# What Can Possibly Go Wrong? Identifying Potential Adverse Impacts on People

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The design, creation and use of digital technologies has consequences, some of which may be unexpected, and some of which are undesirable. Despite widespread agreement on the importance of identifying harms, doing this in practice is very challenging and needs greater attention. Motivated by the need to enumerate impacts of technologies on marginalised individuals and their communities, we investigated how a hazard identification method might be used.

### 1. Revealing harms

Risk analysis techniques often focus on harms to the technology itself and other assets, in relatively closed and constrained systems, but we wanted to know more about potential harms to the people involved. Additionally, each harm (negative consequence) may be produced in more than one way, so using a top-down method analysing known hazards, did not seem to provide an adequate systematic exploration of all elements of a system.

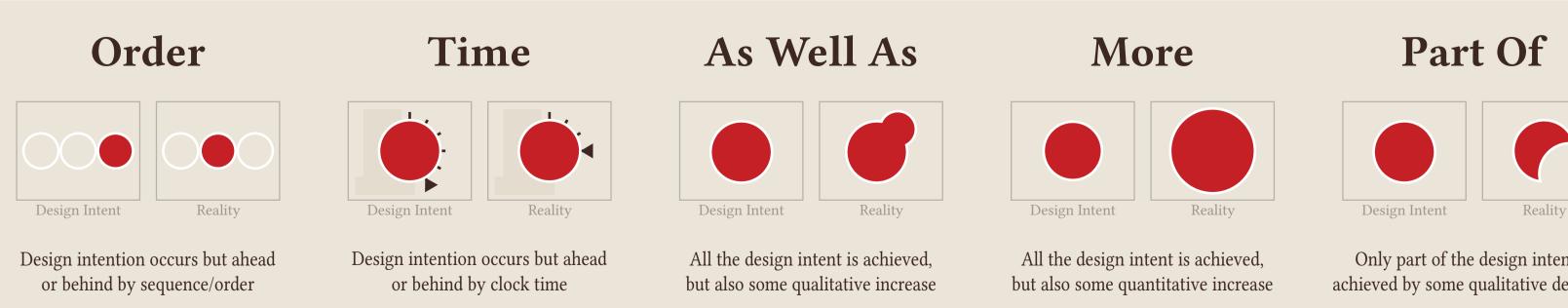
### 2. Could HAZOP be used?

Hazard and Operability assessment (HAZOP), developed in the chemical process industries<sup>1</sup>, is now an international standard<sup>2</sup>. HAZOP is an inductive, bottom-up, group activity which appeared to be a good fit for use in complex socio-technical systems, where deviations arise not only from individual and community use of digital technologies, but also from the wider ecosystem over which there can be little control. HAZOP is relatively simple and intuitive<sup>3</sup>, but despite widespread use, especially for safety-critical systems including software engineering, its use for human-centric Human Computer Interaction (HCI) research had not been thoroughly investigated.

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We undertook two feasibility studies to explore the viability and usefulness of HAZOP, followed by two pilot study workshops using scenarios (e.g.: Fig A) to define digital technology concept design intents. None of the participants had prior knowledge of either the scenario subject matter or HAZOP. In the first pilot, School of Computing final year undergraduate students identified 44 relevant deviations (e.g.: also Fig A) during a 90-minute workshop by considering harm impacts from the perspective of the people in the scenario. In the second pilot, experienced HCI researchers and their manager from Open Lab identified 65 deviations for a different scenario in 50 minutes.

Fig C: Diagrammatic representation of HCI HAZOP guide words and descriptions



**References:** 

- 1. Trevor Kletz. 1999. Hazop and Hazan: Identifying and assessing process industry hazards. IChemE.
- 2. IEC. 2016. IEC 61882:2016 Hazard and operability studies (HAZOP studies) Application guide.
- 3. J Gould, M Glossop, and A Ioannides. 2000. HSL/2005/58 Review of Hazard Identification Techniques. HM Gov.

