TRUEdig – final report

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1. Results and goal fulfillment

The TRUEdig project focuses on how trust and empowerment are created in newly innovated privacy-enhancing digital services. It was a question that had high relevance when we applied for funding, mainly due to the GDPR legislation, but its importance has grown even more. Mainly because of the COVID-19 pandemic and the turbulence that follows from increased digitalization and ingenuity on how companies can track people's behavior online.

As described in the research proposal, TRUEdig was organized in the form of three different subprojects which were partially independent but through effective communication and integration jointly answered the overall synergy research question - *"How can privacy-enhancing technologies, personalized service, and market creation logics together lead to trust and empowerment in new digital services?"*. Thus, a strong component of the TRUEdig synergy is to circulate knowledge generated within the separate subprojects to ensure effective integration, dissemination, and utilization.

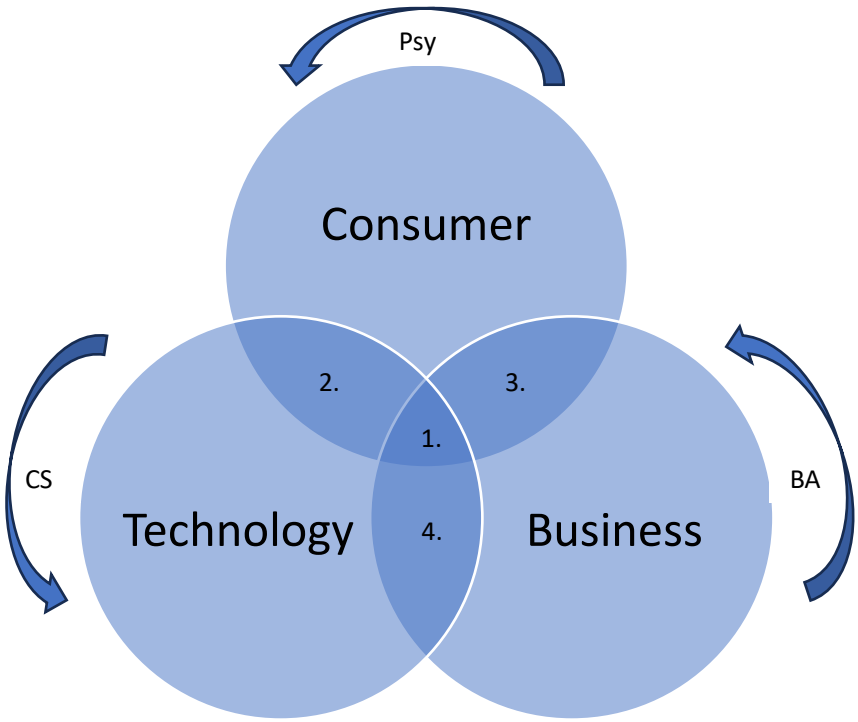
The overall synergy of the project has functioned in accordance with our expectations, thus enabling the three sub-projects to create research results that were integrated in a holistic way to answer the overall research question of how trust and empowerment are created in new digital services. As a result, the research synergy project has managed to meet several ambitious goals. Most beneficial, for researchers and partners, have been the synergy workshops that we have run on several occasions. In short, these workshops have focused on describing what is currently happening in the various projects, and at various partner companies. They also contained a phase where everyone was asked to look forward, to the next step of 'burning' research questions and issues.

Holistic framework

As TRUEdig represents a research project where three different academic disciplines were working jointly, there was a need for a holistic framework that could unite contributions from all of these fields which could enable future cross-disciplinary research, which is one of TRUEdig's main deliverables.

Our proposal for a holistic framework is illustrated in Figure 1 below. In short, it shows that the three academic disciplines of Computer Science (CS), Psychology (Psy), and Business Administration (BA) all contribute with scientifically derived knowledge on technology, human behavior, and business models, respectively. In combination, these three academic fields are all needed to understand how privacy-enhancing new digital solutions can be perceived as trustworthy and empowering. Computer scientists have created scientific results and advice around how privacy-enhancing technology can be designed, made usable, and explainable to pave the way for new digital solutions where usable privacy and transparency are built into the solution. Psychologists have created scientific advice around the perceptions of how human beings understand different situations that might lead to trust when engaging in a new digital solution. Business administrators have created scientific advice on how organizations can go about collecting data on consumers in a way that resonates with the consumers themselves thereby leading to future empowerment. At our project website, https://www.kau.se/ctf/forskning/forskning-vid-ctf/forskningsprojekt/pagaende-projekt/truedig, our visual illustration of this holistic framework can be found. Please also note that at this website a more fully description of the project can be found.

Figure 1: The all-encompassing holistic framework of TRUEdig.



