# What is Theoretical Computer Science?
# An Ethnography of Merit

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**Introduction**  Despite its relative infancy, Theoretical Computer Science (TCS) has made significant contributions towards providing safety and security assurance. On a daily basis, we rely on secure messaging protocols, critical signaling systems, and digital payment services—all of which are built on strong theoretical guarantees. It is also widely accepted that it takes a long time for the potential of TCS research to be realised in practice. This leaves many legacy components vulnerable, reducing the perceived value of theoretical research. Yet, TCS has remained on the research agenda of many institutions worldwide, both public and private.

Despite its prominence, we do not fully understand how and why TCS is *valued*, by whom, and how its value changes over time. In other words, who decides what kind of TCS is done, which topics then become 'undone,' and how do these paradigmatic shifts take place? To address this gap we seek to understand the contributions of TCS through an analysis of its epistemic foundations. Drawing on the past Science and Technology Studies (STS) theorising the social shaping of mathematical proofs for mission-critical systems [1] as well as social studies of valuation [2], we propose to explore the social and material evidence of the notion of *merit*. To do so, we will employ the notion of science as a set of cultural practices that evolve over time and space [3]. We will focus on researchers' tacit agreements as well as attempts to challenge what constitutes high-quality scholarship. We propose that the actors disputing the incumbent notion of merit in TCS are highlighting the phenomenon of "undone science" [4]

**Lab ethnography in theory**  The micro-level practices of knowledge production—such as co-authoring papers or peer review—have been a core area of focus for STS, leading to the emergence of *Lab Ethnography* [5]: STS scholars would typically observe scientists in their day-to-day work and report back to their own peers in the form of monographs. Despite initial successes in understanding experimental disciplines, there is widespread recognition of the inherent challenge in studying the theoretical fields. There are very few and far between accounts of such, mostly authored by Sociologists with dual backgrounds in Physics or Mathematics [6].

More recently, the approach of collaborative ethnography has been championed across STS. Working in close interdisciplinary teams can tackle knowledge gaps derived from the lack of familiarity with theoretical STEM fields. It also addresses the epistemic imbalances between the observers and the observed as it gives an active voice to those who were previously merely 'research subjects' [7]. By discussing the results together as well as publishing them across disciplines, collaborative ethnography has the potential to challenge 'undone science'.

Oftentimes lab ethnographies discuss scientists' pragmatic strategies to thrive in a competitive job market or the funding system. For example, many grant schemes require that applicants engage with the hype surrounding emerging technologies [8]. On the one hand, the vagueness of buzzwords (e.g. AI and blockchain) can distract from more important issues and limit academics' freedom to develop their agendas. On the other, their flexibility has enabled researchers to find unexpected collaborators and set common terms of reference with wider communities [8]. When pitching ideas to funding bodies, scientists were often found to engage

in 'tailoring,' i.e. making their work appear more applied to gain funding [9]. In this context, how do theoreticians assert their value and prevent their agendas from becoming undone?

We will discuss the usefulness of the 'Undone Science' concept in TCS, defined by Frickel et al. [4] as 'areas of research that are left unfunded, incomplete, or generally ignored [...].' We agree that a systematic and longitudinal outlook on trends and influential ideas in TCS can shed light on neglected areas. However, we challenge the claim that science studies ought to move away from micro-level investigations to study macro-levels (e.g. government funding policies). We claim that all these levels of analysis complement each other and ought to be considered together in order to understand what counts as merit in a given field. Our final contention stresses that the interplay between the actors who set the agenda vs. get left behind in TCS is not always framed as 'government agencies/industry' vs. 'civil society organisations/social movements'. Instead, various political struggles occur within conferences and the TCS community.

**Research design**   We propose an approach combining bibliometrics, ethnography, and narratology. In doing so, the research traces the lives of two TCS communities and their outputs: the ACM Symposium on Principles of Programming Languages (POPL) and a flagship venue of the International Association of Cryptographic Research (IACR), CRYPTO. Both are highly-regarded conferences that accept theoretical papers with relevance to safety in programming languages, security, and cryptography. Our research design comprises the following three steps:

1. *Quantiative mapping TCS contributions to POPL and the IACR flagship venues over 50 years.* We will employ a bibliometric approach, encompassing both conference and journal publications, technical reports, and software artefacts. We will also map citation networks, common keywords, emerging areas, and the impact on other domains.

2. *Understanding how TCS researchers in POPL and the IACR venues tacitly establish and then challenge the standard of scientific contributions.* We will supplement our quantitative data with qualitative stories of the 'missing indicators of merit.' We will use the approach of multi-sited ethnography [10] on academic conferences, research groups, and online communities (e.g. Zulip, Twitter, Mastodon). We will record a) what gets researchers enthused; b) how academics create buzz around their work; c) how academics challenge each other and why; d) who people coalesce around; e) who speaks to whom and about what; e) who is left behind. We will also interview researchers to ascertain how they evaluate what is accepted, and how has this changed over time.

3. *Understanding how disciplinary norms of merit change over time.* We will employ the method of biography of artefacts [11] to investigate *the narratives of merit*. We will conduct an in-depth study of four 'significant' outputs in POPL and IACR conferences to uncover the emerging *socio-material* evidence of high-quality scholarship. Each artefact will be analysed as a narrative over space and time, through desk-based research with expert interviews. The outcome will be the construction of *ecologies of actors* [11] relevant to a given output, e.g. authors, researchers who cited the paper, and industry actors for whom the paper has been useful.

**Conclusions**   The talk will present the authors' intent to investigate the notions of *merit* in TCS. Our proposed work consists of a co-creative approach to both doing and theorising science through engagement with both social and computer scientists. This will help members of the TCS community understand the ways in which TCS contributions are valued, and how this valuation is evolving. We hope that this understanding, in turn, can help the community identify valuable research that is left undone, before the relevant knowledge is lost.

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