Concept Glossary

for the Science, Technology and Society course (42622 & 42620)

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Introduction

What is a concept?

A concept is a **thinking tool**: an idea (often developed through empirical research) that helps you notice**,** describe, and reason about aspects of the world. You can think of a concept as a lens: it makes you see some features, while de-emphasising other features. Concepts do not automatically tell you what is "true," but they help you ask clearer questions and build more structured arguments.

This course distinguishes three types of concepts, because they help you do different things:

- **Methodological concepts** guide how you work with data. In this course, they help you parse and analyse a dataset of statements following a controversy mapping approach. Methodological concepts provide rules of thumb and quality criteria: what to look for, what to ignore, how to justify your choices, and how to make your analysis robust.
- **Analytical concepts** guide what you pay attention to in the phenomenon you study. They help you formulate the questions you ask and make explicit which dimensions you foreground. In other words: they shape your particular analytical angle.
- **Interventional concepts** guide what you propose to do based on the analysis. They help you develop, justify, and communicate recommendations in your policy brief, i.e., how to respond to the issues you identified in the analysis.

Why does RRI and AREA not appear in this list?

We treat RRI and AREA not as single concepts, but as frameworks, structured collections of concepts that work together. In the policy brief, you should therefore avoid to refer to "RRI" or "AREA" as a whole. Instead, you should be more precise and draw on the relevant parts (as outlined below under *interventional concepts*).

How to use this glossary

This glossary contains concepts you may use in your policy brief, and that you can expect to be tested on in the multiple-choice quiz. It is meant to support your learning process. You should not cite this glossary directly in the policy brief. Instead, you should be able to explain and apply these concepts in your own words drawing on respective course materials (lecture slides & notes, supplementary texts) as well as empirical data.

Analytical Concepts

1. Normative ethics

How can we judge whether a technology, a design choice, or a policy recommendation is morally good or right? Normative ethics is the part of ethics that asks exactly this: what should we do, what is morally right, and what counts as a good society. In the course, we introduce three main traditions (consequentialism, deontology, and virtue ethics) as different "toolkits" for reasoning about moral questions. They often reach different conclusions not simply because people disagree on facts, but because each tradition starts from different **baseline assumptions** about what matters morally (outcomes, duties/rights, or character/virtues and relations).

Normative ethics is useful because it helps you analyse real-world statements and arguments—in debates, policy, company communications, or public controversy—by making their assumptions visible. Learning multiple ethical theories does not give you an objective answer. Rather, it trains you to understand *why* an argument leads to a conclusion, where it might have blind spots, and why others might reasonably disagree.

In controversy mapping and in your policy brief, normative ethics provides a structured way to compare moral claims without reducing disagreements to ignorance or bad faith. It helps you identify the ethical "grammar" behind competing positions, clarify what each position prioritizes, and reflect on limitations (e.g., consequentialism can neglect rights and justice; deontology can be rigid when duties conflict; virtue/care ethics can be hard to scale to large societal trade-offs). A responsible analysis can then explicitly justify recommendations while acknowledging what they foreground—and what they leave out.

2. Consequentialist ethics

Is a technology "good" because its outcomes are good? And what counts as "utility"?

Consequentialism judges the moral rightness of actions (or rules) only by their outcomes. An action is right insofar as it maximizes overall utility (often framed as welfare, happiness, wellbeing). It comes in act consequentialism (judge each act by its consequences) and rule consequentialism (judge rules by whether they tend to produce the best outcomes).

Consequentialism offers a way to evaluate technology based on measurement-heavy methods (e.g., lifecycle assessments), but it can also create blind spots: rights, justice, autonomy, and structural inequality can get sidelined if they are hard to quantify.

3. Deontological ethics

Are there things we must never do—even if outcomes would be better?

Deontology grounds morality in duties, rights, and principles rather than outcomes. A classic reference is Kant's categorical imperative: (1) universality (act only on maxims you could will as universal law) and (2) humanity (do not treat persons merely as means). Rawls' approach develops deontological principles via hypothetical agreement (veil of ignorance), yielding safeguards like equal liberties and justified inequalities only if they benefit the least advantaged.

Deontology sensitizes analysis to rights-based critiques of technology (privacy, autonomy, fairness) and to conflicts where "good outcomes" don't justify violating core duties. It can be strong for critique, but can become rigid when duties collide.

4. Virtue ethics

Does a technology enable us to live a good life? And how do we define that good life?

Virtue ethics shifts moral evaluation away from isolated acts/rules toward the cultivation of virtues and character required for a good life. Virtues are developed through practice and reflection and are often framed as balanced traits (e.g., courage between cowardice and recklessness). In this course's framing, care ethics can be treated as a close relative: it builds moral responsibility from relations of dependence, attentiveness to needs, and responsiveness—especially relevant where power asymmetries exist between designers and affected groups.

