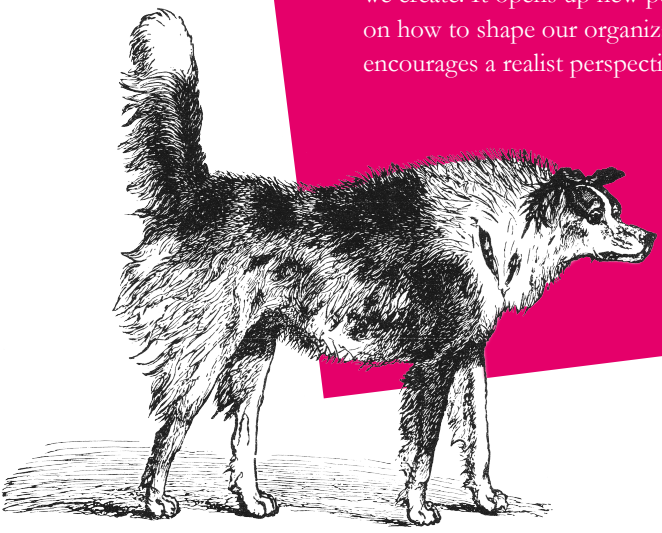
Old dogs still need to dream

This paper describes the disruptive nature of Digital Transformation and how it affects the way we work and the products we create. It opens up new perspectives on how to shape our organizations and encourages a realist perspective.



Hans-Jürgen Kugler, Markus Turber
and Bhaskar Vanamali

HANS-JÜRGEN KUGLER, KUGLER MAAG CIE
MARKUS TURBER, INTUITY
BHASKAR VANAMALI, KUGLER MAAG CIE

OLD DOGS STILL NEED TO DREAM

2019

Hans-Jürgen Kugler
Markus Turber
Bhaskar Vanamali
Hrsg. Intuity Media Lab GmbH
Gesetzt aus der Garamond
https://www.intuity.de

HANS-JÜRGEN KUGLER, KUGLER MAAG CIE
MARKUS TURBER, INTUITY
BHASKAR VANAMALI, KUGLER MAAG CIE

Old dogs still need to dream

This paper is an excerpt of the award-winning lecture held at VDA Automotive SYS Conference 2018.

More information on the lecture can be found here:
https://www.intuity.de/old-dogs-still-need-to-dream/

intuity

KUGLER MAAG CIE
besser mit uns

Why this paper?

In previous papers we explored the analogy of an organization and an organism or an ecosystem. The analogy between natural systems and human social systems (what we call organisation) has been quite striking.[1, 2] We continue this exploration in this paper by looking at two terms, which are "hot topics" everywhere. One is the Digital Transformation every organization will have to master (say all the wise analysts). The Digital Transformation means moving from product and production orientation to services development and operation with customer orientation. This on its own would be a major change of the economy and society, but it is compounded by a second event: "new" horizontal (i.e. across all domains) technologies are entering their deployment stages. These are:

1. The Internet of Things.
2. Artificial Intelligence and in particular Machine Learning.

These forces promise unprecedented increases in connectivity and productivity. This is billed as THE radical change of economy and society. The timescale of this change will be much shorter than the 50 years of software engineering[3] we have just experienced. We cannot comprehensively deal with this matter here and now, but we would like to present a few highlights to start a discussion.

Digital Transformation is portrayed as disruptive. How this will affect organizations? Can we find disruptive change in nature? How does nature deal with disruption? Let us just say that:

Learning will be the key.[4]

Table of contents

Disruptive Change in Nature

Disruptive change happens in nature all the time, ranging from death of individuals to extinction[5] of species. The natural history of Earth tells us of massive global changes that have happened since life began. There were a number of mass extinctions, like the one caused by interplanetary debris[6] crashing into Mexico's Yucatan peninsula 65 million years ago. Three-quarters of Earth's species disappeared. That was the end of the dinosaurs and the start of the rapid evolutionary diversification of mammals.[7]

Even before human race started to contribute to global warming, life affected the Earth's climate. Life itself has caused mass extinctions, like during the Great Oxygenation Event.[8] This was caused (in simplified terms) by the oceanic cyanobacteria inventing photosynthesis about 2.5 billion years ago. Photosynthesis releases dioxygen (O2), which was poisonous to other lifeforms. Replacing CO2 by dioxygen also caused the atmosphere to cool down, which in turn led to a global ice age called Snowball Earth. Life rebounded: the majority of lifeforms today live on an oxygen energy cycle.

These two mass extinctions had very different causes. However, the impact of each event unfolded exponentially.[9] Common is the reaction of nature: After the extinctions evolutionary diversification accelerates, also to exponential growth. Once the stage of a functioning global web of life is reached, the diversification rate drops. A higher level of organisms may arise to dominate an epoch.[10] The timescale creating diversive change is not always measured using geological scales. Some bacteria show near real-time adaptation.[11]

Diversification based on generations of species is not the only answer evolution has. The behaviour of individuals may also become more diverse. Nature invented learning by feedback loops that help change the behavior. The ability to dream[12] allows the individuals to recognize different scenarios in everyday experience

and to integrate them into usable mental models.[13] Dreams occur in particular during the REM phases of sleep. Dreaming makes you smarter, more creative[14] Humans learnt to be adaptive – to play by the rules. Eventually humans learned to day dream, to dream at will. The lesson for homo sapiens was to be prescriptive – to create new rules by changing the conditions.