### 1 – Definition Kate and Jo both work but their jobs are not secure and want to be ready in case Order Need to submit claim before preparations finished hey have to claim Universal Credit Less Benefit award potentially lower than expected Universal Credit (UC) claim made using some other method They decide to use the Pre:Peer digital platform to link up with other people No or Not No internet access doing the same preparations, share nowledge and do activities taking Assistance is not very useful Less them through all the necessary steps can be done in advance No or Not **Missing documents** Not eligible, but find to be eligible for some other benefit Kate and Jo physically meet a Pre:Peer facilitator who helps them get going, No or Not No face-to-face meet-up introduces other local people and ovides telephone and online support As Well As Gain digital skills Department Workbook steps undertaken in wrong sequence No or Not Lack of understanding of workbook Pens Landlord use the steps in the Pre:Peer hysical-digital workbook to gather Welcome to Internet Bankin Less Poor data quality ind add all the information, evidence, No information accessible from other government systems No or Not identity documents and so on, and are shown how to import some details from No or Not No usable information in workbook ernment systems and elsewhere & CU No or Not No workbook As Well As Lose friends due to stigma or jealousy Different people have their own particular ircumstances and are at various stages As Well As Personal information shared more widely than wanted of preparation, so there is plenty of diversity in community support available As Well As Experience puts other people off using Pre:Peer As Well As Make an enemy Technological Harm Identificati Part Of Some saved information expires Pre:Peer registers linked UC accounts for Someone else's identity is used to register / make claim Other Than their household and uploads the identity verification information, creating email As Well As Accidentally make fraudulent claim ccounts too if needed Human-Focused for Socio-Techn Delete a UC claim instead of making one

### Fig A: Technology scenario extract with example guide word - deviation pairs

# 3. Methodology and findings

## 4. Outcomes and impact

The studies progressively adapted the inductive HAZOP method for a HCI context, to foreground people as contributing actors rather than sources of system errors, and to recognise other elements in the socio-technical system (Fig B). We created HCI-specific guide word descriptions, novel diagrammatic representations (Fig C) and guidance materials for this "HCI HAZOP", and published a paper:



HCI - H is also for Hazard: Using HAZOP to Identify Undesirable Consequences in Socio-Technical Systems. In ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS '21). https://doi.org/10.1145/3460112.3471959

Funding:

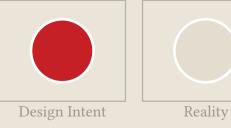
Only part of the design intent is achieved by some qualitative decrease





Only part of the design intent is achieved by some quantitative decrease

No or Not



No part of the original intent is achieved, and nothing else is achieved either

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Other credits:

We would like to thank the workshop participants for their time taking part in the study, and the proof readers and reviewers for providing feedback on our paper. Images and photograpgs in Fig A are open source and public domain. HCI HAZOP was adapted from standard HAZOP<sup>1,2</sup>. v1.1

### Fig B: HCI HAZOP method's four stages

2 -

Assessment scope

Some socio-technical

system with defined

actors, activties and

Purpose of the study

(e.g. aims and coverage

required) and whether

Harm perspective

Usually one or more

Participants

primary actors such as

4-6 person study team

and users at a minimum

topic, subject or technology

independent study leader

comprising designers

but possibly also any

specialists, plus a

and a recorder

HCI HAZOP trained

citizens or a community

comparative or not

Objectives

mediating tool(s), and

boundaries/environment

Preparation	3 – Examination and documentation
Plan study Information and data requirements, design materials, meeting plan and bookings, team briefings, record keeping methods Collection Gather all required source information etc Element lists Using the information, data & design materials prepare lists of all the actors, mediating tools, other artifacts, activities/ actions/intents; include other actors in the wider ecosystem (e.g. people nearby, local communities, wider society, the state and rogue actors (e.g. cheats, fraudsters, hackers and gossip mongers) Define item granularity Design and scope dependent but usually activities or actions	Assemble study leader (L), study team (T) & recorder (R) (L) Select item ( (L) Explain design intent and harm perspective (L) Select guide word ( (L) Read out guide word explanation (T) Consider the item-guide word pairing (T) Develop meaningful deviation ( (T) Propose causes and consequences (R) Record all details Another deviation for the same guide word? Another guide word? Another item?
on Utilising COP ical Systems	<b>4 – Follow-up</b> Review and assess deviations This is research-specific and will usually be linked to the HCI HAZOP assessment's objectives

