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Innovation and Technology
Creating the Future: Software and Risk

November 2018

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Section 1: Creating the Future: Software and Risk

If you ask a stranger about their diet, exercise, and alcohol intake, they will be offended. If you ask them in the context of a life expectancy calculator, they will be happy to tell you. As access to data and the ability to extract its value is increasing through software, consumer behavior is changing.

Venkatesh Rao writes, "After written language and money, software is only the third major soft technology to appear in human civilization."[1] It is difficult to envision the transformative power of written language and money, as we're born into a world which has already been changed by these technologies. Software, the expression of human thought in the language of machines, is only starting to initiate such transformations.

Today, the world generates 2.5 quintillion bytes of data every 24 hours. Software is the mechanism by which this data is processed, and value is created. The high speed and low price of microprocessors, availability of mobile devices, expanding cloud infrastructure, and broadband internet have created the conditions for software to reform industry and society. Books (Amazon), movies (Netflix), music (iTunes), marketing (Google), and recruitment (LinkedIn) are industries that have already been transformed.[2]

The invention of written language was initially perceived as the creation of a storage device for existing information. This information was previously memorized and conveyed orally. As this soft technology became ubiquitous, it exceeded its use of information storage and started creating its own values as a reflection of the values of its users. These values took the form of journalism, novels, almanacs, etc. In this same manner, software is evolving from a tool which reiterates real world value to one which is starting to create new forms of value.

The new value created by software will create more risk for which to account. The surplus of data means there is more to measure. Network effects, wherein the value for users in the network increases as the network increases, and the reduction of information asymmetry will change consumer behavior and demand. These shifts will be driven by software.

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[1] A New Soft Technology, *Breaking Smart,* July 2015.

[2] Why Software Is Eating The World, *The Wall Street Journal,* August 20th, 2011.

Section 2: The Shape of Disruption

Clayton Christensen describes 'disruption' as "a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses."[3] He posits two entry points for such disruptive companies: low-end footholds and new-market footholds. In the former case, a smaller company targets the overlooked segments of an incumbent's customers. These low-end footholds exist because incumbents are typically focused on their most profitable customers, paying less attention to low-end customers. In terms of new-market footholds, disruption means the creation of new customers. The company Zipcar serves customers who want to rent a car by the hour, creating a new market by recognizing demand that was not accounted for in the car rental space.

In 1942, the economist Joseph Schumpeter coined the phrase "creative destruction," describing the "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one."[4] Currently such creative destruction is the result of software innovation. The industrial revolution encouraged large-scale, hierarchical companies to facilitate factory production. The software revolution encourages the creation of small organizations to facilitate the production, management, and extraction of information.[5] Uber has been as influential and far-reaching as Ford with only a small percentage of the automaker's infrastructure.

In "Slicing Up the Gecko," a whitepaper from Core Innovation Capital, the authors question the current cost structure of insurance companies and state, "In a perfectly efficient mutual insurance scheme, with zero transaction costs, 100% of every dollar would be paid out in claims."[6] As a thought experiment, this proposes a new way of looking at traditional concepts of risk and insurance through the lens of software. Are there well-regarded assumptions about the actuarial space that may be abandoned? Alternately, are there unseen forces in the domain which have not been accounted for, similar to the discovery of electrons, which changed the discipline of physics? Can software quantify risk in service of the low-income market or leverage data and network effects to develop health insurance in the developing world?

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[3] What Is Disruptive Innovation, *Harvard Business Review*, December 2015.

[4] Joseph Schumpeter, Capitalism, Socialism and Democracy, 1942.

[5] This idea has been proposed by Naval Ravikant on multiple episodes of the Tim Ferriss podcast.

[6] Slicing Up the Gecko, Core Innovation Capital, May 2015.

Section 3: New Forms of Risk

The availability of static and real-time data from novel sources, the potential for real-time analysis, and the shift of societal infrastructure to digital platforms will create demand for new forms of insurance products. The trend towards the dematerialization of risk will demand new models for quantifying and pooling risk and new means of pricing and distribution. As software replaces previous systems, it creates new critical junctures in public and private infrastructures.