Virtue ethics reorients critique from "Did we optimize correctly?" to "What dispositions and professional responsibilities should guide design and assessment?" It's strong for professional identity and relational responsibility, but less direct as a decision-procedure for large-scale societal trade-offs.

5. Interpretative flexibility

Is the technology "one thing," or does it become different things for different groups?

Interpretative flexibility describes a situation where multiple social groups hold different (and sometimes conflicting) interpretations of what a technology is, what it means, or what it does. These differences can appear in design as well as use. Over time, flexibility often reduces through closure, when one interpretation stabilizes as dominant (through social, cultural, and political processes—not just "better engineering").

This concept counters “technology is inevitable” narratives and steers attention to contestation, meaning-making, and stabilization: to understand impacts, you must study how different groups interpret and negotiate the technology.

6. Script

What kind of user does a design assume? What behaviour does it invite, demand, or block?

A “script” is the set of assumptions and expectations inscribed into a technical object—about users’ competences, motives, environments, and “proper” ways of acting. Scripts can be embedded in interfaces, workflows, physical form, default settings, and rules. Users do not always comply: they may follow, negotiate, repurpose, or resist scripts (Akrich’s “de-scription”).

Scripts make “technology is neutral” hard to sustain: design choices distribute agency and responsibility by shaping what is easy, hard, possible, or thinkable for different users.

7. Explicitly political technologies (Winner)

Who benefits—and who is excluded—because the artifact was designed that way?

Explicitly political technologies are artifacts/systems deliberately designed to produce or reinforce particular power relations (benefiting some groups while disadvantaging others). Politics is not an “after-effect” here; it is part of the design and implementation (e.g., favouring large organizations over small ones).

This concept directs critique toward design intent + politics: which interests shaped the artifact, and which social groups were made winners/losers by the technical pathway chosen?

8. Inherently political technologies (Winner)

What forms of governance does the technology require to function at all?

Inherently political technologies are systems whose technical requirements make certain political arrangements more viable than others (e.g., centralization, hierarchy, security regimes). The politics may not depend on intent: the artifact’s operational demands select for specific organizational forms.

Analysis should include institutional fit: when a technology scales, what kinds of authority structures, expertise regimes, and control infrastructures become “necessary”?

9. Paradigm and thought collective (Kuhn)

Why do some experts disagree so deeply about facts and about what counts as evidence?

A paradigm is a shared framework that organizes what problems matter, what methods are legitimate, and what counts as evidence/explanation. Under "normal science," communities do puzzle-solving inside the paradigm. A thought collective is the group stabilized by these shared assumptions and practices (including implicit norms, instruments, and standards). When anomalies accumulate and can't be contained, fields can enter crisis and undergo paradigm shifts.

Paradigms explain why disagreements persist: they are not just about "information deficits," but about competing worlds of practice that structure observation, measurement, and credibility.

10. Interactional expertise and trading zone (Collins et al.)

How can people collaborate across disciplines without fully sharing methods or worldviews?

A trading zone is a space (institutional, practical, conceptual) where groups with different specialist languages coordinate by developing partial shared vocabularies, protocols, or "inter-languages." Interactional expertise is fluency in a field's discourse and tacit standards without the ability to do its hands-on technical work—enabling translation, mediation, and negotiated alignment across groups.

This reframes interdisciplinary work as the creation of local coordination infrastructures (shared terms, boundary objects, routines), rather than the fantasy of full consensus or universal understanding.

11. Contributory vs. interactional expertise (Collins & Evans)

Who can do the work, and who can speak the language well enough to build bridges?

Contributory expertise is full mastery of a domain's language and practice (you can genuinely contribute to the technical work). Interactional expertise is fluency in the domain's discourse and evaluative norms without the practical ability to perform the work. Both matter in complex sociotechnical problems: contributory experts produce specialized knowledge; interactional experts enable cross-domain cooperation and accountability.

This distinction helps you map expertise claims without collapsing everything into “expert vs. lay”: it highlights boundary-spanning roles and explains how coordination can succeed (or fail).

12. Performativity (of markets)

Do economic models merely describe markets—or help make them?

Performativity is the thesis that economic theories, models, and tools can be world-making: they shape the practices, expectations, and infrastructures that constitute markets. For example, the theory of supply and demand doesn't just explain market behaviour; it influences how market participants act by providing a framework for their decisions.

It shifts analysis from “markets as natural mechanisms” to markets as sociotechnical achievements that depend on tools, knowledge practices, and institutional scaffolding.

13. Framing

What counts as “inside” the transaction—and what gets pushed “outside”?

Framing refers to the process by which market actors define and delimit the boundaries of market transactions. Framing includes determining what is to be exchanged and under what conditions. For instance, in the market for organic produce, framing involves setting standards for what qualifies as "organic" and establishing the certification process. Framings tend to produce unintended ‘overflows’, which can spur public opposition and controversy, calling for re-framings of the overflowing markets.