1. *Knowledge regarding privacy-enhancing new digital services (Synergy)*
2. *Knowledge regarding privacy solutions and user's behaviors and attitudes (CS and Psy): How usable privacy solutions can be designed and how this may affect different users' online behaviors, regarding data privacy and data sharing.*
3. *Knowledge regarding market-making of privacy-enhancing new digital services (Psy and BA): Consumer attitudes and trust in different types of digital business models and in regards to the purpose of data use. Companies´ business modeling with privacy in regard.*
4. *Knowledge regarding business compliance: GDPR-compliant solutions for wellness and eHealth applications creating value for customers (BA and CS)*

1. **Synergy** – *knowledge regarding privacy-enhancing new digital services*

The framework is important as it informs future research on important knowledge fields that need to be integrated for, on the one hand, meaningful research to be explored, and on the other hand, applicable managerial insights that can be incorporated into the business environments we experience today. Adopting our holistic framework enables us to zoom in on either micro-processes (e.g. technical aspects around privacy by design, transparency, and intervenability) without losing focus on interrelated aspects (e.g. the socio-materiality of the consumption of digital solutions or business imperatives such as balancing profitability, legal aspects and business ethics). This is important because understanding, for example, digital consumption practices needs to be done in tandem with changing the technical or regulative mechanisms that condition these practices in the first place (i.e., changing technology or business principles). Likewise, changing business models within companies need to be understood alongside new patterns of consumer attitudes/behavior or new technological opportunities (e.g., machine learning algorithms). Put simply, the holistic framework

recognizes that even when our unit of analysis is a single aspect, i.e., technology, consumer behavior, or business, we still need to collect and analyze complex data in all three areas to receive a holistic view that helps create new digital services that are trustworthy and empowering.

As our synergy wenn-diagram shows, the project is approached by using an interdisciplinary collaborative framework where research from computer science, psychology, and business administration is applied. The first project examined technical aspects and focused on novel usable privacy-enhancing technologies for enhancing transparency and enabling intervenability. In this project, much of the co-production was conducted with Ica-gruppen and Ericsson. The second project starts from a psychological perspective and regards the understanding of user experience in terms of privacy and how services should be personalized accordingly. This project had much to gain from co-production together with Google and InTechrity. The third project is business and marketing-oriented and regards how markets are adopting these services, and how companies develop privacy-enhanced and trustworthy business models leading to consumer empowerment. This project fulfilled its goals by co-production of research together with companies such as InTechrity and Deversify. It should be noted that this project had a slight change of emphasis in terms of focusing on the many new business models that arise from new digitalized solutions (such as customers sharing their data to receive offerings at a lower price) in the wellness sector.

Aside from this important contribution, to be used in future research endeavors, the TRUEdig project has accomplished its goals by presenting press releases on its project website (link on previous page above), and elsewhere conducted several workshops. Moreover, together with one of the partner companies TRUEdig has presented research insights at the international QUIS 18 conference in Hanoi, Vietnam, and a joint workshop with another partner company (ICA-gruppen) at the IFIP Summer School on Privacy and Identity Management in Oslo in August 2023 Research results were also presented at for example the ISPIM Innovation Conference in Ljubljana in June 2023, and make up an episode in the “Värdeskapande samtal” series produced by CTF.

2. **Consumer and Technology** - *Knowledge regarding privacy solutions and user’s behaviors and attitudes: How usable privacy solutions can be designed and how this may affect different users’ online behaviors, regarding data privacy and data sharing.*

An important perspective regarding user trust and empowerment is how privacy information is presented and framed will nudge users to behave in a specific direction as the framing will trigger different mental schemes and thus prime us to act accordingly.

For example, our studies reveal that consumers are inconsistent and can be manipulated by various user interfaces, one prominent being so-called dark patterns. Consumers also have different skills, knowledge, and attitudes – and UI design, technology, and business organizations all need to adapt to this situation and make it simple to apply for privacy protection or understand the consequences if you do not apply these.

Dark patterns are deceptive UI designs that are used to trick users into acting in a specific way that will benefit the service provider, but not the users. In our studies we showed that the

same types of deceptive designs also could be used in the context of digital privacy, to enhance consumers awareness and use of privacy protection. For example, we used hyperlinked text to presentat Terms and Conditions, or Privacy Policies, and increased the acknowledgment of privacy conditions. By using simplified designs in this manner, users were forced to scroll through important information, noticing icons accompanied with text, or visual cues indicating the time required to read the terms, all of which taken together increased the the users' awareness of privacy information. Consumers also have different skills, knowledge, and attitudes – and UI design, technology, and business organizations all need to adapt to this situation and make it simple to apply for privacy protection or understand the consequences if you do not apply these.

