

Hubert Osterle

Life Engineering

*Machine Intelligence
and Quality of Life*



 Springer

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Preface

Humanity is facing a quantum leap in evolution. Evolution in the sense of Damasio [1] and Tegmark [2] means above all cultural (technical and social) development. Individuals, companies, and states are competing to lead technological development and, at the same time, to enhance human well-being. Companies are outdoing each other with promises of salvation, from the fully autonomous automobile to cures for diseases such as cancer. Individuals are frequently overwhelmed by their personal experiences with digital services, by the promises and disappointments, but above all by the ever-increasing complexity. Installing a smartphone, using electronic banking to make financial provision for retirement, agreeing to the use of one's personal data and, ultimately, identifying manipulation come to mind in this context. The media and, in some cases, the world of politics take advantage of people's insecurity for scaremongering on the one hand and awaken simplistic euphoria on the other.

Emotions and misunderstandings frequently shape the debate. The question is how humanity can utilize technological opportunities to boost their quality of life and avoid threats. There is a risk that we shall fail to correctly identify what is probably the most momentous innovation in human history while focusing our attention on symptoms such as the loss of printed books or the younger generation's "cell phone addiction," that we shall underestimate many developments such as the surveillance of Internet traffic under the PRISM program [3] or social scoring in China [4] due to a lack of understanding, and, ultimately, that we do not deduce the right action such as, for example, limiting ourselves to a small number of selected digital services, or that we omit to take individual control of personal data. Citizens are massively overwhelmed by questions associated with the protection of privacy, the growing power of service providers with near-monopolies at the expense of states and citizens or the content of a future-proof vocational education. The same applies largely to the world of politics and, in many cases, to the experts, even if goodwill is assumed on all sides.

Various disciplines are striving to achieve sound theoretical foundations: computer science, economics and social sciences, political science, psychology,

www.lifeengineering.ch provides a platform for discussions and links to publications and people working in the discipline of Life Engineering.

philosophy, neurosciences, ethics, and religion. Scientists, who work at the interfaces between information technology, economics, and social sciences, and are prepared to familiarize themselves with the findings of the other sciences, may be able to contribute to the clarification of some positions and, in so doing, help to place the debate on a more objective footing. This book represents a humble attempt in that direction in full awareness of the following limitations:

- Combining the knowledge from the disciplines involved, with their incompatible worlds of thought and concepts, is challenging.
- Statements and conclusions are seldom quantitatively empirical or mathematically provable. Even argumentative deduction is only partially successful, which means that many statements represent personal opinions or should be regarded as speculative. In many cases, the conclusions are not as clear and operational as would be desirable in design-oriented research. This can hopefully be compensated by the gain in structuring.
- Some conclusions contradict firmly established (mainstream) attitudes or are viewed as unwelcome because they contradict instincts for self-preservation and preservation of the species. It is therefore difficult to accept that humans might not be the final goal but only an intermediate stage of evolution. The idea that state surveillance and control of its citizens, as in the Chinese social credit scoring system, could possibly be a model for the social market economy is at odds with our intuitive desire for freedom. It is not always easy to remain within the boundaries of broadly accepted ethical and political principles when describing consequences. Findings can therefore equally well be encouraging or depressing.
- A rational exploration of the topic is not easy and entertaining, but calls for tedious abstraction.
- This text presents one possible view of the digitalized world; others are to be compared. I represent a scientific, market-economy-based, and human-centric mindset; a Chinese or Congolese viewpoint and a religious worldview will differ significantly in many aspects.

In view of the opportunities and threats posed by machine intelligence in our personal lives, it is clearly preferable to identify structures and derive guiding principles from the available knowledge, however uncertain that might be, rather than waiting for findings that are soundly based from a philosophy of science viewpoint, which are mostly only available *ex post*. However, this also means using the extensive data pools of digital services intensively in order to find correlations and structures.

What is called for is a **Life Engineering discipline**, which shows the opportunities and threats for humans, delivers impetus for entrepreneurial action and contributes to the political agenda. Values such as human dignity, humanism, and liberty need to be concretized in the context of machine intelligence. The reader who is looking for ideas conducive to the understanding and use of technological,

economic, and social change will hopefully find here a rational analysis without overly emotional influence and ideological bias. The intention is for this text to provide ideas for further scientific and, above all, practical analysis.

I would like to take this opportunity to thank everyone who provided support during the creation of this book. With their many thought-provoking discussions, Rieke Bärenfänger, Bernadette Burtscher, Christian Dietzmann, Manuel Eisele, Florian Schweitzer, Bruno Weder, and Bianca Wipplinger played a major role in helping me to hone the statements it contains. Michael Gasser and Annette Glaus turned the manuscript into a book. Melanie Fletcher not only did an excellent translation job but also sharpened many statements during this process.

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Abbreviations

AI	Artificial Intelligence
ARPU	Annual Revenue Per User
BAT	Baidu, Alibaba, and Tencent
BKK	<i>Betriebskrankenkasse</i> (company health insurance fund, Germany)
CEO	Chief Executive Officer
DB	<i>Deutsche Bahn</i> (German Railroad)
DNA	Deoxyribonucleic acid
EBIT	Earnings before interest and taxes
ECG	Electrocardiogram
eIDAS	Electronic IDentification, Authentication, and trust Services
EMA	European Medicines Agency
ERP	Enterprise Resource Planning
EU	European Union
FAMANG	Facebook, Amazon, Microsoft, Apple, Netflix, and Google
FDA	Food and Drug Administration
GDPR	General Data Protection Regulation
IEEE	Institute of Electrical and Electronics Engineers
MOOC	Massive Open Online Course
NSA	National Security Agency, USA
OECD	Organization for Economic Co-operation and Development
PDA	Personal Digital Assistant
PRISM	Planning tool for Resource Integration, Synchronization, and Management
QLM	Quality of Life Model
VR	Virtual Reality

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Abstract

Many types of machine intelligence are changing all areas of our lives. In this context, machine intelligence refers to digital services of any kind that relieve humans of mental tasks or reinforce human intelligence. This can involve administering a bank account as well as managing a supply chain, counterterrorism, home automation, autonomous vehicles, an active exoskeleton, and all apps on mobile devices or internet websites; in other words, everything that supports our lives now and in the future. The areas of life concerned range from communication and medical therapy to financial provision for retirement. Does machine intelligence make us happy or are we becoming unhappy slaves to technology?

1.1 Utopia or Dystopia

For years, the media have been outdoing each other with reports on machine intelligence, which are either utopian or dystopian but seldom realistic. **Fear-related topics** include superintelligence that supplants humans; robots and artificial intelligence that lead to unemployment or dehumanization; the manipulation of humans by social networks; and surveillance by cameras and sensors of all kinds. **Hope-related topics** include prosperity for all, autonomous automobiles with no road accidents, cures for diseases, and the delegation of less pleasant work to robots (e.g. care of the aged). 85% of US citizens believe that information technology is good for their country, and 75% believe that it is good for them personally. At the same time, more than 81% of the 1003 people interviewed in a survey want social media to do more to combat hate on its platforms, 82% want social networks to collect less data, and 89% want fake news to be more readily

identifiable [5]. People therefore like the convenience provided by digital assistants and are concerned about their development.

Even in the non-fiction and scientific literature, one finds extremely contradictory scenarios. Diamandis and Kotler, for instance, create the vision of a worldwide **affluent society** [6]. Zuboff provides a call to battle against surveillance capitalism, which is primarily directed at the dominance of the *datenkraaken*¹ [7]. According to Christl and Spiekermann, these include not only Google and Facebook but also data brokers like Acxiom, Oracle, and arvatoBertelsmann [8]. McNamee, an early and still active investor in Facebook, even goes as far as to warn against a Facebook catastrophe [9]. As early as 2013, Schmidt and Cohen developed a more sober political agenda for dealing with digitalization [10]. Collier puts forward suggestions for reestablishing an ethically based society [11]. Harari sees the vision of a human-level intelligence as an inadmissible simplification of life and places his hopes in human transcendence [12, p. 401], but expects a biochemical improvement and reengineering of our bodies and minds [12, p. 48]. Others attempt to develop digital ethics or rules for dealing with machine intelligence [13, 14].

Are people happier nowadays than they were 3000 years ago? Does technology improve our **quality of life**? Which technical achievements can you do without: telephony, email, electronic banking, electronic government, internet search, photography, music, video, games, 3D printing, augmented reality, computed tomography, weather forecasts, or navigation? Why don't you? Millions of developers and entrepreneurs utilize every opportunity for the innovation of digital services of this kind. Billions of consumers jump at new developments and improvements. After evaluating numerous studies in different countries, the OECD report "How's Life in the Digital Age?" comes to the conclusion that there is a significant correlation between internet access and satisfaction with life, without wanting to derive any causality [15, p. 92]. The report does, however, state possible reasons for the correlation: newly available goods and services, digitally enabled social relationships, voice and other online communications, more flexible forms of work, better access to medical and government services, greater ease in striking up romantic relationships [16] and, finally, simpler means of acquiring knowledge and skills. *Progress and human happiness therefore seem to go hand in hand.* Nonetheless, there are the many critical voices already mentioned [17]. Serious problems or attention catching?

In the last two hundred years, competition in the **capitalist economic system** has brought virtually exponential technological development and, with it, a level of **material wealth**, which until recently had been inconceivable. An ever-increasing proportion of the world's population has access to all the necessary goods and services, enabling the fulfillment of basic needs such as food, water, shelter, medical care, and security in highly developed societies. In the next decade, we expect to see further rapid advances in technology, above all in information technology. These will lead to continuing increases in living standards, even if the

¹The *datenkraaken* is the German term for the "big beasts" of the internet, named after the murderous sea monster of Norse mythology.

prediction of Diamandis and Kotler [6] that by the 2030s humans will be able to obtain all the goods and services they want and need might be broadly exaggerated. Does quantity come at the expense of quality? Are we capable of understanding the wide array of options (The Paradox of Choice [18]) and of limiting ourselves to the right ones? *Measuring progress in terms of monetary income or gross national product per capita says less and less about our quality of life.*

Humanity is facing a **quantum leap in evolution**.² *Humans need to work less and less in order to satisfy their basic needs, and have more and more time to devote to their quality of life.* The available options for the latter are almost limitless, from fashion to video games. Machine intelligence is creating new possibilities for enhancing well-being, be it through convenience such as online shopping and 24/7 access to an inexhaustible supply of music, films, and games, more comfortable forms of mobility such as navigation with a combination of different modes of transport, or through medical treatments to improve and extend life.

At the same time, there is growing concern that technology will lead to a loss of human values. When a Steinway Spirio self-playing piano, rather than a musician, plays thousands of pieces of music as interpreted by the world's best pianists, when electronic books replace the bookshelf containing carefully bound editions, or when youngsters prefer to chat on social networks rather than talking to physically present parents, many people see these developments as the demise of **humanism**. They talk about dumbing down and cultural impoverishment.

“Companies offer what people need, and people buy what makes them happy” is a frequently quoted cliché regarding human **autonomy**. Individuals should decide for themselves what makes them happy. The fact that humans have a limited capacity to do so is borne out by many forms of harmful addiction and the ever-applicable adage: “The spirit is willing, but the flesh is weak.” Moreover: People drive where their satellite navigation system guides them, book what Airbnb suggests, listen to what Spotify plays for them, and buy what advertisements advocate. Machine Intelligence determines humans almost unnoticeably, but to an increasing extent extraneously, or at least exerts a major influence on their decisions. *With each function that machine intelligence performs better than a human, we relinquish part of our autonomy and accept the heteronomy associated with the machine.* Marketing and sales rely more on human weaknesses than on human rationality.

The fear of total **surveillance** is a topic discussed almost daily in the media. Alexa, the smart speaker from Amazon, which is already installed in over 100 million households, as well as the voice controls of TV sets can do far more than merely receive specific commands. These devices detect the presence of the occupants, hear the opening of a beer can [19], and understand more of the spoken words in their environments than we realize [20, 21].

²In this context, a quantum leap in evolution refers to a large evolutionary step within a short time frame. This raises the question of whether machine intelligence warrants the term *saltatory evolution*.

Nowadays, the recruitment process in businesses can use the personal profile from the job candidates' application documents and the interview, additional data such as their creditworthiness, their contacts on social networks, or their search behavior on the internet. In future, it will be technically possible to select candidates on the basis of physiological features such as facial expression, voice, heart rate, athletic capabilities, and specific gene variants in their DNA. For many people, this constitutes a violation of their **personality rights** and poses a huge risk of discrimination.

Robots and machine intelligence destroy millions of jobs and lead to **unemployment**. Since the beginning of computerization in the 1950s, employment has nonetheless risen to levels that are unprecedented in peacetime despite repeated predictions to the contrary because new jobs have been created. Employees have been fighting for shorter working hours for centuries, but rightly fear zero working hours. An unconditional basic income can prevent the impoverishment of broad sections of the population, but will not give people a sense of purpose in life and therefore **self-esteem**, a prerequisite for subjective well-being. Work and a sense of purpose as well as the distribution of income, wealth and power are still being discussed, as they were before industrialization when hunger, medical care, and security were the main issues.

People feel that machine intelligence is changing their lives much more fundamentally than they experienced when businesses were computerized. Humans allow digital services to assist them in all areas of their lives without realizing it and, in so doing, relinquish competence and autonomy to machines.

1.2 Machine Intelligence for the Well-Being of Humanity

The economic benefit to business drives technological development. But do capitalism and technology lead us to paradise or misery? There is certainly a growing focus on **quality of life**, which is reflected in the happiness industry that has been thriving since the 1990s, from science [22, p. 12], practical guides, and drugs to life counselors of all kinds and subsidies such as government support for the arts.

In their **marketing communications**, leading technology corporations address the fear of technologization and formulate slogans for their organizations such as “for a better world”, “for the well-being of people”, “for the future of life”, “better policies for better lives”, and “don't be evil”, without going into detail about what they mean, and without clearly defining positive and negative effects.

A gratifying number of initiatives are attempting to use **machine intelligence for the well-being of humanity**. Figure 1.1 shows some widely discussed approaches, some of which focus around artificial intelligence (AI) (see Sect. 3.6) (for further examples, see Figs. A.2 and A.3 in the appendix). This might be correct, from the point of view of wanting to attract the necessary attention, but nonetheless narrows the picture unduly. Despite all the successes of AI, which tend to be in specific technical areas (e.g. pedestrian recognition in automobiles), its

Initiative / Organization	Key Statements on Quality of Life
<p>The Asilomar AI Principles</p> <p>The Future of Life Institute [23], [24], [25]</p>	<p>Artificial intelligence (AI) for well-being, sense of purpose in life, and ethical values (dignity, rights, freedom, security, and cultural diversity). Create not undirected intelligence but beneficial intelligence.</p> <p>Mastery of AI, responsibility of developers, transparency of AI decisions, rights of the individual to control personal data, freedom of humans to make decisions, open cooperation between AI researchers, preparations for machine superintelligence</p> <p>Benefits and prosperity for all, support for the social order, avoidance of an arms race, links between science and policy-makers</p>
<p>IEEE Ethically Aligned Design. A Vision for Prioritizing Human Well-Being with Autonomous and Intelligent Systems</p> <p>IEEE Standards Association [26]</p>	<p>Human well-being as the highest virtue for a society through autonomous and intelligent systems: human rights, equality, freedom, dignity, accountability, transparency, privacy, avoidance of misuse</p> <p>Control over personal data, human freedom of choice, transparency of AI decisions</p>
<p>The World Economic Forum</p> <p>[27]</p>	<p>Network access, responsible business management, competent policy-makers, robustness against disruptions, trustworthy digital identity, use of data, privacy</p>
<p>OECD Going Digital</p> <p>[15]p.22, [28]</p>	<p>Income and wealth, jobs and earnings, health, education and skills, work-life balance, civic engagement, governance, social relationships, environment, personal security, housing, subjective well-being</p>
<p>European Commission [29]</p>	<p>Rights: dignity, freedom, democracy, equality, citizens' rights</p> <p>Principles: to the benefit, not to the detriment, human, autonomy, justice, transparency, security</p> <p>Values (examples): informed consent, equal opportunities, environment, self-determination</p>

Fig. 1.1 Organizations on the subject of artificial intelligence (AI) and quality of life

possibilities are significantly overestimated. While a superintelligence that surpasses the human brain is still 50–100 years away (see Sect. 7.7), other capabilities of information technology (e.g. connectivity of everything and everyone) are set to affect humans to a far greater degree in the next years and decades. As a consequence, the Internet of Things and the data stocks of the megaportals will radically transform our daily lives by 2030, driven in particular by 5G networks. I address all these capabilities of any information technology by the term *machine intelligence*.

The above-mentioned initiatives take the view that, considering the fundamental changes involved in all areas of our lives, there is an urgent need for **governance of machine intelligence** (see Sect. 7.5) if we do not want to leave development to a process of trial and error or to capital accumulation. “Will the best in human nature please stand up. Before the prospect of an intelligence explosion, we humans are like small children playing with a bomb.” Nick Bostrom’s [30] call, typical of many initiatives, sounds more like desperation than a plan, and the reduction of machine intelligence to superintelligence distracts from the tasks at hand, as formulated below by way of example.

The “Ethically Aligned Design” treatise launched by the IEEE Standards Association fortunately provides concrete recommendations on the organizational implementation of ethical goals, but, like other initiatives, nonetheless remains extremely vague regarding the goals and does not provide clear definitions of goals like autonomy or dignity. The goals of the OECD project Going Digital [15, p. 22] are considerably more concrete, but focus on the same opportunities to develop and use information technology for all people, and are therefore based on technological progress for all rather than on human happiness. *The OECD equates technological development and quality of life to a large extent.*

The prime goal of humans is happiness. What constitutes happiness and the avoidance of suffering, or, to put it in more neutral terms, quality of life, has nonetheless been unclear since Aristotle and Epicurus and up to today’s neurobiological understanding of happiness, but is simultaneously the prerequisite for using technology for the benefit of mankind and for measuring progress. The key statements on quality of life presented in Fig. 1.1 are difficult to turn into concrete instructions and, in many cases, tend to represent slogans that are easy to communicate but difficult to break down into actual human needs and concrete situations. Understanding the quality of life is a prerequisite for using technology for the benefit of people and measuring progress.

Evolution in this book refers primarily to social and technical evolution and only secondarily to biological evolution. Social evolution means the structures and rules of human coexistence. Technical evolution refers to our knowledge and in particular to technical disciplines such as medicine, pharmacology, biology, chemistry, physics, mechanics, mathematics and computer science. Genetic engineering, prosthetics, brain stimulation and other technologies will also further develop human biology. The book concentrates on the development of information technology, consisting of hardware, software and data as well as the necessary organization (part of social evolution). Evolution uses the means of reproduction and selection. It ensures species conservation and, at the same time the selection of the

strongest specimens, whatever is regarded as strong or weak. We can observe that in addition to physical and mental abilities, technical and social traits become part of the selection. The term selection therefore describes the observed mechanisms for the selection and enforcement of those technical and social constructs that seem to bring the greatest benefit to humans in this process. Authors such as Tegmark and Harari also expect to see biological evolution in the sense of transhumanism.

This is not about social Darwinism or even eugenic selection. The rational analysis of the observed human behavior and the identification of selection mechanisms aim at recognizing and avoiding political abuse. The aim of Life Engineering is a high quality of life for all people, which leads to the call for a humane capitalism (see Sects. 6.2.6 and 6.3.6). Examples of constructs of social and technical evolution are social scoring, which China is testing, and digital services financed by advertising, which are dominated by megaportals such as Google, Facebook and Tencent. Evolution is a development that we humans observe, but whose goal we do not know. One might suppose that the prime goal of evolution is progress, and above all technological advance. **Evolution** is a development that we human beings observe, but do not know its goal. If we go along with authors like Tegmark or Bostrom [2, 30], evolution leads to a growing intelligence, which will ultimately surpass the human brain. *If a higher intelligence is the goal of Creation,³ then human happiness is not the goal, but happiness and unhappiness are the control mechanisms of evolution.*

A robo-advisor of the type that banks are currently developing with great effort is a piece of human evolution encompassing technical and organizational development. All the available data relating to customers; in other words, their financial situation, their consumption behavior, and their circle of friends as well as their fears and interests, is evaluated by the robo-advisor. Arguments in favor of the bank's investment products are developed on this basis. When a robo-advisor of this kind uses all the data analysis and artificial intelligence methods available today in order to propose retirement products to a consumer, who will stand to benefit most from that proposal—the bank (marketing and profit goals) or the consumer (protection against poverty in old age)? *The autonomy of humans is limited by their knowledge.* The OECD initiative Going Digital has dedicated one of its own reports to the opportunities and threats of robo-advisors for retirement planning [31].

For many years, Google has been building up a world database (collections of all available data), which is aimed at providing a picture of consumers as well as businesses (e.g. opening hours) and the physical world (e.g. geospatial data in Maps), which is as comprehensive and precise as possible. Google continuously analyzes this data to identify patterns such as purchasing behavior, mobility and living behavior [32]. Google has the potential to understand the people's lives better than any other organization and to apply this knowledge to individual consumers. This can benefit the latter if Google addresses their real needs. Google generates

³In many religions, Creation merely provides readily communicable explanations for our existence, while, even from a scientific perspective, there are no causal reasons for the existence of the world. The term *Creation* is therefore used here as a placeholder.

revenues by selling personal data to companies, which in turn want to sell their products and services. This becomes a problem for people when Google and its paying customers utilize their knowledge to influence behaviors, but the products and services do not increase quality of life. Needless to say, the same goes for other megaportals such as Amazon or Alibaba.

Both examples show that **capital** drives evolution in the interests of technical and organizational development (see Sect. 5.1.2) because capital is increased by competitive edge. *Capital fuels evolution.*

1.3 Evolution or Quality of Life

Machine intelligence is both an object and a tool of evolution. It advances culture, consisting of knowledge, technology, organization, and art.⁴ But are progress and evolution the goal of humanity? And is human happiness the goal of evolution?

*The goals of evolution and humanity are not identical.*⁵ Evolution controls humans through happiness and unhappiness. It rewards behavior that is conducive to evolution with happiness and punishes behavior that is detrimental to evolution with suffering. The control cycle of evolution in Fig. 1.2 is intended to illustrate this process.

Humans use digital services in all areas of life. Through service subscription, advertising proceeds, or commission, they boost the service provider's capital, consign their data to the provider, and strengthen its knowledge and power. In so doing, they are supplying the service provider with the resources to further develop its services, i.e. for the evolution of the technology. Humans only use digital services if they expect to receive a benefit (improvement in quality of life). This is the case if the service (e.g. the taxi service Uber) takes work off their hands and reduces their costs. For Facebook, this means that the service expands the knowledge of users, enables them to present themselves, and helps them to nurture friendships by means of digital communication. A service like Twitter enables users to stay up to date on selected topics or to influence others, and consequently to bolster their own importance and, ultimately, their self-esteem. *The provider makes sure that users expect to benefit from the service, but aims at revenue streams, not the lasting quality of life of the user.* For that reason, this relationship is only shown with a dashed line in Fig. 1.2.

People leave data trails without noticing it. Wide-spread camera surveillance with facial recognition, location data via the smartphone, DNA traces, and in future even odor identification (as performed by dogs) are just a few of the things that enable identification and the linkage with popular activities like sport or shopping.

⁴Evolution is understood to mean sociotechnical evolution here, not biological evolution.

⁵Humans are part of evolution. We therefore need to consider whether they determine their goals autonomously or whether evolution can impose its goals.

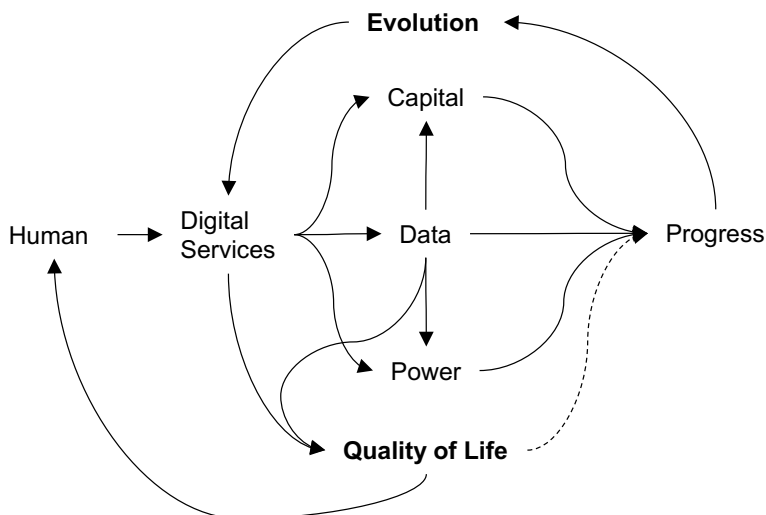


Fig. 1.2 Control cycle of evolution and quality of life

Navigating with Google Maps produces data for Google regarding the user's mobility behavior, the current road situation, and the destination of navigation, e.g. a supermarket. Google sells this knowledge in many forms in conjunction with its knowledge of the supermarket and the search queries before the trip to the retailer. Each use of Google Maps increases the traffic of the service and consequently its competitive power. With this power, the navigation data and the advertising or commission revenue, Google can further develop the Maps service, for example with algorithms to understand the mobility behavior—a small contribution toward the evolution of the technology.

People use Google Maps because it is convenient. As soon as just a few letters have been entered, Maps already recognizes where the consumer probably wants to go on the basis of the consumer's current location and navigation history. It is not necessary to pay for using the maps, calculate the trip time, or get to grips with a road map; traffic jams and deviations are indicated. This meets people's needs, and that is what leads the development of the Maps app.

This would all seem to be aboveboard and to serve the benefit of the service provider and user, were it not for the downsides. The navigation data and contact data make it possible to record the location and time when people meet. This helps to prevent terrorism, but could also be used for industrial espionage (e.g. identifying takeover talks at an early stage) or to identify political dissidents and thus help to promote totalitarian systems. In the private sphere, this could replace the private detective for jealous partners. As a minimum, digital services monetize such knowledge through additional consumption. The impact on people's quality of life

therefore depends on the purpose for which the data is used—and that is usually determined by the price that can be achieved by the digital service.

The contribution to corporate goals determines which human needs are satisfied. Companies that are measured by economic success focus on human (consumption) needs, i.e. on **sales revenues** and **contribution margin**. On the basis of findings from psychology, market research, and an individual's concrete data, businesses communicate the prospect that those needs will be fulfilled in their advertising, even if the product or service has little to do with the happy father-son relationship used to promote the watch or the attractive, scantily clad female who endorses the home contents insurance. A pharmaceutical company plugs a mood enhancer, even if a 20-minute walk would be more effective, but would not generate sales revenues.

Once consumers have purchased the product or service, disillusionment usually sets in immediately as only the product and not the association arrives. If they then see that their Facebook “friends” have acquired even more expensive status symbols, dissatisfaction is inevitable. Evolution places humans on a treadmill that turns the opportunities for social comparison on social media even faster than before. Evolution uses not only happiness but also unhappiness to drive the treadmill if a rival has nicer clothes and higher income or has more “fun” within a social network. When someone fails to fulfill the requirements of a digitalized profession, that can mean job loss and loss of self-esteem.

We rely on the little digital helpers in ever more areas of our lives, such as navigation, financial investments and information searches. Binswanger and Kolmar see humanity on its way to digital slavery [17]. The question is whether being relieved of unpleasant tasks creates greater autonomy for more fundamental considerations or whether technology reduces our ability to make decisions. It is also unclear whether the **autonomy of the individual** called for by Kant makes people happy. What is certain, however, is that the digital helpers are not aimed at the happiness of the consumers but at the revenues of the provider. Consumption, for its part, contributes little toward a life of meaning and contentment. *Dissatisfaction creates a greater need to consume and a greater willingness to work hard.*

Figure 1.2 shows further mechanisms. The **network and data effects** ensure that each click and every sensor contributes to the market position of a digital service. Once a service like Google or Facebook has acquired a dominant position, it becomes difficult for competitors to offer similar or even better services in the same area. For consumers, this means that their choice vanishes, that they have to expect higher prices, and that by the year 2030 the monopolists will be able to charge fees for many of today's free services. Amazon Prime, like many other premium services, shows us where we are headed. *Consumers strengthen monopolization* when they constantly access services they expect to provide the most knowledge (e.g. Google) or the biggest offer (e.g. Amazon) and in most cases no longer know the alternatives.⁶

⁶Do you know the search engines DuckDuckGo, Ecosia, MetaGer or Fireball?

Alongside the network and data effects, there is also a **gatekeeper effect** that should be mentioned. The majority of consumers use only roughly six apps⁷ at least monthly [33]. These apps and the operating systems Windows, Android, and iOS largely decide which services can be developed and used. Consumers cannot get around these systems, but contribute to their market power, for instance, when buying new devices for new functions (e.g. login with facial recognition) or taking out additional subscriptions. Google users pay for the service with their data, which generates advertising revenues for Google. The value of that data to Google is reflected in the fact that in 2018 it paid Apple almost USD 9.5 billion for Google to be preinstalled as the search engine in iOS. *Capital and data drive technical evolution.*

Today, **FAMANG** (Facebook, Amazon, Microsoft, Apple, Netflix, and Google) [34] pos. 2032 and **BAT** (Baidu, Alibaba, and Tencent) already possess huge market power, on the one hand through the consumers and on the other through the suppliers. Which consumer goods manufacturers have access to consumers without going through these platforms? *This market power and the detailed knowledge of individuals can lead to the manipulation of humans.* A frequently observed symptom of this constellation is the **echo chamber** (filter bubble), where the megaportals provide people with precisely the news they like to read, hear, and see, and where social network participants mutually confirm their opinions without allowing opposing voices to express themselves. This reinforces their views, and can go as far as radicalization and generating hate for others. Election campaign managers use the knowledge of voters and, in particular, echo chambers, to feed voters with precisely the party messages that coincide with the views expressed and, if necessary, with fake news too. Individual members of echo chambers even try to make a name for themselves by using pithy words to reinforce messages.

In summary, the following can be said about the evolution control cycle:

- Consumers use the services from which they expect the most. By using the services, they strengthen the providers' data, capital and power base, which drives evolution, particularly that of digital services.
- People leave data trails on every digital service and can almost always be identified and therefore addressed by combining data.
- Providers use their knowledge to influence consumers. With their knowledge of general consumer behavior and individual preferences, they stimulate needs and promise benefits that they can only partially fulfill.
- Providers optimize their profits, not the quality of life of consumers.
- Providers with the biggest network and the most comprehensive personal data can offer the most attractive service, with the consequence that consumers choose that service and therefore strengthen the provider's monopoly.