Framing directs attention to boundary-making work: who gets to define the relevant qualities and conditions, and what social/environmental consequences are treated as out-of-frame?

14. Market devices

How are market actions guided, coordinated, and made possible?

Market devices are tools, technologies, and institutions that facilitate economic transactions, such as pricing mechanisms, quality standards, and marketing strategies. They should not be understood as ‘pure’ instruments, but as material and discursive assemblages that orient action and organize markets in particular ways.

By structuring comparison, valuation, and exchange, market devices privilege certain forms of knowledge, value, and behaviour while marginalizing others.

15. Market socio-technical agencements (STAs) (Callon)

What assemblage of humans, technologies, rules, and infrastructures has to hold together for "the market" to exist?

STAs refers to the arrangements and assemblages of human and non-human actors (including market devices) that constitute a market. These can include institutions, technologies, regulations, and even cultural norms. For example, the market for electric vehicles is shaped by a network of actors, including car manufacturers, government regulations, charging infrastructure, and consumer preferences.

"The market" becomes an empirical object you can map: identify the agencement, then ask how it distributes agency, power, and responsibility.

16. Users (Hyysalo, Jensen, Oudshoorn)

Who counts as a user and how do users reshape innovation rather than merely adopting it?

Users are individuals or groups who interact with a technology through consumption, adaptation, feedback, or participation in design. STS work on "the new production of users" treats users as co-producers of innovation: they modify technologies (user innovation), develop new uses, build communities, and sometimes enter design earlier through participatory or distributed innovation networks.

This concept disrupts linear "producer → user" models and makes diffusion, modification, and resistance part of innovation's core dynamics.

17. Non-users (Wyatt) — four types

What does "non-use" do to a technology's trajectory and why is non-use meaningful?

Non-users are those who do not engage with a technology, either voluntarily or involuntarily. Wyatt's typology distinguishes: resisters (never use and actively choose not to), rejecters (used before, then stopped voluntarily), excluded (lack access due to socio-economic/infrastructural barriers), and expelled (lose access involuntarily). Non-use is not simply absence; it can be an active stance that shapes public meanings, adoption pathways, and redesign pressures.

Studying non-use reveals hidden assumptions in design ("the user as everybody") and highlights how exclusion and resistance are constitutive of sociotechnical change.

Wicked problems (Rittel & Webber)

How do you "solve" a societal problem when people disagree on what the problem is and the problem is evolving?

Rittel & Webber argue that many of the problems that engineers and scientific planners are tasked with solving are *wicked* rather than *tame*.

Tame problems are well-defined, making it possible to solve them in a rational and scientific manner. It is clear what counts as a good and optimal solution. Scientists and engineers need problems to be tame if they are to be able to solve them professionally.

Wicked problems, on the contrary, are ill-defined for various reasons (see factors of wickedness in the next section). Rittel & Webber observe that in a pluralistic society there is no such thing as the undisputed public good and that it makes no sense to talk about optional solutions unless you impose severe qualifications. Wicked problems are problems where the good is disputed, and there is no agreement on what an optimal outcome is.

The point is not "give up on solving." The point is to replace the expectation of optimal, final solutions with a more responsible approach: be explicit about assumptions and framings; anticipate distributional consequences (who benefits/loses); treat proposed solutions as interventions that reshape the field; and expect disagreement as normal. This is exactly why controversy mapping and RRI-style reasoning matter: they help you map competing problem definitions and justify recommendations under pluralism and uncertainty.

Five factors of problem wickedness (Rittel & Webber)

Rittel & Webber list ten factors of problem wickedness, and we have worked with the following five on the course (see lecture note and slide for more detailed definitions and examples):

There is no stopping rule. The problem is ongoing. There can be several reasons why problems are ongoing. In some cases, the problem adapts to the solution in a way that constantly makes new solutions necessary. In other cases, our standards for solving a problem evolve over time, moving the goal posts.

The way a problem is described determines its possible solutions. When different actors frame the same problem in different ways, they will often also have different ideas about what counts as a good solution. We call this a framing controversy.

Solutions are irreversible. Path dependence means that some solutions are harder to undo than others. This, in turn, makes it hard to experiment with different solution strategies through low-cost trial-and-error because interventions are often high-stakes and can be irreversible.

Solutions can be better or worse, not true or false. If there is no undisputed public good and no agreed upon optimal solution, there will always be someone who stands to benefit from a solution, and others who will be less lucky. This means that solutions can only be judged as *better or worse* (and typically better for some groups, worse for others).

A problem can be described as a consequence of other problems. One thing is that a problem is wicked (according to the factors above), but that is further compounded in the cases where the problem is partly caused by other wicked problems (a factor of wickedness in its own right).

18. Cultural Theory of Risk (Mary Douglas)

Why do some dangers become politicized "big risks" while others remain tolerated or ignored? Why do different people perceive the same objective risk differently? And why do they prefer different risk management strategies.