The intuitive and conscious creativity of dreaming allowed humans to become the most adaptable lifeform, conquering all habitats in all climates. Humans are adaptive and prescriptive. Their success was built on a combination of adapting to the regional conditions and adapting the regional conditions to fit their needs.

Life itself has caused mass extinctions.

The Digital Transformation Will Be Disruptive

Will the digital transformation be like a mass extinction of outdated enterprises? According to McKinsey, only 8% of the enterprises think their business model will still be workable in the new economy.[15] This insight does not seem to translate into an urgency that drives action. The reasons for this "wait and see" approach seem to be:

1. Disbelief in the massive scope of the change, which will affect all industries and all markets.
2. The exponential nature of the change. Normal human experience deals with gradual change. Exponential change is gradual – until you "hit the wall".[16] The generally accepted laws of the current economy will be invalidated.
3. The scale is unprecedented. For 2025 the digital economy is predicted to connect 5 billion human users and 50 billion devices to its IoT.
4. Goals or strategies for companies are fairly short-sighted as they reflect often on short-term targets like high dividends rather than longevity of the organization.

In some sense all enterprises face the same threats, or are given the same opportunities. Already existing key digital players, like Amazon or Google are not threatened in the same way, but will have to compete in the digital economy, too.

Does this mean that we are facing a mass extinction of companies? Probably – Yes. To be candidates for survival companies must already today be flexible enough to adapt to changes that are happening in the relevant ecosystem. As these changes grow in amplitude and frequency it makes sense for an organization to establish a capability similar to nature's dreaming to learn by the organizations own equivalent of natures REM phases. This could be a regular retrospective involving all levels modelled according

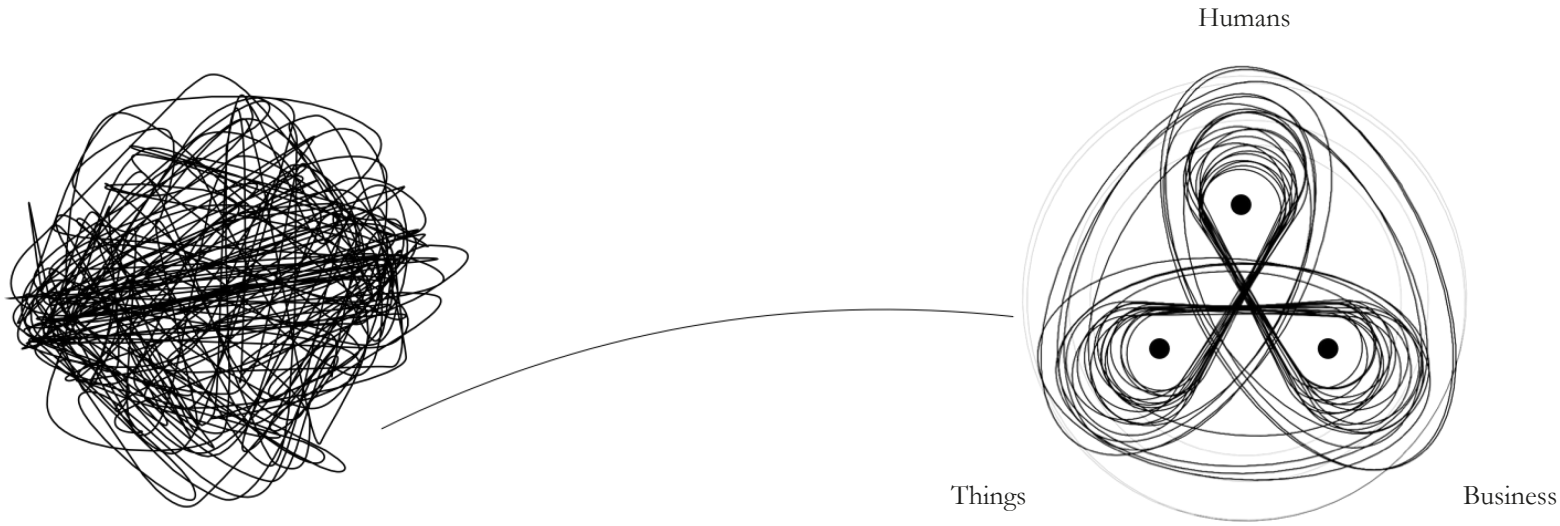
to the nightly dreamcycle to understand "what is." Combine this with a regular prospective[17] or day-dreaming session to imagine what could be and you can:

Explore & Rate
Heighten awareness of moves in the ecosystem, especially in disciplines that currently have no or little connection to current hotspots.

Test & Learn
Establish interdisciplinary teams involving all levels and looking at indicators and building bold scenarios without being shackled by the current state.