Furthermore, the project also studied explanations and metaphors for privacy-enhancing data analytics based on differential privacy or functional encryption. Differential privacy (DP) is a mathematical framework for ensuring the privacy of individuals in datasets that are statistically analyzed and protecting statistical data against inference attacks by adding noise to the statistical data (or machine learning models). A first user study on the comprehension of commonly used metaphors for explaining differential privacy showed that metaphorical explanations can successfully convey that perturbation protects the privacy and that there is a privacy-accuracy trade-off. However, conveying information at a high level via metaphors leads to incorrect expectations that negatively affect users' understanding and misconceptions. Commonly used metaphors for DP are based on structural explanations (illustrating how a technology works, e.g. through the pixilation of pictures metaphor for DP) while previous research revealed that functional explanations (explaining the key functionalities of a technology) are actually better understood. A second study compared the perception of functional vs. structural explanations for functional encryption of expert vs. lay users. It revealed that for both user groups, the overall objective comprehension was indeed higher with functional explanations, while structural explanations were perceived as more trustworthy, convincing, helpful for decision-making, and were perceived as better understandable. One conclusion from this study is that privacy policies and consent forms should be multi-layered, providing a functional explanation at a higher layer (for better comprehension) plus a link to structural explanations with more technical details (for enhancing end-user trust).

In addition to UIs, we found that data-driven innovations seem dependent on users' individual differences. An interview study of YouTube content creators in Europe on their use of data from YourTubes Analytics showed that the user's experiences, capabilities, and personal goals, will determine if and how well they make use of the available data, regardless of the quality or the quantity of the data provided to them. Conclusively, the issue of privacy is more complex than the issue of the actual information or the presentation, as the above-mentioned studies on Dark patterns, PET metaphors, and data-driven innovation indicate.

3. **Business and Consumer -** *Knowledge regarding market-making of privacy-enhancing new digital services: Consumer attitudes and trust in different types of digital business models and in regards to the purpose of data use. Companies´ business modeling with privacy in regard.*

Three consecutive cross-studies have asked a representative sample of the Swedish population questions on their behaviors and attitudes to online services and digitalization. Depending on what type of service and technology, there were some noticeable differences depending on age and sex. Women and younger tended to be more trusting and have a more positive attitude, whereas men stated that they took more privacy precautions for instance using VPNs while internet browsing. However, the results at large showed that the Swedish consumer has more trust in certain organizations than others, for example, governmental organizations such as health care and Skatteverket; and that they are more willing to share personal information if the purpose of sharing serves a greater good, such as research or traffic communications. Here it seems as if there is a pattern of situational aspects (i.e., organization and purpose of data sharing) that may affect the willingness of the users to share their data and thus in the long run affect the efforts made by businesses that use user data for service development.

4. **Business and Technology -** *Knowledge regarding business compliance: GDPR-compliant solutions for wellness and eHealth applications creating value for customers (BA and CS)*

Somewhat oddly, privacy and privacy-enhancing technology is seldom paired with a business model perspective. Therefore, this research area focused on conducting a framework for how digital business models use private data as a resource for value creation. Having a framework for consumer data within digital business models is important for raising further research in the area. Frameworks will help illustrate conceptual clarity and can also be a foundation for further studies. In addition, the framework should also help managers seeking to address privacy issues and manage future innovation and development.

Significant deviations, unexpected results and new collaborations

Significant deviations

It should be emphasized that the Synergy project has been executed during quite turbulent times. First, it was the COVID-19 pandemic for two years and secondly, during the last year, we experienced a deflated stock market with inflation and an ongoing war. In sum, this has had three types of implications, firstly, this has forced almost all meetings to be digital. In a project that focuses on the consequences of an ever-increased digitalized society, this has not been overly negative but of course relationship building in a new project is not optimal when only taking place online, so, there was a start-up phase where we lost tempo. Secondly, within the participating organizations, there has been a quite high turnover of personnel. While this neither is necessarily all negative it requires extra time to be put into onboarding new people in the projects. Thirdly, for the companies, the turbulence meant a strongly increased focus on their own operations and daily business, instead of on research and development and the potential of picking up competitive advantages through scientific knowledge. Two companies left us during the Synergy period and one additional company has had a tough time on the market.

Due to the turbulence, we decided to collect mid-term reporting in terms of co-financing certificates from all partners in the project (we have uploaded them all here). Looking at the summarized co-financing from all of the companies it should be noted that we meet the

budget estimations once stated in the initial project application. However, the back side of this is that researchers have been forced to spend some time recruiting new partner companies.

Unexpected results

During the Synergy project, one reoccurring result regards the situation that consumers indicate strong protection of their privacy at the same time as they express irritation with irrelevant commercial messages and reveal their preferences explicitly on social media We have termed this 'inconsistent integrity fears' and they are, from an theoretical standpoint, be explained by cognitive dissonance theory. Psychologically, cognitive dissonance is the experience of contradictory information where a person's actions, feelings, or emotions are colliding. In line with the theory, when the idea of privacy meets the behavior of displaying personal or even private information online, two psychologically inconsistent entities collide with each other. Previous research has also indicated similar patterns of contradictory and irrational mix of attitudes and behavior.