Cultural theory treats risk not only as a technical matter (probability × magnitude), but as something that is interpreted, selected, and debated within social groups. People's judgements about danger are tied to trust/distrust in institutions, ideas about responsibility and blame, and broader conflicts about legitimacy, justice, and who has the right to decide.

A key move is to focus on solidarities and attachments to social groups: shared ways of life (and associated values) that shape what counts as an acceptable risk and what counts as an unacceptable threat. In this view, public risk controversies are not simply "irrational perceptions" that need to be corrected by better communication; they are also arguments about what kind of social order is desirable, who should carry burdens, and who should be accountable when harm occurs. Cultural theory therefore puts weight on the process of risk governance (who is included, what is transparent, what is considered fair), not only on risk quantification.

Cultural theory helps you analyse risk disputes as sociotechnical and political—especially when expert assessments clash with public concerns. It provides a vocabulary for explaining why actors can disagree in systematic ways (not randomly) and why "more facts" often do not end the controversy. That makes it highly useful for controversy mapping and for writing policy recommendations that anticipate conflict around trust, fairness, and accountability.

19. The Grid/Group Model (Mary Douglas)

If cultural theory says "risk perceptions are patterned by social life," how do we describe those patterns in a simple way? Douglas' grid/group model is a two-dimensional map of social organisation used to explain recurring "cultural biases" in how people preceive risk and prefer different risk management strategies. "Group" describes how strongly people are bound into a collective identity and shared norms. "Grid" describes how strongly people's lives are structured by rules, roles, and hierarchies (i.e., how regulated and stratified the social setting is).

Combining the two dimensions yields four stylised positions (often used as ideal types, not as personality labels):

- **Hierarchists** (high group, high grid): trust established authority, prefer regulation and expert management.
- **Egalitarians** (high group, low grid): distrust hierarchy/markets, emphasize community control, often precautionary.
- **Individualists** (low group, low grid): prefer competition/markets, treat risk as opportunity, emphasise personal responsibility.
- **Fatalists** (low group, high grid): feel constrained but unrepresented; outcomes seem beyond control.

The grid/group model is a compact way to map predictable differences in risk rationalities inside controversies—who trusts which institutions, who demands which forms of proof, and what kinds of governance arrangements different actors find legitimate. It helps you identify clashes between different risk perceptions and design recommendations that acknowledge them (instead of assuming one "correct" risk attitude).

Methodological concepts

20. Post demographics (Rogers)

Is online friendship "real" friendship? Are social media accounts "real" people?

According to Richard Rogers, post-demographics is a way to study personal data in social networking platforms, focusing on how profiling is performed and its consequences, and departing from traditional demographic research methods.

The key takeaway for us is that the demographic way of doing sociology, which uses the person as a unit and focuses on race, ethnicity, age, income, or educational level, is not the

only way to do sociology. We do not have to pretend that a user account matches a person, which is not true in general.

We can still study user accounts sociologically.

In our case, we study the statements of various actors in the digital public space, without pretending that those statements are "representative," in a traditional sense, of their thoughts. We can simply study the statements for what they are (traces).

Read more: https://www.digitalmethods.net/Digitalmethods/PostDemographics

21. Just observe (Latour)

Bruno Latour, who shaped the pedagogical exercise of controversy mapping, famously stated that it boiled down to this:

"Just observe and describe controversies"

"Just observe" refers to a methodological stance that emphasizes careful, detailed observation of controversies as they unfold, without imposing predetermined theoretical frameworks or rushing to resolve the disputes. As argued by Tommaso Venturini, what makes it hard is precisely to refrain from the urge of writing your analysis using your favorite theories, your personal perspective on the subject, and your own certainties.

Venturini's advice:

- Do not restrain your observation to any single theory or methodology;
- observe from as many viewpoints as possible;
- listen to actors' voices more than to your own presumptions.

Read more: Tommaso Venturini's "Diving in Magma" (2011), the main paper about this: https://www.tommasoventurini.it/wp/wp-content/uploads/2011/08/DivingInMagma.pdf

22. Second degree objectivity (Latour)

Within a controversy, the absence of agreement between actors prevents us from finding "the objective truth." But if there is no objectivity in controversies, how can they be studied objectively?

In short, we can be objective about the dispute itself.

Second-degree objectivity acknowledges the impossibility of first-degree objectivity (complete neutrality about what is controversial) while still striving for a rigorous analysis (of the controversy). Second-degree objectivity means being objective about what actors

say and do regarding disputed facts, rather than trying to objectively determine which facts are true.

Read more: Like above, Venturini's "Diving in Magma" (2011): https://www.tommasoventurini.it/wp/wp-content/uploads/2011/08/DivingInMagma.pdf

23. Exploratory Data Analysis (EDA)

Exploratory vs. confirmatory: exploring data differs from applying the statistical toolbox to confirm hypotheses. Exploration finds questions, while confirmation finds answers.