Focus & Accelerate
Probe own strategy and business model to re-evaluate why things are the way they are, and what would change if some of the underlying assumptions were to change.

Best conditions for getting organisations to REM mode is sharpening the senses to what's outside and inside the company.



Intuity Digital Product Ecosystem

World Machine

Fig. 1

Amplifying our products and services

As humans have learnt to master technology they have also learnt how to organise themselves to make use of even higher levels of technology. Connectivity and intelligence are the buzzwords. Now the software-based products or services start learning by themselves, and even program themselves.[18, 19]

How does the promise of intelligence and connectivity stack up against safety and security of software determined products or service, for instance? What are the implications for building systems which incorporate machine learning? Best practices and platforms for the designing, initialising, training and deployment of machine learning systems are being created, along similar lines as for (traditional) software engineering.[20]

Society is unlikely to accept mobility which, from today's viewpoint, adds risks. Some of the architectural aspects of intelligence in connected automotive systems have been explored in the Software Drives studies[21, 22] separating hard real-time from analysis and learning tasks. Adding machine learning to products and services requires a new look at all aspects of building and training the system, because the overall system may be reasoning based on different perceptions and assumptions.

The validation of machine learning (ML) systems, for instance, is in its infancy. The newer, self-learning, systems develop their own reasoning. This is welcome as fragments of strategies may be found that no human would have thought of.[23] However, because of that, the reasoning may not be traceable. Even transparent reasoning has problems, namely a potential unwanted and undetected bias of the reasoning. Such bias can be introduced by the data or the algorithm used in machine learning, especially in the early training phases. Data scientists need to continuously analyse the composition of the data and if it fits with historic use.[24] Deviations may indicate errors, or new trends. New trends contribute to opportunity generation.

Machine learning is already used to distinguish real and fake news, and to deal with bias.[25, 26] Different architectures of machine learning systems have different ways to work without bias or fall prey to false news. The whole field is moving very fast, with different learning systems appearing and new experimental deployments.

Machine learning is also being used to ensure that those ML systems, on which the services are based, operate the way they should. This is applying ML to improve the quality of ML. Could this be generalised to using ML to guide a development team through development project stages? Knowledge-based software engineering was already a topic in the late 80s and early 90s, but the development and delivery platforms were seriously underpowered.

Today's technologies allow us to connect everything with everything.

The dialectic of human development

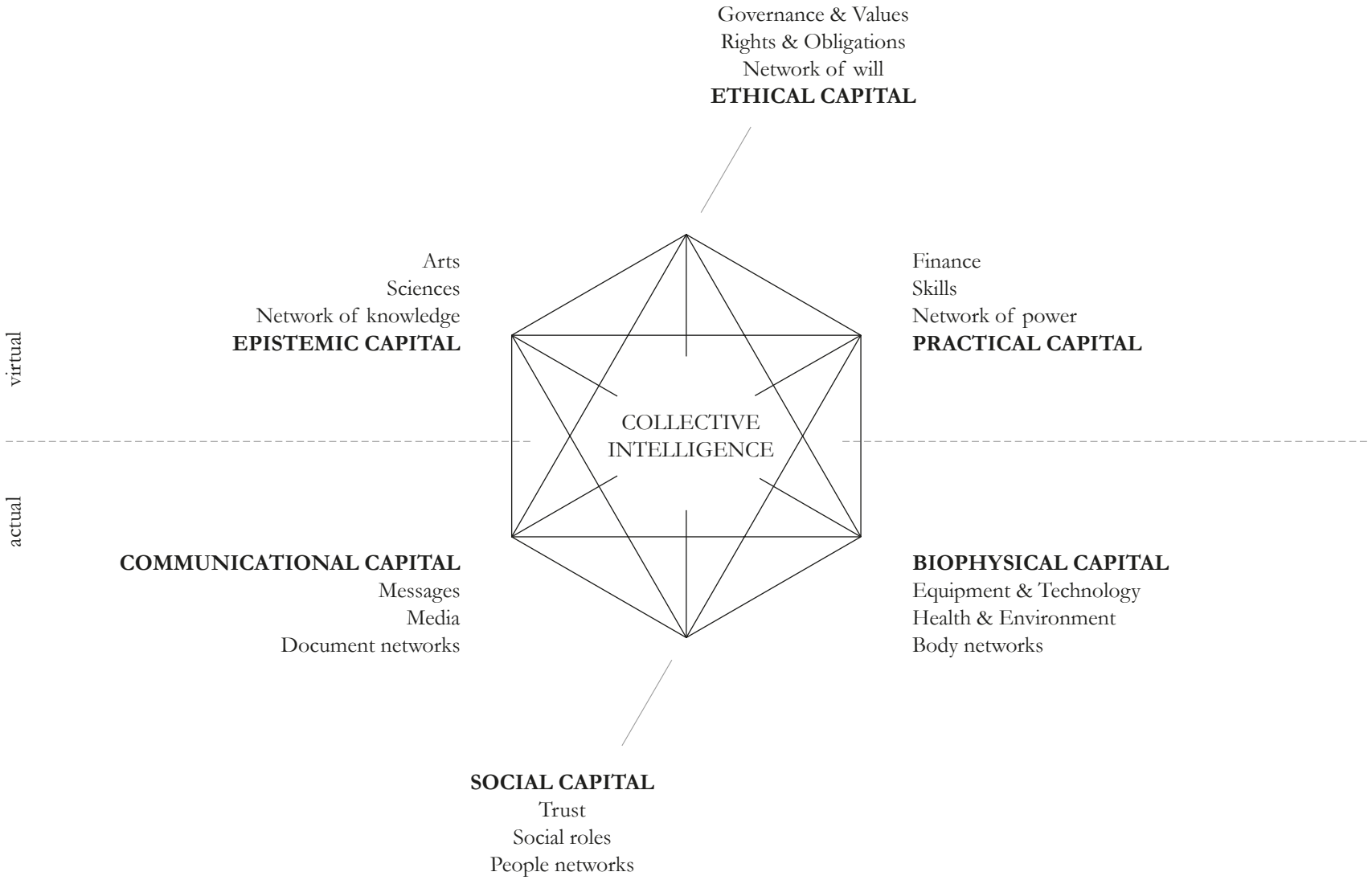
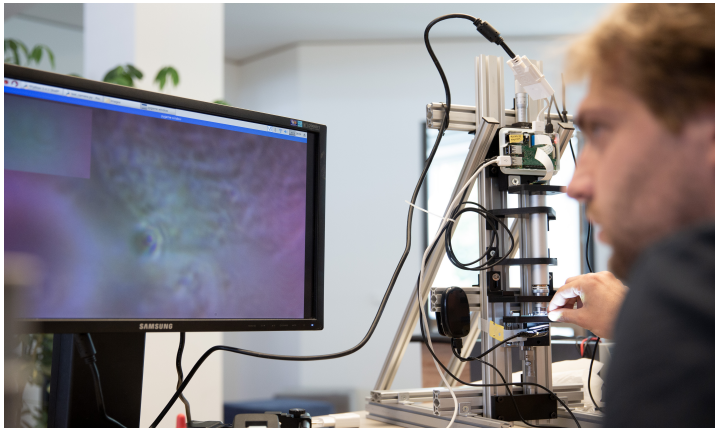