Previous models of risk did not account for the combined private and commercial use of vehicles by Uber drivers. Traditional homeowners' insurance did not anticipate the trend of running a part-time bed & breakfast from a residential property. Current policies do not reflect these new modes of car and home ownership. The sharing economy, originating in software, is redefining the requirements for homeowner and automotive insurance. This increase in complexity and available data will create opportunities for incisive segmentation and products that are adaptable. MetroMile's pay-per-mile insurance marks a shift from traditional insurance models and hints at the development of modular products.

One clear articulation of new value created by software is cryptocurrency. The distributed ledger system and consensus protocols of the blockchain have the potential to render third-party verification of transactions unnecessary. This displacement of traditional banking and real estate functions creates new forms of machine-originated risk and consumer demands for custody and risk-transfer products. The identification and mitigation of such risks will require adaptation of the old models. Bitcoin is the first prominent network for securing and exchanging digital assets via distributed computation, but it has already influenced hundreds of similar models. Cryptocurrency creates new risks regarding consensus algorithms, models for currency generation, and authority of issuance. The decentralized nature of a cryptocurrency exchange is not reflected in previous economic or risk models. How will the current models adapt to measure and quantify the resistance of a cryptocurrency to coercion?

The online virtual world of Second Life doesn't have challenges or objectives like traditional video games. Its users, referred to as residents, create avatars of themselves and interact with other residents and the environment. The game has over half a million active users and allows for the creation of virtual businesses using the in-game currency of Linden dollars. In the 15 years since Second Life was released, this in-game economy has started to interact with the real-world economies of its users. The game's city of Amsterdam, a virtual reproduction of the Dutch capital, was created as an in-game business by a user and auctioned to another user for $50,000 USD. An outdated view of video games lends an air of triviality or frivolity to such transactions, but Second Life is not simply an exercise in escapist recreation. It is an attempt to create an analogous virtual society. The importance of this virtual world varies to respective users. A contingent of Second Life's residents are paraplegics for whom software creates a level of accessibility unavailable in the real world.[7]

Advancements in video games parallel advancements in software. The aforementioned network effects are present in the genre of Massive Multiplayer Online (MMO) games whose millions of active players constitute populations larger than those of some nation states. Matching such populations with an in-

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[7] [Flying with disability in Second Life](#), Eureka Street, January 2008.

game economy creates new forms of risk. The Entropia Universe, designed by MindArk, uses an in-game currency called Project Entropia Dollars (PED) that can be exchanged back to USD at a fixed rate of 10:1. In 2009, an in-game space station was sold for $330,000 USD. Another piece of in-game real estate, Club Neverdie, was sold for $635,000 USD.[8] There is a significant amount of risk generated outside of the traditional real-world models. While these figures are outliers, they are also precursors. Augmented and virtual reality combined with network effects will create novel risk with implications for real-world economies.

As public and private infrastructure shifts from centralized to distributed systems, there will be an increase in machine-originated risks. A cryptocurrency exchange or ridesharing platform respectively carry the risk of systemic failure. Platforms such as Uber and AirBNB account for the transportation and accommodation needs of millions of users and the income of autonomous service providers. The network effects, which account for the significant growth of software companies, also create vulnerabilities to systemic failure. How many travelers would be rendered temporarily homeless in foreign countries if the AirBNB network went down?

Software is shaping a world in which there is more information to measure and more risk to manage. The availability of real-time data will create opportunities for the creation of new models and real-time analysis. An increasing reliance on software as infrastructure of public and private enterprise will create demand for new forms of insurance products focused on systemic failure. Machine-originated risk will create a novel market and equally new challenges for quantifying, pricing, and pooling risk. The use of network effects and reduction of information asymmetry will change industries and consumer behavior therein. Perhaps the best advice regarding adaptation to the software revolution comes from computing pioneer Alan Kay who said, "The best way to predict the future is to invent it."[9]

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[8] Top 10 Most Expensive Virtual Items Sold, gamehypermart.com, October 2017.

[9] Said by Alan Kay at a 1971 meeting of PARC.

About The Society of Actuaries

The Society of Actuaries (SOA), formed in 1949, is one of the largest actuarial professional organizations in the world dedicated to serving more than 30,000 actuarial members and the public in the United States, Canada and worldwide. In line with the SOA Vision Statement, actuaries act as business leaders who develop and use mathematical models to measure and manage risk in support of financial security for individuals, organizations and the public.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

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