Exploratory vs. explanatory: although the tools are the same, exploration entails visualizing for yourself while explanation entails visualizing for other people, which requires different strategies. Visualizing for yourself is about building internal knowledge and pivoting quickly between data facets. Visualizing for others requires communicating efficiently (more on this in lecture "visual storytelling").

Read more: This medium post showcases various techniques to explore data in Python with Pandas: https://medium.com/data-science/a-data-scientists-essential-guide-to-exploratory-data-analysis-25637eee0cf6

24. Close / distant reading (Moretti)

Exploring data with algorithms and visualization can be seen as a form of reading. Franco Moretti distinguishes close reading and distant reading. Close reading is traditional reading, where the source material is not transformed. Distant reading entails transforming the source material to make patterns appear. Your data exploration de-facto qualifies as a distant reading of what is said and disputed in the digital public space.

Read more: A concise intro to distant reading by Brandon Walsh and Sarah Horowitz in their excellent book "Introduction to Text Analysis": https://walshbr.com/textanalysiscoursebook/book/reading-at-scale/distant-reading/

25. Quali-quantitative analysis

Qualitative analysis typically focuses on interpretations and contexts. It uses interviews, observations (field notes), or long textual data. It looks into the richness and complexity of (social) phenomena, generally through close reading.

Quantitative analysis is focused on measurements and statistical patterns. It typically uses surveys, datasets, and experimental data. It aims to identify general trends and correlations, i.e. distant reading.

Quali-quantitative analysis combines both: it seeks to preserve the richness of qualitative insights while leveraging the scalability and structure of quantitative data. In digital sociology, this often means analysing large data sets in a way that maintains attention to meaning, context, and narrative. In other words, it aims to provide thick description at scale.

Quali-quantitative analysis is not quali and quanti at the same time, but *alternates* qualitative moments and quantitative moments, close reading and distant reading.

Read more: Once again, Venturini's "Diving in Magma" (2011): https://www.tommasoventurini.it/wp/wp-content/uploads/2011/08/DivingInMagma.pdf

26. Principle of symmetry (Bloor)

The principle of symmetry is an element of David Bloor's "strong programme" for the sociology of scientific knowledge. It demands that the same types of explanations are used for successful and unsuccessful knowledge claims alike.

Our methods should be able to analyse bad science as well as good science, whatever that means. We should be able to understand the knowledge claims of flat earthers as well as the knowledge claims of renowned physicists.

Of course, that does not mean that we consider them the same (see "Weighing positions" further down this list).

Read more: the Wikipedia page about the strong programme is insightful: https://en.wikipedia.org/wiki/Strong_programme

27. Actor (in actor-network theory)

In "actor-network theory" (ANT), an actor is someone or something that *makes a difference* to the situation. Not every person is an actor: people who do not make a difference are not considered actors. We can also have non-human actors, like organizations (agencies, companies, associations…) but also animals, rivers, technologies… Non-humans can be considered actors insofar as they make a difference.

The key takeaway for this course is that we are mainly interested in actors insofar as we can track and document which difference(s) they make to the issue we analyse and the discourses about it. Here, an actor is an actor because it makes knowledge claims (e.g., involving expertise or risk) that influence decisions, answer open questions, shape the public debate, mobilize new actors, or make a difference in any other way.

Read more: Bruno Latour's "Where Are the Missing Masses?" (1992) explains it well: http://www.bruno-latour.fr/sites/default/files/50-MISSING-MASSES-GB.pdf

28. Follow the actors (Latour)

In accordance with the principle of symmetry, we do not investigate according to our own beliefs and knowledge, because this way we would not be able to account for the knowledge claims of actors we disagree with. Instead, we follow the actors by listening to their knowledge claims and how they argue about them to retrace their underlying logic. We potentially follow the actors to uncomfortable places we disagree with, and we account for it. In practice, it means we pay special attention to the specific terms and arguments used by the different actors. We do not replace their words by ours, even when we think they are the same (because to them, they may not be the same). This is especially relevant when using queries to investigate a dataset.

Read more: for a more in-depth discussion about the symmetry principle and what it means to follow the actors in the digital public space, check Noortje Marres and David Moats' "Mapping Controversies with Social Media" (2015): https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2567929

29. Weighing positions

Some actors are stronger and make a bigger difference than others. You must show it. The principle of symmetry states that we treat all actors equally, that we describe them fairly regardless of whether or not we agree with them. But this does not mean that we pretend that they are equal, in fact quite the contrary. Our analytical job is precisely to account for the fact that some of them make a bigger difference than others. For example, their knowledge claims were repeated by more other actors, or convinced more policymakers to take action, or were more influential on what topics are debated on social media, etc.

Following second-degree objectivity, provide an objective description (a measurement) of each actor's ability to make a difference in the discussions about the issue we analyse.

