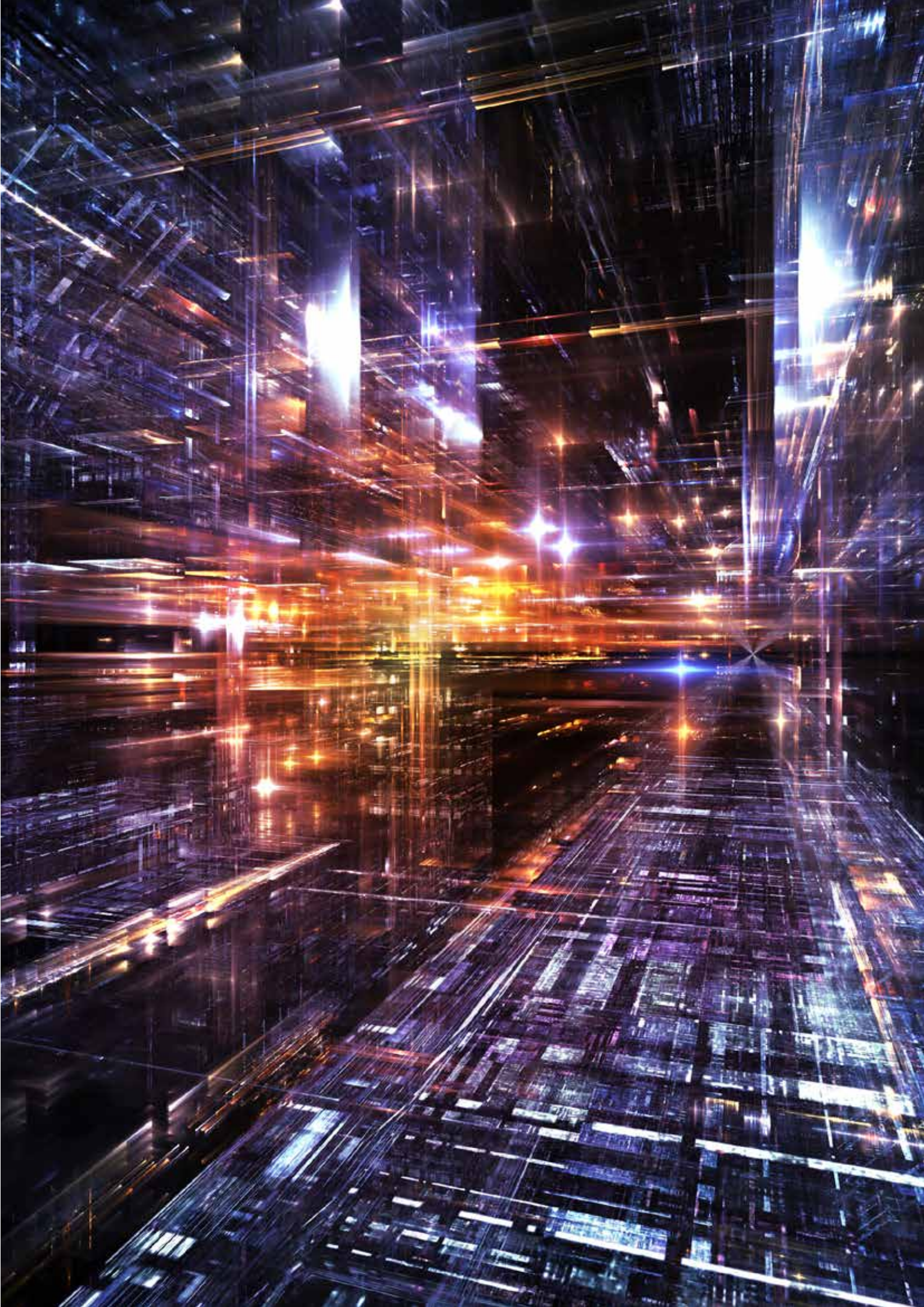
If these context-aware systems are also coupled with other technologies such as a metadata-based architectures, where data is logically accompanied by interoperable “metadata tags” that contain use policies associated with the data and related provenance information, user preferences and permissions can be further captured and made visible to any entity that touches data in the ecosystem.[11]

Combining these technologies would perpetuate context-aware data use beyond the externally facing service providers to all other providers in the data ecosystem. In providing automated mechanisms that can facilitate contextually appropriate data use, the technologies can also be leveraged to enforce the use of data. What is considered acceptable context would be reflected in the data-use policies; examining these policies would reveal contextually inconsistent uses resulting from inconsistencies between either the context and resultant policies, or the policies and resultant data uses.

Such technologies would further empower individuals in data-driven economies, and should be considered essential components of enabling user-centred personal data ecosystems. However, although technology can simplify good behaviour, it cannot, by itself, prevent bad behaviour; appropriate policy frameworks are still necessary. Examples of such regulations include penalizing a violation of use context or stated policies, and preventing the modification of policies without supporting evidence. Regulations can also encourage use of these technologies by reducing any penalties imposed on service providers that implement them.