⁷In addition to those preinstalled by the operating system.

- Once a provider has achieved a monopoly position, it can influence the opinions of consumers, charge consumers a monopoly price for its service, command a high price from product and service suppliers for acting as intermediary, and exclude competitors to its own products and services. Numerous examples of all these behaviors can already be found today; it will not be necessary to wait until the year 2030.

The goals of **humans** are only partially identical to those of **evolution**. The alternative **evolution or quality of life** in the sense of an inclusive “or” is therefore the central focus of this book. *Capital is the fuel of evolution and determines its direction of development*. As a human being, however, I am committed to human goals. If we want to steer technological development toward human happiness, we must understand

- how the digital world will look in the future (in this case, 2030) (Chaps. 2 and 3),
- what distinguishes our quality of life (happiness and unhappiness) (Chap. 4),
- what technology, in particular machine intelligence, can contribute to quality of life (Chap. 5),
- what the consequences are for the individual, for companies, and for society (Chap. 6), and
- what the tasks of a Life Engineering discipline are (Chap. 7).

Business Engineering [35, 36] serves the purpose of material progress and therefore evolution. In an affluent society, we also need **Life Engineering**, which brings together findings from the fields of economics, computer science, happiness research, and neurosciences as well as political science, and also from fields such as philosophy and religion, from which it derives recommendations for action. Machine learning in all its forms should recognize the correlations between human life phenomena and lead to applicable rules in order to shape the future for our well-being. This is not only about the narrow and overemphasized area of AI, but also encompasses every form of digital information processing as well as data, algorithms, devices, and organizations. And it is not only about rather abstract ethics from the perspective of society, but deals with transforming the life of the individual, transforming business models, and social transformations. A Life Engineering discipline will not be able to answer all the questions regarding a happy life with information technology within a foreseeable time period, but should nonetheless create the foundations for the human-centered use of *machine intelligence* and, on this basis, gradually provide answers to detailed but concrete questions such as the following:

Questions from the individual’s perspective

- Should you use Instagram as a 14-year-old? How many times a day should you activate your smartphone for this purpose?
- As a Tinder user, how do you prevent your preferences in the choice of partners being used against you?

- When do you feel happiness? What torments you? When are you content with your life?
- Do you feel at ease in the heart of the city or more so in the country? What does Airbnb recommend for you?
- Which professional career will bring you joy and secure your financial existence for the long term? What will the working day be like for a software developer, a plumber, or a welder in the digital world?
- Which of the millions of apps do you need and which are right for you (e.g. banking)?
- Which technology stocks are appropriate for financial retirement planning?

Questions from the company's perspective

- What motivates people to use a digital service? Why do people use Facebook, Wikipedia, Amazon, Games, and WhatsApp? Is it about self-expression, convenience, or money?
- How can a digital therapy assistant persuade an obese patient to keep to a diet and exercise plan?
- In what context (travel, home, etc.) does the consumer use our digital services? Does our marketing staff understand this context from its own experience?
- In future, will consumers buy our products and services (e.g. dog food, hotel rooms) online directly from us? Or through an adviser (e.g. insurance broker)? Or from a megaportal (e.g. concert tickets)?
- Which data (e.g. ski tours of Facebook friends) do we need to find our potential customers (e.g. ski tourers) and address them individually according to willingness to spend, brand image among friends, and skier ability? Who has the appropriate data?
- How can a football club generate revenue flows from its fan data?

Questions from the perspective of society and the economy

- What can consumer protection achieve and, above all, how?
- Is the GDPR (EU General Data Protection Regulation) a blessing or a curse for European consumers and for the economy?
- What will a state identification server or state control of private identification services achieve? Who benefits from eIDAS (electronic Identification, Authentication and trust Services)?
- Who should own your personal data and who already does so?
- Where do FAMANG and BAT have more power than our governments? How can the power of megaportals be limited?
- Who decides what is good for you? Should Amazon or Apple recommend or book a vacation destination for you, taking into account your financial resources and your preferences? Where do you need consumer protection?

- Is social scoring an addition to criminal law that should be taken seriously in a Western multiparty democracy? Can it control capital for the benefit of consumers?

This book can only answer these and similar questions in part, but may contribute some new perspectives and outline the main principles of a quality of life model and the resulting consequences.

Abstract

In 2030, we shall not yet have a universal life assistant for all aspects of human life but instead an individually compiled hodgepodge of technical assistants to cover needs ranging from home security to therapy and round-the-clock entertainment. This chapter picks out and examines individual areas of life to a degree that makes it possible to identify the broad outlines of fundamental trends, starting with the status quo and extending up to the year 2030. The few areas of life selected and the associated digital services available reveal the extent to which machine intelligence has already changed our lives, and the fact that connecting the findings currently available will accelerate that change. The examples cited show that digital services bring together as many sources as possible to form gigantic data collections that can be used to derive ever more patterns and rules. As a consequence, the services will become smarter and more active, and take over ever more tasks from humans.

A Life Engineering discipline must orient itself toward a future world with growing *machine intelligence*, not toward the past. For that reason, the starting point here is a consumer scenario in the year 2030, a time horizon for which technical, social, and political development is reasonably predictable. Humans are already using digital services in all areas of life (see Fig. 2.1). The following depiction picks out and examines individual areas of life to a degree that makes it possible to identify the broad outlines of fundamental trends, starting with the status quo and extending up to the year 2030.

- **Machine intelligence** exists in many forms: websites, apps, entertainment electronics, vehicles, household appliances, medical devices, etc.
- Services become **more intelligent**. Even cheap surveillance cameras will detect people as well as movement.

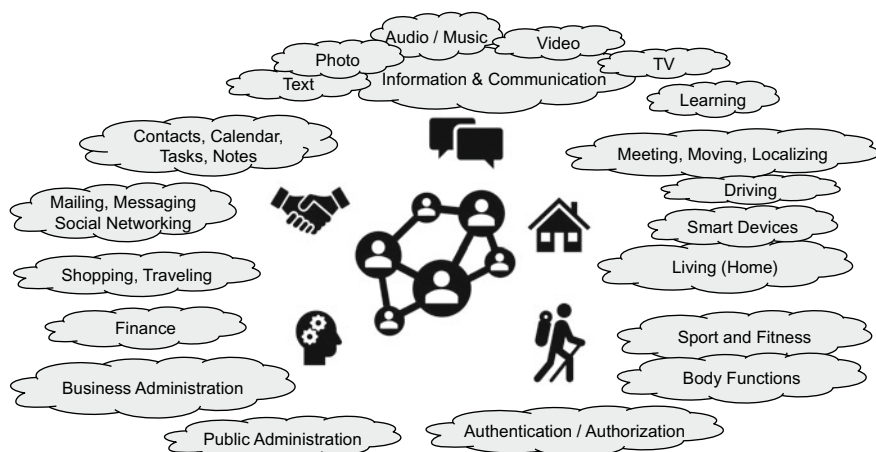


Fig. 2.1 Areas of human life

- Passive services, which have to be operated by humans, give rise to **proactive assistants** that operate autonomously and make recommendations and, if necessary, trigger actions themselves.
- Digital services converge (**integration**). A future therapy assistant from Apple or Google, for instance, can combine making and paying for a doctor's appointment with biometric data, calendar, contacts, and navigation, and take care of settlement with the insurance company.
- Digital services **cooperate** by means of mutual access to **data**. Navigation uses personal mobility history, personal contacts, road maps, weather data, company addresses, timetables, interests (e.g. from reading behavior), costs, etc.
- **Sensors** detect additional aspects of reality for which humans do not have senses. Today, the smart home product Netatmo measures CO₂ levels and humidity in the room; new sensors will detect electromagnetic radiation and pollutants such as particulates, and record indicators of our well-being such as clearing the throat, voice timbre and breathing frequency.
- **Actuators** perform many tasks automatically. The blinds motor closes the blinds; the insulin pump replaces the syringe; the autonomous automobile drives in part without human intervention.
- **Man-machine collaboration** becomes easier. Amazon's Alexa instructs the chef by means of voice communication, even if he has dirty hands and cannot operate a tablet, let alone a keyboard. In 2030, Alexa will use more forms of communication and require fewer entries from humans as she will understand more about cooking, food, and diets.

2.1 Information, Communication, and Entertainment

Private individuals consume professional, digital information services such as news, search engines, knowledge bases (e.g. netdoktor, geographic information services), learning platforms (e.g. MOOCs), streaming services (e.g. television, Spotify, and Netflix), and games. However, they also consume media for which they themselves **produce**: telephone, messaging (e.g. WhatsApp), broadcast messaging (e.g. Twitter), mailing (e.g. Outlook), podcasts and blogs (e.g. Fashiontweed), photo and video platforms (e.g. Instagram, YouTube, Snapchat, and personal photo and video collections) as well as knowledge bases (e.g. Wikipedia and other wikis). Advertising, social engagement, and the propensity for self-promotion ensure that all of these receptacles are filled. Live cams, weather observation, business transaction monitoring (e.g. financial information services), and newsbots (see “Computational Journalism” by Cohen, Hamilton and Turner [37]) are examples of machine-generated information that contribute to the **oversupply of information**. *The greatest challenge for consumers is selecting correct, sound, balanced sources of information that are also relevant to their needs.*

In 2030, electronic communication and entertainment will be a much more real experience for humans than it is today. **Virtual (VR) and augmented reality (AR)** [38] will have made the breakthrough from the gaming world into the information and communications world by 2030, one example being a VR headset linked to a webcam of a potential vacation destination, which enables the consumer to “take a look around” at the resort. The cameras on millions of autonomous automobiles will be available as webcams with exact localization and can be oriented by head movements of the person wearing the VR headset. Alternatively, drones fitted with cameras or robots like the Knightscope K5 could offer live pictures of almost any location for a fee. This is already technically possible to a certain extent today and, with the 5G mobile network, will be economically feasible by 2030 at the latest, although legal restrictions may well be imposed.

In 2030, immersion into a virtual world will have advanced to include stimuli such as image, sound, touch, and smell, enabling the user to experience being present in a different location, such as that of the communication partner, as almost real, and to interact with the remote environment. This gives rise to new opportunities for livelier communication in meetings, for machine maintenance, for modeling in architecture, or for sex with avatars and robots [39].

Megaportals gain an ever more precise picture of consumers. Corporations like Alibaba are devoting a great deal of attention to machine image and voice recognition and consequently to image searches in documents, catalogs, photo libraries, or film archives, which will bring an important addition to the text searches that have been customary up to now. An idea of what we can expect to see in the year 2030 is already evident with Google Photos today, when someone has saved photos in this app and then browses through the photos of a specific person or of New York in the rain. Image and voice recognition is already a feature of many surveillance cameras as well as being used in household appliances and, in 2030, will be

ubiquitous as an affordable consumer service. Machine voice and sound recognition, which is constantly fed with data from voice assistants like Alexa, Google Assistant, or Cortana and from devices with voice control (e.g. TV and automobile), not least from telephone surveillance, not only identifies spoken words but also things like the hissing sound of a beer bottle being opened. Sound and image dramatically expand the knowledge of machines without any need for human contribution. Fitness trackers can supply physiological data such as the surface tension of the skin, heart rate, or blood pressure in order to measure the impact of consumed information on human emotions.

In spite of the General Data Protection Regulation (GDPR), which came into force in 2018, consumers accept the **privacy policy** of every digital service virtually without hesitation, find being asked to do so irritating, read the terms and conditions in far less than one percent of cases, and, even then, only understand them at best in part. For the sake of convenience, therefore, they will continue to allow megaportals to use their personal data in 2030 and have few options for defending themselves against data collection by public institutions. Detailed and comprehensive **digital twins** of humans will be created.

In 2030, megaportals will have such detailed pictures of consumers that they can filter information and communication offers to suit individual needs. In some areas, a digital assistant will then know you better than you know yourself. As it also knows the information and entertainment offers better than you do, it can provide more suitable content and play music that is more appropriate to the situation. In order to expand the individual's horizon and avoid the risk of a **filter bubble (echo chamber)**, i.e. only providing information that confirms the individual's own opinions, the digital assistant can specifically provide controversial views on the same topic or extend the individual's musical taste with unfamiliar pieces. The long-term development of human mood indicators and the analysis of large numbers of similar people could in future allow a digital assistant to derive offers that not only provide users with reliable information but also enhance their long-term well-being.

The question of whether a digital service promotes plurality or the filter bubble, and whether it offers information to maximize revenues or in the interests of quality of life will depend on the service provider's incentives. Offers are currently determined by the economic benefits and power interests of the providers, for example ARPU (Annual Revenue Per User) in the telecommunications industry, customer profitability indicators in the financial sector, or the censorship of articles considered to pose a danger to the state by intelligence services. The information assistant can contribute a great deal to human quality of life, but can also simply maximize a consumer's commercial value for the content provider without taking human well-being into account.

Clever digital assistants provide consumers with information tailored to their every need. They help people plan their vacation finances, select the clothes to take with them on the trip, supply an itinerary, remind them of departure times, recommend restaurants and activities, connect consumers with other people with similar interests in the locality, and warn about health risks. They also provide

support for consumers wishing to take out a retirement plan, rent an apartment, or improve their parenting skills. People use this gigantic wealth of content in all areas of life, such as for entertainment (e.g. music and gossip), learning (e.g. videos), research (e.g. electronic publications), and financial investment (e.g. stock exchange information). By 2030, a comprehensive, proactive information assistant could replace the search engine Google, the market information on Amazon and Alibaba, and social networks like Facebook and WeChat (from Tencent). Innovative services like Snapchat will then be subsumed into the megaportals, so private individuals will be left with very few information assistants to choose from.

The information and communication profile of a human can also be utilized socially and **politically**. On the plus side, the information assistant can encourage environmentally friendly or social behavior and provide an early warning to state security services of terrorist or criminal intent. On the negative side, however, the information assistant can aid the power ambitions of individuals or organizations, providing citizens primarily with content that represents a specific political orientation. According to press reports, this was what the company Cambridge Analytica did using personalized election messages in the 2017 US elections. Digital communication channels influence political opinion in the interests of the paying customer.

Games, films, and also books take the user into **virtual environments**. In 2030, we shall spend much more of our time in electronic worlds than we do today and consequently less time in the physical world, for instance in the garden, cooking, or meditating while surrounded by nature. For older people in particular, the vision of a digitalized world of information, as reflected all around them in the sight of intensive smartphone users, is something they associate with the demise of humanism.

In extremis, digital services can lead to **addictive behavior**, such as constantly communicating with other people via a smartphone for no particular reason, exposing oneself to a constant stream of content, and thus avoiding any chance of digesting it and thinking about oneself. Social media can lead participants into a competition for self-promotion and hugely reinforce values derived from the ownership of consumer goods as well as religious or ideological messages.

It makes a big difference whether machine intelligence contributes to human well-being or to increasing capital and power (see Fig. 1.2). Capital and power push the technological progress, and therefore contribute in effect toward evolution. Internet users agree that better information, communication, and entertainment are very valuable for humans, but can also turn against them. Totalitarian regimes, and sometimes democratically elected governments also, have frequently used their data collections very much to the detriment of their citizens.

Decisive factors will be who develops the dominant information, communication and entertainment assistants, and what checks and balances are (or can be) established by society. The candidates are megaportals, which have access to personal data on the one hand and the information offer on the other. States are increasingly using the power of information assistants. China censors the information offer in accordance with communist party policies, Russian lawmakers are

working on a bill that will enable the Russian internet (Runet) to be cut off from the global internet [40], and the Western world is seeing a growing debate about the prevention of fake news, hate messages, internet campaigns aimed at influencing elections, or “enemy propagandists” on the internet in general. Many see these developments as another form of censorship.

In utopia, humans emerge as the autonomous masters of all information in the real as well as in the virtual world; in dystopia, however, they become manipulated idiots. Evolution driven by the pursuit of capital and power on the part of a small elite is more likely to lead to dystopia, but humans should grasp the opportunity for a high quality of life.

2.2 Social Control

The Chinese communist party is attempting to establish a social scoring system acting in parallel with free market mechanisms in order to exercise control on the basis of proper social conduct [41]. “Under this system, individuals, businesses, social organizations and government agencies are assessed based on their ‘trust-worthiness’” [42]. Alternative social scoring systems, which are still in their infancy, cover socio-demographic factors like education, online behavior such as the use of social media, compliance with the rules of the road and with regard to payment behavior, the conduct of students at school, or political attitudes such as trust in the government or charitable donations. Lily Kuo reports [43] that Guangdong Guangya High School has introduced tracking bracelets for its students, which record pulse, physical activity, and other parameters.¹ The social score affects acceptance for a place at university, acquiring a home, and the granting of credit.

At the moment, the social scoring system is not one central system but a number of competing approaches operating in a pilot phase. One small example is the fully automatic traffic fines for pedestrians in Shanghai. At individual crossroads with pedestrian lights, cameras monitor adherence to the green phase, recognize the face of any transgressor, and send the person concerned a fine on WeChat before he or she has reached the other side of the road. This solution is certainly an effective means of encouraging a behavior that is conducive to road safety and unhindered traffic flows. The same pedestrian recognition can also help a ruling elite to suppress any insubordinate behavior at an early stage and severely restrict liberties.

Western media accuse the Chinese government of wanting totalitarian influence and surveillance; the Chinese government sees an opportunity for the automatic and objectivized promotion of socially desirable behavior [44]. In 2030, megaportals, security services, and political as well as ideological organizations with a high level of information technology development will have the capability for extremely

¹In the Western world, we voluntarily wear fitness trackers with the same data potential in the cloud.

nanced personality profiling. By then, they will probably have just as much data at their disposal as the Chinese social scoring system. It is a matter for our societies to decide whether we use the knowledge created to enhance human **quality of life**, in the interests of capitalism to increase **enterprise value**, or in the interests of political organizations to establish and expand their **power**.

The years up to 2030 will largely determine how this balancing of interests takes place. While an informed debate is absent from both the media and the sciences, excessive reporting on individual symptoms can be observed, such as on possible abuse of the electronic health card in Germany, suspected attempts to influence the outcomes of elections or the bullying of young people on social networks.

A well-considered system of social control can achieve a step toward the utopia of a low-conflict society; familiar versions operated by authoritarian governments tend to fuel the fear of dystopia. By 2030, megaportals can become new power centers alongside governments.

2.3 Consumption

In 2016, 64% of the German population shopped online [45]; in 2030, the figure will be closer to 90%. Consumers will continue to want the physical shopping experience, but at the same time utilize the benefits of electronic purchasing, i.e. product search, price comparison, time saving, and right of return. Corporations like Google or Amazon hold ever more detailed data about consumers, know the majority of product and service offers in the market, and understand the purchasing behavior of consumers, which enables them to match an individual requirement with the most appropriate offers. Information, communication, and entertainment are increasingly converging with consumption (electronic commerce).

In 2030, proactive digital assistants will use **knowledge about consumers** (e.g. preferences, household, body measurements, finances) and **knowledge of the product and service offer** to propose concrete purchases, and will probably even buy routine items automatically [46]. If permitted to combine the personality profile derived from information and communication behavior with purchasing behavior, these assistants will very cleverly direct and predict requirements. Eric Schmidt, then CEO of Google, expressed the following view in 2012: “I actually think most people don’t want Google to answer their questions. They want Google to tell them what they should be doing next” [47]. A proactive **shopping assistant** recognizes consumer requirements, looks for suitable offers, makes suggestions, processes the order, payment, return, or complaint for the consumer, documents the purchases for the warranty and the tax return, and explains how to use the products and services.

Madden [48] regards Google, Facebook, Amazon, and Nextdoor as corporations that, in the USA alone, are set to transform the USD 800 billion market for **professional services**, from physiotherapy to household helps, through online intermediation. Digital assistants will automatically arrange **routine appointments** such as tire changing, dental check-ups, and group appointments for events.

Digital services facilitate the joint use or reuse of products (dubbed the **sharing economy**). Time exchanges, where people with specific skills (e.g. tax returns, mowing the lawn) do work for others, usually in exchange for other services but sometimes without compensation, fall into the same category.

By selecting really useful products and services, a shopping assistant can help consumers to *enhance well-being, purchase at reasonable prices, avoid misbuying, keep their debt within acceptable limits, and reduce the time and effort spent on shopping; in other words, generally increase their quality of life*. But who invests in the development and operation of such assistants? It is more likely that the shopping assistant will be geared solely to revenues and contribution margin, i.e. enterprise value, and consumers will be driven into a consumption competition with their peers, causing them to spend unnecessarily and pushing them into debt. Examples include barely fathomable charges for telecommunications, banking and insurance products, which the consumer no longer understands and which lead to unpleasant surprises in terms of costs or benefits (e.g. bandwidth, coverage for losses). Providers utilize the growing information asymmetry to their advantage.

McNamee criticizes Facebook, and by implication FAMANG, in his book “Zucked. Waking Up to the Facebook Catastrophe” [9]. FAMANG track people on the internet, use the acquired personal data for their own purposes, understand consumer behavior, and control consumers in order to boost advertising revenue. Alt and Reinhold cite four case examples to show in detail how companies take advantage of social networks to influence consumers [49].

A digital shopping assistant could advise consumers on purchases, like an investment adviser or insurance broker, if agent neutrality was assured by a practicable incentive system. Without state intervention, it is probable that enterprise value and not quality of life will prevail in the year 2030. State intervention in consumption sounds like heavy-handed surveillance and paternalism, but was already the case, for instance, when it came to standardizing insurance products in the past and is fundamental to consumer protection. A discipline of Life Engineering should, however, instead of government prohibition look for positive incentives that focus on the quality of life of consumers.

2.4 The Home

Long before the advent of the smartphone, the smart home [50] was seen as “the next big thing”. A large number of isolated devices and programs still define the state of the art in 2018. The question to be asked here is: Which of the many services are tied to the house and which to the occupants?

In 2030, smart home technology in most new housing will control the **room climate**, heating in the winter, cooling in the summer, and providing ventilation to ensure the right air quality on the basis of the measured CO₂ content, to the extent the mechanical equipment (e.g. ventilation) is installed. Today, **shading** (e.g. blinds) is already controlled on the basis of (outdoor and indoor) temperature, solar

altitude, and wind, and ensures a brightness-dependent privacy screen. Similar features are available for the **lighting**, which is regulated in accordance with the available daylight, movement within the space and, when required, the mood of the occupants. **Energy management** analyzes and controls energy consumption and, if need be, energy generation (e.g. solar cells, batteries). **Security systems** help to prevent intruders by means of access systems and perimeter surveillance. Robots mow the lawn, vacuum the floors, and clean the windows. These functions will not remain a luxury for the few, but are set to become standard features of the home, like hot and cold water.

Entertainment electronics in households have long been regarded as the integration point for the home, but in 2030 will probably be limited to the presentation of content on displays and projectors (e.g. the VR headset Oculus Rift), sound playback (e.g. Sonos), gaming consoles, local input devices like microphones (e.g. Alexa or Sony TV), and gesture recognition (e.g. Kinect). The content (data, images, videos, music, games) provided by the network is individualized to suit the consumer, which means that stationary and mobile digital services converge in terms of operation, contracts, data, profile, etc., while merely the communication devices differ in the household, in the automobile, or as wearables. A music service will behave in the same way in the home, automobile, or office as well as on a hiking trip.

Device-independent services in and around the home, such as a service marketplace, will no longer be isolated apps, but instead be integrated into dominant applications. A neighborhood portal like Nextdoor, which among other things reports a missing dog, helps to look for a plumber, provides information on closed roads or events in the locality, and becomes a local group functionality on social networks and messaging portals. Functions such as the management of purchased appliances (refrigerator, etc.), furniture (sofa, etc.), and other household and garden equipment will initially become an integral part of home applications and subsequently that of a more comprehensive private administration system, a **consumer ERP**.²

A **home assistant** (e.g. Gira Home Assistant and Smart Living from Bonacasa) relieves humans of many tiresome tasks, increases comfort and, particularly in the case of seniors, can help them to maintain their independence, for instance, by enabling them to call emergency services via a room microphone or by deterring intruders with camera surveillance at the entrance with trustworthy authentication. This gain in quality of life is diminished by the increased complexity associated with the installation, operation, maintenance and administration of all these devices and services.

For the system providers, this opens up another source of revenue, often in the form of subscriptions, such as to a security service. There are significant concerns regarding the collected data (including voice recordings), which reveals the behavior of people in the home to the providers of consumer goods and services. State authorities are given the means to monitor citizens, here once again possibly for the purpose of fighting crime, but potentially for snooping into political attitudes

²ERP stands for Enterprise Resource Planning. Today, companies use ERP systems such as SAP, for instance, as the basis for all their administrative und planning activities.

and exerting influence. *The digital home assistant provides megaportals with access to data regarding a sphere of life, which up to now has been considered to be particularly private.*

2.5 Health

Digital services aimed at maintaining physical and mental health could make the biggest leap by 2030. Today, smartwatches are already performing permanent measurement of **vital parameters** such as pulse, blood pressure, sporting activity, calorie consumption, and sleep. Smartwatches will soon enable mobile ECG recordings, which currently still require expensive special equipment. In 2030, adhesive or implanted sensors will record blood values such as blood sugar or a hormone status and measure the surface tension of the skin. Cameras track **facial expressions**, dilation of the pupils, and physical rest [51]. Other devices detect the human environment (air quality, noise, radiation) or calculate the quantity and type of food consumed (food scanners like DietSensor) as well as urine values (e.g. BioTracer from Duravit) [52]. Back in 2012, Melanie Swan already highlighted the potential of the Internet of Things, particularly sensor technology, for human health [53]. Machines are receiving increasingly more reliable indicators of well-being and possible causes, such as diet.

23andMe sells a home gene testing kit for USD 99 and is using this to build up a worldwide DNA database, which now covers more than 1000 regions of origin (ethnicities). Apps like VAMC-SLUMS (St. Louis University Mental Status Examination) or the website MyBrainTest.org offer a simple, but very rudimentary, assessment of mental state and collect psychological data in the process. In 2019, the Center for Medicare & Medicaid Services in the USA launched an initiative aimed at enabling health data to be saved on a smartphone or smartwatch, medical data to be exchanged throughout the entire health sector, and patients to access their own data [54].

Medical research is obtaining an unprecedented database for the analysis of correlations. Once we have sufficient knowledge regarding the effects of diet, lifestyle habits, and many other factors on our health and well-being, health assistants will become part of our daily lives. An important question here is who develops the health assistants. The candidates are the megaportals, i.e. Samsung, Apple, and Google, for instance, using the data available on their devices, the pharmaceutical industry, clinic chains, or insurance companies. The monetization of these digital services will determine their objective. “Amazon has started selling software that mines patient medical records for doctor information, ostensibly to help cut costs” [55].

The availability of this kind of data relating to an individual will enable a digital assistant to monitor that person’s health, prepare diagnoses, support therapy and, above all, encourage healthy behavior if he or she is given an early warning of

dangerous developments and understands the link with behavior. In accordance with Witte and Zarnekow, research will initially focus on the applications monitoring and diagnosis [56].

A therapy assistant for obese patients, as piloted by the Center for Digital Health Interventions [57], will be more successful in 2030 than it is today because

- analysis of the gigantic database will explain the correlation between obesity, a genetic risk of addiction, and living conditions,
- the overall picture of DNA data, mobility data, working and sleeping hours, etc. will identify the risk factors more accurately than today,
- all functions will be integrated into existing devices (smartphone and smartwatch) and apps, i.e. generating little additional complexity, and because
- data acquisition and evaluation will be performed automatically, i.e. without human intervention.

At the same time, the incentives to undergo therapy may well be stronger if, for instance, this is associated with an insurance bonus or made transparent by the voluntary comparison of health values within a tightly knit community (e.g. family or sports club).

In contrast to the areas of life previously mentioned, the health assistant is a case where it is easier to believe in a utopia in which powerful, well-funded pharmaceuticals and device manufacturers develop digital helpers in the interests of human well-being as the benefits will be examined by organizations like the FDA (Federal Drug Administration in the USA) and the EMA (European Medicines Agency). From the dystopian perspective, however, it should be pointed out that the developers of a health assistant are primarily interested in selling products and services, and less in healthy human behavior. If the megaportals or health assistants of other providers know more about us than we do ourselves and are perhaps better able to change our behavior than we are, then we must hope that the developers and masters of this technology will exert a beneficial influence on us. If a drug becomes available that noticeably enhances our performance, but leads to brain damage as a side effect after thirty years, the suppliers will probably find it relatively easy to sell this product. The owners of the medical data and the information regarding its effects will have such a knowledge edge that they may well be successful in obtaining approval from the FDA and EMA.

2.6 Mobility

Traveling from A to B takes up a considerable amount of time in people's lives and is, for the most part, viewed as disagreeable. It poses a danger to health (e.g. accidents), involves high costs, and consumes natural resources. Being able to search for public transport connections (e.g. DB Navigator), navigation (e.g. HERE

Mobility or Google Maps), car sharing (e.g. Car2Go), and calling a taxi (e.g. MyTaxi or Uber) as well as booking flights online have made passenger transport more efficient in recent years. Multimodal mobility services [58] and, in some cases, autonomous automobiles will significantly transform mobility by the year 2030 [59].

The most resource-friendly form of mobility is virtual mobility. Even 20 years ago, it was seriously discussed whether the demand for aircraft and airports would continue to grow as rapidly as it had done up until the 1990s or whether teleconferencing would dispense with the need for a large number of flights. The preference for physical meetings destroyed many predictions and hopes. If, by 2030, virtual and augmented reality, the image and sound quality and the freedom of movement of cameras bring virtual meetings close to physical presence (immersiveness [60]), this could actually replace many physical trips. Being able to enjoy a football match on television in a heated home, the unhindered view of the ball, and the option of replaying parts of the game from different perspectives, quite apart from the saving in time and money for the trip to the stadium, are strong arguments in favor of the living room. The direct communication with other fans, the sense of belonging to the fan community, and possibly the beer and hot dogs, are nonetheless likely to remain insurmountable challenges for virtualization in 2030. That applies much less in the case of a board meeting if highly immersive virtual reality enables bilateral meetings over coffee during the meeting, and less still for specialists discussing a purely technical topic.