30. Measurements

In sociology, measurements refer to the practical work of making social life knowable, comparable, and actionable within different research communities (or networks of practice). The visualizations and numbers we obtain from the dataset through the notebooks constitute measurements.

A measurement is as independent as possible of who made it. If someone else would follow the same procedure as you did, they should obtain the same result.

From a post-demographic perspective, we recognize that our corpus does not represent "the public opinion" about the issue we analyse, because "the public" is not a thing. We neither measure nor aim to measure "what people say" in general, as many things are said behind closed doors, where we do not have access. However, counting things in our dataset still constitutes measurements that can be compared, contrasted, and contextualized with one another to generate valid insights, even though the corpus lacks traditional representativeness.

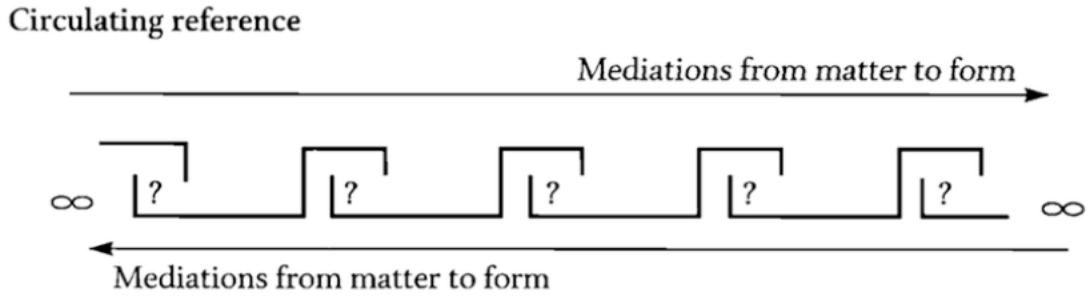
31. Circulating reference (Latour)

Latour's "circulating reference" underscores that scientific facts don't just mirror reality directly but instead gain their power to represent the world by moving through chains of transformations where each step changes the format but maintains the connection. Here is a way to describe our analysis of a public controversy as a chain of reference:

1. What people say over the internet is transformed into a series of web documents to harvest
2. These web documents are transformed into a structured table of actor statements (with metadata)
3. The statements in this table are transformed into homogeneous, normalized statements (translation…)
4. The normalized statements are transformed into data points we enrich with algorithms (semantic map, clusters, issues coding…)
5. The dataset is used as source material to produce measurements and visualizations using the notebooks
6. The visualizations and measurements are used as source material to ground arguments in a policy brief

Your policy brief will be well grounded insofar as your argument, through an unbroken chain of transformation, actually refers to what people say over the internet. A single broken link, such as misusing a visualization, or failing to point to the data used, can make your entire argument fall apart.

Read more: Bruno Latour's chapter "Circulating Reference" in Pandora's Hope (1999): http://www.bruno-latour.fr/sites/default/files/downloads/53-PANDORA-TOPOFIL-pdf.pdf



32. Truth and robustness

When engaged in the production of scientific knowledge, we must recognize that our arguments do not become robust because they are inherently true; rather, they start becoming true as they get more robust. In other words, we must invest considerable effort in consolidating our arguments. It is not enough for us to be convinced of the validity of our analysis; we must also demonstrate to others what makes our reasoning resilient to criticism and counterarguments.

This is especially important when analysing a controversy, where competing versions of "truth" emerge from disagreements among different actors. In such contexts, we must not only be capable of deconstructing others' arguments to examine their foundations and assess their robustness, but we must also be able to construct compelling arguments of our own.

Here, the key takeaway is that solid arguments have a specific structure. This structure lets your audience easily follow your reasoning: they can see what evidence you're using and understand how you're building your case from that evidence.

Read more: Bruno Latour's chapter "Opening Pandora's Black Box" in Science in Action (1987): https://thehangedman.com/teaching-files/svd-phd/1-latour/latour-SIA-0-introduction.pdf

33. The Toulmin approach to building an argument

The Toulmin model was introduced by British philosopher Stephen Toulmin in 1958. It helps us understand how arguments are structured and categorized. There are six parts to it:

- *Claim*. A statement that something is so.
- *Grounds*. The backing for the claim: data and measurements (among other possibilities).

- *Warrant*. A bridge-like statement explaining why the claim follows from the grounds. General rule justifying the claim given the grounds.
- *Backing*. Support or explanation provided for the warrant. Many kinds are possible depending on the field.
- *Qualifier*. The degree of certainty offered for the claim. The modality.
- *Rebuttal*. Exceptions to the claim.

The key takeaway is that a robust argument is not just a claim backed by grounds (i.e., data). It is also, and perhaps more importantly, about the relation between the grounds and the claim, which Toulmin calls the "warrant" and the "backing." To make better arguments, learn how to make your warrant and backing explicit.