Fig. 2

Amplifying human abilities

We are about to cross the Rubicon towards new AI-based technologies and robotics, expanding our capabilities to sense, learn, decide and act. The interaction between humans and software agents is becoming more and more immersive. Andy Clark[27] described the human capacity to fully incorporate tools into our cultural practices. This allows humans to evolve from natural born cyborgs, into co-dependent, socio-technical agents. Software was used to help real-world processes, making those more efficient. Today, software has already conquered the central stage. Software defines the rules and logic of the real world. The Anthropocene will become augmented by software-defined socio-technical, and eco-technological systems. Today's integration of human society and technology is such that technology is already inseparable from who we are and how we live.

Bioengineering (including Bio-Hacking) will accelerate the merger of biology and technology. This will need a redefinition of what it means to be a human.



Don't think it is hard science to make use neural networks!

Fig. 3

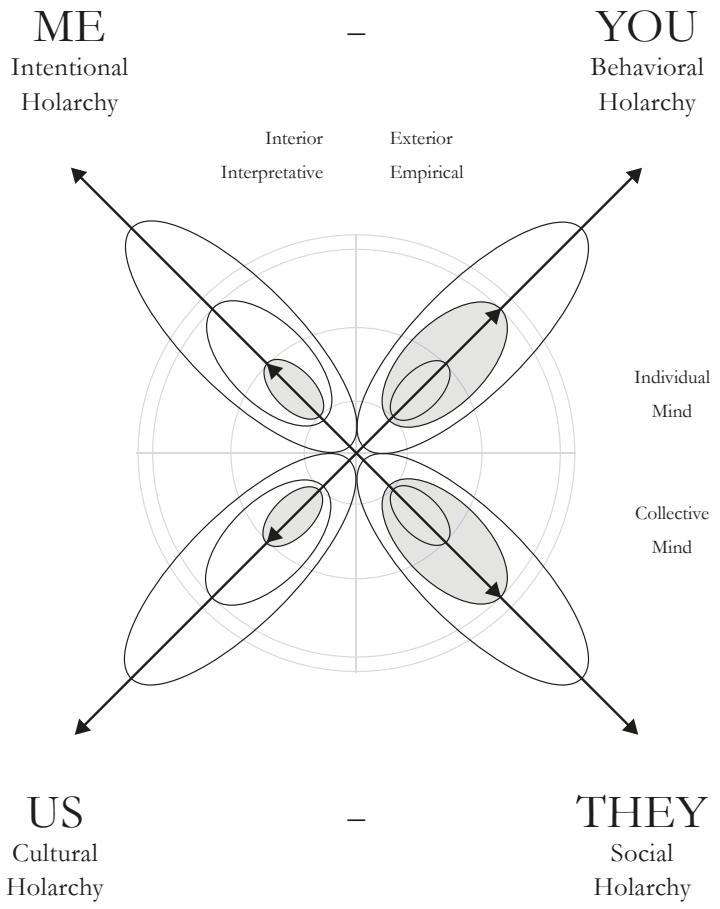
Hyper-economy
or: Augmenting the economy

We are about to create the tools that might define the end of our industrial economy as we know it. We are entering a stage of hyper-connectivity, hyper-productivity, and hyper-efficiency, say the proponents.