The use of virtuality as a mode of “mobility” will grow, but in 2030 will only avoid the need to travel in part. Today, the mobility assistant HERE already provides a one-stop interface for options such as public transport, automobile, walking, bicycle, taxi and car sharing. Autonomous vehicles will gradually become another possibility for selected routes. In December 2018, Alphabet subsidiary Waymo launched a test for the commercial self-driving taxi service Waymo One in Phoenix, Arizona, provisionally under the supervision of human drivers [61]. Back in 2016, the Swiss Post put a self-driving bus into operation in the city of Sion, which has since carried over 40,000 passengers (as of August 2018) [62].

As in other areas of life, data lies at the heart of mobility. One case might involve bringing together all the data relating to one person required for planning the trip. The appointments calendar, addresses of meeting participants, potential co-passengers, preferences, and financial restrictions can be helpful when making travel arrangements. The mobility assistant can initiate departure times, destination address, payment, and the settlement of travel expenses. It can even book the seat and provide instructions on when to change and how to find the seat, as well as telling users how to find their way in large buildings such as airports (indoor navigation).

Another case might focus on the current traffic situation. In 2030, the mobility assistant will not only derive traffic jam reports from the speed of vehicles but also warn of specific hazards, such as black ice and pedestrians, via car-to-car communication, or control driving in lines at a reduced distance from the preceding vehicle. Yet another case might involve the exact measurement of driven paths, the position of traffic signs, the location of road works, or the weather.

In 2030, navigation services will superimpose the road or sidewalk onto the image of the surroundings seen by the camera and by the human. In combination with texts, images, and videos, navigation services will become city or museum guides.

Wearables and vehicles become automatic providers of abundant data without any effort on the part of the consumer. The data is of great value for things like transportation planning, road safety, crime fighting, location-based advertising (e.g. restaurant), and insurance. A mobile camera on an automobile, for instance, can provide useful additional information to supplement stationary webcams when the vehicle is traveling on the highway or over an Alpine pass.

Movement data complement personal data from other sources. When a megaportal analyses the movement data of two people who are connected with each other via their contact data, the megaportal can establish frequency, location, and duration of their meetings.³ Nowadays, an instant messaging service with the appropriate permissions already has the capability to identify the participants in a meeting on the basis of their telephone data.

By the year 2030, digital mobility assistants will be able to make physical movement from A to B much simpler and more agreeable (even without utopian means of transport). *At the same time, however, permanent location tracking plays a major role in creating the transparent human being, and, contrary to many hopes, the growing convenience associated with mobility might even increase traffic volumes.* Negative examples include road congestion, passenger overcrowding on public transport, and access restrictions that have become necessary in the centers of cities like London or tourist attractions like Venice.

2.7 Summary: Life Assistance for Consumers

The outlined picture of digital services in the year 2030 is not yet the scenario of an all-embracing life assistant. It is merely intended, on the one hand, to illustrate the intensity of change facing the world of the consumer and, on the other, to indicate some fundamental directions for development.

In 2030, we shall not yet have a universal life assistant for all aspects of human life but instead an individually compiled hodgepodge of technical assistants to cover needs ranging from home security to therapy and round-the-clock entertainment. The few selected areas of life and the associated digital services available reveal the extent to which machine intelligence has already changed our lives, and the fact that connecting the parts currently available will accelerate that change.

³Anyone who finds this rather far-fetched only needs to sit down with a friend and check out their movements over the past few months in the data contained in both Google accounts.

The examples show that digital services bring together as many sources as possible to form gigantic data collections, which can be used to derive ever more patterns and rules. As a consequence, the services will become smarter and more active, and take over ever more tasks from humans.

*When the digital assistant connects the **data** and its **knowledge of rules**, it is increasingly better able to address the needs of a human or a corporation or a political organization, and to control their behavior.* A digital assistant could identify, for instance, which factors lead to spinal damage. From the DNA, blood values, the amount of time spent at the desk, sporting activities, diet, traveling times, and other data relating to many people, it could identify what effects on the spine are to be expected, and use this information to provide behavioral instructions from time to time, such as leave the desk for a short time and perform a simple relaxation exercise. Using the PC's built-in camera, it could detect bad sitting posture and monitor relaxation exercises.

FAMANG and BAT are increasingly becoming gatekeepers: In 2030, consumers will be using them almost exclusively to access digital services. For product and service providers, there will virtually be no way around them. Ultimately, they match a consumer's need to a manufacturer's offer. This gives them a level of power never seen before in the economy and in society, which they use first in the interests of capital and second for the benefit of humans. They lure people by means of short-term needs without regard for long-term well-being (e.g. addiction). And they also cause harm if it serves their interests. Examples include over-indebtedness, drug addiction (e.g. to opioids), or contributing to the development of depression when people are led to believe in unrealistic goals. State authorities utilize electronically available knowledge to fight crime, but also to restrict autonomy.

As already seen from individual areas of life, digital services have a decisive influence on our quality of life. However, we are anything but well prepared for this. Technology as such is value-neutral but available, and is set to change the world much more than it has done thus far. We shall only be able to judge and influence whether this happens for the well-being of humanity or only for the purpose of progress in the broadest sense of evolution if we understand what constitutes quality of life of human beings and how the technological possibilities affect well-being or suffering. For this purpose, we need a Life Engineering discipline.

Even if it is difficult, our assessment of machine intelligence should neither be too optimistic nor too pessimistic. The need for security and trust in existing knowledge has prompted doom and gloom scenarios before every major technological innovation (printing press, railroad, electricity, etc.). In some cases, the transformation has actually caused a lot of harm, if one considers the loss of jobs as a result of electricity or the miserable working conditions in the early days of industrialization. But would we want to forgo the technological achievements of the last two hundred years? There are nonetheless other mechanisms at work in the case of machine intelligence. They lead to an unprecedented accumulation of knowledge and therefore power, through which individuals and states relinquish authority

(e.g. identification and authentication of people) to global corporations. It is hoped that this book will help many people to identify opportunities and risks, and to use machine intelligence for the well-being of humanity.

If the statement is correct that evolution drives forward technological progress by means of power and capital, whereas humans strive for happiness, *humans must do their utmost to steer evolution in the direction of happiness, rather than allowing evolution to control humans by means of happiness and unhappiness.*



Abstract

Machine intelligence is already assisting humans in all areas of life with today's technologies. Digital services expand the intellectual capabilities of humans, either by relieving people of routine tasks such as the administration of a bank account, performing traditional services like management of an appointments calendar or navigation, or by organizing photo and video archives including descriptions of the images. Machine intelligence amplifies human intelligence. The enormous potential for technological development up to the year 2030 lies in the convergence of a number of developments: Gigantic personal and factual databases that are automatically filled with detailed and up-to-date information from digital services and above all from sensors, the capabilities for machine learning, the necessary IT performance, intuitive man-machine collaboration, and the increasing execution of decision-making and actions by machines will transform our lives by 2030 to a far greater extent than imaginable today. A generalized artificial intelligence, the long-term goal of AI research, will, however, by no means have been achieved in 2030.

In spite of all the skepticism regarding future technology predictions, it is worthwhile taking a look at a few technological developments in order to identify the degree of possible assistance in the year 2030. The possibilities of the smartphone and its impact on consumers were already identifiable long before the first iPhone was launched onto the market. The Apple Newton arrived in 1993 and the Nokia Communicator in 1996, i.e. 14 and 11 years respectively before the iPhone. The term *Personal Digital Assistant* (PDA) predates them [63]. The breakthrough was achieved by the extraordinary entrepreneurial accomplishment of Steve Jobs, who combined the technology, especially the miniaturization of electronic components, the ecosystem, in particular the App Store, the design, the marketing, and the processes within Apple to form a successful business model. I anticipate the greatest potential for groundbreaking innovations in the Internet of Things through

5G communications, in AI, and in virtual or augmented reality. Apart from actually unforeseen disruptive innovations, the developers of digital services can expect to see the following trends.¹

3.1 Digital Image of the World

Digital services utilize and generate data relating to all aspects of life. *They build a digital image of the world, comprising humans, things, organizations, and knowledge of their connections.* The already huge datasets, particularly in the case of the *datenkralen* FAMANG and BAT, will provide a much more comprehensive digital image of the world in 2030, of humans on the one hand and of the world in which humans live on the other.

3.1.1 Personal Data

Megaportals currently collect data primarily from consumers' **internet use**. Even if they refrain from using such data in part for legal reasons, they have technical access to searches, purchases, photos and videos, communication on social networks, emails, and even to cloud storage. In addition to this "classic" data, more and more data is recorded automatically, such as locations, contacts, and moods from photos, videos, and voice, or emotions and needs from posts by Facebook and Twitter users [64, 65].

In terms of volume, the sensors of smartphones, navigation, home management systems, automobiles, and wearables (smartwatch, shoes, clothing, etc.) will be the biggest providers of personal data over the next ten years. Ubiquitous cameras, microphones, and other sensors capture images, sounds, smells, or tactile stimuli, and, in this data, recognize patterns such as people, pupil dilation, voice timbre, speech rate, trembling, or movement. Apart from these patterns, which are also perceived by humans, they gather data for which humans have no senses, such as hormone level, blood sugar, electromagnetic radiation, cardiac rhythm, and blood pressure.

Government organizations and megaportals are currently bringing medical data like DNA and blood values onto smartphones and clouds. Back in 2012 and 2013, Melanie Swan provided a still helpful overview of tools and data under the term *quantified self* [53, 66]. Some organizations (including Open Data, MIDATA, and

¹The assumptions on which these predictions are based include the following:

- Humans have largely forgone privacy for the sake of convenience in their day-to-day lives, and legislation nonetheless adequately prevents the misuse of personal data.
- Policy-makers have agreed a code of conduct with the oligopoly of the megaportals, which continues to permit technological and economic development, and adequately protects citizens from one-sided market power.

the U.S. National Library of Medicine) have made it their goal to make as much personal data as possible publicly available for research in anonymized form (see, Sect. 7.1 World Database).

3.1.2 Factual Data

Sensors not only create a detailed and up-to-date picture of humans but also of their environment, i.e. of things or business transactions, for example. In the home, they measure the air quality, humidity, heat and smoke development, brightness, noise, and energy consumption. The automobile is a measuring station on wheels. It observes pedestrians and vehicles, and detects wheelspin (in the case of black ice), visibility in fog, precipitation, speed, traffic signs and signals, the exact road boundaries, road works, and free parking lots. It forwards this data to central traffic control centers and map-making organizations or exchanges it with other vehicles by means of car-to-car communication. According to Brian Krzanich, CEO of chip manufacturer Intel, one person will produce 1.5 GB of data per day in 2020, while a self-driving automobile will produce 4000 GB on a daily basis [67]. The sheer volume is primarily of relevance to the chip manufacturer, but gives an indication of the importance of sensor data. Needless to say, the consumer's digitally recorded environment will continue to include the classic data relating to things like companies, products, buildings, and logistics.

The megaportals not only possess huge datasets, but identify **patterns** in these datasets of countless users with a wide range of learning algorithms, and derive behavioral knowledge from them. One example of this kind of approach is the knowledge graph (a simple form of neural network), which Google has been building for many years. The search engine presents not only links but also more and more knowledge from a wide range of sources relating to the search terms. The search for the vacation destination Malta, for instance, gives the capital, the time zone or the flight time from the inquirer's current location without being asked to do so.

In summary, digital services in 2030 will be able to draw on a more multidimensional, more refined and up-to-date picture of consumers and their environment than is currently the case in order to provide concrete recommendations for all areas of life, from travel to shopping and housing.

3.2 Proactive Services

With this database and the behavioral rules derived from it, digital assistants can themselves become proactive. Proactive services are either management services, e.g. a reminder for a meeting or an automated trade of shares in the portfolio, or they are proactive machines, which e.g. automatically close the blinds, adjust an insulin pump, or drive on simple road sections. Germany's National Academy of

Science and Engineering (acatech) calls them *autonomous systems*, which encompass not just robots but every type of autonomous device such as vehicles, household appliances (e.g. robotic lawn mowers), alarm systems, and heating systems [68].

While today humans mostly have to serve (operate) passive digital services, proactive assistants will increasingly serve humans in 2030. These services will provide concrete suggestions for vacation trips on the basis of personal preferences or the experiences of people with comparable interests, which the human merely has to accept, or they will book a doctor's appointment. They will know how the occupants of a house behave and their preferences for room temperature, undisturbed sleeping hours (e.g. blinds and calls) or for activating the alarm system. The data relating to the occupants and their devices enables services to act autonomously. *Digital services evolve from passive services (e.g. searching for information or searching for and buying a flight ticket) to (pro)active services* [69],² *which use the knowledge regarding individuals and correlations between consumption and preferences to provide concrete recommendations (e.g. a new video or a package trip) or, ultimately, actually **perform actions autonomously***, such as booking an appointment with the garage for a tire change at the start of the winter and then paying the bill. In 2030, many consumer processes will be **silent processes** requiring no intervention by the consumer.

3.3 Integration

Today, from the consumer perspective, every app, every website, and every device constitutes its own little world (see Fig. 3.1). Users have to understand different concepts (e.g. password, code word, code), experience navigation menus in all their creative diversity, have to repeatedly enter personal data (e.g. address), contend with data inconsistencies (e.g. contact and product data) between services and, finally, take care of the entire administration from installation and updates to the general terms and conditions separately for each service. A proactive life assistant that integrates all the above-mentioned services into one consistent digital butler on the basis of a comprehensive personality profile will not yet be available in 2030. By then, the megaportals will have merged the core functions and data relating to individual areas of life such as mobility or housing. Full integration of today's common digital services could well take until 2040. Even then, special equipment like the alarm system or diabetes therapy will run separately, but be closely linked by means of interfaces.

Consumers want comfort and convenience. *When an integrated service offers consumers all the functions they want from a single source irrespective of the device, they will choose this rather than a large number of individual services.* If a

²Knote et al. relate activity to the consumer. As a logical consequence, they use the terms *active* and *passive* the other way around, i.e. a digital service that switches on the light when it gets dark without human intervention is described as *passive*.

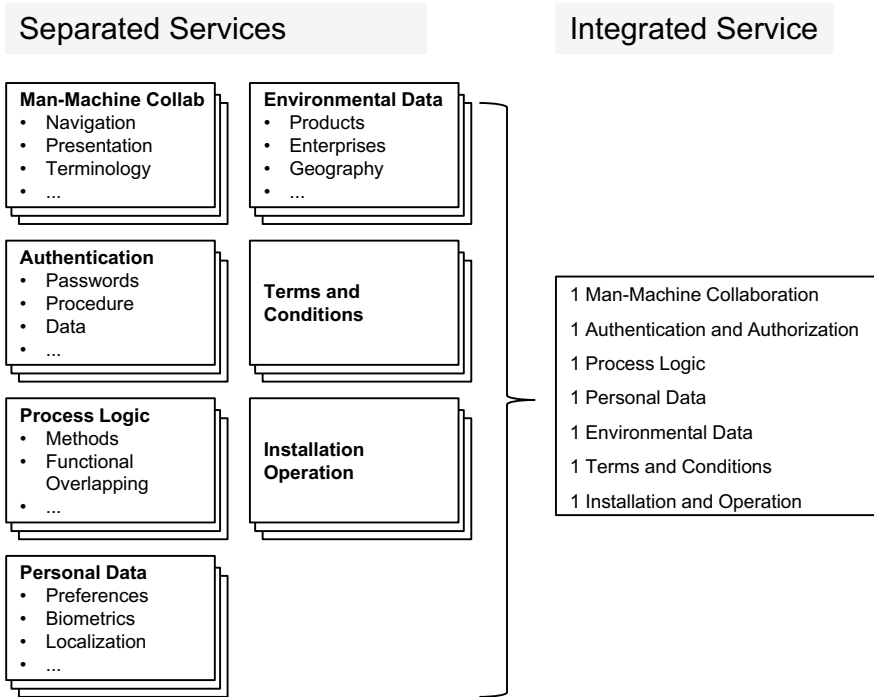


Fig. 3.1 Integration effect

therapy assistant uses all personal data to support the patients, the patients will ultimately release all the data for this purpose. And, presumably, they will do so not only when they are sick but also for their fitness programs. The greater the comfort offered by digital services by relieving people of tiresome tasks, the more consumers forgo their privacy.

Blockchain technology supports integration between companies and consumers by providing transaction records that are encrypted and legally secure. However, the expectations associated with integration using blockchain technology are likely to be significantly exaggerated. This distributed ledger technology does not take the techniques for maintaining the privacy of personal data between services to a new level, as sometimes promised.

For years, **megaportals** have been merging increasing numbers of previously independent apps into one integrated service. Navigation, social networks, instant messaging, music and video streaming, and photo galleries are already taken for granted. Appointments management, payment, authentication, therapy, and many more besides are in the process of becoming an inherent part of the megaportals. This raises the fear that innovation could suffer as a result because megaportals are rapidly covering the market for new services, and therefore investing in isolated services is no longer worthwhile [70].

3.4 Performance

It may seem somewhat trivial to state that, today, we already possess a huge *machine information processing capacity*, and that this is set to multiply over the next decade. This applies to the processors, the memories, and the networks. Whereas voice input recognition currently still runs on powerful servers, mobile devices will also have this capability in a few years' time. The same applies to autonomous driving, facial recognition in cameras, rendering on gaming consoles, or the measurement of pressure, movement, and location in footballs and football boots. *Even if developers and users sometimes find it difficult to imagine, they should assume a manifold increase in performance over today's hardware when considering any scenario of technical possibilities in the year 2030.*

The capacity of IT infrastructure has triggered a surge in development in the areas of data analysis, the inference of AI, and blockchain technology. The expectations of quantum computing are high, but remain nebulous and are presumably not yet relevant for the digital services of consumers in 2030.

3.5 Man-Machine Collaboration

In contrast, groundbreaking innovations can be expected in man-machine collaboration. Smart speakers like Alexa from Amazon, Cortana from Microsoft, Assistant from Google, and Siri from Apple have already influenced collaboration between humans and digital services to the extent that the sale of 164 million devices is anticipated in 2019. This means consumers will get used to voice communication with machines [71].

Facial recognition and the use of other biometric data for authentication in conjunction with payments, access, and immigration have already established themselves to a certain extent and will be taken for granted in 2030.

Virtual reality and augmented reality place the user in an artificial (virtual) world and in a real world extended by virtual objects respectively [72]. They originally formed the basis for computer games, but are now increasingly permeating other areas, particularly in technology. In 2030, virtual and augmented reality will take over a significant part of man-machine communication, for instance as part of a digital service for city or museum tours.

Humans react socially to machines, i.e. they interact with them in the same way as they do with other humans. Development of the man-machine interface will give the machines a human-like behavior [73], but I do not expect large numbers of humanoid robots in 2030. Merging mechanical and intellectual skills into a human-like organism as opposed to specialized devices makes sense for just a few application areas.

3.6 Artificial Intelligence

Particularly among laypeople, the term *artificial intelligence* (AI) tends to conjure up the idea, at least unconsciously, of machines with human-like abilities. The marketing departments of IT corporations use this association to promote their own solutions as being particularly powerful and promising for the future. I use the term *machine intelligence* here in the sense of machine processing of information with increasing cognition-like capabilities. Just as there is no authoritative definition of human intelligence, there is no generally accepted definition of artificial intelligence. Legg and Hutter have published a collection of definitions, which are worth noting here [74]. *An advanced AI perceives its surroundings, evaluates the situation in line with its goals, continues to develop its picture of the world, makes decisions and implements them.* In detail, this means the following.

AI **perceives** its surroundings (temperature, brightness, gases, location, movement, etc.) by means of sensors or evaluates existing knowledge (stored texts and speech, images and videos, and other electronic datasets). It recognizes people on photos and regularities in a household's energy consumption.

The world view (knowledge) of an AI system consists of objects and patterns of the real world. One example is the pattern *football*, which is formed from a large number of smaller patterns such as *round*, *air-filled*, *specific size*, etc. A pattern that is much more difficult to grasp is *defensive play*, which even humans interpret differently. AI systems **recognize patterns** in data streams, either under human instruction (supervised learning) or independently (unsupervised learning). In the case of supervised learning, the machine receives e.g. images of traffic signs along with their meaning and can then recognize the meaning of similar images. For the purpose of weather forecasting, the machine uses a wide range of sensor information such as temperature, humidity, and air pressure as well as topological data, sunlight, precipitation, and wind force to identify patterns without human assistance (unsupervised learning), which makes weather situations predictable depending on measured values. In the future, the machine will be able to improve its model on its own if people set it goals—such as human needs. In the case of weather forecasting, this is the minimization of deviations between predicted and actual weather. A decisive step, while probably still some decades away, will be when AI can evaluate the entire knowledge of this world in order to rethink human goals from the perspective of evolution; in other words, with the goal of enhancing intelligence.

Deep learning with artificial neural networks, a particularly successful AI technology, possesses a certain capability for **abstraction** in that it examines the identified patterns for similarities and, from these, derives a condensed representation of the patterns. In weather forecasting, that can be the pattern *thunderstorm*, which, in turn, is derived from patterns of electric charge, humidity, cloud formations, etc.

The capability for abstraction is one of the weak points in the current status of AI, as the value of a concrete abstraction is difficult to assess. Drawing **conclusions** from patterns (inference) is even more difficult, such as, in the example of weather

forecasting, a rule that the rate of pressure drop and the change in atmospheric electricity indicate a probability of thunderstorms. The “expert systems” on which AI was focused in the 1980s failed in part due to the problems of inference. The ability to predict on the basis of given data constellations determines the value of an AI solution, be it for the weather or for braking in autonomous driving systems.

AI needs a goal system according to which it can evaluate its perceptions. The AI of an online store evaluates the success of its recommendations to consumers on the basis of achieved sales revenues and, from this, develops patterns that link specific forms of product promotion with the sales success. AI can also identify unusual credit card transactions (goal: fraud prevention) and separate spam in email correspondence (goal: reduction in the number of unsolicited emails).

From its perception of the current situation, its existing knowledge, and its goals, AI derives the actions to be taken. This might be a concrete sales forecast for the retailer, a purchasing proposal for the material requirements planner, or warehouse replenishment. An example in the case of autonomous driving systems would be the steering angle; in the case of a credit card, a phone call to check back with the card holder. The **evaluation of a solution** is one of the weak points of AI. Sometimes the criteria for determining solution quality are difficult to define; other times it is not clear whether the search route taken will lead to a local optimum that distracts from finding the best overall solution.

In the last 50 years, the threshold at which a machine is considered to have artificial intelligence has been continuously raised. Once upon a time it was playing chess, later it was the more complex game of Go, and, finally, a quiz show (Jeopardy), where the computer was to beat the human brain and win acceptance for the intelligence of the computer. Today’s AI solutions have surpassed all three thresholds, but only to a small part thanks to improved abstraction and inference—to a far larger part thanks to the **performance of today’s hardware**, which makes it possible to run through ever greater numbers of variants (brute force method).

Some authors define an additional criterion for the intelligence of machines, namely **emotional intelligence** [51]. However, this involves applying familiar AI technologies to the evaluation of human mood indicators, such as the impact of advertising messages on the emotions of the consumer.

The great vision of AI research is GAI (*Generalized AI*, also known as *Artificial General Intelligence*, *AGI*), which will ultimately surpass human intelligence and then develop itself autonomously into **superintelligence** (see Sect. 7.7). In 2013, Müller and Bostrom asked 549 AI experts when they expected to see an AI that can perform most of the jobs currently performed by humans (High-Level Machine Intelligence, HLMI), and how long it would then take for this HLMI to become a superintelligence, which from this threshold onward would grow exponentially at least for some time. “[...] we think it is fair to say that the results reveal a view among experts that AI systems will probably (over 50%) reach overall human ability by 2040–50, and very likely (with 90% probability) by 2075. From reaching human ability, it will move on to superintelligence in 2 years (10%) to 30 years (75%) thereafter” [75, p. 14].

Major contributions to the development of superintelligence are expected, among others, from computer science, statistics, and neurology, in particular whole brain emulation. To this end, the EU started the Human Brain Project [76], while the USA runs the BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies) [77].

AI occupies far too much space in the media if it is understood to mean the replacement of humans by machines (AI in the narrower sense). However, most authors and discussants probably think of AI in the broader sense; ultimately, the entire information technology described above. In this case, it would probably be more appropriate to talk about *intelligence amplification* rather than artificial intelligence. In this book, machine intelligence stands for all kinds of information processing by machines.

3.7 Summary: The Application World of the Consumer

All digital services are intelligence amplifiers (referred to as machine intelligence in this book). They expand the intellectual capabilities of humans, either by relieving people of routine tasks such as the administration of a bank account, performing traditional services like management of an appointments calendar, navigation, or by organizing the photo and video archive including the descriptions of the images. Machine intelligence amplifies human intelligence. By 2030 and far beyond, humans will make extensive use of these intelligence amplifiers, but will only be replaced by them in highly specialized areas, primarily in the field of technology.

The picture of information technology in 2030 outlined here focuses on personal digital services. Robotics, 3D printing, biotechnology, medical, and other technologies are further components of the technological evolution up to the year 2030. Riemensperger and Falk discuss a scenario for the industrial world, which resembles the one described here for the consumer world [78, pos. 796].

The enormous potential for technological development up to the year 2030 lies in the convergence of the developments outlined above: Gigantic personal and factual databases, which are automatically filled with detailed and up-to-date information from digital services and above all from sensors, the capabilities for machine learning, the necessary IT performance, intuitive man-machine collaboration, and the increasing execution of decision-making and actions by machines will transform our lives by 2030 to a far greater extent than imaginable today. Historically unprecedented resources, the human capital of millions of developers on the one hand, and the financial capital of successful service providers on the other, will ensure that transformation.

Abstract

Scientists, representatives of information technology companies, and politicians are increasingly recognizing the opportunities and dangers of machine intelligence for the quality of people's lives. They therefore repeatedly call for the use of technology for the benefit of people, but do not say what constitutes people's well-being. Even happiness research provides hardly any guidance for a desirable use of the technology. Evolution controls us according to the principle of homeostasis through happiness and unhappiness. Humans strive for actions that lead to perceptions with positive feelings and avoid actions that cause suffering. Evolution, on the other hand, is aimed at progress, not at human happiness. Quality of life, i.e. happiness and unhappiness, is a relative and fleeting quantity: We measure ourselves against our demands, compare ourselves with our peers, and accommodate to both positive and negative situations. Hope seems more important than the actual achievement of goals. Since Plato, people have been striving not only for short-term satisfaction of their needs (hedonia), but also for lasting satisfaction with themselves and the environment (eudaimonia). As the rapidly growing datasets increasingly contain indicators for the well-being of people, data collections and pattern recognition make the quality of life more and more objectively measurable. Even if our knowledge about the use of machine intelligence for the benefit of mankind is still very modest, it would be grossly negligent, in view of the enormous changes, not to use the existing knowledge for the benefit of mankind.

In 2006, I launched the Independent Living project with a small team. We set ourselves the goal of enabling elderly people to continue living in the comfort of their own four walls and enjoy a high quality of life through the use of information technology. Initially, we—like many at that time—were driven by the idea of making the lives of the elderly safer with many little electronic helpers, from the pill dispenser to the automatic personal alarm such as in the case of circulation problems. More than one doctor with whom we discussed our possible solutions

seriously questioned whether we would actually be improving quality of life if we postponed the natural death of people who were very sick and suffering. Those affected, i.e. the seniors themselves, also showed little interest—on the one hand because they were not keen to be burdened with so much technology, and on the other because they thought they were still much too young. Two CEOs of large health insurance funds viewed our approaches as detrimental to their business and had no interest whatsoever in collaborating on solutions of this kind.

Many discussions with seniors, nurses, care staff for the elderly and relatives raised two surprising questions: “What do pensioners need; what motivates them to get up in the morning?”; and “How can seniors in need of assistance benefit from the many available services on the basis of their own independent decisions?” As a consequence, we developed and piloted an app for booking and handling personal services such as hairdressing or window cleaning and physiotherapy. Alongside this aspect of the project, we tried to gain an understanding of what constitutes quality of life. It quickly became clear that these were issues that not only affected seniors, and it emerged that roughly around the same time—as a result of economic and technical developments—a veritable tidal wave of happiness research was building. After years of focusing on the topic of “improving quality of life through information technology”, we were forced to recognize that none of the people involved had any useful answers.

A Google search for the term *well-being* or *quality of life* each produces 3 billion results; the search term *theory of well-being* still gives 500 million hits (by way of comparison: *Labor* results in 0.3 billion hits). Disciplines like philosophy, psychology, sociology, political science, economics, neurobiology, brain research, religion, marketing, and ethics have been developing ideas about quality of life since time immemorial under names such as happiness and unhappiness, joy and sorrow, or subjective well-being. In the edited volume “Glück. The World Book of Happiness”, Leo Bormans [79] has compiled a collection of the views of over one hundred happiness researchers from around the world. In “Glück. Ein interdisziplinäres Handbuch”, Thomä, Henning, and Mitscherlich-Schönherr examine the opinions of authors from the perspective of 13 disciplines [80]. The World Happiness Report [81], commissioned annually by the UN and written by several authors, and the World Database of Happiness [82] are further examples of collective works on the subject of happiness. Some countries have started to measure the happiness of their citizens in recent years, one example being the United Kingdom with the bulletin on subjective well-being produced by the Office for National Statistics (cf. Appendix, Fig. A.2) [83, 84]. Common to all these efforts is the search for a better understanding of happiness (quality of life) and, in particular, for objective ways of measuring happiness.

The rapidly increasing expectations of artificial intelligence over the past few years, particularly under the heading of deep learning, have triggered broad-based efforts to use AI for the benefit of humans and to avoid negative consequences. Examples here include the Ethically Aligned Design treatise launched by the IEEE Standards Association [85], the UN platform for dialogue on AI known as the AI for Good Global Summit [86], the 2030 Vision initiative of the AI4Good

Foundation [87], and the Asilomar Principles developed by the Future of Life Institute [23], which have since been endorsed by a resolution of the California State Legislature [24] (see Fig. 1.1).

Anyone who demands the use of machine intelligence or other technologies for the benefit of people must at least have a vague idea of what constitutes people's quality of life and how technical possibilities affect it. All the approaches and efforts mentioned above are far from operationalizing the factors of quality of life or understanding the effects of technology on them. Scientifically based, verifiable findings are only available on partial aspects such as the effect of a walk in nature, sexual satisfaction or sleep deprivation on well-being. All kinds of ideological claims such as the desire for human autonomy, equal opportunities and satisfaction through religion shape the public discussion.

