# Scaling things up! The philosophy of technology at scale

Scaling technologies from proof-of-concept to industrialized production is an essential part of engineering. Rather remarkably scaling processes have neither been discussed much in philosophy of engineering nor in philosophy of technology. This is even more astonishing as there are lots of philosophical questions that can be asked about scaling. For example: What makes a technology "scalable"? What kind of knowledge is gained in scaling technologies? What can we learn from failures of scaling? Should we scale? Is there a fixed point where maintenance requirements balance scaling gains? And perhaps the most important question is: Can we know any of this before we attempt to scale?

One aim of this talk is to give a first exposition of questions philosophy of technology could ask about scaling. Answers will at best be tentative as we are charting unexplored territory. But we will try to learn some lessons from the scaling of computer technology. The predicted error rates of the first vacuum computers e.g. ENIAC where so high that many engineers believed that they never could be scaled up. Von Neumann developed a theoretical argument against these skeptics which kick-started the field of fault-tolerant computing and error-correcting codes. In the end his argument was not needed because engineering advances suppressed error rates beyond imagination. But it lives forth in the current debate about the practical possibility of quantum computers. Here we do have proof-of-concept but the engineering challenges are manifold. One obvious lesson we can draw from this case is that practical success trumps theoretical considerations. But if practical success is lacking, theory might be the only thing guiding scaling attempts.