Read more: an accessible introduction to the Toulmin method: https://owl.purdue.edu/owl/general_writing/academic_writing/historical_perspectives_on_argumentation/toulmin_argument.html

34. Technical mediation

In Science and Technology Studies (STS), mediation is a core concept that contests the naive idea that technology simply transmits or carries information unchanged from one point to another.

In short: technology is not neutral.

Technologies are better understood as mediators rather than mere intermediaries, because in order to analyse how they shape controversies, we need to observe that they translate, modify, and redirect the interactions they facilitate. There is another side to this. As we use tools (ex: algorithms) to process data and make measurements, mediations pile up. Each step is another link in the chain of the circulating reference, and a mediation whose non-neutrality we need to account for. When we produce a visualization, we need to be able to explain what is going on for each mediation involved.

Read more: Bruno Latour's "On technical mediation" (1994): http://www.bruno-latour.fr/sites/default/files/54-TECHNIQUES-GB.pdf

35. Explanatory visualization for visual arguments

Explaining requires a different strategy than exploring, because you need to communicate context to your audience. Even when you use the same tools (for example, the notebooks).

Visual communication is an entire field that we cannot summarize in a few words. A classic advice would be to prioritize clarity about anything else, and after that to minimize

distortions. Indeed, visualization is a mediation, so it is not neutral, and introduces information loss and distortion; nevertheless, those should be mitigated as much as possible.

When it comes to building a robust argument in a policy brief, you need to unpack the mediation for the reader. The same way the Toulmin model emphasizes the necessity to make the warrant explicit to connect the ground to the claim, you must highlight the visual pattern you ask the reader to see, and you must explicitly state why your reading follows from the visual pattern. This constitutes the context the reader needs to be communicated to follow your visual argument.

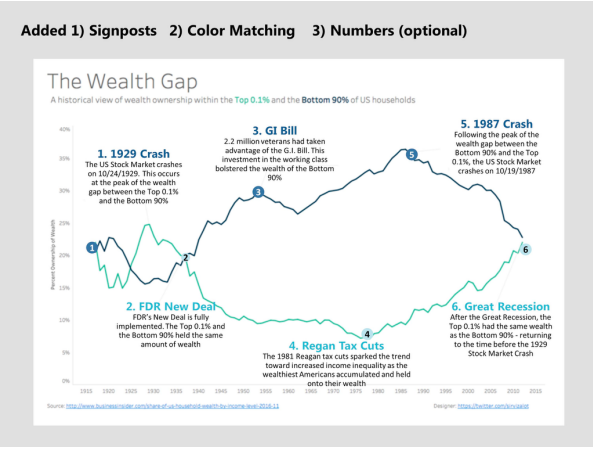
36. Annotation (of data visualizations)

After an exploration phase, your brain is loaded with context about the data. But when you transition to communicating your results to an audience, you need to externalize this internalized knowledge so that your audience has access to it. Your visualizations must feature a title, a legend, textual explanations, all of which can communicate the context. But your best tool is to annotate the visualization.

Annotation is a way to guide your reader's eyes to the visual pattern you need them to see. The textual content of the annotation allows you to state what the pattern means. Your text explanations should also state with clarity how your interpretation follows from the visual pattern (like a warrant does in the Toulmin system) which may require some backing (again, like in the Toulmin system).

As an annotation points to a key visual pattern, it is always better in-place, i.e. close to the pattern itself.

Read more: 10 good practical tips about annotating data visualizations: https://speakingppt.com/10-rules-for-graph-annotations/



Interventional concepts

37. Public engagement

How can research and technology development be shaped *with* the people who will live with its consequences? **Public engagement with science (PES)** is an approach that treats citizens and stakeholders not as passive audiences to be "educated," but as legitimate participants in dialogue, mutual learning, and (ideally) decision-making about research, innovation, and policy. It is often contrasted with **Public Understanding of Science (PUS)**, which is linked to the "deficit model" (the assumption that resistance to science mainly comes from lack of knowledge, and that better information will automatically produce acceptance).

Public engagement matters because controversies are rarely only about facts; they also involve values, lived experience, and trust. STS work shows that expert framings can ignore local knowledge and thereby generate mistrust, so "more information" alone can backfire. Engagement formats include citizen panels, deliberative workshops, online forums, participatory research, and co-design with users. A recurring risk is **tokenism**: engagement that looks participatory but does not actually share influence or change decisions.

Public engagement is an interventional concept because it helps you justify *recommendations* such as "include affected communities earlier," "create a dialogue forum," or "co-design with users," and it gives you language to evaluate whether existing participation is meaningful (influence, transparency, openness) or merely symbolic.

Read more about methods of public engagement in Stilgoe's text on RRI (see RRI lesson)

38. Universal Design

Who gets excluded when we design for an "average user"? **Universal Design (UD)** is an approach to designing products, services, and environments so they are *inherently usable by as many people as possible*, regardless of age or ability. UD is contrasted with "accessibility" as a narrower practice of tailoring solutions for people with disabilities after the fact; UD aims to build inclusion into the baseline design from the start.