It certainly seems foolhardy to develop a comprehensive model of quality of life (happiness model). Even though, I tried to draft a **quality of life model (QLM)** using all the isolated individual insights of the above-mentioned and in Fig. A.2 listed sources. The starting point is evolution in the biological, technical and social sense. It leads biological development via homeostasis in the sense of a control mechanism, but also technical and social development in the figurative sense. It is based on reproduction with mutation and recombination of genes as well as sexual selection on the basis of the criterion of advantageousness for development. This form of homeostasis in a broad sense uses happiness and unhappiness as drivers of human action.

Based on the psychological insights into the needs and feelings of people, I have deduced a network of needs and reviewed it in many iterative steps, wherever possible checking it against the statistically founded or deductive findings from the numerous sources. In many situations I had to resort to self-reflection. I also cannot document every single step to the present model in detail, but ask the benevolent reader to put his focus less on the inadequate verification of the statements than on their correction and further development. Readers who are more oriented to the theory of science may do without the formal point of view in favour of urgently needed progress. In my opinion, it makes more sense to build on a reasonably comprehensible assumption than to wait for an exact verification.

The emergence of the huge collections of personal and factual data together with the new analysis techniques of the AI puts us more and more in a position to check, correct and refine individual aspects of the quality of life model outlined. Initially, these will probably only be correlations in some areas, such as the effect of status symbols in social networks on rank in the community. It is the first and greatest challenge for the required discipline of Life Engineering to formulate a more detailed and resilient model of quality of life, or at least its components.

Life Engineering is an **engineering discipline** and therefore its primary goal is to solve existing problems with available knowledge. Engineering disciplines have to use the secured knowledge of the basic sciences, be it mathematical derivations or statistical or even argumentative-deductive findings as far as they are available, but must have the courage to formulate models that also use assumptions and pre-suppositions. For our culture it is indispensable not to wait for the validation of all model components in medicine, mechanical engineering, computer science or pharmacy, among other disciplines, but to seek solutions immediately for the benefit of people.

The development from our traditional society into a society with machine intelligence does not only take place when the machines have reached the level of human intelligence, it has been going on with increasing speed since the middle of the last century. We have the choice of waiting for a quality of life model that satisfies all demands of scientific theory, but then run the risk of no longer needing the model if it ever exists, because we are already in the midst of a change to a life with machine intelligence, possibly on the way to a next stage of civilization. Companies like Google have long been pursuing a development direction known as social engineering. Life Engineering should recognize socio-technical development, better understand the quality of life and finally formulate instructions for action for the individual, companies and politics.

4.1 Homeostasis

Damasio [1, p. 24] sees emotion as an inherent part of **homeostasis**, which evolution uses to drive not only replication (self-preservation and preservation of the species) but also, and even more importantly, the further development of human culture. Homeostasis controls the behavior of single-cell bacteria according to the same principles as human behavior. A living creature has a need, knowledge to satisfy that need, triggers an action, perceives the result, checks the contribution to the needs, receives a reward or punishment (emotion), learns from it, and derives the next action (see Fig. 4.1).

Actions are physical processes, e.g. turning the head, and psychological processes, e.g. thoughts. The action *eat a hot dog* produces a perception on the part of the gustatory and optic nerves, satisfies the need for food, and arouses a pleasurable sensation through nutrition and flavor. The action of eating the food, the perception

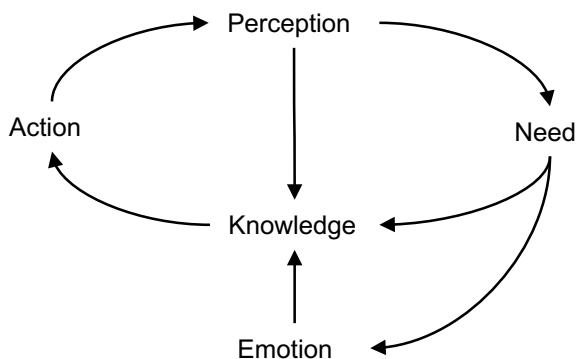


Fig. 4.1 Behavioral control cycle

of sustenance, the need for food, and the sensation of pleasure create conscious and unconscious knowledge about the hot dog.

The gastric nerves produce the perception of satiation and reduce the need for food. If a human repeats the action *eat a hot dog* for the third time within a short period, this triggers the perception of a strongly satisfied need for food, leading to a feeling of satiety and developing knowledge as to a reasonable quantity of food. The knowledge of the relationship between the action of eating and the sensation of pleasure decides about the action, not the satisfaction of the need in itself. This hope for more pleasure is what causes us to eat more even if the need for food has been satisfied.

A **perception** consists of sensory stimuli and thoughts. **Sensory stimuli** are signals of sensory receptors for vision, hearing, temperature, smell, taste, and pressure, but go much further. Perceptions are also produced, for instance, by the gastral nerves, blood sugar level, fluid balance, or hormones.

Thoughts can trigger emotions without physical external signals. When someone recalls being humiliated by his boss, this can trigger a negative emotion that is equally as intense as that produced by the incident itself; or an even worse feeling if the person concerned has only become aware of the seriousness of the humiliation and its consequences after the event. The subject feels mental anguish without any physical sensory stimulus causing pain, and can learn from the experience, i.e. derive consequences such as a change in behavior, revenge, or leaving the job.

A perception affects several **needs**. The need for food, the need for a time-saving meal or the need for a cheap meal can trigger the action *eat a hot dog*. Basic needs (e.g. hunger, security) are embedded in our genes. However, needs can also be learned from perceptions, needs, emotions, and actions. A guest at a top Paris restaurant who asks for ketchup might be called a philistine and therefore refrain from doing so in the future (in the presence of French people).

*The effect of a perception on needs produces a **feeling** (affect), a positive contribution happiness (joy), or a negative contribution unhappiness (sorrow).* Satisfaction of the need for food produces pleasure; exceeding satiation leads to displeasure, possibly nausea. Evolution controls self-preservation and preservation of the species as well as progress by means of positive and negative feelings, for which we have countless terms like hunger, satiation, heat, cold, love, jealousy, compassion, aggression, harmony, conflict, fear, and fatigue. Homeostasis evaluates every perception for its contribution to replication and human development. Knowledge is always linked with emotion. This applies just as much for the smallest, unconscious perception like feeling cold in one's little toe as it does for major events such as the birth of a child. Even the apparently neutral knowledge that " $1 + 1 = 2$ " produces a sense of achievement, at least for a small child. "In functional and neurobiological terms, learning, reward and motivation are [...] inextricably linked" [88, p. 115].

The brain is a gigantic network of neurons, which communicate with one another by means of synapses. Every signal from the sensory organs and every thought triggers fireworks in the brain [89]. A neuron that exceeds a specific charge sends electrical signals to other neurons via the synapses, which in turn fire and

consequently stimulate other neurons. Complexes of neurons and synapses form **patterns** such as *dog*, which are linked with a perception. Other complexes link the *dog* pattern with other patterns like *bark* with the pattern *threat*. The largely inherited pattern *aggressive dog* triggers the feeling of fear in conjunction with the size of the dog, its body posture, and baring of the teeth as well as barking and snarling. If the human identifies an insurmountable fence between itself and the dog, the signals will be aggregated to the pattern *security against the dog*. If the same signals are perceived in conjunction with the human's own dog when protecting the house, these might even lead to the creation of the pattern *security*. Perceptions can be real or imagined; the human can actually be confronted with an aggressive dog or merely imagine it, for instance when entering someone else's property without permission. As perceptions are situation-dependent, the same signals can be associated with different patterns in different contexts.

Humans develop their knowledge as a network of patterns with different levels of aggregation. They recognize the patterns *dog*, *aggressiveness*, *distance*, *dog owner*, etc. These subpatterns are compressed into an aggregate, the pattern *threat from dog*. However, the pattern *dog* occurs not only as a threat pattern but also in the pattern *playmate*, in the pattern *feed dog*, and in the pattern *guard dog*. The dog pattern is also part of other patterns. Knowledge is comprised of a very large number of experienced and learned patterns, which are interlinked by way of aggregation and classification. *Threat from dog* is an **aggregation** of several patterns, *guard dog* a **classification** of dog. Kurzweil describes the principles of human **pattern recognition** as *Pattern Recognition Theory of Mind* [90, p. 34].

The human brain, with its 86 billion neurons and between 100 and 400 trillion synapses as well as its enormous capacity for concurrent processing, masters the information flow from all the sensory organs and the constant further developments of patterns [89, 91]. Humans can handle this flood of information because they filter the signals for what is relevant and because some of it runs in decentralized control circuits without involving the brain, a lot in the subconscious, and a small amount in the conscious. The brain only adapts knowledge to include what is new and important. Mere confirmation of the existing model therefore takes little effort.

A perception is not stored additively like an individual database entity,¹ but immediately modifies the **knowledge** of the individual valid **at the point in time t**. *A human's knowledge (including capabilities) is the set of all patterns genetically inherited or learned from that human's perception, irrespective of whether the learning was conscious or unconscious.* Knowledge steers actions, again, consciously or unconsciously. Knowledge is not a 1:1 depiction of the real world in the imagined world; it is a network of patterns that the brain applies to signals from the real world or to thoughts. Knowledge is always a subjective view of the world.

Positive psychology, which is increasingly able to draw on findings in neurobiology, views happiness as the result of body and mind, which mutually influence each other and are closely connected by chemical and electrical mechanisms. This is a major principle of mind-body medicine according to Esch [70, p. 240ff].

¹Only particularly important perceptions such as a face are additionally stored.

Damasio stresses that happiness originates in the brain and the rest of the body,² and that psychology has long neglected the physiological perspective—or at least strongly overemphasized the conscious, cognitive aspect [1, p. 25].

To make evolutionary control through feelings (happiness and unhappiness) clearer, the **relationship** can be described more formally as:

Homeostasis:

(knowledge o (action, perception, need, feeling)) (t) → knowledge (t + 1)

Each 4-tuple action, perception, need, and feeling develops existing knowledge further by deriving or adapting one or more patterns (see Kurzweil [90, p. 34ff]).³

If a football player leans back when performing the action *shoot*, the ball will fly over the goal. The player derives the shooting position and trajectory of the ball from the signals received from the eyes and the sensations in the legs, links the perception with the need to score a goal, and improves the pattern *shoot*. At the same time, the player can assimilate the tip from the trainer not to bring the supporting foot too close to the ball when shooting, and, in so doing, consciously improve the pattern *shoot* (learning). The football player has the sensory stimuli of a current goal and the old, general pattern *shoot*. The new instance of shooting at goal updates the general knowledge about shooting at goal. The football player possesses a pattern (knowledge) *shoot at goal* with the action *shoot*, the need *score a goal* (recognition), and the feeling *success*. From sensory stimuli, the player receives the patterns *ball, goal, defense player, trajectory, kicking leg, supporting leg, movement*, etc. as new information relating to the action *shoot at goal*. In addition, the player remembers the trainer's tip about shooting position. Shooting, like most human actions, is an extremely complex pattern in comparison with most actions of machines, but can be learned by machines, as walking robots demonstrate.

Perception patterns become learned needs. When a child wins a card game, this triggers joy because the child associates it with recognition. She will want to play this game again in future. When a pensioner arrives in a Porsche, he will attract admiring looks, which will boost his feeling of self-esteem. If he has repeatedly experienced or observed this effect of luxury goods, or if advertising engenders the hope of beauty and energy, the ownership of luxury brands will become a need, even if he is not conscious of the relationship with admiring looks or the association with youth, and actually denies such “low” motives. Needs of this kind develop intuitively from observation, from socialization, and less through systematic reflection.

Evolutionary control uses reward and punishment for the purpose of learning. Not experiencing the satisfaction of a need but the hope of satisfaction or of the avoidance of punishment is the driver of our actions. A school student arrives punctually for class out of a desire to avoid punishment.

²Damasio relates homeostasis to brain and body, to a continuum of body and nervous system [1]. In the following, I limit myself to the regulating mechanisms that involve the brain. However, these mechanisms also apply to the peripheral nervous system and physiological processes.

³Here, homeostasis represents a general control mechanism as well as a physiological process.

Our feelings derive from the expectation (wanting) of a future perception, the evaluation of the actual perception (liking), and the processing of the experience (learning). Kringsbach and Berridge [92, p. 192] describe this as the **pleasure cycle** (Fig. 4.2), consisting of appetitive phase, consummatory phase, and satiety phase, and corroborate their definition with images of brain activity based on the example of sexual intercourse. Whereas Kringsbach and Berridge relate the pleasure cycle to short-term hedonia (pleasure), Durayappah arrives at a similar cycle for eudaimonia (life satisfaction) in his 3P model of subjective well-being [93].

Despite all the caution of transferring such studies to the entire evolutionary control of our actions, they do seem to confirm the observation that the **hope of satisfying a need** determines our action to a far greater extent than the actual satisfaction itself. From the perspective of evolution, need satisfaction is only required to the extent that the human will derive motivation from it; the satisfaction itself distracts from the endeavor. Evolution orients action toward the promise of need satisfaction. Kringsbach and Berridge emphasize that learning is the prime function of the satiety phase.

If an apprentice electrician has the goal of becoming a master craftsman in three years, he will have to pass through many steps along the way. He will be happy when he has connected his first socket and feel annoyed if he has to rectify a job performed incorrectly. He will feel a high on passing his master's examination, but afterward experience a feeling of emptiness until he has his sights set on a new goal such as a better paid job. In this phase, he will consider what he can do better next time and develop his behavior. The same applies on a small scale when someone sends her first WhatsApp message. A grandmother wants to send a photo to her granddaughter and has to learn a few concepts (e.g. recipient, message, attachment, send confirmation) for this purpose, gets excited every time she makes progress, and is proud when communication is successful for the first time or annoyed if she has sent the message to the wrong recipient.

Transhumanism, in particular, is based on the premise that machines will expand the mind, i.e. human intelligence, beyond its natural boundaries or, at some stage, even make it independent of the frail and restrictive human body. From a present-day perspective, that would mean an inconceivable quantum leap in evolution (singularity) [30, pos. 46]. Without a physical body, body-related feelings in conjunction with health and reproduction become irrelevant. A bodiless human feels no hunger, no need for sex and reproduction. The question then arises of whether evolution will continue to require other human needs (e.g. power, self-esteem) as control parameters. Is happiness only relevant to the body? What are the goals of a bodiless human, who might also be described as a mind or pure intelligence? How does this mind differ from an artificial intelligence? The answer to this question can provide an indication of whether the goal of Creation is human happiness or an unknown result of evolution.⁴

⁴Consider, unemotionally: What is the difference between a human intelligence without a physical body and a machine intelligence? Does the same apply if the intelligence was created by downloading the mind onto a machine? What are the needs of a bodiless intelligence? Do our

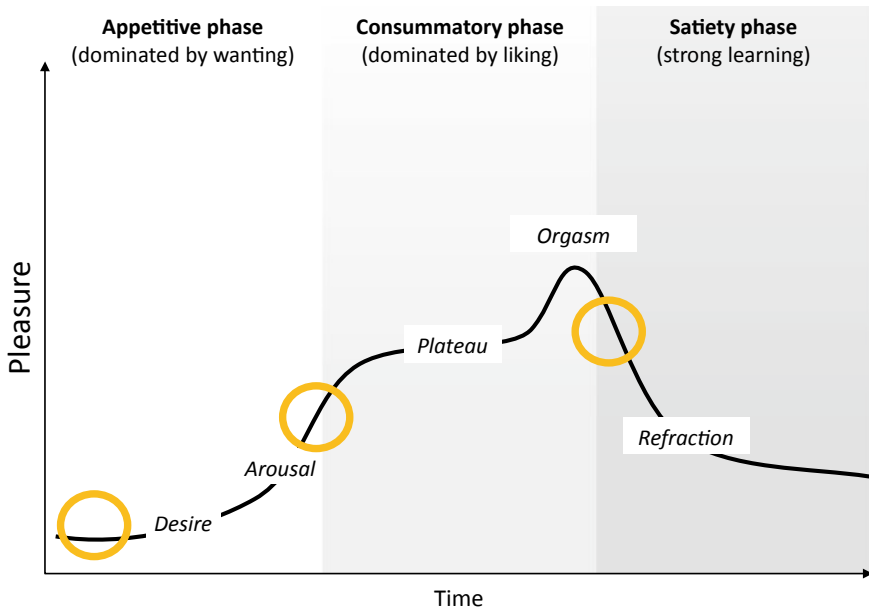


Fig. 4.2 Pleasure cycle according to Kringelbach and Berridge [92, p. 192]

To return from the distant future to the reality of the next few years: This question already arises today, when replication needs are covered and **development needs** are coming to the **fore**; in other words, not at a later date when the brain becomes independent of the body but at the point in time when humans increasingly possess more resources⁵ than they need for replication. If we fail to consciously shape the control mechanism of evolution, progress and, above all, selection will steer us. This will not happen primarily for the good of humanity but for the good of evolution with a goal that is unknown to us.

*Humanity is currently in the process of accumulating knowledge at a fast pace, raising its **culture** to a new level with technology (information technology, data, algorithms, medicine, mobility, energy, society, art, etc.) and, ultimately, enhancing and developing its own hardware (body) in line with the transhumanist premise.* However, this development is not limited to the individual, but affects the totality of explicit and implicit knowledge, i.e. human culture [1, p. 165]. Does homeostasis continue to ensure our happiness in this new human development phase or does it maximize progress with no regard for human well-being?

needs for self-preservation and preservation of the species prevent us from answering these questions rationally?

⁵As long ago as 1819, Beethoven wrote in a letter to Archduke Rudolph: “In the world of art, as in the whole of our great Creation, freedom and progress are the main objectives.”

4.2 Needs

The goal of humans is their happiness and not evolution. If technology is to improve quality of life, it will be necessary to clarify what constitutes quality of life. Evolution controls us with homeostasis through the hope of satisfying our needs. Particularly since Maslow [94], psychology has focused on these needs. From the 16 Basic Desires of Reiss [95], the OECD Model of Subjective Well-Being [96], Alderfer's ERG⁶ Theory [97], and other sources on the topic of happiness, I have derived a Quality of Life Model (QLM) as a network of needs (Fig. 4.3). Figure A.2 (in the appendix) shows that further quality of life factors found in the literature can be traced back to the 13 needs of the QLM. For space reasons, I limit myself here to describing examples rather than explaining this model in detail, factor by factor.

Even if this primitive model of needs merely represents an initial approach to a better understanding of the quality of life factors, it is a remarkably useful aid in explaining virtually any perception pattern. Nonetheless, the goal of a Life Engineering discipline must be to verify or falsify this model and, above all, to extend it to include additional and, in particular, more detailed perception patterns. Once we understand how a Facebook like, a social scoring reward, a video game, or a violation of gender equality, and new clothes affect our short-term and long-term happiness, we shall be more successful at actually controlling machine intelligence systematically for the benefit of humanity.

The needs of the QLM are not standardized terms and are therefore to be explained as follows:

- **Food** refers to the intake of substances by means of eating, drinking, smoking, or injecting into the body.
- Living creatures use their energy economically. They avoid unnecessary effort (negative feeling), and try to accomplish mental and physical work as efficiently as possible. For this reason, this need is referred to here as **efficiency**. Machine intelligence relieves people of work and thus increases their efficiency (convenience).
- **Safety and security** in this context stand for shelter as protection against intruders, clothing as protection against cold and heat, weapons to defend against threats, and security through communities.
- **Health** means freedom from pain as well as energy and physical capacity. Beauty traits are indicators of good health, e.g. toned muscles, clear skin, or strong hair.
- **Sex** is a strong, hormone-driven need even without the need to reproduce.
- The **reproduction** need is the desire to pass on and promote one's own genes, evolution's key driver.
- **Capital** is a learned pattern and here refers to money and other resources humans need to satisfy the other needs. Capital encompasses income, ownership, and entitlement to resources. Contrary to the impression given in Fig. 4.3, capital is not the most important need but a means of satisfying other needs.

⁶Existence, Relatedness, Growth.

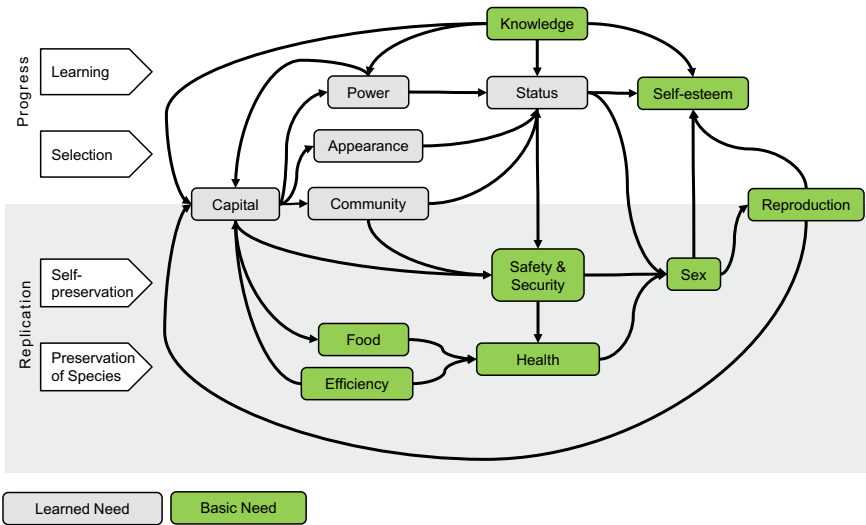


Fig. 4.3 Quality of Life Model (QLM) as network of needs

- Humans are social beings and need contact with other humans. A **community** is a group of people who give us a sense of belonging and with whom we share certain values. As part of a community, we benefit from security, power, and recognition. A community can be e.g. the family, a circle of friends, a WhatsApp group, a company, a tribe, or a nation. The community enables us on the one hand to rank ourselves in comparison with others, and on the other to enhance our status through reference to friends and acquaintances (e.g. by name-dropping).
- Humans inherit an **appearance** through their bodies, and can improve it with cosmetics and body-building. They get into debt through buying luxury goods such as fashion brands, and damage their health through excessive sports and diets in an effort to boost attractiveness. They seek association with artists, philosophers, authors, composers, musicians, and architects or football players, even politicians and other celebrities. Philipp Meier describes this phenomenon with great precision: “The cult of exclusivity, which is supposed to rub off on consumers who buy famous brands, finds its counterpart in the art world in the cult of genius, which is reflected onto the owner of a work” [98].
- **Power** is presumably a stronger driver than money, at least once a person’s basic needs have been met. Someone who can dictate my actions occupies a higher place in the ranking order, and therefore is better situated to pass on his genes.
- The pursuit of **knowledge** seems to be embedded in our genes. Curiosity, the urge to understand and abilities such as playing the piano are certainly means of improving one’s status within a community. It is possible that our urge for knowledge comes from the pursuit of efficiency, that knowledge (cognition, abilities, skills, capacity to develop and improve) is a basic human need, and that it helps to enhance status in the community. An architect seeks knowledge regarding technical innovations in the area of materials and hopes this will enable her to win the next competition.

- Community, appearance, power, and knowledge determine a person's **status** in the community and therefore the possibility of passing on his or her genes with a partner who possesses a similarly high level of attractiveness. By means of this selection, evolution ensures that it is always the most valuable genes that are passed on even if, in an affluent society, status symbols are at best very indirect indicators of quality.
- The fulfillment of all these needs gives a person **self-esteem**, the need that certainly has the greatest influence on human happiness. A child who is reprimanded at school (negative recognition, loss of status) loses self-esteem. It is not a person's actual attractiveness but the attractiveness she perceives in comparison with her own expectations which determines her self-esteem. A sense of purpose in life, role models (influencers), and self-actualization contribute to expectations and consequently to happiness or unhappiness.

Reiss describes another need, **vengeance**. What purpose does vengeance serve from the perspective of evolution? It often means physical and psychological danger for oneself. Vengeance or revenge can be explained with the needs of the QLM. If a rape victim prosecutes the perpetrator, who is then sent to prison, she is interdicting unacceptable behavior and stigmatizing the rapist. This means a severe loss of status for the rapist within the informed community and may correct the victim's loss of status resulting from the rape. This is the only way of interpreting a retaliatory foul in football, which may well lead to a yellow or red card and therefore harm the retaliator.

People often try to boost their self-esteem and their status in the community by denigrating their rivals, even causing them psychological and physical harm, and, in extreme cases, annihilating them (war), which applies not only for territorial battles in the case of animals. This is less about vengeance and more about everything that keeps rivals at bay, and therefore improves standing within the reference group (community).

There are two methods of satisfying the need to improve one's status in the selection process: Humans can **improve themselves** or **downgrade competitors** by disparaging them, harming them, driving them away, or, ultimately, even killing them. The hormones oxytocin and vasopressin obviously intensify this inclination as they not only strengthen the bond within one's own group but also foster the rejection of outsiders [99]. If the **humiliation of rivals** is understood as a need to improve one's own status, this explains hate messages, racism, bullying, and political mudslinging on social media and elsewhere. Responses from like-minded participants confirm one's own opinion and create an echo chamber, which in turn promotes well-being. The phenomenon of humiliating rivals with the goal of improving one's own status can also be observed when people elbow for position in companies, in the world of politics, in sports clubs, and even in the seemingly rational field of science. Status is an inherent part of every community even if we try to fight against it.

An apparently contradictory need is **altruism** or social engagement. Humans experience happiness when they help other humans, without expecting anything in return [100]. Why do people give away money they worked hard to acquire, forgo a benefit, or place their own lives in danger to save others [101]? It is more blessed to give than to receive. “Behavior that increases social bonds (altruism and pro-social behavior) reliably increases well-being in children and adults and appears to be consistent across cultures” [102, p. 98ff]. Park et al. [103] were able to prove the relationship between altruism and happiness in experiments using magnetic resonance imaging. Damasio describes altruism as a cooperation strategy (social cohesiveness), which brings the individual greater benefit than cost. He observes this in living creatures at many different development stages. In the needs of the QLM, altruism satisfies the need to preserve the species, strengthens community, and contributes to status and self-esteem [100]. For this reason, altruism, like vengeance, is not shown as an independent need in the QLM.

In Fig. 4.3, the needs are connected by directed edges. These symbolize the most important impacts of needs on other needs in order to provide an indication of the relationships between the needs. Although the need for self-esteem does not show any impacts on other needs, this does not mean that self-esteem has no impact on other needs, but indicates that these are not significant. Figure 4.4 is an attempt to weight the interactions between quality of life factors by way of example (empty = very low, 9 = very high). While Fig. 4.3 only shows the most important impacts, Fig. 4.4 provides a few more, but is based on an intuitive assessment with no claim to completeness and without empirical or argumentative substantiation. An empirical analysis of the increasingly more comprehensive databases of personal data is required to identify the needs, break them down into evidence-based perception patterns, and derive their correlations.

If the impact of perceptions on needs and the associated feelings could be measured operationally and in sufficiently large numbers, it might be possible to calculate the intensity of the impacts on needs statistically. A scientifically sound and robust happiness model of this kind, on which all technologies could be based, can at best serve as a vision from the present-day perspective. The machine measurement of human feelings as happiness indicators, the deduction of all the necessary patterns for perceptions and experiences as well as the linkage of these patterns with the happiness indicators surpasses our possibilities, in terms of the possible combinations alone, quite apart from the lack of existing capabilities for the machine recording of perceptions and derivation of patterns.

A fundamental decision is the differentiation of **replication needs** (self-preservation and preservation of the species, which Damasio calls *enduring*) and **development needs** (selection and learning, *prevailing* in Damasio’s theory) [1, p. 24]. When an affluent society has largely achieved the supply of goods and services to satisfy replication needs, the development needs come to the fore, above all status in the community and thus selection. When resources that until recently were tied up in the procurement of food, safety, and health become available, people use this capacity to improve status in their communities. Through power, luxury, and knowledge, they increase their attractiveness for partners with equally high attractiveness, enabling what are presumed to be the best genes to reproduce.

Row impacts column	Food	Efficiency	Safety & Security	Health	Sex	Reproduction	Self-esteem	Status	Knowledge	Capital	Power	Appearance	Community
Food		7		9			3	3	2			5	
Efficiency	7		7	7			7		8	8	6		5
Safety & Security				7	5	8	4	5		8	9		6
Health			5		9	8	8	8	5	3	9	7	6
Sex				5		9	8	7			7		8
Reproduction	6	5	8				8	8		8	8		8
Self-esteem			5	7	8			8			9		7
Status			7		9	7	9		7	9	9	3	9
Knowledge	6	6	5	6			8	8		8	8		7
Capital	9	5	6	7	7	7	7	7			8	7	7
Power	6	6	7		7	8	9	9	5	8			9
Appearance			6		9	7	9	7		7	8		9
Community	5	5	8		7	8	8	8	7	8	8		

Fig. 4.4 Mutual impacts of quality of life factors

Happiness is not determined by actual attractiveness but by one’s own assessment of it, i.e. one’s self-esteem. In an affluent society, men and women often do not work to secure basic needs but to strengthen their status and to self-actualize. While a mother in an agricultural society is busy with the children, the household, and the farming, her counterpart in an affluent industrial society pursues a career as early as possible after starting a family, on the one hand so that she can finance differentiating luxury goods for her children and herself, and on the other hand in order to increase her self-esteem, even if the father’s income already enables a high standard of living—and the father chases after his career, even if it damages the family.

Human needs are partly **inherited through** genes (**basic needs**, marked green in Fig. 4.3), partly learned (marked gray in Fig. 4.3). The need for food is embedded in human physiology without the intervention of conscious thought. The need for community is in part genetically determined and controlled by oxytocin, sometimes known as the *cuddle hormone* or the *love hormone*, which is released during breastfeeding or orgasm, for example. Sometimes it is a learned need because the family provides security, a club membership brings conviviality, or the relationship with the customer facilitates the sale.

Learned needs are patterns which humans form from perceptions. Capital, power, appearance, community, and status are particularly important learned patterns and therefore explicitly identified in the network of needs. Each of these

patterns in turn consists of a network of more detailed patterns. Body weight, hairstyle, clothes, automobile, apartment, etc. all contribute to what defines appearance. Each of these subpatterns in turn uses further subpatterns.⁷ An athlete wears tight clothing to show off his well-toned muscles, a nouveau riche does not buy a Porsche immediately to avoid being considered a nouveau riche. We greet the annoying neighbor in a friendly manner to minimize any trouble with him. Learned needs always include the indirect effect on basic needs. If someone is given a raise, it has a positive effect on self-esteem, security, and the attraction of sexual partners. If, instead, only one colleague receives the salary increase, this has a negative impact on the same basic needs.