However, it is not clear to what extent the nature of the digital transformation of our world signifies a breakdown of the existing economic model. Digitization offers excellent potential to renew the social and economic foundations of our social life. If we use these potentials well, digital transformation can usher us into a new phase of enlightenment and social emancipation, culminating in post-capitalism.[28] The central aim must be to initiate steps towards a more inclusive working environment so that everyone can live a meaningful, prosperous life, and take responsibility for this. This requires all members of society to be able to understand themselves as free and equal, not as excluded or superfluous.

It is nothing less than "the denied or granted place in the overall structure of society," as Heinz Bude[29] puts it.

Hyper-productivity does not necessarily lead to the land of milk and honey. Hyper-productivity may pave the way for an economy in which many or most humans are unemployed – in the old sense of being needed to keep the economy going. In the future, an enterprise may not only act as an employer. It creates opportunities for its people, not only providing products or services but giving systemic orientation for customers and employees. Organizational forms may have to change to be able to cope with creative chaos and effective operation. Among those the long term promise of chaordic organisations may finally become true.[30]



Chaordic systems thinking (CST)

Degree of Partial Development

Degree of Holonic Development

Fig. 4

Unabsorbable jump in productivity releases transformative potential

Compared to pre-industrial times, the productivity of a single farmer has increased by about a factor of 50. It seems plausible that today we do not consume 50 times more food. If markets fail in balancing suppliers and buyers, structural distortions arise. These lead to changes in the framework and rules, until a dynamic equilibrium is reestablished, within the updated regulatory framework. The explosion of agricultural productivity, that the majority of farmers available to satisfy the growing industry demand for manpower. The combination of this with the use of fossil energy to power machines made the industrial revolution possible.

The current economy has lead to an overexploitation of natural resources and to significant waste. Waste does not occur naturally. The industrialization failed to consider the waste in the design of the lifecycle of consumer products. We expect the new economy to provide better circular and balanced processes.

In many ways, the open source movement provides impulses for how people can co-creatively and collaboratively create mutual benefits. Monetary value creation often becomes the side effect of solving an existing problem or challenge. Just like the open-source movement, we also find valuable impulses in the classic commons, as it lends orientation, attitude and action framework through meaningful values of human cooperation. In contrast to globally networked open-source movements, the classical commons realize social optimization in a regional context.

From a historical perspective, monasteries need to be highlighted as networked economic and scientific organizations. Many current enterprises do not have the required community reach to act as substitutes, even if community orientation is part of their remit. Important for the community spirit was the joint care and safeguard against fire and theft, or the sharing of agricultural machinery. Similarly we expect that modern issues, such as CO2-neutral production, or decentralized energy supply, will be better addressed in complex socio-economic networks, based on the experience of commons, than by today's market players with their centralistic outlook.

Software at the center stage of organizations

Today's organizational patterns have long traditions. The ability to organize equals power. This fact applies to politics as well as science, economy, military, etc. A hundred years ago, Alfred Sloan structured General Motors in a new way that enabled outperforming the competition. With this he laid the foundation for the majority of corporation structures throughout the 20th century. As the software was initially expensive, early Enterprise-Resource-Planning (ERP) software developers profited from that de-facto standard organization. As a result of the triumph of ERP software, we often find a classical organizational landscape, because the Sloan model was poured almost everywhere in software, and this caused the structure to freeze. Managers could move from a bank, to a car manufacturer or sausage factory, and keep the same style of management. Can this form of organization be the best for everyone? Many organizations and employees have already dropped the antiquated structure and moved to agile team structures, or swarms outside the matrix. Heavy use of collaborative software tools characterizes those teams. Tools include Kanban, Gira, Git, Slack, etc., toolchains for automation (Gulp, Grunt, etc.), and containerization of software-in-the-large, such as Docker, Kubernetes, etc. Significant parts of companies experimenting with agile remain untouched by the change. The tools infrastructure is quite powerful, but management uses the tools mainly to accumulate software metrics, i.e. essentially the performance data of a traditional type matrix organization. Why don't we use intelligent learning software agents to design and operate the organization itself?