Moreover, the longitudinal case studies of companies developing new business models in the wellness industry showed surprisingly similar results in terms of the vast challenges of complying with privacy laws. The similarity of how the companies modeled their business models over time was also unexpected.

A fun and final unexpected result regards that one of the participants from Google participated in CTFs 'Värdeskapande Samtal' together with one of the researchers in the project. Värdeskapande Samtal is a speaker series at CTF that matches a researcher with a person from the industry and the chat between these are filmed and put on YouTube.

New Collaborations and Potential Future Funding

During the project, ICA-Gruppen, Elvenite, Deversify, and Genelle joined the project. Zynapp, SkiData and Sandvine all left the project. Zynapp went into bankruptcy during the pandemic, SkiData faced large difficulties as the ski resorts and facilities were significantly hurt by the pandemic. Sandvine faced another difficulty as they came out unfavorably in news media coverage in Dagens Nyheter, this has already been reported by us in the mid-report of the project. For the future, new doors have also been opened to Translution (www.translutionsoftware.com) and to Picadeli (www.picadeli.se), which have explained interest in our research and where we have had meetings and discussions around a potential new Synergy application.

As of current, we are looking into new opportunities to fund this research further. We will apply for a new synergy and also for EU-Horizon funding.

Co-production

The goal of TRUEdig as a research project was not only to contribute to an exciting and important external mission (how to manage privacy in a digital era) but also to pave way for companies that need cutting-edge knowledge to improve their competitiveness. One advantage of the TRUEdig research project is that it is tightly connected to business challenges in the participating organizations. As a result, employees from business

organizations have been co-authors of papers together with TRUEdig researchers. This is important as this makes the co-production take place in a much more natural way.

To be more specific, the co-production has taken place in various ways. The most important means to co-produce research is to physically meet and ideate, analyze, and problem-solve together. Sharing a whiteboard, for instance, is a great way to collectively try to identify relevant questions that need to be solved, or analyze what data in the forms of interviews or lab experiments actually states.

As already mentioned, the TRUEdig project faced some serious challenges when the pandemic broke out and we, for the first time, had to change all the co-production over to new technologies such as Teams, Zoom Menti, Padlet, and many more, instead of the traditional ways of co-producing research physically.

However, the project soon managed its transition and at several instances throughout the project we held Zoom meetings where a lot of participants were active in contributing to the research. For example, our researchers and project members shared the initiative on identifying important research angles, and in break-out rooms we could open up for discussions on how to interpret results, etcetera, that we previously in time only had managed to do physically. All of these activities can, to some extent, be found described in the companies co-financing certificates uploaded in section 8.

In terms of co-production, we still find the meeting, whether digital or physical, between an employee from a partner company, and the researcher, as the 'secret sauce' to successful collaborative research. The important challenge for researchers might sometimes be to convince employees that their insights and experiences are equally important as the researchers', and when business experiences and academic theories can mix the results are very valuable and useful research results (i.e., in stark contrast to research from the US, where much user experiments is the result of involuntary student participation in university labs).

To sum up, our working methods in TRUEdig have to a great extent been digital meetings(except from the very end where we finally could have large group meetings in Stockholm) and the activities consist of seminars, where researchers and employees have identified important questions to be researched, and jointly conducted the analysis together.

Contribution to the university

TRUEdig is the result of a joint collaboration between CTF and Computer Science. The engagement that led forward to the synergy application was actually the result of a suggestion from the KK foundation. Both CTF and Computer Science constitute the largest research groups at Karlstad University.

For the last 15 years business organizations have integrated and developed their business operations through the advancement and usage of technology. It began slowly with self-service kiosks, and bank-on-the-internet, and continued with technology enabled by means of the web. In the last couple of years, technological expansion has increased rapidly. Not

only by means of mobile phone applications but also service robots and all kinds of technology in areas where such solutions used to be unthinkable. Due to Open AI, 5G, IoTs, AI, and ML, everything seems to more or less be able to connect. It is in these situations that *privacy* becomes relevant. Likewise, it is in this situation that research from CTF and CS becomes important and useful. Knowledge from service management has been married to knowledge from computer science. By cooperating with each other, both CTF and CS are moving toward the important goal of becoming an integrated research and education academic environment. In this situation, when TRUEdig has been accomplished, we see two research groups that are stronger than before the start of the project and that have established many new links and relationships between researchers between the involved research groups CTF and CS. The overall implication is that TRUEdig has implied important progress for Karlstad University. In addition, new networks and partnerships with companies have been established which supports our position in Sweden as a strategic knowledge provider. Thus, the overall contribution of TRUEdig implies an important step toward a stronger Karlstad University.