Such complex patterns emerge predominantly in the subconscious and are referred to as *gut instinct* or *intuition*. A malicious comment on a friend's body weight, gossip among acquaintances, a political discussion on television, the Facebook page of a celebrity, or advertisements for watches in conjunction with beautiful women, radiant men, or happy children shape our values. These **societal values** are patterns that connect perceptions with their contribution to status in society.

Needs are closely interlinked and evolve through each perception. A perception can have a direct or indirect effect on one or more needs. Chocolate satisfies the need for energy (food) very directly; the body rewards this with the appropriate messenger substances; humans feel pleasure. In addition to this direct reward, however, chocolate consumption often simultaneously creates a guilty conscience. Humans consciously and unconsciously know the connection between high energy supply and appearance and status in the community, i.e. attractiveness (sex, reproduction).

Work means energy consumption (negative emotion), but is accepted if security (clothing and housing) is gained through capital and if rank and self-esteem increase through work. Security and status in the community are prerequisites for sex, and serve the preservation of the species and the passing on of one's own genes. The evaluation of these needs can vary widely from culture to culture.

Happiness is also **situation-dependent**. A glass of water after a long hike quenches thirst, and thus contributes positively to the need for food (hunger and thirst) and through that to health. In this case, there is a very direct feedback from the perception of the stimulus *thirst* via the action *drinking* to satisfy the need for food. Without thirst, a glass of water produces no joy. A beer instead of water also quenches thirst, but increases enjoyment. For an alcoholic, a beer satisfies a need, even if he does not feel thirsty. When we have to drive a car, the knowledge about "alcohol and driving", for which the road traffic regulations give clear rules, tells us that we might have to do without the beer.

The presented network represents a **core that is invariant** for all human beings, but which receives very different weighting depending on heredity and socialization. The patterns of perception associated with the needs differ even more.

⁷Since patterns are used in several classes or aggregates, it is more correct to speak of networks of patterns rather than hierarchies as Kurzweil does.

A successful entrepreneur combines his status and self-esteem with the value of the company, a scientist with the impact factor, a carpenter with the demand for his work, a nurse with her popularity with patients, a pupil with her grade average, and a grandfather with the frequency of visits by his grandchildren. Human DNA differs from the DNA of other mammalian species only in small parts of the gene structure and function; DNA differs among humans by approximately 1 per mille [104]. The perceptions of the individual result from the human genome, its minimal variation between humans, personal experience, and the stochastic development of the nervous system [105]. *Human happiness is individual because needs and their weighting differ through inheritance and socialization.* The presented network of needs can serve as a starting point for all humans. Since every human has individual patterns of perception, the gift of a watch has different impacts on the status and self-esteem of the entrepreneur, the scientist, the carpenter, the nurse, the pupil, and the grandfather.

4.3 Feelings

Happiness and unhappiness manifest themselves in a variety of feelings: love, hate, envy, pleasure, exhaustion, satiation, etc. Perception and emotion are always linked; each perception affects needs, and creates a feeling in the form of chemical and electrical impulses that address specific brain regions and other areas of the body. A need represents a goal (e.g. food); a feeling represents the evaluation of the contribution of a perception to the goal (e.g. pleasure from chocolate).

Love is one of the strongest positive feelings to which hormones such as dopamine, oxytocin, and vasopressin contribute significantly [106]. Love refers to a community of two people (couple) or several persons (e.g. family) but also to one's own race. It conveys a sense of security, i.e. security regarding the transmission of one's own genes and security for the preservation of one's own offspring. However, it also develops rejection toward members of foreign communities [99]. Brown has investigated the role of love in sex, reproduction, self-preservation, and preservation of the species using imaging techniques of brain activity, and confirmed this mechanism [106].

Heartbreak and jealousy are negative manifestations of love. From the point of view of evolution, they can be derived from the need for sex, from the need to pass on one's own genes, and from the struggle to maintain status in the community. Jealousy is one of the strongest negative feelings, a motive for opera and crime, a drive to harm the competitors. Love and jealousy are feelings that arise from the needs of security, sex, reproduction, and self-esteem.

Grief is a feeling that results from a loss. It is particularly intense when it involves the loss of a loved one, but also when it comes to the loss of a job, a position in an association, or the loss of savings. Grief thus describes the feeling of a negative impact on needs.

Pride, guilt, embarrassment, shame, hate, sexual arousal, pleasure, disgust, fear, anger, surprise, compassion [107] are **feelings** (happiness or unhappiness, joy or sorrow) that describe the effect of a perception on needs. Through feelings, evolution drives us to self-preservation, preservation of the species, and progress.

Beauty can also be seen as a feeling. Chatterjee [108] summarizes the studies he evaluated on the perception of beauty as follows: What is beautiful is that which promises the survival and transmission of one's own genes, i.e. health, sex, reproduction, safety, and security, status, and power in the QLM. This can be a landscape that signals fertility, a person's fitness or youth and fertility. The sense of beauty seems to be largely innate and only partly conveyed by the media.

4.4 Perceptions

Sensory stimuli and thoughts do not produce an image of reality but assignments to existing patterns, subjective perceptions, which trigger pleasant or unpleasant feelings. The *task of Life Engineering is to enable perceptions that make humans sustainably happy*, regardless of whether perceptions of reality or virtual worlds are involved. Companies aim at perceptions that generate turnover and contribution margins. In an affluent society, these are not aimed at covering basic needs but at the needs of selection (differentiation) via a wide range of symbols.

A chair at a dining table can trigger different perceptions in the observer. It is an opportunity to relieve the strain on the back and thus satisfy the need for freedom from pain in the back. An old, shabby chair can have a negative effect on the need for capital and reduce self-esteem with low status. Advertising for a vacation destination serves patterns of perception such as sun, peace, cuisine, beautiful people, great food, and sex. The reality on the spot can be quite different, as the vacationer knows from previous trips.

An important perception, especially in a world with new business partners on digital channels without personal contact, is **trustworthiness**. It contributes to security, community, and power as well as capital. Patterns that build trust are recommendations, own experiences, certificates, and communities.

An **Instagram posting** is an example of a complex perception from digital media. The example in Fig. 4.5 can address a wide range of perception patterns. The first thing to distinguish is whether the sender or the addressee views the posting.

The skier who posted the picture and looks at it again is happy about the perfect track. Perhaps for the second time, he will experience the feeling of skiing on a beautiful slope in the open countryside with brilliant weather. What needs do the trip and then the picture actually satisfy? Being the first to ski on an untouched powder snow slope creates—even if fleetingly—a feeling of power. The slope is “my” slope for a short time. The perfect run conveys the feeling of strength (health) and ability (knowledge) as well as self-esteem. The picture awakens the hope of recognition among the addressees. The skier in the picture conveys power and

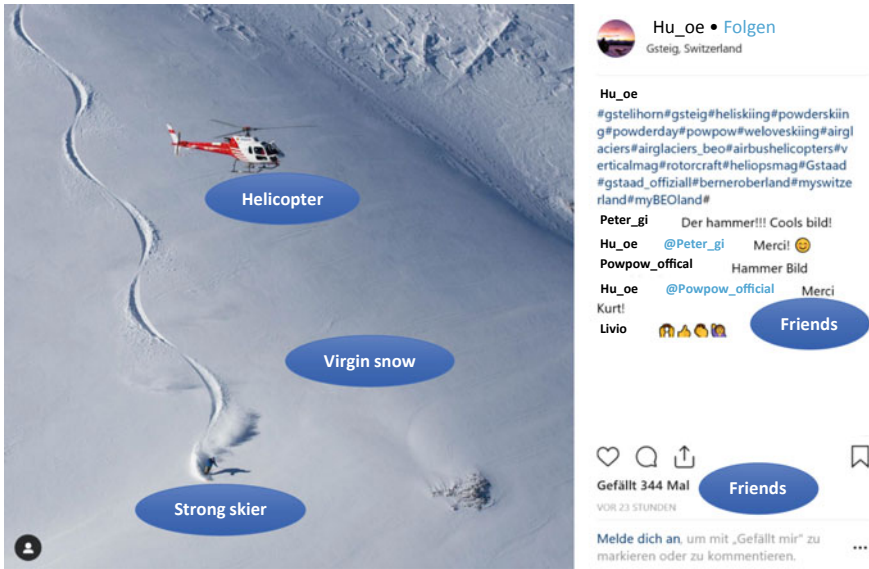


Fig. 4.5 Instagram posting of heli-skiing

mastery; the helicopter shows financial prosperity. The glowing comments of friends or even unknown viewers and the 344 likes strengthen status in the community. At the same time, the skier raises the bar for his future postings, which can mean stress if he has to live in accordance with an image he has built of himself in his community. But he also thinks of the money for the helicopter flight, which he lacks elsewhere.

The addressee who looks at this posting has clearly different perceptions. If it comes from a good friend, he at first feels for him and is proud to have such friends, senses the positive impact on his status and self-esteem. Then he begins to feel envy. Why can't he present himself to his friends with a similar heroic deed? His friend's gain in status relativizes his own status. His more modest skiing skills gnaw away at his self-esteem. He looks forward to soon being able to present his motorcycle tour over an alpine pass to his friends and thus enhance his status.⁸

Since the French Revolution, **liberty, equality, and fraternity have been** regarded as fundamental human needs. However, they can be better interpreted as perceptions that serve certain needs. When a woman is paid less than a man for the same job, this tortures her, on the one hand because she has less capital to satisfy other needs, and on the other hand because she is treated badly in comparison with other members of her community so she is not awarded the same status she (rightly) expects. If someone cannot send his child to an expensive private school, this torments him because he does not have the same capital and thus the same power as

⁸This interpretation appears trivial and unfounded. But don't discard it unless you have a better explanation!

a comparable family, because his status suffers, and because he cannot offer his child the supposedly better conditions for her selection. When disadvantaged population groups are shown the increasing distance that separates them from the winners of technological advance and globalization or from old noble families through the digital media, they ask themselves why they have to work 40 h a week in “inferior” jobs for the benefit of the privileged (who “unjustly rank higher in status”). Efficiency (convenience), capital, status, and self-esteem suffer. Giving and taking orders are particularly clear signals of status, i.e. inequality, the associated restriction of liberty, and the absence of fraternity.

Liberty, equality, and fraternity are learned patterns that arise from the need not to be treated worse than the others in a peer group when it comes to selection, regardless of origin, gender, capital, or sexual orientation. Life Engineering is better oriented toward basic human needs since liberty, equality, and fraternity are more of a populist illusion. In *affluent societies, machine intelligence should ensure that humans enjoy knowledge and self-esteem even if liberty, equality, and fraternity are not attainable*.⁹

4.5 Hedonia and Eudaimonia

Aristotle, Plato, and Epicurus are regarded as the forefathers of the philosophy of happiness (in Western culture), which sees happiness as the prime goal of humans. They and many of their students, such as Ruut Veenhoven [109] or Davidson and Schuyler [102], distinguish between hedonia and eudaimonia.¹⁰

Hedonia (and anhedonia) arise from the direct satisfaction of needs, work for a short time, and are often associated with hormonal and other physiological states. From the perspective of the QLM, they mainly concern the basic needs of replication, food and health, safety and security, sex, reproduction, and efficiency. Feelings like satiation, pain, anxiety, orgasm, and exertion are responsible for pleasure and suffering [92]. We can even increase these basic needs beyond what is necessary for replication to heightened pleasure through exquisite food and drink or good sex. The purchase of a dress, making a statement and being proved right, the punishment for exceeding the speed limit, the warm welcome of a friend, and the loss of a bet have an immediate and brief effect on the needs of progress (selection).

⁹You might strongly object to this statement if you were socialized with such values. Articulate and justify your objection on lifeengineering.org in order to arrive at a more sustainable goal for Life Engineering. Emotionally, I also find it difficult to accept my statement.

¹⁰The OECD report on living in the digital world [21, p. 92] distinguishes between life satisfaction, affect, and eudaimonia. However, it does not clarify what distinguishes life satisfaction from eudaimonia. The source to which the definition of eudaimonia refers contains neither the term *eudaimonia* nor the term *life satisfaction*. I therefore use the differentiation between hedonia and eudaimonia commonly found in other literature. It is possible that the employment of these three terms in the OECD report is due to the mechanisms of committee work, which is often based more on collection than on consolidation. This report is otherwise a valuable collection of studies on the relationship between quality of life and machine intelligence.

Eudaimonia originates primarily from self-esteem and its influencing factors. Eudaimonia means a fulfilled life [92], sustainable satisfaction with oneself and the environment, what is termed “inner peace”. Health, security, and efficiency are important, but self-esteem through knowledge, status, and reproduction dominates eudaimonia. Humans can feel a certain degree of eudaimonia even if they are seriously ill and threatened by violence or have to work to the limits of their capabilities. Eudaimonia arises through reflection, e.g. in the form of meditation; in other words, through a conscious assessment of the life situation. Love and jealousy may result partly from hormonal states, but, like praise and insult, victory and defeat, they have a strong impact on the needs of self-esteem, security, and reproduction, the pillars of eudaimonia. If someone is always right with his assertions or is repeatedly greeted warmly by many friends, this permanently strengthens his self-esteem and creates satisfaction with his situation.¹¹ Kringelbach and Berridge use another example of eudaimonia: playing with children and caring for a toddler. It could be worth examining whether eudaimonia arises as a sequence of hedonistic feelings.

Perceptions such as a command of a foreign language, an athletic performance, the repeated compassionate smile of a colleague, a title in one’s profession, or a failed exam affect self-esteem because they strengthen or damage the needs of knowledge, capital, community, appearance, power, and status. They are based on more abstract and complex patterns and are therefore more difficult to model, i.e. to define by means of rules.

Neuroscientific imaging techniques confirm the millennia-old distinction between hedonia and eudaimonia. They show that **different areas of the brain** are activated. According to Kringelbach and Berridge [92], hedonia corresponds to the rapid activation of a small number of clearly defined brain areas (hotspots and coldspots), while eudaimonia involves many brain regions and has a slower but longer effect. However, they find that eudaimonia is always associated with hedonia. They describe eudaimonia as “life well-lived, embedded in meaningful values together with a sense of engagement” [92, p. 195], i.e. with a term that is difficult to objectify, but which they try to approach with whole-brain modeling. Neuroscience has a much vaguer concept of eudaimonia than of hedonia. Damasio would rightly add that the modeling of happiness must not only include the brain but also physiological factors such as hormone status.

Eudaimonia is the result of all the needs which, in the QLM, predominantly affect self-esteem and is therefore difficult to localize in imaging of brain activity. The personal goals (meaning and purpose, values) and the satisfaction with goal achievement or the expectation of goal achievement generate a subjective degree of well-being. Capital acquired through one’s own effort, attained prestige and power, one’s own offspring and circle of friends as well as knowledge and abilities determine satisfaction with oneself and the world [93].

¹¹An attempt to differentiate between hedonia and eudaimonia, as weak and vague as the term *eudaimonia* is today.

An affluent society can increasingly focus on eudaimonia. An indication of the growing importance of self-esteem in satiated societies is the ubiquitous urge for self-actualization, whether through cultural activities, through scientific publications (such as this one), through the equal rights of all those who derive the hope of improving status from it, through the dominance of status symbols such as fashion labels, irrational luxury goods such as sports cars, or through positions in associations. It is unclear if and how we can improve eudaimonia by means of technological progress. Can machine intelligence improve people's self-esteem (see Sect. 5.1.1 Treadmill of Differentiation)? *Technology cannot improve the status of all members of a community simultaneously, but it may be able to improve the perception of status and thus the self-esteem, for example in the virtual worlds of games.*

There are numerous empirical studies on the factors influencing quality of life, such as the influence of television consumption, the purchase of clothing, a salary increase, and the perception of nature on human well-being. The empirical statements usually remain rather vague due to the difficulty in measuring such factors and do not explain the causes of the feelings, i.e. the impact on needs. The QLM proposed here is an attempt to better understand the impacts of actions and perceptions.

4.6 Dynamics of Happiness

Happiness and unhappiness are not static. Quality of life is not only dependent on the needs of the QLM but changes over time. Life Engineering must start from a process with positive and negative feelings and try to keep the quality of life high in the long run.

Satisfying needs can be something **absolute** or something **relative**. Hunger depends on insulin and noradrenalin levels, among other things. Food stimulates the production of insulin hormone and other signaling substances, creating a feeling of satiation that can be understood as an absolute value. Eating, drinking, sex, and resting (energy efficiency) meet needs absolutely, albeit not one hundred percent, and only for a limited time, as the needs for their satisfaction grow again.

In contrast, status and the self-esteem associated with it are **relative values**. Status is the position of an individual in comparison to other individuals in a community. A change of status means a gain in happiness for one person and a loss of happiness for another. *A rise or fall in status rather than an unchanged status has an impact on happiness.* The pursuit of happiness thus implies a constant striving to improve or maintain status, be it through symbols of power and status or through a community (e.g. a fan club).

The same applies to knowledge. Only an increase and the comparison with competitors count. Self-esteem, knowledge, status, power, appearance, and community (circle of friends) are therefore relative in two respects: on the one hand in comparison with the other individuals in the community, on the other hand in comparison with oneself over time (*multiple discrepancy theory* according to Michalos) [93]. With this dissatisfaction, evolution controls **selection** of the best genes and further develops the **knowledge** and abilities of humans, which Tegmark describes as the cultural phase of evolution [2, p. 26].

The joy of improving one's status or—more precisely—of boosting one's self-esteem is fleeting. The value of the delta reached disappears from the moment it is reached, but the need for the delta remains. A person who has drooping eyelids corrected by plastic surgery is happy when the traces of the operation have healed, but subsequently becomes accustomed to the new appearance and then begins to think about the nose, which seems too long. If a man owns a Porsche, this distinguishes him from many rivals. If everyone owns a Porsche, the benefit is removed and the subjective value of the Porsche is very small. The happiness or unhappiness that derives from development needs arises mainly from the delta, the improvement or deterioration over time or compared to other members of the community. In psychology, and more recently in biology, this phenomenon is referred to as the *hedonic treadmill* [110] (see Sect. 5.1.1). “[...] *biological sensing systems are designed to respond to changes in the incoming stimuli, rather than to the magnitude of a stimulus*” [111, p. 299].

Hedonic adaptation deprives us of the joy of achievement on the one hand, and helps us to cope with a permanently negative situation on the other. Improving a golf handicap increases well-being until the golfer becomes accustomed to the new status. Fortunately, this habituation works in both directions; we can also adapt to a deterioration. In his book “Man’s Search for Meaning”, Viennese psychiatrist Viktor Frankl, who survived four concentration camps, describes how he and his fellow prisoners reached a certain eudaimonia, despite being in the concentration camp, by singing and acting [112]. Lucas, Clark, Georgellis, and Diener confirm this adaptation to a life situation by means of life events such as marriage, divorce, birth of a child, or death, but emphasize the strongly subjective differences [113]. Based on interviews with prisoners, Wildeman, Turney, and Schnittker show that habituation to living conditions also takes place in prison, but that well-being during and after prison differs significantly.

A considerable part of our happiness or suffering is attributable to the anticipation of a positive event or the fear of a negative event. *The path is the goal. Our well-being is oriented more toward the expectation of goal achievement (hope) and the realization of intermediate goals than toward the evaluation of what has been achieved (like)*. Evolution aligns action with the future (**goal orientation**, motivation, wanting) [93]. This can involve the smallest goals, such as scratching to eliminate itching, or large goals, such as starting a career after completing an apprenticeship. Kringelbach and Berridge [92] as well as Durayappah [93] demonstrate this for both hedonia and eudaimonia (see Pleasure Cycle in Fig. 4.2).

4.7 Predisposition or Conscious Behavior

The **set point theory** [114, 115] assumes that our genes determine a large part of our characteristics such as body size, hair color, and needs. Accordingly, all humans have an individual happiness “baseline”, which is determined by their genes.

A person's happiness level is only moved up or down temporarily by perceptions such as orgasm or a rebuke from a superior, and returns to its baseline level after a certain time.

Genetic makeup determines an individual's personal happiness set point. Oswald and Proto [116] investigated why Denmark and the Netherlands repeatedly lead the international league of life satisfaction in various studies, which to date could not be explained by known influencing factors such as income or religion. Using genetic material from 131 nations, they concluded that the high subjective well-being of the Danes correlated strongly with the absence of a **gene variant** (t-HTTLPR polymorphism), while nations with a high presence of the gene variant were at the lower end of the satisfaction scale. While Kobiella et al. confirmed this finding using imaging techniques on 54 healthy individuals, they attributed the effect not to 5-HTT availability but to a smaller amygdala volume in individuals with the 5-HTTLPR genotype [117].

After evaluating numerous empirical studies, Lyubomirsky et al. [110] come to the conclusion that *50% of eudaimonia (chronic happiness level) is genetically determined and thus cannot be influenced, that 10% is due to personal circumstances (environment, health, money, etc.) and difficult to change, but that 40% can be shaped by conscious and targeted behavior.* This is reason enough for us to try to improve quality of life through Life Engineering.

4.8 Measurement of Happiness

Today, the empirical foundation of statements on quality of life is essentially based on **interviewing** individuals, a method that is extremely questionable in many respects [118]. Humans want to look good in surveys, barely understand the causes for their state of mind, and use different scale values to determine the same emotional state. Causality can rarely be clarified clearly; in most cases only the correlation of phenomena can be explained. When individuals are asked about motives, they are often ashamed to openly confess them. Who wants to admit that they are not noticed by their partner of choice, that they are tormented by the success of their school friend, that they enjoy pornographic websites, or have an alcohol problem?

Several disciplines, above all the neurosciences [92, 102], have made promising progress in recent years. They use imaging techniques to measure brain activity in response to stimuli, determine hormone status, analyze voice timbre, record and interpret facial expressions, and measure vital signs such as blood pressure and electrodermal resistance. A wide range of sensors, image and video analyses, online behavior, and conversations enable the machine recognition and thus the successive categorization of human perceptions. The vision of the *quantified self* encompasses biological and physical as well as behavioral and environmental information [66].

Statistical analysis and deep learning algorithms extract more and more patterns, including personality traits such as skill profiles and inclinations, from all this data. These patterns make the subjective well-being of people increasingly objectively

measurable [92]. The MIT Media Lab founded a specific group for affective computing in 2018 and set itself the goal of “advancing well-being by using new ways to communicate, understand, and respond to emotion” [119]. Companies like Affectiva already offer tools to measure emotions, mainly to measure the impact of advertising on consumers [120]. Google founded an Empathy Lab in 2015 with the aim of understanding the emotions of communication partners [121]. The World Well-Being Project of the Penn Positive Psychology Center in Philadelphia is working on tools to measure mental well-being and physical health based on the analysis of language in social media [122].

In the sense of Damasio, it should again be added that our behavior is not only controlled by the brain or even by consciousness, but that physiological signals like heat sensation, hormones like adrenalin, and other chemical signals like the blood sugar level often have an underestimated influence on our well-being. The multi-dimensional data of the *quantified self* [53] objectifies the measurement of happiness and will replace or at least supplement the collection of subjective impressions. *Physical data from sensors and various measuring instruments will objectify and displace the currently dominant measurement method of the survey in many areas by the year 2030.*

4.9 Summary: Quality of Life Mechanisms

Homeostasis is the control mechanism of evolution. It leads humans, and other living creatures, to replication and progress by defining needs, evaluating the effect of perceptions on needs with feelings, developing knowledge about the world from these experiences and, finally, by triggering the next actions. We refer to positive feelings as happiness, and to negative feelings as unhappiness.

Replication through self-preservation and preservation of the species, and progress through selection and knowledge determine our needs, which are partly inherited through our genes and partly learned from perception in the form of patterns. These patterns consist of actions, of perceptions triggered by actions through sensory stimuli and thoughts, of needs, and of feelings as an expression of the satisfaction of needs. Human knowledge is formed from the totality of all these patterns and is therefore connected in every detail with an emotional component. The outlined Quality of Life Model (QLM) tries to explain our behavior with 13 needs. The basic human needs are refined by learned needs such as capital and power. The learned needs of the QLM are patterns, which in turn comprise many levels of needs. The need for power, for example, may consist of physical strength or the mastery of a foreign language; the knowledge of that language in turn consists of things like the knowledge of the meaning of a word.

The majority of needs are embedded in our genes and are the same for all humans. Differences in genes and differences in socialization are responsible for the individual manifestation of needs. Humans can significantly influence the satisfaction of their needs through conscious actions.

Evolution controls us by means of happiness and unhappiness. Humans strive for actions that lead to perceptions with positive feelings, and avoid actions that cause suffering. Evolution aims for progress, not human happiness. Quality of life, i.e. happiness and unhappiness, is a volatile quantity. Comparison with oneself and others, as well as accommodation, makes quality of life a dynamic factor. Homeostasis works more through the hope of satisfying needs than through the satisfaction of needs in itself.

Hedonia is the direct, short-term joy of perception; eudaimonia means satisfaction with the situation and with self-esteem. The reverse is true for anhedonia and disdaimonia. The affluent society gives us the opportunity to concentrate on eudaimonia, i.e. subjective well-being. Even if happiness and unhappiness are imprecise concepts that are still difficult to measure today, the goal of humans must be to *choose actions that lead to perceptions which generate a lasting high quality of life through positive feelings*.

Intensive research is needed to determine whether the needs postulated in the QLM actually determine quality of life, whether the relationships highlighted in the QLM are the most important, and whether the intuitively assumed impact strengths in Fig. 4.4 can be confirmed empirically. The proposed QLM is at best an initial approach; extensive empirical and deductive studies as well as human and machine learning are still required. The fact that it is possible to explain all the examples discussed above in terms of this network does not prove the robustness of the model of needs, but at best provides an indication. As long as happiness measurement is based on interviewing individuals, all statements remain inaccurate and subjective, making it virtually impossible to derive verifiable correlations. More accurate and objective measurements of quality of life will make it possible to better determine needs and their interrelationships.

We should then use machine learning to grasp and generalize patterns of actions, perceptions and feelings. Even if great progress can be expected in the measurement of feelings by 2030, we shall still lack an operational understanding of human behavior and emotions. This must standardize the actions and perceptions that can be associated with needs and feelings. The classification of actions and perceptions is even more difficult than the measurement of biometric characteristics, since it presupposes a perceptual apparatus such as that of humans. Consider, for example, the effect of the action *body building* on perceived power within the community. The mere generalization of almost infinitely diverse perceptions and the recognition of feelings are huge challenges for research into machine intelligence.

As with most effects of information technology, however, it is not about everything or nothing, but about small steps on the pathway to an improved quality of life. Many companies are already using simple patterns today, such as Spotify in the selection of music tracks that appeal to the tastes of their consumers. One could say that they derive these patterns from the large number of *perceptions* they derive from consumers' listening habits.

Anyone—of the many—who calls for technology to be used in the interests of human well-being and wraps the appeal in fine-sounding papers or websites must answer the question of what improves or diminishes quality of life for humans.

What should we do if we do not have a scientifically proven understanding of quality of life and an empirically tested model of needs? Wait for the robust model in a hundred years' time or make reasonably plausible assumptions with the available half-knowledge? *In view of the way in which technology is set to change our lives in the next ten years, it would be grossly negligent not to employ the modest knowledge available to ensure that technology is used for the benefit of humans rather than to their detriment.* In the language of the AI researchers, this means giving the machines the rules for human well-being. Currently, we content ourselves with slogans like "Don't be evil.", the motto of Google's founders, or "Make the world a better place" [123].

Abstract

Where does technological development promote quality of life and where does it endanger it? The instruments of evolution, above all homeostasis, are aimed at progress, not at quality of life. Happiness and sorrow, joy and pain are only the control instruments of evolution. Satisfaction is an enemy of progress; dissatisfaction drives development. People, companies, and states with the highest technological and social level of development determine the direction of development and dominate the less developed. Therefore, we must try to be leaders in evolution, especially in technical and social development, and at the same time use progress for the quality of life. Evolution puts us on the treadmill of differentiation through the needs for power, recognition and self-esteem. Convenience leads to a renunciation of privacy. Digital services generate an addiction to news and information and an ever less manageable complexity. Psychology, medicine, and religion can lead to quality of life, for example with healthy nutrition, drugs, brain stimulation, or virtual reality. A personal, digital happiness coach can be the goal, but will still be a long way off in 2030.

Technological development promotes quality of life, but can also endanger it. This is evident in the utopias and dystopias, the hopes and fears associated with machine intelligence. The examples in Chap. 1 not only show that digital services meet many human needs but also that the mechanisms of evolution can turn against human quality of life. The same applies vice versa: Satisfaction is an enemy of progress; dissatisfaction drives development. However, development can only be shaped by those who lead it. It is therefore necessary to examine here how we can combine socio-technical evolution with an improvement in quality of life, i.e. how we can shape evolution while at the same time averting its threats to quality of life and exploiting opportunities.

5.1 Evolution Versus Happiness

Pain and pleasure, joy and sorrow, happiness and unhappiness have helped us to achieve our present cultural and technological level, which covers our replication needs to a large extent. In view of the foreseeable technological possibilities, the question arises as to whether traditional guiding principles are more helpful for evolution or for human quality of life. The needs inherent in our genes are aimed at replication and progress through selection and knowledge. *The instruments of evolution are aimed at evolution, not at human quality of life.*¹ Human happiness and unhappiness are merely the control mechanism of evolution and can harm quality of life, as the following examples show.

5.1.1 Treadmill of Differentiation

The **affluent society** basically offers more hedonia than a **scarcity society**, as it reduces suffering from hunger, disease, insecurity, and effort. It enables satisfaction through status symbols, shopping, exquisite food, and sex, and largely alleviates pain.

When humans need less effort to satisfy basic needs, they have more capacity for development needs (referred to as *prevailing* by Damasio [91]). Evolution selects the best genes for reproduction, so we do everything we can to increase our attractiveness in terms of capital, power, appearance, community, status, and knowledge. *In this phase of evolution, our lives are determined by the struggle for status in the community and thus self-esteem, and no longer by the necessity to satisfy basic needs.*

Once our income covers basic needs, comparison with our peers becomes more important than the absolute level of income [102, p. 220]. Ambition (status) drives even income millionaires and wealth billionaires to extraordinary efforts (use of energy), to neglect their families, to accept criminal acts such as corruption and tax evasion, and even to damage their health (e.g. doping). Many people get into debt because they want to afford a more powerful car than their friends, a bigger house than their colleagues, or a more expensive vacation than their neighbors. They torture themselves with bodybuilding as in other sports and may even take muscle-building substances that are harmful to their health in order to be able to show off a more impressive body or a more impressive performance than their rivals. *Hedonia is a driver of consumerism and other forms of differentiation.*

A problem of status or attractiveness is their relativity. The advancement of one individual means the demotion of another, so the latter usually strikes back with increased effort. Changes in status are by definition zero-sum games with equal winnings and losses. We unconsciously and permanently compare the golf handicap or the evaluation of a professional achievement with other members of our

¹Once again, it should be pointed out that we do not know the goals of evolution but can merely observe how it works and, from this, identify a direction rather than a goal (cf. Sect. 1.2).

community. We even consider it a defeat if we fail to take our athletic performance or the number of likes on Facebook or Instagram to a “worthy” level that is in line with our expectations of our own status in the community [13, p. 63]. The characteristics that determine our self-esteem vary from person to person. One person’s model railway is another’s number of press reports or a role on the parish council.