Alexnet to alphago zero:
a 300,000x increase in computer
in Petaflop/s-day (Training)

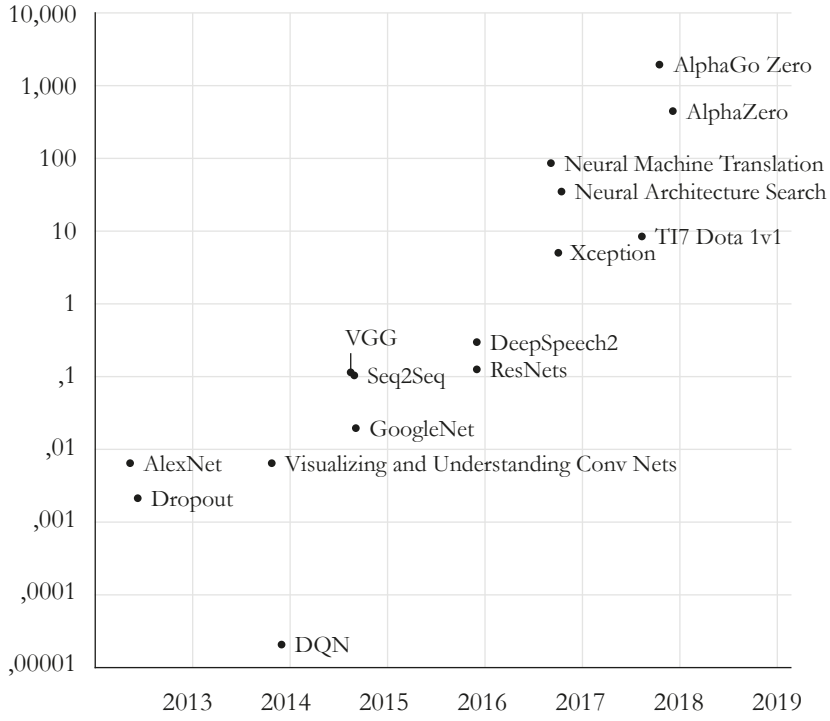


Fig. 5

Augmenting organizations

We have talked about the change that the digital transformation will mean for organizations. The crystallization core for organizations is the purpose. Why do people work together? The next question is how to work together to achieve that purpose. We can augment organizational capabilities by using connectivity, e.g. IoT, and machine learning to support operations. This can include advising management,[31] even self-management to deal with resource utilization is a potential.[32]

Coming back to the way nature organizes itself. Evolution is not just a "dumb" experiment of nature. The "experience" of evolution is stored in our DNA, in fact in any DNA supporting living creatures and ecosystems. Richard Dawkins experimented with software programs which simulated natural selection. By using a fairly simple computer model he was able to produce an eye similar to the complexity of a fish's eye out of a flat layer of photocells sitting on a flat layer of transparent tissue.[33] The advantage of software in this context is obviously that the sequence of generations can be modelled much faster than performing experiments with natural matter.

Computational organization science is an established research area with a history of more than 20 years. We are able to simulate organizations and their overall behavior. Gaming theory and similar approaches are being used to identify the behavior of individuals and organizations.

Thinking about organizations it would be a great support for management to be able to simulate different organizational set ups. Instead of simple simulation an ML system supporting management would benefit the improvement over time.

A ML system would be able to identify which organizational approach and which teams would be the best set up under the current conditions. New and old organizational patterns abound, such as chaordic organizations that thrive on the creative turbulence, or decentralized autonomous organizations (DAO), which runs on blockchain.[34] Again, an ML system similar to the example of the evolution of the eye above, can simulate and learn much faster than the management team.

"If you can dream it, you can do it!" (Walt Disney)

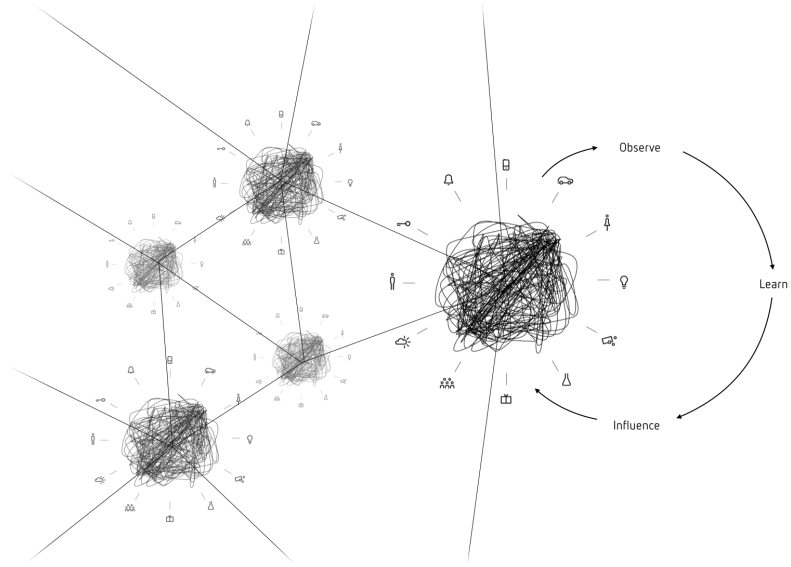


Fig. 6

Summary
Trust in a good future

1. Systemic problem at the next level
In the 20th century, we consumed ten times more energy than in the hole human history before. During the last century consumption was mainly caused by few industrialized nations. Growth was fed by energy and resources from the less developed world. The imperialistic lifestyle used to be a spatial problem. Today, as our economic system reaches nearly every place on the planet, many countries adopted our lifestyle of a society rich in consumption. By that, the problem not only grew but was translated from space to time.