In the research, collection method and data usage had the highest impact in most countries. The highest acceptability rates resulted from scenarios with active data collection and data usage that was as users agreed – the equivalent of notice and consent at the data collection point. The world of big data renders this approach impractical if not impossible to implement. The remaining context variables, especially trust in service provider and value exchange, must therefore be employed to increase acceptability of different data-use scenarios, at least until what are considered accepted norms have emerged and people are more comfortable with the new technologies.

The research showed that context is also dependent on cultural norms; the contextual factors had varying levels of impact for respondents in each country. However, with the evidence that context exists in all the countries studied, a global framework can be adopted and used for interoperability, with allowances for local preferences.



Conclusion

In a world of big data, the potential of data-driven economies can be realized only if data can flow and be commingled to drive new and innovative applications. Importantly, these new uses need to be consistent with user preferences and expectations, earning users' trust by avoiding unexpected breaches of context. Context-aware data usage is a critical enabler for the sustainability of such ecosystems.

Context is key, even if not well understood. The research presented here shows context being driven by multiple variables – some objective, but some clearly subjective – as well as by continuously evolving social and cultural norms. However, defining such abstract concepts in regulations is not ideal and can lead to overly prescriptive laws that will be cumbersome and most likely outdated as soon as they are written. Technologies such as those described in this report enable the development of context-aware systems, and an alternative approach to policy frameworks that incorporate the principle of data use respecting individual preferences and needs. This is different than allowing data to be used only in ways that are consistent with the context(s) in which the data were initially collected. This difference, and the technologies that facilitate it, are crucial for trustworthy personal data ecosystems.

More research is needed on how context can be defined more clearly and simply, and how it can be practically integrated into systems and interface designs that create meaningful user engagements. This understanding is essential to developing effective ecosystems and policies. Too often, the sociological and behavioural aspects are overlooked, in favour of more technocratic approaches that have not worked when actually implemented.

This research is needed at the global level to provide evidence that can be used to develop an interoperable global framework, or simply a framework that would allow individuals from one region to access services in another – a basic enabler for today's internet commerce.

Context-aware systems can also lead to new approaches to transparency for commercial services. Until now, transparency has not been well defined, and has led to literal interpretation and ineffective implementation. Context offers an alternative to reframe transparency as presenting information that is relevant to users, with the objective of enabling meaningful control and interactions.

The findings here further reinforce the need for interdisciplinary dialogue between technologists, social scientists, economists and policy-makers. The complexities involved require a balanced approach that takes these multifaceted perspectives into consideration. Some urgency clearly exists: unless individuals are empowered and engaged, the crisis of trust will persist and personal data ecosystems will remain asymmetric – and unable to maximize their full potential.

Endnotes

[1] Orange, February 2014. *the future of digital trust: A European study on the nature of consumer trust and personal data*.

[2] World Economic Forum, February 2013. *Unlocking the Value of Personal Data: From Collection to Usage.*

[3] International Institute of Communications, November 2012. *Personal Data Management: The User's Perspective.*

[4] The White House, February 2012. *Consumer Data Privacy in a Networked World: A Framework for Protecting Privacy and Promoting Innovation in the Global Digital Economy*; Federal Trade Commission, March 2012. *Protecting Consumer Privacy in an Era of Rapid Change: Recommendations for Businesses and Policymakers*; H. Nissenbaum, "Privacy as Contextual Integrity," *Washington Law Review*, 2004, Vol. 79, No. 1: 119-157.

[5] The work was carried out by P. Leon (Carnegie Mellon University, USA), A. Kobsa (University of California, Irvine, USA), and R. Murphy (Rhode Island School of Design, USA).

[6] *User-centred* personal data ecosystems, where all stakeholders are focused on empowering individuals, are distinct from *user-centric* personal data ecosystems, where individuals themselves are solely responsible for managing the use of all data related to them.

[7] The qualitative study consisted of a total of eight focus groups and 26 individual interviews across 4 countries. The quantitative results involved a total of 9,600 individuals surveyed online across eight countries.

[8] *Service provider* is used generically to denote any entity that the individual is interacting with for a service, either through a web-based interface or a mobile application.

[9] Scenarios with low acceptability rates were intentionally selected for this discussion, e.g. those of personal data being collected passively, without user awareness. As a result, even in the best cases (i.e. when other contextual factors were more favourable), the acceptability rates remain relatively low. Scenarios that involve active data collection, e.g. where users knowingly provide personal data, would have much higher overall acceptability rates. Factors that drive higher acceptability rates are discussed in more detail in later sections of the report.

[10] The two distinct groups of responses remained consistent throughout the research results. This may be partly because of the overall higher level of technological savvy among respondents from China and India, reflecting similar trends in their respective online user populations when compared to those of other countries. In the remainder of the report, the term *Western countries* is used to denote these Western-oriented countries, and is not meant to generalize the findings to all Western countries. Similarly, the term *Asian countries* is used to denote China and India.

[11] M-H. Carolyn Nguyen et al. "A User-Centred Approach to the Data Dilemma: Context, Architecture, and Policy," *Digital Enlightenment Yearbook 2013*. Amsterdam: IOS Press BV.

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