Our own claim and the delta in relation to the past determine our happiness or unhappiness. The status achieved in terms of capital, power, appearance, community, and recognition soon becomes “normal” (*hedonic adaptation*, see above) and has little impact on satisfaction. Once we have taken a step up in status, we compare ourselves with a new set of peers.

Evolution obviously puts us on a treadmill of differentiation, i.e. in the permanent struggle for attractiveness and recognition. The need for self-esteem leads to ambition and the urge for self-actualization, and the fleeting nature of needs satisfaction drives the wheel. The treadmill of differentiation is necessary for evolution, i.e. for the further development of our culture (science, technology, art), but is often an enemy of our quality of life, since it not only produces joy but also suffering (e.g. unhealthy stress [15, p. 56]). It generates joy and suffering through comparison within the community, through loss of prestige, through over-indebtedness, and through damage to self-esteem when one is constantly exposed to the values of an affluent society.

Machine intelligence contributes threefold to the rotation of the treadmill: It provides us with the **resources** to differentiate ourselves by requiring less and less working time to cover our basic needs. The digital media provide us with the **benchmarks** for our satisfaction (values), be it through the delusion of perfect role models in films, “influencers”, comparisons on social media, or through other electronic channels. Digital platforms are transparent **marketplaces** of communities, which virtually incite comparison. The treadmill of differentiation drives the progress of technology, science and art.

The treadmill is the engine of evolution. To express it with proverbs: Necessity is the mother of invention; satisfaction is the mother of inertia. Young people’s lack of commitment to their careers and the emphasis on leisure and consumption, which the older age groups like to complain about, are probably in part an attempt to get off the treadmill and achieve a work-life balance with a high quality of life.

In its Better Life Index, the OECD also addresses the human work-life balance [96]. A high number of working hours is implicitly associated with suffering and joy with a lot of leisure time, thus confirming the misguidance of the treadmill. It is obvious that effort contradicts the need for efficiency (convenience) or conserving energy and that too much effort damages health, but it is unclear whether fulfilling work with long working hours makes people more unhappy than aimless leisure time.² Work gives many people meaning in life, where a leisure time focusing on entertainment tends to provide little. As the leisure activities of people in affluent societies show, humans seek meaningful activities in their leisure time, for example

²Perhaps the *ora et labora* motto from the Rule of Saint Benedict is a more successful path to work-life balance.

in sports, model making, social activities, or in fan clubs. They enter a treadmill of leisure and often need higher income and therefore a greater commitment to making money.

Machine intelligence accelerates the treadmill. Teleworking allows people to spend more time with the family, but at the same time can considerably disturb their private life through the high level of accessibility. Surveys on job satisfaction in Europe [15, p. 61] show that online availability generates negative stress.

5.1.2 Capitalism and Consumerism

The central role of capital in the QLM becomes clear in Fig. 3.1. Individuals decide what they spend their money on, while companies try to turn as much of it as possible (*share of the wallet*) into sales revenues and thus increase their enterprise value. If humans spend their money on what makes them happiest, then all is right with the world for both sides. The question is whether people are capable of doing so and whether companies want them to.

Phenomena such as drug trafficking dramatically illustrate the discrepancy between eudaimonia and capital. But even fairly harmless surprises for consumers contradict the image of an ideal, self-determined world. A cell phone plan surprises the consumer with bills, an insurance premium disappoints the policy holder with omissions in cover, a bank's attractive savings product often performs worse than a government bond. The automobile manufacturers, fashion brands, the furniture industry, or beauty care also fail to keep the promises of a better quality of life they imply in their advertising through associations with power, prestige, or appearance. Tasty but unhealthy food, together with lack of exercise (avoidance of exertion), leads to obesity. Marketing relies on consumer insight, analyzes purchasing motives, and derives its message to consumers from them. The goal is not the highest quality of life but the highest sales revenues or contribution margin.

Advertising associates a product with the satisfaction of needs such as friendship, sex, recognition, power, security, or convenience. Once consumers have their new garment, expensive watch, or room at the hotel on the dream beach in front of them, or have drunk their alcopop, the illusions rapidly vanish into thin air, leaving them with the sensation of a hangover. They experience the discrepancy between hope and reality.

When people search the internet for a product, they expect a result that includes all the information stored on the internet and displays the most important first. What they get, however, are the hits that bring the highest advertising revenue. When a man consults a bank's robo-advisor regarding retirement provision, he wants to use his savings as efficiently as possible, but receives products with high profitability for the bank. When a woman visits a health portal to obtain information about her illness, she wants advice on therapy to ensure the best possible quality of life for the long term, but receives suggestions that provide the developer of the portal with the highest contribution margin. That can be a pharmaceutical company, an insurance company, or a chain of clinics. While this discrepancy between the goals of

providers and consumers existed long before the advent of digital consumer services, it has greatly increased as a result of such services.

The biggest challenge for consumers is wanting the right thing. How do humans develop their personal values, the patterns of perception they associate with happiness and unhappiness? Their view of the world is shaped by the communities in which they live, their own experiences, and the media. More than ever before, providers are analyzing people's interests, their behavior, in particular their buying behavior, and their attitudes. Providers not only strengthen people's political attitudes but also their consumer behavior by serving up exactly what they like best, placing consumers in an echo chamber. *Digital media did not invent the art of seduction, but have multiplied its possibilities.*

Humans in highly developed countries could manage with a fraction of the products and services consumed today to satisfy their replication needs. Controlling the creation of goods and services by means of money is necessary because we are yet to find better control mechanisms, but it is also outdated because it leads to the production of unneeded goods and services, thus causing unnecessary exertion on the treadmill and, ultimately, environmental damage, which in turn impairs quality of life.

Milton Friedman stated unequivocally that "the business of business is business". Consumers are faced with the task of selecting what will in the long run improve quality of life among all the offers. Information technology enables the creation of countless new, extremely useful services and products, and leads to efficient markets, but also promotes consumerism with its many impacts on quality of life. Automotive navigation systems, the digital daily newspaper, electronic banking, and the ever more accurate weather forecast make a noticeable contribution to quality of life. The smartphone, which has to be replaced annually, a sports idol's training shoes, the vacation trip to the other end of the world, self-promotion on social networks, and the excessive consumption of streaming services are examples of successful marketing, promise differentiation, but in the long run often generate more suffering than pleasure.

Capital enables us to satisfy the basic needs of food, efficiency, health, and security, and even sex and reproduction. In our society, capital is a dominant means of differentiation with the aim of passing on our own genes. It gives us the opportunity to enhance our attractiveness, and is a prerequisite for participating in communities and accessing knowledge (education). In addition, capital is an instrument of power, for example in the competition for an attractive home or in the voting rights of shareholders.

Since companies generate capital through sales, which they can invest in further development and thus ensure their survival, they must encourage people to consume, even if this impairs their quality of life. Employees are judged on their contribution to sales and profits, and must satisfy the interests of investors. That sounds like a condemnation of the capitalist economic system, but it is not. Capitalism has brought an historically unprecedented prosperity to an increasingly broad section of the population. Despite all attempts, humans have not produced any better economic models. Capitalism helps poorer societies to secure their basic

needs. It is not a question of combating capitalism but of complementing its objectives with quality of life.

Capital drives progress primarily in the interests of evolution and only secondarily in the interests of quality of life. Evolution uses capital to advance technology, in particular machine intelligence. The measure of evolution is not quality of life but capital and therefore consumption.

Capital has developed a life of its own. It is no longer simply a means of satisfying needs such as food or appearance (status symbols), but becomes an end in itself. This is particularly evident in the financial sector and above all in investment banking. It is no longer a question of those working in these areas or the investors generating enough capital to satisfy their personal needs, but rather of them having to meet targets for measures such as the market capitalization of a company, profitability (e.g. EBIT margin), or trading success. In part, it is no longer a matter of improving one's status through capital, but of not losing one's job or power because the capital targets are not met. In order to achieve this, humans must drive forward technical and organizational evolution. *Capital thus becomes the fuel of evolution.*

5.1.3 Infomania

All humans, not just researchers and software developers, are constantly working on the further development of their model of the world, i.e. they try to understand their environment in order to be able to react more efficiently to the challenges of life. In its simplest form, this involves the interest in gossip, the search for the best tool in the case of manual occupations, e.g. for cleaning the windows, the delegation of administrative activities to machines, and, finally, also the recognition of connections in basic research.

The same applies to the thirst for knowledge: We consume information all day long, in the newspaper, on television, on Instagram or Facebook, in conversations, and in business. Are we obsessively curious, are we in fact addicted to information of all kinds, regardless of the usefulness of additional knowledge (e.g. gossip)? This may cause us to lose the ability to select what is important and process what has been absorbed.

Information technology provides us with an information and communication offer for which we are not prepared. We have access to an unprecedented knowledge base, but allow ourselves to be driven by what is offered rather than by what we want or need to know and why. We prefer to consume easily digestible, highly simplified and visually presented chunks of information rather than thinking about a complex topic such as who to elect as our representative in parliament or which profession to choose. Professional communication uses all the means at its disposal to attract attention, takes short attention spans into account in the length of messages, and replaces texts with images and videos. The constant stream of news often takes away the time we would need to form our own opinion and to understand the connections. The photos of groups of people in which everyone is communicating

via a smartphone instead of with those who are physically present are increasingly showing seniors and not merely young people.

The possibilities of digital information have virtually encouraged addictive behavior. The acoustic signal of an incoming message generates a measurable “reward” in the consumer’s brain [105] and increases the release of dopamine, which causes the craving for messages. Social networks like Twitter have such a strong impact because they constantly deliver messages, the brevity of the message leaves much to the imagination, and both sender and content are surprising [124]. We follow streams of information without being guided by a need for a particular piece of information, blocking our cognition for reflection and deduction. This applies in particular to the formulation of goals that define our quality of life, and to the determination of our personal positioning. In his book “Irresistible”, Adam Alter [125] describes the exposure to constant streams of information as an addictive behavior and reports on numerous approaches to combating it. *Digital media abuse our reward system to attract **attention**. They fight for the attention of the addressees, and measure the intensity and duration of their attention like a currency.*

5.1.4 Complexity Overload

Life in a world with intelligence amplifiers overwhelms people with an unmanageable variety of organizations, laws, devices, and functions. Abstract concepts (e.g. Photo Stream), services that are not understood (e.g. quality filters on Twitter), unclear consequences of consenting to use of data (e.g. telephone number in Google), incomprehensible business conditions (e.g. data transfer), and the wide range of user interfaces (e.g. navigation systems), authentications and authorizations lead to countless negative experiences. It would be worth examining whether globalization is actually driving people to populists or whether the excessive demands of a more complex and abstract world are making people insecure and creating a desire for simplifications. In any event, the majority of people of all ages and educational levels do not want to do without the services of ubiquitous information technology, but at the same time bemoan the complexity and lament the time they have to spend on digital services [126]. A world that is becoming increasingly complex due to technology instills in us a sense of overload and insecurity.

Young people in particular disagree with this view, pointing out that devices and services are constantly becoming simpler and more intuitive to use. While this is true, digital service providers immediately use this simplification of technology to offer additional options and versions of their products, and thus differentiate themselves from their competitors. This applies not only to WhatsApp and other communication services but also to electronic banking, cell phone contracts, insurance products, tax returns, and social security applications. It is often the case, however, that complexity only becomes clear when the overlooked consequences have actually occurred. *Technical and organizational progress enables more*

complex products, services, contracts, organizations, and laws, or makes them economically necessary.

5.1.5 Irrational Emotion

The science of economics has long taught that humans do not decide rationally in financial terms. Behavioral economics shows that humans also decide according to their non-pecuniary needs (see QLM). But even this seems questionable, as we let ourselves be seduced by promises made by providers. An example here might be the unrealistic associations with beautiful people in an advertisement for building insurance or for a cleaning agent. Another, however, can involve food patterns, such as the connection between the consumption of chocolate and rapid energy absorption. Often our subconscious decides, eudaimonia is sacrificed to the short-term hedonia, we recognize the seduction, and do not have the strength to resist. We pay a high price for a car with 500 hp, which we can hardly ever use. We commit adultery even though we know the negative consequences for all involved. We eat the calorie bomb for dessert, although we are annoyed about the rolls of fat for a long time afterward.

Even in apparently rational, professional investment decisions in companies, the personal needs of the decision-maker for capital, power, reputation, and security play a role in addition to the return on investment calculation. Indeed, even the effort required for a thorough examination of alternatives often leads us to take the more convenient route (efficiency) of a quick decision instead of the strenuous route of rational evaluation (“Close your eyes and go for it!” or “It’s time to stop theorizing and start deciding.”).

Research in the field of consumer behavior shows that people first decide on the basis of unconscious perceptions and then try to rationally justify the decision [127]. This is equally true for a chocolate bar or for an item of clothing, for a motorcycle or for an apartment, and definitely for the choice of partner. Our genes and experiences (rules), which connect perceptions with needs such as efficiency, power, recognition, and knowledge, shape our behavior in the subconscious.

A terminally ill cancer patient, who lives a severely restricted life in pain and is fully aware of the situation, usually struggles for life to the last breath, although this is marked by pain and suffering. The patient is driven by the instinct for self-preservation and not by a rational assessment of the quality of life to be expected. For thousands of years, humanity has been preoccupied with happiness, but has developed few rules that can be used in daily life, and does not follow the few proven rules that do exist. If, with the help of technology, we were able to reliably predict the factors determining quality of life, a personal life assistant might tell us: “From now on, the cumulative expected value of happiness is clearly negative, so I recommend you die.” Would you follow the advice, or would the instinct for self-preservation drive you to unhappiness against your better knowledge? This probably also applies to other instincts in our genes such as love and jealousy.

Needs hinder human **rationality**. It is difficult to accept something that goes against our basic needs, especially the instinct for self-preservation. We fight just as intensively for the selection and transmission of our own genes. *Basic needs carry more weight than needs that we derive from rational considerations.*

Even the contradiction between evolution and quality of life cannot be discussed unemotionally, i.e. rationally. For example, would we be willing to leave the choice of a life partner entirely to machine intelligence, even if we knew that the machine could select a suitable partner for a successful relationship better than we could ourselves? Are we willing to let our freedom be restricted, even if we know that it is better for us? Do we renounce the recognized human right of freedom if it makes society as a whole happier? *Our inherited needs and learned patterns prevent us from conducting a rational debate about happiness. We fear reality and the loss of values to which we have become accustomed.*³ *Through needs, evolution exerts a stronger control over our behavior than conscious reasoning and logic in the pursuit of quality of life.*

5.1.6 Irrational Age

In nature, selection of the best genes in reproduction obviously leads to success in the sense of progress. The needs that are right for twenty- or thirty-year-olds are therefore not necessarily right per se for the quality of life of sixty- and eighty-year-olds. Why does a wealthy pensioner seek to increase his wealth like a young man who is still looking for a life partner and wants to start a family? Why, apart from money, are the buyers of sports cars and powerful motorcycles usually over 50 or 60 years old? Why does an emeritus professor want to further distinguish himself through scientific publications? Why does a seventy-year-old still respond to the charms of a twenty-year-old? Is it right that a retired person should still compete with people in employment?

The needs of selection, with which evolution controls us, mainly affect humans in the age of reproduction. The task of the elderly is at best to continue safeguarding their descendants, i.e. their family or tribal community [1, p. 71]. But needs do not change once humans have passed reproductive age; those needs are partly embedded in the genes, partly proven and consolidated over the decades. When a senior chases after the usual needs, this leads to disappointments, damages self-esteem, and hinders progress. Waning stamina and the adherence to outdated ideas are prompting many companies to set age limits for members of the executive board. *The needs of selecting the best genes are meaningless in old age, but nevertheless drive our actions directly and indirectly. They harm quality of life and may hinder evolution.*

³Time and again, this was borne out in the discussions I conducted regarding this book, not only by my discussion partners, but also by myself.

5.1.7 Renunciation of Privacy

Convenience (efficiency) moves us to accept almost any privacy statement in the general terms and conditions of digital services, and to not even read them as they are beyond our comprehension in any case (see Sect. 5.1.4 Complexity). In addition, many digital services can capture our data without our knowledge and consent [128]. And the more an integrated and active life assistant, as outlined above, knows about us, the more it can support us. Non-acceptance of a service's privacy policy means forgoing the service.

In an economy controlled exclusively by capital, personal data gives providers of products and services the key to the successful manipulation of our consumption. In a totalitarian system, and also to a limited degree in a democratic social system, exact knowledge of citizens is the lever for political control and for guaranteeing security as well as for “synchronization” and using humans in the interests of capital or established power.

Is privacy a sign of weakness because our true self is worse than our external image? What if everyone shows their colors? Maybe Marc Zuckerberg is right when he says “Privacy is a concept of yesterday”. In 2013, Dave Eggers shocked readers by painting a world without privacy with his novel “The Circle” [129]. However, his scenario is already lagging behind reality in many areas. A complete renunciation of privacy means that my neighbor knows my financial circumstances, that my girlfriend can track all my meetings with acquaintances, that my colleague can look at my assessment by my superior, that my friends can access my medical examination results, and, of course, that all companies I deal with can also use all this data to “improve their service to me”.

Privacy is regarded as a human right, but we constantly renounce it for the sake of convenience. We do not know who collects what data about us and to whom it is passed on. Any renunciation of privacy gives others the opportunity to influence us, for our benefit as well as to our detriment if it suits their interests.

5.1.8 Against Evolution

“People consume what’s good for them. We all know best what makes us happy. Companies produce what consumers buy and make them happy.” This is often the first reaction when someone draws attention to the discrepancy between evolution and happiness. The range of products and services on offer actually contributes to the quality of life of consumers in most cases. Evolution has equipped us with needs that were appropriate until recently. In a scarcity economy, it is important to first meet the needs of replication, food, health, security, sex, and reproduction. The need for differentiation additionally ensures that the genes of the fittest are passed on.

In an affluent society, the needs of replication are largely covered and thus resources for differentiation in interpersonal competition are available to an evolutionarily unusual degree. Humans are driven by unrealistic models to consume,

place themselves on the treadmill by comparing themselves with others, allow exposure to constant streams of information to rob them of time to think, feel overwhelmed by the growing complexity of life, do not cast off the needs of selection even in old age, and also stoke up the mechanisms that lead them astray by disclosing personal data. In the information age, as in the times of hunter-gatherers, humans allow themselves to be led by hedonia in the interests of evolution but not in the interests of lasting well-being (eudaimonia).

Highly developed societies are experiencing a dramatic increase in mental illness. One in five US citizens suffers from a mental illness; the suicide rate in the USA is higher than ever before; 115 people die daily from opioid abuse; and one in eight US citizens over the age of 12 takes antidepressants every day [130]. Similar observations are made in other highly developed countries such as Germany (see Fig. 5.1) [130, 131]. In many places, these findings are explained by the above-mentioned evolution misguidance and as a result of technological progress. A large part, however, can be attributed to the fact that only an affluent society has the time to address mental illnesses and that the stigmatization of these diseases has decreased [131, p. 19].

Happiness is evolution's control mechanism, not its goal. *If the goal is the further development of the world, i.e. technology, organization and humans, then evolution probably steers us correctly. But if the ultimate goal is human happiness, then the inherited and learned needs do not always guide us in our best interests.* So what is the ultimate goal: human happiness or evolution, reaching the next stage of development with or without humans?

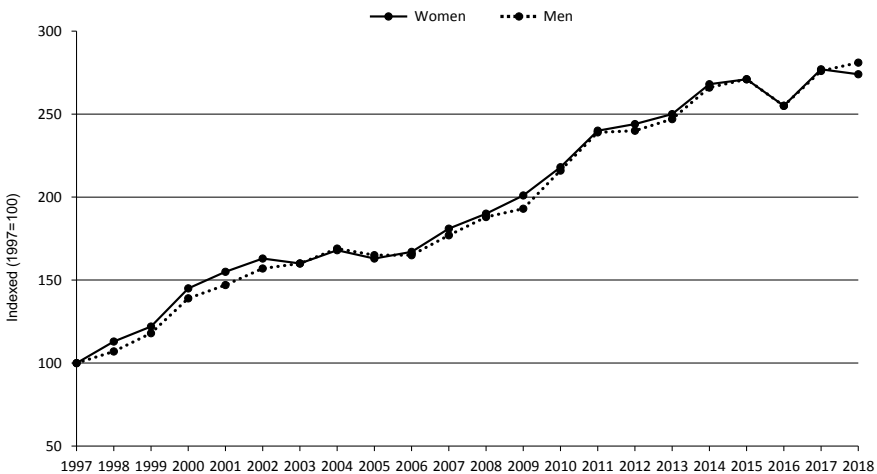


Fig. 5.1 Working days lost due to mental disorders (indexed 1997 = 100)

5.2 Happiness Versus Evolution

The ultimate goal of humanity is happiness, not evolution. Humans look for instruments (*happifiers*) that improve quality of life. Evolution is only good for humans as long as it serves their happiness. While set point theory in psychological research considers happiness to be primarily determined by genes and difficult to influence, authentic happiness theory is based on the idea that life goals and priorities can at least partially shape happiness [133].

Paul Watzlawick published his humorous book “The Situation Is Hopeless But Not Serious (The Pursuit of Unhappiness)” [134] in 1983, which draws our attention to self-inflicted negative feelings. Amazon has over 30,000 book titles on the subject of happiness in its catalogue, most of them with advice on happiness. The following list of *happifiers* summarizes some of the suggestions on happiness and unhappiness. It is based on the above deductive considerations of needs and on the evaluation of empirical findings [81, 132, 135].

5.2.1 Nature

Science provides little concrete knowledge about the relationship between information technology and nature, but individual empirical studies point to the positive effect of nature on well-being, particularly in view of the fact that relaxation, physical activity, proper nutrition, and meditation are associated with being in nature. Landscape psychology [135, 136] proves that the conscious perception of nature (landscape) reduces stress, restores mindfulness, and triggers positive feelings. If physical exertion (e.g. hiking) is added to the nature experience, well-being is further increased because the body also releases the neurotransmitter dopamine (also known as the *happiness hormone*). Hunter et al. report on a trial with 36 people in which a 20-minute walk in natural surroundings reduced the stress hormone cortisol by approximately 10% and thus increased well-being [138]. *The perception of nature has a positive effect on well-being.*

Sunlight promotes well-being through the production of serotonin. A lack of sunlight, for example in the long winters of the Nordic countries, favors depression. Similarly, adequate sleep determines our well-being; sleep deprivation is even used as an instrument of torture. Food and digestion in the gastrointestinal tract play a widely underestimated role in human well-being. Digestive problems and mood phenomena are closely related; 95% of the body’s serotonin, which contributes to inner calm and contentment, is produced by the enteric (intestinal) nervous system [139].

The time we spend on digital services, from weather forecasting and navigation to computer work, is time lost for the perception of nature: Children prefer to play on the game console rather than with other children outdoors, hikers are more concerned with the outdoor app than with the landscape, and train passengers read the newspaper on tablets instead of looking out the window. What does the

transition from hunter-gatherer, who only had perceptions of nature, to supermarket cashier, stockbroker, or software engineer mean for quality of life? Can technology even augment our perception of nature?

Facebook groups, outdoor apps such as Komoot, and intelligent sports equipment (such as a golf app) can make it easier for us to access nature experiences and motivate us to generate the necessary energy for an activity. However, it is unlikely that digital assistants will substantially encourage us to enjoy nature in the foreseeable future. *Compared with social networks like Instagram and Twitter, games like Fortnite, shopping on Amazon, and electronic banking with Capital One, nature apps deliver a very modest return on investment, so we cannot expect any dramatic development in this field.*

5.2.2 Health

Freedom from pain and vitality are fundamental to a high quality of life. Numerous applications of information technology help to maintain human health, diagnose diseases or predispositions, and support therapy. The examples provided below are used to illustrate the interaction with quality of life rather than including a comprehensive overview.

Harari describes the benefits of predictive algorithms using Angelina Jolie's decision to have a mastectomy as an example, after an algorithm based on high statistical evidence of the relationship between the gene mutation BRCA1 and breast cancer recommended this course of action. Harari concludes his somewhat populist portrayal with the sentence: "Algorithms won't revolt and enslave us. Rather, they will be so good at making decisions for us that it would be madness not to follow their advice" [10, p. 339].

A further example from the medical field is taking lipid-lowering drugs, as the statistical relationship between blood fat values and heart attack appears to be sufficiently established. However, the patient may have to accept considerable side effects such as fatigue, lethargy, mild depression, and muscle pain. Today, the algorithm recommends a drug, but the patient or the physician decides whether to accept a lower quality of life in return for the possibility of a longer life. The interests of the pharmaceutical company, the doctor, the health insurance company, and the patient can be quite different.

Yaden et al. [140] see enormous potential in "predictive algorithms", but state their usefulness for life choices much more cautiously than Harari. *Even the potential of predictive algorithms for quality of life identified by Yaden et al. is to be viewed with strong reservations. Machine intelligence to capture actions and perceptions as well as thoughts and feelings is at a very early stage.*

5.2.3 Drugs

If neurotransmitters, hormones, and other endogenous control mechanisms of homeostasis have such a great influence on human happiness, it makes sense not only to produce them through physical exertion but also to artificially supply these substances in the form of drugs. It is not necessary to deal here with the world of drugs, from mood enhancers and alcohol to opium; the enormous consumption of drugs and psychopharmaceuticals worldwide is proof that a large part of the population believes in the happiness-promoting effect far beyond the treatment of pathological conditions. A study on the use of prescription drugs in the USA, for example, shows that the prevalence of the use of antidepressants jumped from 6.8% to 13% between 1999 and 2012, and then remained at this level (Kantor et al. 2015, p. 1825). 17% of Americans had at least one prescription of an opioid in 2017 [142].

Executives, politicians, soldiers, artists, and students take many types of drugs to enhance their performance and thus their success. On the other hand, numerous organizations, above all government agencies, try to avoid or reduce the negative impacts of these *happy pills* by means of drug prevention and support for addicts. They are obviously convinced that if the positive and negative contributions to hedonia, and especially to eudaimonia, are weighed up, the ultimate result is clearly negative. This view may also be guided by the economic costs of the impaired work performance of those affected.

Yaden et al. [140] summarize a collection of studies on psychotropic drugs with the statement that there are many psychoactive substances with, for example, positive effects in the treatment of depression or pain, but that there is a great risk of dependence and long-term negative effects, and the correct use to improve well-being is not yet sufficiently understood.

As drug use is hardly ever based on expert knowledge, and the social environment can favor consumption, efforts are being made to support **drug therapy** with digital services. The FDA (Federal Drug Administration) has approved the Reset app as an aid against alcohol and drug abuse, and has thus made it possible to prescribe the app in conjunction with medical supervision. Such apps are currently being developed for various health areas. They not only help patients to follow therapies (e.g. obesity) but also provide previously unavailable data in large quantities and consequently support the understanding of the context.

5.2.4 Electrical Brain Stimulation

Brain cells can be stimulated chemically, i.e. by means of pharmaceuticals, or electrically. Electrical impulses—invasive and non-invasive—can stimulate more narrowly defined brain areas than pharmaceuticals. Invasive procedures include **deep brain stimulation** using implants (*brain pacemakers*), which deliver electrical impulses with low amplitude to brain cells. Today, they are still used primarily for the treatment of diseases such as Parkinson's and multiple sclerosis.

However, their use to stimulate areas responsible for hedonia is also being discussed for cases of severe depression. Yaden et al. [140] emphasize that, as with chemical stimulation, the connections and long-term effects are still poorly understood and for this reason the application is currently limited to serious diseases where they can bring relief, as Kessler also points out on the basis of concrete cases and their side effects [143, pos. 2227]. Yuste et al. [142] use examples to show the opportunities and dangers of such interventions.

Under the umbrella term *brain hacking*, Meckel not only reports on some approaches and products for electrical, non-invasive brain stimulation with the aim of increasing performance or reducing stress but even on a self-experiment with unpleasant side effects [143, p. 105].

5.2.5 Virtual Reality

Virtual reality has not only existed since the creation of digital worlds. Reading, especially in the case of novels, takes us into another world. The experience becomes more intense when we immerse ourselves in an alternative world when watching a film, and even more so when we play and actively participate in a game in which a strange world is presented visually, acoustically, and sometimes haptically. Technological development in the next few years promises to reach a stage where virtual reality will barely be distinguishable from the real world and partially interwoven with it.

Virtual reality allows humans to free themselves from many restrictions of the real world, to satisfy needs (power, capital, appearance, abilities) in a way that is not possible in the real world. We can observe dangerous animals at close range, visit wonderful landscapes, experience sexual partners who are out of reach in the real world, or kill enemies without harming real people. For decades, Karl May has enabled children to identify with the heroic role of Winnetou and many experiences that fulfill their needs. J.K. Rowling has taken this virtual fantasy world to a new level with Harry Potter.

Particularly with regard to virtual reality, which, in contrast to reality, we can design completely according to our will, it is important to better understand the impact on quality of life, hedonia, and especially eudaimonia. The appeasement of citizens in ancient Rome under the motto *panem et circenses* served the needs of replication (*panem*) and differentiation (*circenses*). Gladiators fought in place of spectators, who experienced “their strength” from identifying with a gladiator.

The longer-term impact of spending time in virtual worlds is only rudimentarily understood. Weiss [146] has investigated studies on the effect of frequent consumption of internet pornography, which, according to various estimates, accounts for 30% of internet traffic, and concludes that more and more extreme material is being sought, and that pornography consumption and depression reinforce each other. Online games can be addictive and lead to the negative consequences of addiction. Benesch [147, p. 130] empirically states that watching television for hours tends to make people unhappy, not because they have to return from the

virtual to the real world but because of the time lost to other activities. Virtual reality can easily lead people to neglect the real world and suffer as a result, prompting them to escape all the more into the virtual world.