In nearly every aspect of our lifestyle, we live on resource-credit which future generations have to pay back. We are about to face a multi-level crisis if we do not transform.[35]

2. From perception to solution
According to the Kübler-Ross model[36] the perception and solution of a problem progresses in phases. Today many still have to overcome the initial state of denial and accept the facts. Facing issues is critical to change for the better. This means accepting that the enterprises, which provide our work and our wealth, contribute to this severe problem. It is up to us to come up with sustainable solutions.

3. No way back
In 1519, Captain Hernán Cortés landed in Veracruz to begin his conquest of Mexico. To show his men that the only direction is moving forward, he gave the order to burn the ships. Looking forward to the next 10 to 20 years, business as usual will no longer be an option. Our "ships" did a fantastic job. They are luxury cruise

ships with Wirtschaftswunder atmosphere, bringing prosperity to a growing global middle class. But staying in these ships lose their sea worthiness, since they were mostly built with 19th and 20th century knowledge. They are overused and beyond repair. Aren't we better off, if we leave the ocean and evolve on land?

4. Choices and Moonshots
Harald Welzer and Bernd Sommer outlined utopian and dystopian options for the next decades.[37] Transformation – by design or by disaster – is a plea for taking the future in our own hands to creating drafts for desirable futures. Change is not always comfortable. From all experience gathered, we can trust in Schumpeter's law of creative destruction. Turbulence is the primary ingredient of change and substantial for making significant progress.[38] With technologies like IoT, robotics, ML etc., combined with a surplus of money in the financial markets, we have the knowledge and resource to create moonshots leading towards desirable futures. We need to move from how to build software to what software to build.

The rise of AI in the guise of machine learning is perceived by some as a threat to human superiority. Our creation might end up with a different consciousness to ours. That is actually true for humans of different generations.

We cannot fully control the learning machines, just as we cannot control our children. But, we can be good parents.

5. Options are key to your entrepreneurial freedom!
Build and maintain a garden of your dreams and develop your options portfolio. This will be the future foundation of your freedom of action!

The risk dimension of what lies ahead is often referred to by the acronym VUCA (Volatile, Uncertain, Complex and Ambiguous). How do we develop answers to global challenges and finite resources? How can we simultaneously make our business models

fit for the digital economy and society? We have to leave our existing framework of thinking and action and design-responsive, dogma-agnostic structures. We have to gather experience and insights from outside our self-imposed current borders. We must first map our future environment beyond these borders. We need to define the principles we want to live by to serve as a compass for our expeditions. Our world today was not just charted by the handful explorers whom we know from the history books. There were countless expeditions, of which most never returned or which came back empty handed. To be lucky, you have to try, and try again. We need to develop a cornucopia of options![39]

The entrepreneurial will is the driving force for sustainable success. The possibility of choosing individual options or letting them pass is the foundation of entrepreneurial freedom and, hence, future earnings.

Everyone appreciates freedom! However, who manages his option room consciously and sustainably? Like the fruits in a garden, options also need to be sown, cared for to make real business opportunities.

To have good options in the future, you have to secure yourself many options today. Options are not an investment themselves but, but they ensure the possibility of being part of the game in the future. There is an abundance of options. We have to learn to recognise them and evaluate their worth. Knowingly working on future possibilities enables teams to remove blindfolds, leave incremental innovation patterns, and to come up with Moonshot ideas.

The entrepreneurial will is the driving force for sustainable success.

Never stop dreaming!

Annotations

[1] Hans-Jürgen Kugler, Bhaskar Vanamali, You can teach old dogs new tricks, VDA Automotive Sys Conference 2016.

[2] Hans-Jürgen Kugler, Bhaskar Vanamali, Healthy Growth, VDA Automotive Sys Conference 2017.

[3] Both terms were coined at the First NATO Conference on Software in 1968 in Garmisch in Germany.

[4] And here you have the clue for the title of this paper.

[5] Paleontologists call events that kill 75% of all species mass extinctions.

[6] It is generally assumed to have been a comet or part thereof.

[7] Paul R. Renne et al., Time Scale of Critical Events Around the Cretaceus-Poleogene Boundary, Science 339, 684, 2013.

[8] Phil Plait, Poisoned Planet, www.slate.com, 24 July 2014.

[9] The impact of the comet initiated massive outbreaks of seismic and tectonic activities.

[10] Andreas Wagner, Arrival of the Fittest: How Nature Innovates, 2015.

[11] Adam Z. Rosenthal, Michael B. Elowitz, Following evolution of antibiotic resistance in real time, Nature, 2012.

[12] This is true for all sentient beings. There are, of course, differences between mental models of mice and humans. The mechanisms are very similar.

[13] Francis Crick, Graeme Mitchison, The function of dream sleep, Nature, 1983.

[14] Rachel Kaufman, Dreams Make You Smarter, More Creative, Studies Studies Suggest, news.nationalgeographic.com, 17 August 2010.

[15] McKinsey. Why digital strategies fail, McKInsey Quarterly, 2018.