A practical way to operationalize UD is the **seven principles of Universal Design**: (1) equitable use, (2) flexibility in use, (3) simple and intuitive use, (4) perceptible information, (5) tolerance for error, (6) low physical effort, and (7) size and space for approach and use. The course materials connect UD to the fact that abilities are distributed (and change with age), and to the social harms of exclusion—making UD both an ethical and an engineering issue.

UD is an interventional concept because it supports recommendations like "redesign the interface to be intuitive under stress," "add tolerance-for-error features," or "ensure multiple sensory channels for key information." It also helps you argue that inclusion is not only a moral add-on but can drive innovation (designing for edge cases often produces better solutions for many).

39. Social Acceptance

Why do some technologies succeed technically but fail socially (or face strong resistance)? **Social acceptance** refers to the willingness of individuals, communities, and stakeholders to support and integrate a technology into society. In the CCS lecture, acceptance is treated as multifaceted: it includes attitudes, perceptions, beliefs, and concerns—and it is shaped not just by "knowledge," but also by trust, fairness, emotions, perceived risks/benefits, norms, and whether people feel involved in decisions.

Because acceptance is complex, it can be studied (and influenced) in multiple ways: surveys, experiments with different information framings, and qualitative interviews/focus groups. We distinguish between **project/site-specific acceptance** (e.g., a local facility) and **general acceptance** (support for a technology in the abstract). Measures to tackle social acceptance need to take into account heterogeneity across groups (age, gender, education, geography, etc.).

Social acceptance is an interventional concept because it helps you justify recommendations about *how to proceed*: what to communicate, whom to involve, what worries to address (e.g., safety, justice), and how to make sense of resistance to a given project, product or technology rather than relying on gut feeling or assumptions about "public irrationality."

40. Anticipation

How do we take responsibility when we cannot reliably predict what a technology will do in the world? In the RRI framework, **anticipation** means systematically asking "what if…?" questions to explore possible intended and unintended impacts (social, ethical, environmental, political) not only those that fit existing risk models. Anticipation explicitly treats uncertainty and ignorance as normal conditions of innovation, not as a temporary lack of data that will soon disappear.

Anticipation is often operationalized through tools like foresight, technology assessment, horizon scanning, scenarios, and vision assessment. A key tension is that "prediction" can

lock people into one imagined future, whereas anticipation should also **open up** multiple plausible futures and discuss what is desirable.

As an interventional concept, anticipation helps you justify recommendations like "run scenario workshops," "map second-order impacts," or "test how different futures affect different groups," and it gives you a rationale for *not* restricting evaluation to narrow risk metrics when stakes are broad.

Read more about methods of anticipation in Stilgoe's text on RRI (see RRI lesson)

41. Reflexivity

What assumptions are built into how we define the problem—and what do those assumptions make invisible? In Stilgoe et al.'s framework, **reflexivity** means "holding a mirror" up to one's own activities, commitments, framings, and limits of knowledge. It is *second-order* in the sense that it questions not just methods or errors, but also the values and theories shaping research, innovation, and governance, recognising that different stakeholders may not share the same framing.

Reflexivity can be supported by practices like embedding social scientists/ethicists, multidisciplinary collaboration, ethical technology assessment, codes of conduct, or structured reflection processes. Importantly, Stilgoe et al. stress that reflexivity should not stay private inside labs; responsibility makes reflexivity a **public** and institutional matter.

Relevance for the course: Reflexivity supports recommendations like "make assumptions explicit," "reframe the problem with stakeholders," or "audit which values the system encodes," and it helps you explain why controversies persist even when "the science is sound": people may disagree about purposes, meanings, and legitimate concerns—not only about facts.

Read more about methods of reflexivity in Stilgoe's text on RRI (see RRI lesson)

42. Responsiveness

What does it mean to actually *change course* when concerns emerge? **Responsiveness** is the capacity of research and innovation systems to adjust direction in response to new knowledge, shifting norms, and public/stakeholder values. Stilgoe et al. draw on Pellizzoni's point that responsiveness is about both meanings of "respond": to **react** and to **answer**—and that it involves acting despite limited knowledge and control (linked to ideas like "corrigibility").

Responsiveness can be enabled through governance mechanisms that create real decision points and flexibility—e.g., standards and regulation, transparency/open access, stage-gates in R&D, moratoriums or precautionary pauses, value-sensitive design, and policies that keep alternative pathways alive rather than locking into one trajectory. Importantly, responsiveness depends on institutional culture and leadership: if participation happens but nothing can change, "engagement" becomes hollow.

Responsiveness helps you justify recommendations like "build feedback loops into deployment," "create criteria for pausing or redesign," "set up governance that can revise goals," or "design for reversibility," making your policy brief about *steering* innovation—not only describing it.

Read more about methods of responsiveness in Stilgoe's text on RRI (see RRI lesson)