Perhaps virtual worlds, such as those in games, offer people not only the satisfaction of their needs for power and appearance but also for community. If video games had the capability to give people not only a short-term sense of achievement but also a sense of purpose and lasting satisfaction, they would have to be recognized as possessing serious potential for improving quality of life, even if this does not harmonize with today's social values.

Irrespective of the longer-term consequences for well-being, many humans are constantly opting for virtual worlds, as studies on the use of the associated media show. While barely conceivable today, when book printing was first introduced, the associated dangers were discussed just as they are nowadays in conjunction with computer games.

5.2.6 Suicide

The association ERAS (*Echtes Recht auf Selbstbestimmung*—Genuine Right to Self-determination) in Switzerland demands the right to decide on the nature and time of one's own death [147, 149]. It also wants assisted suicide for the healthy. Even in Switzerland, where assisted suicide has been permitted by law since 1985, and where the EXIT association has over 100,000 members, this demand has triggered a great deal of opposition.

From the right to self-determination over one's own life, it can be concluded that a person who does not expect a satisfactory quality of life may end that life. This is the case when someone is suffering from an incurable disease and does not want to endure the suffering of the last few weeks. In a generalized sense, however, this means that even a healthy person who no longer expects anything positive from life can choose suicide. In contrast to the demands of ERAS, the German *Bundestag* (German Federal Parliament) decided in 2015 to make commercial suicide assistance, such as that provided by the EXIT association, a punishable offence.

If machine intelligence, on the basis of its knowledge of our personality and thousands of similar life situations, “calculated” with 99% probability a negative expected happiness value for the rest of our lives, would or should we then actually decide to commit suicide?

5.2.7 Religion

A study in the UK from 2011 to 2012 shows a weak but positive correlation between belonging to a religion and self-assessment of well-being [83]p.16. A further study for Germany also describes a small but significant influence of religion on happiness, irrespective of the specific religion. *“Individuals who persistently pursue pro-social/altruistic goals record long-term gains in satisfaction,*

just as do people who increase their involvement in religious activities” [133, p. 22]. This suggests that practices such as those used in positive psychology, i.e. altruism, forgiveness, gratitude, and meditation, promote subjective well-being, as Grinde notes for Tibetan Buddhism [150].

In many places, it is additionally pointed out that a religion gives life meaning (sense of purpose) and awakens the hope of a happy life after death, although empirical studies only partially prove this connection [133, p. 22, 152]. Religious apps exist, but I am yet to find one that attempts to contribute to quality of life through altruism or the meaning of life.⁴

5.2.8 Psychology

Psychology tries to increase human well-being with a variety of means. Traditionally, it has focused on the treatment of mental illnesses, i.e. deficits, since the 1980s under the heading of positive psychology and increasingly on the well-being of humanity in general. Lyubomirsky summarizes happiness-promoting behavior in her guide “The How of Happiness” [152] in twelve happiness activities. Esch describes the techniques of **positive psychology** according to Robinson with the following principles [88, p. 239].

- *Remember positive, recent events*
- *Be mindful and present*
- *Forgive*
- *Experience flow*
- *Be grateful for personal blessings*
- *Be willing to compromise for common, realistic goals*
- *Prioritize to avoid stress*

Flow is a central concept of positive psychology. In essence, it means that people should engage intensively in activities that are neither excessively nor insufficiently challenging, but enable them to experience repeated successes on the path to a goal. Video games seem to confirm this.

A second important concept is **mindfulness**, “the immediate and present experience of what is without evaluating it” [88, p. 155]. In other words, one deals exclusively with current activity. Killingsworth [153] summarizes several studies on the subject with the statement that mind wandering, which is the loss of mindfulness, makes us unhappy, possibly because unpleasant issues attract our attention at the expense of current activity.

A **sense of purpose and meaning in life** (goals) is regarded as a fundamental component of eudaimonia [110, p. 12, 111, 115]. The elderly, in particular, ask themselves about purpose in life: Why do I get up in the morning? The feeling of not being needed and not being able to contribute anything erodes self-esteem and

⁴Any findings to the contrary are most welcome via www.lifeengineering.ch.

causes unhappiness. Seniors should consider which needs are still important to them. Do they adhere to their familiar needs of capital, power, appearance, status, and procreation, even health, or can they consciously adjust these needs in line with their diminishing possibilities? There is much to suggest that it is very difficult to rationally override the needs inherited and learned over many years [127].

Unrealistic expectations, comparisons with superior rivals or film idols, excessive ambition, and overestimation of one's own capabilities or simply having no goals are a sure path to unhappiness for young and old alike. The result is an unfulfilled need to feel valued, disdained love, and dissatisfaction with what has been achieved. The elderly also make comparison with earlier times. An explicit examination of expectations creates more experiences of success and reduces the speed of the treadmill to what is feasible.

A person who is not satisfied with his status within the community of the company where he works can at least partially fall back on another community. Finding recognition in the mountaineering club, at a political party, or among stamp collectors helps boost self-esteem.

In addition, the advocates of positive psychology emphasize that a prolongation of positive emotion and a faster recovery from negative emotion can train the brain to be more perceptive of positive experiences, rather like the way we train a muscle. This **plasticity** of the brain is also the basis for Esch's case for **happiness training**. Schubert calls for happiness to be a school subject, which has meanwhile been introduced in six federal states in Germany, and also in India, for example [154, 155].

Digital media can help train these skills through training programs that promote desirable behavior or point out harmful habits. A still very elementary digital service is the screen time analysis in Apple's iOS version 12, which allows you to set time limits for certain apps or screen-free time. A considerably more advanced service that tries to implement positive psychology findings is Happify with 1.3 million users in 2015 [156]. Blankenhagel et al. report that digital stress management systems can contribute significantly to coping with stress and thus to well-being [56].

Today, it is already possible for a digital psychological coach to draw on an enormous amount of data on an individual. Emails, chats, internet searches, websites visited, articles purchased, health data, reading behavior, electrodermal resistance, and heart rate say a lot about a person's psychological situation. As yet, today's apps [157] barely make use of this potential. *As for the happifyer nature, the expected sales of a digital psychological coach might not justify too high an investment in development.* It is also questionable whether the market would accept such a coach at the present time.

5.2.9 Community

Humans are social beings. We need a community of people we can trust. For example, married people describe themselves as very happy twice as often as

unmarried people [102, p. 221]. Jones and Randall [158, p. 6] report that friends have a positive effect on quality of life, while loneliness makes people unhappy and can even lead to health problems. Needless to say, the causality of these studies must also be critically examined. However, a look at the network of needs makes these empirical results plausible. A community provides security and strengthens status as well as self-esteem.

The question of whether digital services can strengthen this type of community has been investigated in many studies with the result that *digital communication strengthens social capital and frequent users are more satisfied with their social lives*. Facebook and Instagram friends or Tinder acquaintances are not relationships that can be relied on in difficult life situations, that improve one's personal status in communities. But they do pave the way for finding true friends, while possibly favoring more fleeting relationships at the expense of fewer, but more intense, relationships.

What motivates people to join social networks? In addition to the need for social contacts, it is the potent opportunity for self-promotion: People produce content on Facebook, Instagram, Twitter, and other services as a fast and efficient means of communicating attractiveness factors to their own community (friends and followers), be it selfies, vacation experiences, political statements, or landscape shots, which present the status of the person with beauty, strength, capital, friends, and power to followers. On the other hand, they can also denigrate rivals (bullying). In his blog, Eugene Wei describes social networks as *status as a service for status-seeking monkeys* [159]. *People read and view content because they want to find out about the attractiveness of members of the community, because they want to assess their own status within the community, and because they then know what determines attractiveness (what is in?)*. Usually, this only happens in the subconscious. It is useful for the revenue of the providers but dangerous for the happiness of the consumers if they allow themselves to be influenced by the values conveyed. While the companies generate demand, the consumers develop unrealistic expectations, or at least lose self-esteem [15, p. 63], when they see what others can afford or how attractive and successful their role models are.

The huge databases of megaportals like Google make it possible to understand people's social lives to an ever greater extent. Emails, chats, contact data, gifts, location data, and even biometric data help to recognize and evaluate the relationships between people. Learning algorithms can extract the factors that lead to strong and lasting relationships, and thus possibly predict the quality of a friendship better than humans can themselves. Dating portals like Parship claim that they can contribute to lasting relationships.

The goals of companies and consumers can diverge widely, especially when it comes to the topic of community. The goal of a tour operator, for example, is to sell travel services and not to deepen relationships between young couples. Facebook has an interest in the longest possible online time of its users, not in communities in the physical world.

5.2.10 Safety and Security

Security is a basic need for self-preservation and preservation of the species that is particularly important for seniors. Technology of any kind can contribute to perceived security, be it a weapon, a building, or a safety belt. However, we gain more comprehensive security from the community, in the case of a toddler from the family, a student from the college class community, a business leader from his network of business contacts, and every citizen from the state security agencies. Status in the community contributes decisively to security because it determines how far other members of the community stand up for a given individual.

Information technology addresses the need for security in many respects. This begins with the availability of the cell phone for communication in almost every life situation and extends to comprehensive security facilities in the home, in the car, and at work. Sensors (for movement, fall, pulse, etc.) in and around the body or in the environment can detect dangerous situations and independently request help.

The sensible selection of technical possibilities is a challenge for consumers. They are unaware of the range of digital services on offer, have difficulty assessing their usefulness, and are usually overwhelmed by installation and operation. By the year 2030, a security wizard that recognizes a dangerous situation for individuals from their data will be able to integrate a large amount of data and a large number of functions and thus facilitate technical equipment and operation. *The services available today are designed from the point of view of individual components but not of the consumer.*

5.2.11 Digital Happiness Coach

A flood of publications provides numerous, in part empirically proven influencing factors on happiness and unhappiness. Even if the understanding of quality of life, especially the connection between actions and feelings, is still very rudimentary today, a conscious pursuit of quality of life promises a higher probability of success than a purely intuitive one. However, humans are not able to follow all the valuable clues in daily life. This is why a lifestyle industry has developed that offers a wide range of aids to improve the individual's quality of life, from yoga and happiness training to guides and digital consultants.

It is obvious that digital services should help people to implement the tips on quality of life. The first harbingers of digital happiness coaches, such as Apple's *Health* and *Screen Time* services, record things like pulse, sleep, training performance, or the amount of time spent using an app. They do not tell us what to do yet, but they draw our attention to our behavior and help us to plan screen-free time. They at least help us to reflect on our behavior in respect of the happyfiers as well as the unhappifyers discussed above. Happify, Ginger.io, Ellie and Arya are examples of happiness coaches that go a little further. They want to help people recognize psychological stress and change their behavior for their own good. They

interview the user, analyze non-verbal behavior (facial expressions, delay in responding, etc.), suggest behaviors, and document progress.

The emerging Chinese social scoring systems can be regarded in a certain sense as state-prescribed happiness coaches. They reward socially desirable behavior (e.g. charitable activities) and punish unwanted behavior (e.g. violation of traffic rules). They reflect the goals of the communist party. If the party captures and reconciles the needs of the citizens, the economy, the environment, and, ultimately, the state, this can contribute positively to the quality of life of the citizens. If, however, such state control serves the power interests of a small elite, this leads to historically known patterns of exploitation and repression.

The goals of the individual, i.e. a sustainably high quality of life, do not necessarily coincide with the goals of digital services or social scoring. The providers of free services want to have their development and operating costs paid for through advertising revenues, the sale of products, or chargeable premium services and make a profit. Social scoring systems can make the coexistence of citizens more harmonious and even reduce crime, but they can also strengthen the power of the rulers, even if they violate the needs of individuals. Digital assistants will pursue the goals of those who pay for and determine their development. Digital services, such as investment products from banks, cell phone contracts, insurance offers, or pay-TV channels, obviously offer consumers the services they want, but leave little doubt about the objectives of the providers.

Even if the all-embracing happiness coach remains a vision for many years to come, we must already decide today what goals our digital assistants should pursue, as we are already delegating more and more decisions to them. They help us to find the most interesting route on a vacation trip, to select the news in an election campaign, and to buy a surfboard or a pension product, or they tell us what kind of behavior is socially desirable.

The task of a Life Engineering discipline must be to put human well-being first, to strengthen abilities for technological development, to offer individuals products and services that actually and sustainably improve their quality of life, and at the same time to enable the provider to create a business model that is so attractive that it makes sense to invest in the development of the assistant.

The examples already mentioned show time and again that digital happiness coaches and, ultimately, all digital assistants, can contribute a great deal to human quality of life. They also show, however, that the developers' quest for profit and power can lead to human unhappiness. Evolution utilizes the interests of capital and power, even if this is detrimental to human happiness. Conversely, permanent happiness can hinder technological and social evolution. A person who, for example, experiences a sustained happiness high through electrical brain stimulation, probably loses all drive for further development, i.e. motivation for career, research and learning—unless it were possible for brain stimulation to maintain the striving for progress at the same time. In this context, brain stimulation is representative of any happifyer, such as a feel-good virtual world.

5.3 Summary: Paths to Quality of Life

Machine intelligence, i.e. every information technology and, ultimately, every technology, should serve the purpose of human happiness. *However, happiness and unhappiness are the control mechanisms of evolution, not its goal.* The positive and negative variances between needs and satisfaction of needs have been the basis of homeostasis for 3.8 billion years [1, p. 40]. With each perception, humans associate the feeling that an action contributes to the satisfaction of needs and adapt their personal model of the world (knowledge) with each perception. The hope of satisfying needs drives them more than the satisfaction itself.

Genes determine our basic needs, i.e. self-preservation and preservation of the species, on the one hand and progress through selection and learning on the other. The evolutionary control of humans by means of needs was successful in the development phase, which was primarily concerned with satisfying replication needs. In an affluent society, the needs of community, prestige, power, status, knowledge, and self-esteem come to the fore. Selection with the aim of progress, often under the heading of self-actualization, becomes more important than basic provision and drives the pursuit of differentiation. In a technologically advanced world, humans should rethink their needs in order to avoid misguidance such as the treadmill of differentiation.

The relativity of needs satisfaction, the importance of hope in comparison with fulfilment, accommodation, the overcoming of innate needs, and the lack of understanding of the effects of actions make the conscious control of quality of life very difficult. Happiness guides and the advice given are correspondingly diverse, ranging from the tranquility of the natural environment and virtual worlds to positive psychology and religious meditation.

If we want to develop technology for the benefit of humanity, we must learn to understand what produces hedonia and eudaimonia. Although the understanding of the connection between human actions and the resulting happiness is the subject of numerous studies in various disciplines, it is still very fragmentary and uncertain. The new technological possibilities, such as the objective measurement of physiological indicators of quality of life using sensor technology and evaluation by means of machine learning, help to better understand the cause-and-effect relationships. At the moment, expectations probably exceed the realistic potential of the next 10–20 years. Chap. 7 describes topics of research in the field of Life Engineering which include the new possibilities of technology in the year 2030 as far as can be recognized from the present-day perspective.

If at least partially operational quality of life models are available by then, for example in the area of healthy nutrition or hormonal control, digital assistants can contribute to a better quality of life and further develop their model of well-being by measuring success. But there is still a very long way to go before we have an all-embracing life assistant.

Today, we should already be assessing the impact of all forms of digital assistance on quality of life. The more powerful these tools become and the more decisions we delegate to them, the more urgent it becomes to commit machine intelligence to the goals for human well-being. This is not a topic that will only be relevant when machine intelligence becomes super intelligence, but one which needs to be addressed now: We are already using digital assistants in all areas of life and allowing machines to make more and more decisions for us.

Because every development edge improves market position, capital controls technological progress largely in the interests of evolution. We have to decide where the goals of evolution and humans are congruent and where they compete, and how we put sociotechnical progress at the service of quality of life.

Emotion often stands in our way when dealing with these and the questions and statements mentioned above. Or can you imagine accepting progress as the ultimate goal at the expense of happiness? Do you renounce your freedom of choice, even if you know that the machine is better at deciding in the interests of your happiness? Do you leave the house in bright sunshine without an umbrella when the algorithmic weather forecast announces a thunderstorm in the next half hour?

My reflections on the subject of happiness may sound premature, too little founded and unscientific in the sense of evidence, but are nonetheless extremely realistic.⁵ The world will not wait until we can give statistically significant reasons for our answers. If we look back at the current state of the art in *machine intelligence*, we find on the one hand many ongoing developments to the detriment of quality of life, although mostly without ill intent, while on the other hand opportunities await for an unprecedented quality of life.

⁵Some scientists will probably want to crucify me for my fuzzy modeling and the conclusions I draw from it. If they are able to provide exact and well-founded answers to the pressing questions on the basis of their research, I shall willingly oblige.

Consequences for Individuals, Companies, and Society

6

Abstract

Data analytics and learning algorithms evaluate the data of billions of people to identify patterns and build a world model that links personal data with geospatial data, product data, and company data. In the year 2030, active digital assistants will use this data to relieve people of many more tasks than they do today and to give individualized recommendations for action. The human needs for income, power, status, and self-esteem drive evolution and steer people to technological progress by means of capital. The more the services know about a consumer, the better they can support him. The more the consumer uses the services, the better they understand her. This is a welcome situation as long as the goals of the service provider and the consumer are the same but dangerous if the goals diverge. Capital controls the market economy in the sense of socio-technical evolution and must therefore be supplemented by a quality of life control mechanism. This is a task for the individual, the company, and society.

Humans will use digital services (see Fig. 6.1) in all areas of life (see Fig. 3) in the year 2030. This will enable service providers to capture an **increasingly comprehensive, detailed, and up-to-date digital image** of service users. In 2030, proactive digital assistants will use this data to perform many more tasks than they do today and to give individualized recommendations for action, even without human intervention. The needs of capital and power drive **evolution** and increasingly control humans in this sense. The more services know about consumers, the better they become at providing support. The more consumers use services, the better they become at understanding them. This is a welcome situation as long as the goals of the service provider and the consumer are the same, dangerous if the goals diverge.

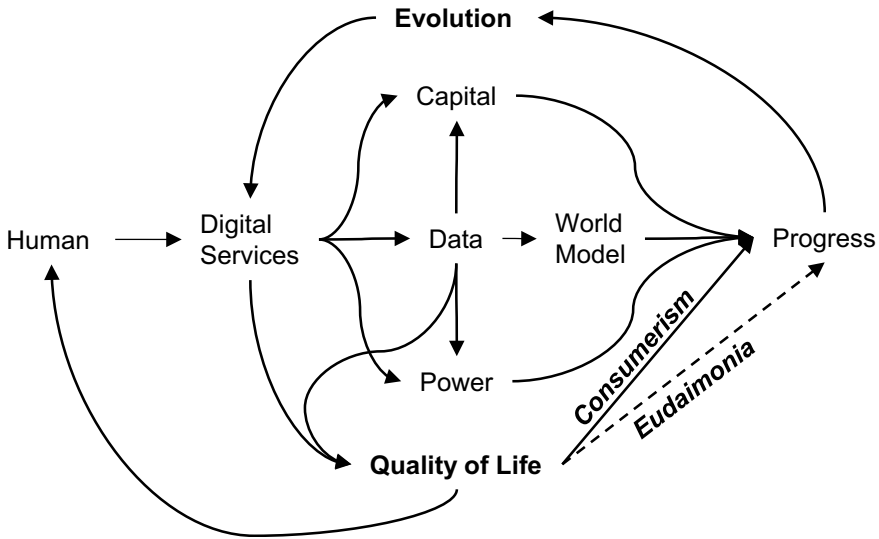


Fig. 6.1 Quality of life embedded in digital services

Data analytics and learning algorithms evaluate the **data** of billions of people to identify patterns and build a **world model** that links personal data with geospatial data, product data, and company data. Google not only knows what I am looking for but also knows the restaurant in my current area along with its opening hours, can connect me by phone and, in the near future, will also be able to book for me.

Digital services generate the **capital** and **power** that enables their further development (progress) on the basis of the **world model**. According to Tegmark, evolution, together with other technologies such as genetic engineering, brings humanity from the biological phase, which was determined by basic needs, and the cultural phase, in which we began to shape the world with our knowledge, into the **technological phase**, in which we further develop our own hardware and software [2, p. 29]. By 2030, we shall have taken clearly visible steps along this path.

Through this sociotechnical progress and capitalism, evolution has created a high standard of living for an increasing proportion of the world's population and thus largely satisfied their need for replication. In a society in which basic needs are met to a high degree, we are increasingly controlled by the **need for progress**, i.e. the acquisition of knowledge and selection. Digital services focus on that part of the needs which generates the most revenue and contribution margin, and neglect the needs of a good life with purpose and meaning. They primarily serve hedonic **consumer needs** (above all differentiation) and pay scant attention to **eudaimonia** because it generates little revenue. Expressed in the language of the class struggle: *Machine intelligence* uses the sweet poison of convenience and consumerism to lead us into dependence on global monopolies and their algorithms in the service of capital.

Capital controls the market economy in the interests of socio-technical evolution. The goal of evolution seems to be knowledge and intelligence, whereas the goal of humans is hedonia and eudaimonia. If the majority of AI researchers are right in saying that superintelligence and thus singularity will only occur in 70 years' time, it is worth our while to actively shape our lives for the better in the meantime. If we want to commit machine intelligence to human values and well-being, we must first understand what actually constitutes quality of life. Whether we can enforce compliance from the superintelligence, however, remains questionable.

If the goal of humanity is happiness, we must embed **quality of life**, and in particular **eudaimonia**, in digital services. To do this, we need to better understand what constitutes quality of life and how digital assistants contribute to it. Understanding the mechanisms of quality of life is doubtless a heroic goal. Overcoming the needs inherent in our genes and learned in education, especially those of differentiation, in order to avoid the described misguidance through evolution and to improve the quality of life through conscious and rational steps (happifiers) is probably an even greater challenge.

Sensory stimuli and thoughts are the triggers of happiness and unhappiness (see Fig. 5). They are not an objective image of reality but **subjective perceptions** such as in the virtual world of video games. *The task of Life Engineering is to enable perceptions that make humans happy, even if the perceptions do not come from reality but from a virtual world, as long as they lead to hedonia and eudaimonia.* This is a statement that will take many of us far outside of our emotional comfort zone and is just one example of the difficulties that a Life Engineering discipline will have to overcome.

For many years, millions of researchers and developers have been striving to increase enterprise value with information technology in the spirit of Milton Friedman. In comparison, science and business have devoted little effort to sustainably improving the quality of human life. If the current thinking on digital services and quality of life is correct, we urgently need a **Life Engineering**¹ discipline that systematically aligns technological development with human well-being, rather than leaving it to chance and intuition. At the moment, given the complexity and emotionality of the subject, we tend to bury our heads in the sand.

We need to look for ways to combine the goal of evolution, which we serve primarily through the needs of capital and power as well as self-esteem, with a high quality of life for humans. There is sufficient evidence that people, businesses, and societies that do not remain competitive through progress fall into relative poverty and, above all, dependence. *As long as there is no better control mechanism than capitalism, we need it, but we must extend it to include quality of life; in other words, facilitate progress toward a humane market economy.*

To avoid becoming too abstract, this chapter first describes concrete tasks for individuals, companies (including other organizations), and society, tasks arising

¹Not to be confused with Life Science, which deals with the biological processes of all forms of life.

from digital consumer services in the year 2030, and the findings on quality of life. Chapter 7 then outlines a discipline called Life Engineering, which is to develop the foundations for systematic development for human benefit.

6.1 The Individual

Individuals should know what constitutes their hedonia and eudaimonia, and which digital services contribute positively or negatively to them. *Humans in fact understand little about either quality of life or digital services and their consequences.*

6.1.1 Learning to Use Digital Services

The amount of time we invest in studying a user manual or general terms and conditions, in other words as little as possible, is perhaps the best gauge of our readiness to understand digital services and their consequences. We expect intuitive operation, i.e. without having to learn new concepts that go beyond the familiar. While digital services are no easier to master than driving an automobile, the consequences of their incorrect use are less obvious.

The first thing humans have to do is **choose** their digital services. People do not have an overview of the range of digital services on offer, do not understand the functions of these services sufficiently, and hardly notice whether a service contributes to their happiness or misfortune. The greater the volume of personal data a service provider can access, the greater its ability becomes to influence consumers in its favor. The consumer, on the other hand, has little awareness of this when agreeing to the general terms and conditions.

The next step is the **correct handling** of the selected services. Even the old familiar email and the different forms of instant messages can massively disturb a person's working day and leisure time. When the technology magazine *Wired* posts an article under the heading "Turn off your push notifications. All of them", this should make us stop and think. An average smartphone user in the US receives 46 **push notifications** per day [160], i.e. about 3 per hour based on 16-hour availability. Each push notification interrupts a train of thought and thus makes any fundamental consideration or the solution of larger tasks more difficult. This means increasing stress due to unresolved tasks and in many cases poor quality of work. Users also answer business messages in their free time and thus lose the separation between tension at work and relaxation at leisure. People in the environment of a digital communication addict conclude their relative importance from the addict's behavior, and their need for self-esteem suffers as a result. The communication of personal matters by email or instant messaging tends to lead to emotional escalation, which could be avoided by a face-to-face conversation.

People waste a lot of time searching, installing, learning, and continually **maintaining** digital services. They also experience stress in their private lives due to non-functioning services, forgotten passwords, lost files, or through checking debits from their bank accounts. The time involved in replacing obsolete hardware, be it with a new cell phone or a personal computer, is a case in point. For this reason, the renowned and successful internet entrepreneur Peter Thiel has even questioned the efficiency gain through digital services [126].

On the other hand, consumers want to enjoy the **benefits of digital services**. They want to communicate electronically (email, messaging, telephony, video communication), use books, newspapers, photo collections, games, and streaming services, access payment and other banking services, and communicate efficiently with public authorities. At the same time, they should be able to judge the value of internet information, from search results to social networks and blogs.

After all, people must learn the technical skills that their **occupation** requires. Even if schools could provide perfect technical training, employees would still have to keep up with new developments at least in their field of work and, in many cases, learn new jobs involving a high proportion of technology if machines take over all or some of the activities previously performed by humans.

*Individuals need thorough **training in technology** if they are to utilize the possibilities of machine intelligence to their advantage and avoid the risks.* Issues to be addressed here include the necessary digital services, the privacy of data, authentication and authorization, the risk of malware, the financial burden of subscriptions, and, last but not least, one's own IT administration.

6.1.2 Learning Quality of Life

A much more difficult task than mastering technology is mastering behavior and needs, i.e. quality of life. A person who tries to explain quality of life to an adult is likely to be dismissed out of hand and may well be regarded as slightly crazy, or at least as out of touch with reality. We prefer to expend all our energy running on the treadmill of evolution, seeking opportunities for differentiation and chasing after them. This can involve completing a vocational training course that is too demanding for us, climbing the career ladder to a position where we are out of our depth, aspiring to a perfect body that nobody will ever have, or to a musical skill that we will never achieve. We buy consumer goods that are more of a burden than an asset the day after the purchase, and unconsciously compare ourselves with friends or enemies in areas in which they will always be superior to us. *People need **happiness training** that helps them find a personal meaning in life, set realistic goals, ensure a sustainable work-life balance, and strengthen their self-esteem.*

Work-life balance is a particularly difficult tightrope act. A person who sees a part of her purpose in life in her job will only be satisfied if she can be proud of her performance in at least one area. However, this can only succeed if she invests as much or more than her peers, or is more talented. Those who perform less than their colleagues in the perception of the community are dominated by them. This means

loss of status and self-esteem. However, those who invest too much of their time in their profession (or hobby) run the risk of neglecting the other factors that influence their quality of life, above all friends and family. A person who primarily derives his self-esteem from his job will need an appropriate, meaningful activity after retirement, such as a part-time job in his traditional field of work or participating in civic engagement initiatives [161].

If it were possible to shut down the need for selection, i.e. the needs of self-esteem, status, power, and appearance, with a pair of “genetic scissors”, we would immediately get off the treadmill, but at the same time would probably switch off the drive to do anything that goes beyond preservation of the species. People we describe as particularly successful are almost always those who have put evolutionary needs (differentiation for the purpose of selection) before their eudaimonia. While the winners achieve eudaimonia by this means, the much larger number of losers end up with disdaimonia. Work-life balance means consciously maintaining a state of equilibrium between evolutionary needs and one’s own quality of life.

Every individual can try to avoid misguided evolution and reinforce behaviors that lead to happiness (happifyers). We can make the necessary decisions implicitly or explicitly. Decisions such as the disclosure of personal information, the use of an internet service provider, and committing to a therapy are often made implicitly and spontaneously because people like to avoid difficult decisions. It will also be difficult for digital assistants to encourage people to make explicit decisions, as the ARYA app is trying to do.

Digitalized therapies to combat obesity are an impressive example. Overweight patients are aware of the problem of obesity, but are not able to commit to long-term therapy and thus damage their quality of life. Experiments conducted with a therapy assistant prove that weight loss is impressive as long as the therapy is followed, but that the need for eating high-calorie foods and for comfort instead of strenuous exercise is too strong. Short-term hedonia dominates eudaimonia and also harms hedonia in the long run (e.g. painless mobility) [162].

6.1.3 Securing Autonomy

A particularly emotionally charged question is the **autonomy** of the individual, the delegation of tasks to digital assistants, and consent to the use of personal data. Readers are invited to decide for themselves which of the following questions they answer with *yes*. What is your spontaneous, emotional response, and what is your rational response when confronted with quality of life considerations?

- Do you use a search engine like Google even though you don’t know which sources Google evaluates and how Google ranks the results?
- Do you allow a digital service to decide what is important to you with push notifications (e.g. storm warnings)?
- Do you follow the navigation service in the car?
- Do you buy a bank’s investment product if the robo-advisor recommends it?

- Would you like to meet a partner who is suggested to you by an electronic dating service?
- Do you answer messages on Facebook, WhatsApp, WeChat, etc. within 5 minutes?
- Do you allow the use of cookies, and the transfer of your data from one service to another, and thus a subtle influence on you?
- Do you allow a digital service like Facebook to access your contacts?
- Do you have a genetic test performed, e.g. by 23 and Me; do you accept public access to your intimate health data; and do you trust the machine analysis of the gene structure [163]?
- Do you allow your DNA data to be used by a dating service if it increases the likelihood of a successful relationship?
- Do you use the option to register with a digital service through a social network like Facebook or Twitter if this enables the service to further refine its collection of data relating to your person?
- Do you allow a bank's client adviser access to your camera in a video conversation if you suspect that the bank is evaluating your facial expressions to better understand your response to the adviser's statements?
- Do you use the photos posted on social networks to compare yourself in your community?
- Why do you allow a fitness tracker to dictate your diet and physical exercise?