[16] The German hyperinflation and how it impacted society are a case in point: in 1922 one US$ was worth Reichsmark (RM) 320, and in 1924 you had to pay RM 4,210,500,000,000.

[17] Digital Prospector is a new role to be filled.

[18] Murat Vurucu, How do we teach a machine to program itself? – Neat Learning, towardsdatascience.com, 25 July 2017.

[19] Jade Boyd-Rice, New A.I. application can write its own code, Futurity.org, 25 April 2018.

[20] Martin Zinkevich, Rules of Machine Learning: Best Practices of ML Engineering, martin.zinkevich.org, accessed 6 June 2018.

[21] Horst Hientz et al., Software Drives – Automotive E/E Development 2030, Kugler Maag Cie, 2015.

[22] Horst Hientz et al., Software Drives – Digital Capabilities for Automotive Innovators 2030, Kugler Maag Cie, 2017.

[23] Dawn Chan, The AI That Has Nothing to Learn From Humans, The Atlantic, 20 Oct 2017.

[24] McKinsey, Controlling machine-learning algorithms and their biases, McKinsey & Company, Nov 2017.

[25] Marie Boran, AI is learning to trump purveyors of 'fake news', Irish Times, 10 May 2018.

[26] Sreekar Krishna, Still in their infancy, AI algorithms need parenting, Quartz at Work, 6 June 2018.

[27] Andy Clark, Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence, 2004.

[28] Hauke Behrendt, Steffen Süpple, An der Wiege des Homo Digitalis, Intuity, 2017.

[29] Heinz Bude, Society of Fear, Polity, 2017.

[30] Dee Hock, On the Nature and Creation of Chaordic Organizations, thesystemsthinker.com, 1999.

[31] Rob Wile, A Venture Capital Firm Just Named An Algorithm To Its Board Of Directors – Here's What It Actually Does, Business Insider, 13 May 2014.

[32] See self managing forest.

[33] Richard Dawkins, Climbing mount improbable, 1996.

[34] Leila Ueberschlag, Terra: The Self-Owning Augmented Forest, MoneyLAB, institute of network cultures, 29 Sep 2016.

[35] Rockström et al., Planetary boundaries, Nature, 2009.

[36] Elisabeth Kübler-Ross, On Death and Dying, 1969. The five stages of the Grief Model are: Denial, Anger, Bargaining, Depression, Acceptance.

[37] Harald Welzer, Bernd Sommer, Transformationdesign: Wege in eine zukunftsfähige Moderne, oekom Verlag, 2014.

[38] Joseph A. Schumpeter, Can Capitalism Survive? Creative Destruction and the Future of the Global Economy, Martino Fine Books 2011.

[39] Joseph A. Schumpeter, Can Capitalism Survive? Creative Destruction and the Future of the Global Economy, Martino Fine Books 2011.

Table of figures

Intuity Media Lab

Intuity is a strategic innovation and design studio based in Stuttgart developing the digital services and products of the next generation. Intuity combines creativity and strategic-systemic thinking within the field of UI design, software-hardware-prototyping, AI and robotics.

Markus Turber

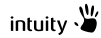
Markus Turber is a founding partner of Intuity. He likes thinking and planning innovative design and service solutions. The design of desirable, sustainable and smartly interconnected solutions makes him tick. In charge of R&D programs, Intuity is helping businesses to succeed in the digital world (e.g. by exploring, defining and implementing an IoT strategy for a large system integrator, various future mobility products and services for Daimler, connected services for Daimler Research, moovel, Carl Zeiss, energy companies and banks).
Shaping ventures with young entrepreneurs as a mentor, or hands-on with the team is a matter of heart for him. Together with Intuity he helped a range of startups (moovel, homee, Comfy, the native web, cellbricks) in prototyping their product or service and developing their business.
He frequently speaks at conferences on the impact of design within ever connected eco systems and advice C-Level to overcome traditional patterns in organization and start shaping options for desirable futures.

Hans-Jürgen Kugler

For 20 years Hans-Jürgen Kugler, Chief Scientist of Kugler Maag Cie GmbH, has has helped automotive companies to turn the challenge of software into business opportunities. He now works on “organic” concepts for networked co-creation.
Previously he worked with clients in the aerospace and communication industry. As adjunct Professor at the University of Limerick, he was Industry Director of Lero, the Irish Software Engineering Research Centre, which he helped to establish. Mr. Kugler was previously a lecturer at Trinity College Dublin, a director of software product and services companies, and Technical Director of the European Software Institute. Hans-Jürgen Kugler holds an M.Sc. in Computer Science from the University of Dortmund and an M.A. of Trinity College Dublin. He was awarded the IFIP Silver Core in 1986.

Bhaskar Vanamali

Bhaskar Vanamali is Principal and partner at Kugler Maag Cie GmbH. He has been working on process improvement for nearly 20 years and is secretary of the working group 13 of VDA QMC. He is Principal assessor and trainer, and a co-author of books. Due to his background he is trying to shed light on new approaches from different perspectives. He is actually a veterinary by profession but is working in IT since 24 years.



Hrsg.
Intuity Media Lab