Why have I been working on this topic for years, and why do I summarize the findings in this treatise? There is no economic motive (need for capital) behind my endeavors. Perhaps I am moved by the need to preserve the species and ensure an appropriate quality of life for future generations. Another driving force could be the pursuit of knowledge, the desire to understand connections, and derive solutions to improve quality of life; in other words, scientific curiosity. An alternative answer, however, might be that I would like to demonstrate the scientific prowess I still possess at the age of 70 to my community, which can be interpreted as the inherited and lifelong needs for status and self-esteem.

The consequences that the individual should draw from what has been said can be summed up in three words: ***Learn to live.** An important part of this is the use of digital services for the benefit of the individual.*

6.2 The Company

The aim of company management is to achieve a sustained increase in **enterprise value**. The most technologically advanced companies determine the direction of development. Business administration and management consultancy first referred to technological advance as *automation* (e.g. payroll accounting), then as the *redesign of business processes*, since the advent of the internet using the embellishing adjective *electronic* (e.g. electronic banking), since the success of mobile apps as *digitalization* and since the advances in data analytics as *artificial intelligence*.

Millions of developers, consultants, organizers, and entrepreneurs use all their creativity and energy to search for new digital solutions and the associated business models. We must accept that, *in the long run, only technologically and organizationally advanced companies can successfully compete, ensure the economic prosperity of society, and create the space for improving quality of life.*

In this section, the view presented is from the perspective of companies, not that of consumers, even if the argument seems to run counter to considerations regarding quality of life. Companies need to examine how they can utilize quality of life for their corporate goals. In the following, I focus on this aspect and therefore refer to Hess [164] or Gassmann [165], for example, with regard to the general entrepreneurial potential of *machine intelligence*. Fleisch et al. present numerous sources [166] specifically relating to business models arising from the Internet of Things.

A Life Engineering discipline should provide companies with answers to the following questions:

- What opportunities and threats will arise from the consumer scenario in 2030?
- What human needs can the company satisfy?
- What steps will the company have to take to achieve the transformation?

6.2.1 Digital Service Development Capabilities

First of all, it must be remembered that the people who lack an **understanding of technology and quality of life** are not only consumers but also employees. Few business innovations can be expected from these employees as long as existing levels of prosperity make efforts to understand technology and quality of life unnecessary, and technical ignorance is even worn as a badge of honor. Companies need employees who understand the world of the consumer in technical and human terms as they will be the ones with the ability to identify the opportunities and threats posed in the year 2030 and to develop entrepreneurial solutions.

While in some cases companies are strongly committed to promoting *MINT* subjects (mathematics, information technology, natural sciences, and technology), in many countries they are still not doing enough to at least prepare people in their regions for the demands of technological competition. *A fundamental step is to explain the job descriptions of the information age.* How should the son of a saleswoman, the daughter of a lawyer or a teacher know what the quality inspection of medical devices involves for the employee, and what the salesman of digital services does in his daily work, or how a plumber communicates with the architect? Why should students face the requirements of a MINT subject when they associate it with predominantly negative assessments of the technical professions (e.g. programming slave)? The school system can neither grasp the diversity of new occupations sufficiently quickly nor communicate it convincingly.

6.2.2 From Provider to Consumer Paradigm

Companies usually have an inside-out view of consumers. The **consumer journey map** (see Hess [164] pos. 2443), as used in very elaborate form, for example, with Strativity's *Touchpoint Dashboard* [167] to examine the quality of the customer relationship and to find starting points for improvement, begins with a company's touchpoints, i.e. the occasions when the company interacts with the consumer. While it is certainly one of the consumer's goals to work smoothly with a company, the consumer attaches far greater importance to having one company that performs the tasks of daily life comprehensively, independently, and satisfactorily. Some banks have succeeded in combining the operations of searching for, selecting, financing, and moving into an apartment on a real estate portal, a considerable step forward for companies that only want to sell mortgage loans. The goal of consumers is nonetheless their idea of how they want to live their lives. The associated needs determine their feelings regarding the as-is situation and the to-be situation. Their perception of the quality of the residential neighborhood, the distance from the workplace and shopping facilities, their taste in furnishings, and, of course, the financial burden must match their needs. They avoid the complexity that arises from doing business with a variety of different companies. Companies that want to offer a home assistant must start from the needs of the occupants, not from the capabilities of their own organization. They must achieve a paradigm shift from enterprise to consumer centricity. Automotive manufacturers have been trying for many years with varying degrees of success to move from a customer relationship centered around the car to a platform for mobility [58], but this may fall short of the mark because mobility is often associated with other services such as appointment scheduling or therapy.

The development of automotive navigation impressively illustrates the urgency of the paradigm shift. The first versions of the digital navigation service appeared in the nineties. Garmin, TomTom, and others were able to achieve a considerable spread with stand-alone devices. The automobile manufacturers installed a proprietary navigation system in their vehicles. Users then had to buy and install updated road maps on CD (Compact Disc) again and again. The automobile manufacturers were able to differentiate themselves somewhat from the cheaper, separate devices through the ready-installed system and the improvement of the location by means of vehicle data like speed and direction. Nonetheless, some motorists were already using freely available navigation services on their laptops and downloaded the latest road maps at home from the internet. This meant they no longer had to buy the expensive optional extra of navigation and road maps. Planning a route on the laptop was easier than with the tedious user interface of the built-in navigation service. The smartphone and the 3G mobile network marked the next step. The road maps and traffic reports, especially the traffic jam reports, were always up to date online without the driver having to worry about them. Automobile manufacturers slowly followed suit, but drivers often preferred the smartphone to the expensive navigation equipment option. The solution on the smartphone was not only cheaper (Google Maps and Apple Maps are free) but also

much easier to use. The travel planning can start outside the vehicle and distances covered after the road journey, e.g. the last part of the trip on foot, can be part of the route. The next simplification from the consumer's point of view was being able to enter the destination. Google and Apple use all their address data, the user's contact data, and even their search engines, and suggest individualized destinations based on the knowledge about the user. *The consumer paradigm demands extensive personal, product, service, and provider data.* The vehicle and geospatial data are not sufficient.

Navigation has become an integral part of the smartphone. For route planning and guidance, the user's relationship with the automobile manufacturer is largely irrelevant. The only thing that counts for users is that the navigation system leads them as conveniently as possible as well as providing all the information (e.g. appointments) and services, and that they can use other apps such as Spotify or the phone easily and in the way they are used to from the smartphone. This includes the fact that navigation also encompasses public transport, bicycles, pedestrian routes, taxis, and car sharing (e.g. Citymapper). The focus is not on the automobile manufacturer but on the consumer. A comparison of the most recent versions of navigation services offered by automobile manufacturers (e.g. HERE Mobility) with the free navigation apps from Apple and Google (including Waze since 2013) illustrates the problems facing the automotive industry. In some cases, they have abandoned the development of their own apps based on *connected car* technology and adopted Apple's CarPlay or Google's Android Auto, thus making all apps released for in-dash use from these two megaportals available in the automobile. The car manufacturer now only provides the user interface devices, the screen, the microphone, the loudspeakers, and a few buttons on the steering wheel [168]. It will be interesting to see whether automobile manufacturers take advantage of their access to vehicle and traffic data in their products to come up with differentiating services, such as accident alerts, before the megaportals do.

Consumers are part of an ecosystem in which they obtain services from many providers from a single platform in order to accomplish their tasks. The **customer process** of a consumer is not the process involving an individual company but the process in which the consumer interacts with all the companies required. The customer experience is often related to one or more touchpoints with a given company. When it comes to quality of life, however, the consumer's feelings over the entire consumer process and in the interactions with several companies are decisive.

The consumer process is not as repetitive and structured as a business process, and is more of a spontaneous approach to solving a task. For most companies today, it will still mean a paradigm shift if they want to see the customer, rather than themselves, at the center of a process (see Fig. 6.2). Car manufacturers want to sell navigation systems, while consumers see navigation as a small part of a trip or a working day spent at different locations (e.g. construction sites for a tradesman).

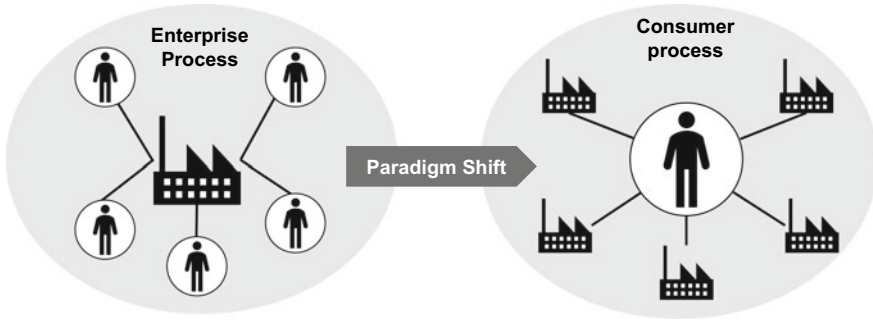


Fig. 6.2 Paradigm shift

6.2.3 Access to Personal Data

Consumers are leaving behind increasingly detailed digital data trails on all digital services, from the navigation app and the internet search engine to credit card payments and television viewing or book reading behavior. If a company wants to respond to consumer needs and feelings, it needs access to personal data and the resulting patterns of millions of consumers and their environment (world model). From these patterns, a travel agency can select potential customers who are likely to be interested in certain destinations. It can derive individual preferences and aversions not only from the travel history of specific consumers but also from their reading behavior in conjunction with digital journals and books, and in 2030 this will encompass even more indicators of feelings than today, in particular from the voice and noise analysis of voice controls and from the health data on smartwatches and smartphones. By offering targeted information, it can also steer the needs of consumers in the direction of its products and services, for example by incorporating newspaper articles about a specific vacation destination or activities at that location into consumers' news feeds. In the USA, 41% of adults read daily news on Facebook, which customizes the news selection to the reader [169].

The **access to personal data**, both generalized and individual, becomes a decisive competitive factor. The battle for navigation data being fought by Google, Apple, Inrix, and HERE illustrates how personal data determines the market position of companies, with people's location data as a case in point. Navigation, traffic jam forecasting, car park search, driving safety, travel expense accounting, and restaurant recommendations are digital services based on personal data. These services help to decide whether the built-in navigation of an automobile manufacturer influences the buyer in favor of the brand or whether the navigation app on a smartphone devalues the built-in navigation system as a selling point or optional extra. The consumer's ecosystem determines who can access what data. The companies within the ecosystem collect customer data at their touchpoints and allow each other to access this data.

Major tasks for consumer-oriented companies are the development of their specific consumer data model, data collection, access to external data, the consolidation of data from the various sources, and the understanding of customer behavior.

6.2.4 Monetizing Hedonia²

Companies use hedonia to attract consumers to their products and services. Marketing formulates generally accepted guiding principles such as “The first rule for all market-focused actions is to create customer benefits” [170, p. 5]. Companies largely pursue consumer interests when they are guided by consumer needs, and are economically successful when they match consumer interests.

Benefit means satisfying the needs of the QLM. Hedonia means that it is not about the long-term well-being of consumers (eudaimonia) but about short-term satisfaction, i.e. pleasure.

I have installed a Netatmo weather station that measures and records the CO₂ content of the air, humidity, temperature, etc. indoors and outdoors in my apartment. My justification for the purchase was the knowledge I would be avoiding excessive CO₂ levels and ensuring a relative humidity of at least 30%, and thus attaining a gain in health and well-being. The benefit argumentation was therefore clear. However, the decision to purchase was probably driven far more by the fact that I would be able to observe the various measured values and to understand the quality of the indoor climate (knowledge, power). Moreover, I also enjoy demonstrating my technical credibility (status) to friends with an affinity for technology. In return, I accepted having to pay a high price, install the external and internal stations (efficiency), and surrender the measured values to the Netatmo cloud (security). The pleasure gained from the needs of knowledge, appearance (technical understanding), power (ability to control the indoor climate), self-esteem (pride in a being one step ahead), and health (less eye irritation) outweighed any discontentment arising from purchase price (capital) and the work involved with the installation and operation (efficiency). The question is whether the developers and marketers of the Netatmo weather station were and are sufficiently aware of these needs of their purchasers.

For some years now, attempts have been made, with great difficulty, to employ digital services [171, 172] that record biometric values through sensors and provide immediate feedback to assist obesity therapies. Patients suffer physically and psychologically from their overweight, are willing to undergo therapy, but nevertheless fail to stay the course. If the needs stated in the Quality of Life Model in Chap. 5 are used as a checklist, the following conclusions can be drawn.

The needs of self-esteem and status are obviously the drivers for starting any therapy in the first place. Obesity is negatively sanctioned in almost all communities

²The emotional contrast between the terms monetization and hedonia or eudaimonia is intended to highlight the difference between the perspectives of companies and consumers.

in highly developed societies. It even prevents participation in certain communities, such as sports groups. As well as contradicting the beauty ideal of fashion journals, being overweight does not correspond to the common notion of a healthy appearance and leads to medical problems. Obese people are often much lower in status than people of normal weight and thus lose their attractiveness to desired sexual partners.

The feeling of hunger is not primarily controlled by consciousness but by hormones such as insulin and noradrenalin (through stress). For obesity patients, therefore, this means one part of the brain consciously fighting against another part that is hormonally controlled and unconscious. The feeling of hunger and the expectation of satiation at the sight of energy drinks, pies, and roast pork have such a strong impact on the need for food that hedonia surpasses all other needs for the moment, only to turn into a feeling of regret shortly afterwards.

Digital services such as PathMate2 [173] are still unable to cope with this situation. Part of the problem is inherent. The effort required to record the ingested food and the rewards for renouncing or selecting the right food prevent long-term use of the apps. In the year 2030, when the smartphone or wearables automatically recognize and record food, analyze the patient's breath, note fast food consumption, detect body weight, and record exercise and the related effort, the high hurdle of data entry will be removed. However, the patient's discipline still stands in the way. The hedonia from the expected enjoyment is greater than the eudaimonia from delayed rewards in the form of weight loss and the associated recognition. The patient needs an immediate reward while facing the decision to ingest food. This could be, for example, a competition in a community of obesity patients where the patient's current therapy discipline would be published on his page in the social network. Another option might be feedback from a chatbot, which immediately provides a positive reinforcement for the patient's adherence to discipline. The patient could also take part in a VR game and be rewarded for "Lenten sacrifices", for example, by receiving a key for the next game level (capital). A mere graphic showing weight development in a daily short message or a humorous reminder can help reason (consciousness) in the fight against hormonal control. An influencer could set an example for the therapy. The therapy assistant will be successful if the patient receives automatic feedback at the time of the decision for or against eating a certain food, which increases the need for self-esteem to such an extent that it outweighs the need for food.

The *Unified Theory of Acceptance and Use of Technology 2* (UTAUT2) [174], which Venkatesh et al. tested in an empirical study in Hong Kong on the use of mobile internet services, explains the acceptance of digital services on the basis of factors (see Fig. 6.3) similar to those of the Quality of Life Model proposed in Chap. 4.

Effort expectancy, relearning (habit), and help with use (facilitating conditions) are components of efficiency. The performance expectancy and the hedonic motivation can relate to capital, community, appearance, power, knowledge, status, and self-esteem as well as security and efficiency, so they are rather fuzzy and contribute little to the successful design of digital services. Venkatesh et al. detail hedonic

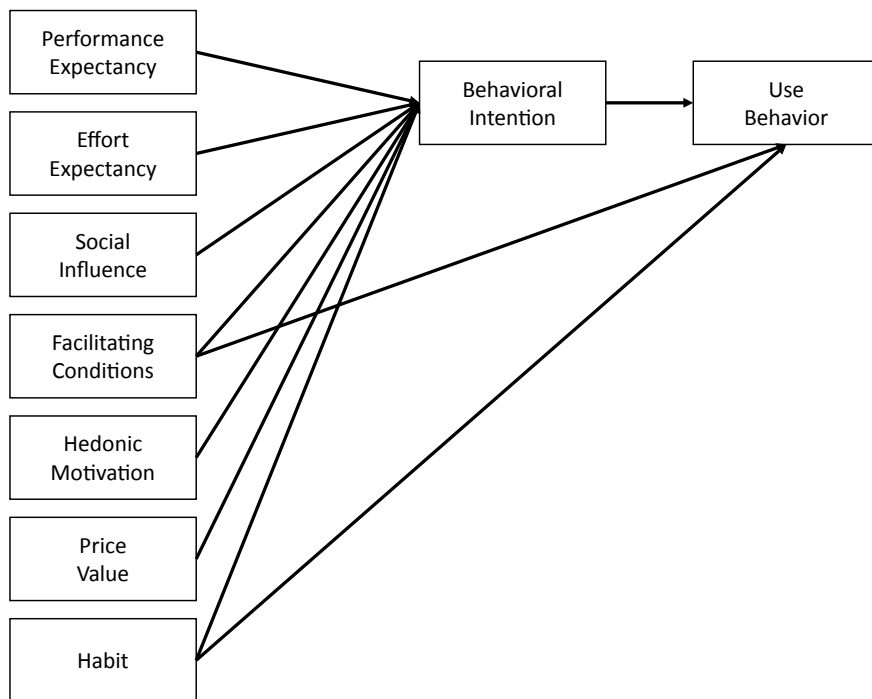


Fig. 6.3 Unified theory of acceptance and use of technology 2 (simplified)

motivation with references to further literature, but do not include it in the UTAUT2. The sheer act of examining a service on the basis of the 13 needs of the QLM will sharpen the view of developers. Far more concrete success factors for a digital service are provided by Blankenagel et al. on the basis of a specific example, the digital stress management system, which they investigated [175].

Consumer needs drive the consumer process. *When consumers have more disposable income than required to cover basic needs, the needs of **comfort, status, security, self-esteem, knowledge, and price (capital)** come to the fore.* A patient abandons obesity therapy because the needs for self-esteem, status, appearance, and health are weaker than the needs for food (pleasure) and efficiency (e.g. convenience through snacks or ready meals).

As numerous experts point out in their predictions for the future of the automotive industry, the intelligence of the automobile is set to become more important for the consumer's appearance, status, and self-esteem than its mechanics. What products and services will people use as status symbols in the year 2030: car, watch, clothes, apartment and furniture, holiday trip, presence on social media, game level in video games, education and culture, entertainment, or esotericism? Brand and luxury are instruments of **differentiation**—for some companies a danger, for others an opportunity. Consumer goods companies are faced with the choice of serving the

consumer need for differentiation in the luxury segment or competing on price in the mass market, particularly as a result of the comparison portals on the internet. In recent years, an increasing **dichotomization** of the market has been observed.

The needs shown in the QLM in Chap. 4 are patterns that are anchored in the world model of consumers and must be broken down into further patterns. Body, face, clothes, car, apartment, title, and profession are some of the things that together determine the need for appearance. *The needs presented can serve as an initial checklist for the development and marketing of digital services, but the discipline of Life Engineering must develop them further to make them more concrete and operational.* The media, and digital media in particular, invest a great deal of energy in attempting to influence the patterns that consumers associate with attractiveness. These patterns are subject to change.

6.2.5 Monetizing Eudaimonia

Companies face a far more difficult task monetizing the eudaimonia of consumers than in the case of hedonia. The problem of obesity therapy can also be seen as the dominance of hedonia over eudaimonia. Companies and consumers pursue the same interests in many areas when companies orient themselves toward the benefits hoped for by the consumer. Better products, additional services related to the products, lower prices, and faster availability not only secure a company's competitiveness but can also bring the consumer a sustainably better life beyond the current hedonia, if they promote health, increase security, expand knowledge, and ultimately strengthen self-esteem.

Advertising relies on the **hopes** of consumers, even if the associations conveyed have little or nothing to do with the product. When is anyone likely to drive a four-wheel-drive car through a swamp or frozen wastes? When will the consumer meet the beautiful woman or the attractive man who features in the cleaning agent commercial? The confectionery commercial shows slender, joyful children, while the beer commercial does not show people with beer bellies and blurred vision, and the car commercial does not show pictures of road accident victims. Advertising is also hardly likely to show how the renunciation of these products promotes eudaimonia, as this would not be conducive to revenues and earnings.

However, there are examples which show that digital services can promote eudaimonia, and these are advertised as such. Since 2015, health insurance companies in Germany have been legally obliged to reward their customers for a healthy lifestyle, and advertise different models for sport and healthy nutrition. Motor vehicle insurance providers offer reduced premiums for safe driving. Sports footwear manufacturers offer platforms for running communities and the comparison of training performances. Alarm systems force compliance with security measures. These examples have an effect not only on hedonia but also on eudaimonia.

But does intensive running training in competition with a comparable group harm health more than it benefits it? Do health insurers punish genetically

disadvantaged customers? For each example, there are counterarguments that call into question the benefits for companies or the contribution to eudaimonia. *The operationalization of eudaimonia is much more difficult than that of hedonia, which stands in the way of monetarizing eudaimonia.*

The question can be posed the other way around: Which companies and products satisfy not only replication needs and hedonia but also the needs for lasting satisfaction and a meaningful life? The value of a fashionable pair of trousers disappears shortly after they have been worn for the first time or at the sight of a more exclusive alternative. Even an expensive car and a luxury villa do not give meaning to life and lasting satisfaction. The needs for progress and differentiation are relative over time, and the benchmarks are subject to habituation and based more on hope than fulfilment.

Where do a company's profitability and a consumer's quality of life converge? Can a company earn from the consumer's eudaimonia? Does it even know what contributes to hedonia and what contributes to eudaimonia? The marketing and sales specialists have a versatile toolbox at their disposal for influencing the purchase decision. They possess methods for determining the benefits hoped for by consumers. In other words: They have learned what motivates the customer to buy. But to what extent do the buying motives coincide with eudaimonia?

In the process of elimination, companies could dispense with anything that harms consumers' eudaimonia, such as fattening sweets, alcohol, cigarettes, or overpowered vehicles. But how does a company earn by not selling, and where does *machine intelligence* help?

If the instruments of evolution described in Sect. 5.1 are used as a checklist, one can find many indications of unhappiness as a result of striving for hedonia but almost no suggestions for eudaimonia. From the perspective of companies, avoiding misguidance consistently damages their business. On the other hand, starting points can be found in the tools for quality of life (happifiers). Facebook wins customers and generates revenues by creating and nurturing communities (e.g. hiking groups) that give people a feeling of security on a long-term basis. In a virtual world, game providers can enable their customers to forget their everyday worries and experience a sense of achievement. Digital health services are expected to show strong growth up until 2030, but the willingness to pay for preventive healthcare is low, and therapy is focused on traditional healthcare providers such as doctors and hospitals.

The happiness coach from Sect. 5.2.11 could help people to avoid evolutionary mechanisms that are detrimental to happiness and to systematically use happifiers. The biggest obstacle is the willingness to pay for a digital happiness coach, especially since consumers are used to a seemingly free world in the context of digital services. Health services such as WebMD must be funded through the sale or promotion of products or premium services. A company may be able to promote consumer eudaimonia in the longer term, at least in specific areas such as security, and achieve economic success through a particularly strong customer relationship. Pragmatists may well tend toward Milton Friedman's phrase "The business of

business is business”, and refer to the quality of life of the consumer as a nice-to-have.

If we do not want to accept pernicious competition and destructive consumerism as undesirable side effects of technological evolution [174], we must make the eudaimonia of people (consumers and employees) a corporate goal. We have to find ways to combine financial goals with the goals of eudaimonia. If quality of life becomes operationally measurable, the chances of achieving it will improve. The research area Life Engineering can then try to pursue the goal of quality of life through the subgoals *hedonia*, *eudaimonia*, *profit*, and *competitiveness*.

In any case, it is worth looking for ways to steer quality of life, because if we cannot find answers to these questions, those companies that generate the greatest profit will determine the direction of development and thus have the greatest development and marketing capacity. While this will advance evolution at least until the companies reach a monopoly position, it will, however, endanger quality of life. It is to be hoped that computer science, economics, and law as well as business ethics and other disciplines will find feasible concepts for steering corporate management in the interests of human well-being. It is probably easier to do this in a new discipline of Life Engineering than to dismantle the thought patterns of established sciences. Perhaps this idea is as naive as Bostrom’s desire for an initiative on the part of the noblest and most intelligent humans to master superintelligence.

6.2.6 Corporate Social Responsibility

Corporate social responsibility has long been a topic of management theory, and one would expect it to pursue eudaimonia as a corporate goal. ISO 26000 [177] lists human rights, working conditions, the environment, fair competition, consumer protection, and social commitment as core topics of corporate social responsibility. It formulates seven principles: responsibility, transparency, ethical conduct, respect for stakeholders, compliance with the law, compliance with international standards of conduct, and human rights. While the associated initiatives are indeed welcome and the ISO standard reflects established patterns of thought (slogans, narratives), these concepts are extremely vague, which probably explains why little progress has been made despite many serious efforts.

Looking at the core issues and principles, corporate social responsibility obviously wants nothing more than quality of life for all the people affected by the company. *Companies that strive for corporate social responsibility can make their efforts more concrete if they refer to the needs of replication and progress presented here, explain them in detail, and present them as patterns of perception.* Examples include avoiding working hours that are harmful to health or checking general terms and conditions for comprehensibility.

Hansen and Schrader describe the motivation for corporate social responsibility [176] on the one hand with the business case in the form of reputation gain and other monetary results, i.e., ultimately, in part with monetization, and on the other

hand with altruism in the sense of social interests. From the perspective of companies, the focus is on monetization, while, from the perspective of individuals, the emphasis is on their human needs, and, from the point of view of society, on altruism.

Further research on corporate social responsibility could aim to monetize quality of life as a whole and, ideally, generate income streams from guidance on eudaimonia. This may sound utopian and extremely abstract, but becomes very concrete when a company considers whether it should earn money from advertising products to combat back pain, or whether it should offer a premium service with the support of health insurance companies that helps potential patients prevent back damage through dietary advice and gymnastics exercises. Monetizing health knowledge would be an effective form of corporate social responsibility.

6.2.7 Ecosystems and Monopolies

*The network and integration effect of portals promotes the **monopoly** or **oligopoly position** of providers of digital services and devices.* The need for efficiency (convenience and complexity) motivates the consumer to choose digital services that involve the least effort or the highest benefit. Each isolated service requires registration including the entry of data such as home address, the familiarization with a user interface, functional logic, and authentication mechanism, the understanding of a business relationship, and, last but not least, the installation, customizing, integration, and billing of the digital service. Consumers want to use as few different systems as possible, ideally to obtain the services of telephony, messaging, driving, television, therapy, home automation, etc. from one integrated, uniform system (see Sect. 3.3).

Companies must be present in whatever space the consumer occupies (traffic). They have to decide in which ecosystems they want to offer their services. For the innovator, this always raises the question as to when and if the **dominant players in the ecosystem** will replace their innovative service with their own developments. “In America, venture capitalists shy away from backing startups whose business centers on the consumer internet, because the likes of Google and Facebook are so dominant there” [68, p. 3]. Consumer goods manufacturers such as Adidas develop fitness trackers that are on the one hand connected as far as possible to their physical products, and on the other hand deeply integrated into a megaportal, for example into Apple’s Health app. Banks try to compete with payment services like Apple Pay and WeChat Pay by means of their business relationships with retailers, for example, or by means of their established credit and debit cards. It remains to be seen whether this approach will have enabled banks to retain payment transactions in the year 2030. By then, it will also be clear whether travelers prefer to use the apps of public transport providers such as Deutsche Bahn (German railroad) or a Google travel assistant (extended Maps). Even in the early days of electronic commerce at the end of the 1990s, it had already become clear that consumers were also looking for and ordering branded goods on megaportals such as Amazon and

booking.com, despite the fact that providers of coffee, hotel rooms, or pharmaceuticals were investing a lot of money in their own portals and apps with little traffic.

Operating systems, telecommunications services, IT equipment, automobile manufacturers, and online retailers have established oligopolies in many areas of life. Consumers' switching costs are so high that we have to speak of monopolies in some areas. This puts these providers in a position to implement a **monopoly profit**. The high margins of megaportals will be even higher in 2030. It will be interesting to see whether Amazon can turn its Prime service into a monopoly-like revenue stream if certain products and services are only available to Prime customers. On the one hand, this is a consumer problem, but, on the other hand, it is an obstacle to market access for product and service providers. They have to be present on the megaportals and therefore accept the terms and conditions of the providers. Google pays Apple nearly \$9.5 billion annually to place its search engine as standard in iOS [177].

In order to avoid the bottleneck of megaportals when selling, insurance companies, telecommunications providers, banks, airlines, and travel agencies, among others, differentiate their products through a bewildering array of product choices as well as incomprehensible terms and conditions. This protects them against price comparisons and undesirable performance claims. *Dealing with the oligopoly of megaportals is becoming a critical strategic decision for providers of consumer products and services.*

6.3 Society

To make a key assumption clear from the outset, I would like to point out that I expect individuals, companies and states to use (almost) all available technologies in the competition to achieve capital, security, power, status, and self-esteem. Based on the experience with gene editing, crypto currencies, and social networks as examples, it is difficult to imagine a greedy internet tycoon, a researcher craving for recognition, a terrorist, a power-hungry politician, or a lazy consumer who would refuse to develop or use a digital service with high potential for ethical reasons. To make matters worse, it is not a question of a yes/no decision but of many small steps, the consequences of which are not always predictable, and to which we have already become accustomed in many areas. *Development cannot be halted. And those who resist development leave progress to others and become dependent on them.*

This is not about abolishing capitalism and the **market economy**, hindering the technological advance and development of businesses, promoting a crippling **bu-reaucracy** for the well-intentioned purpose of protecting society, or nurturing social illusions. The aim is rather to look for ways to promote technological and economic progress and, at the same time, to secure and strengthen human quality of life. Anyone who wants to control development in the interests of quality of life

must be at the forefront of development in order to shape digital services and how they are handled. In short: *Lead or be led!* And this is only possible in a market economy.

Since 2017, the OECD has been running a Going Digital project, which develops recommendations for governments on how to deal with digitalization. The first results were presented at the Going Digital Summit in Paris in March 2019. The project deals with the following policy topics [26]:

- Artificial intelligence
- Digital consumers
- Digital infrastructure
- Digital security and privacy
- Education and skills
- Labor markets
- Productivity
- Public governance
- Science and innovation
- Tax
- Trade
- Well-being

The OECD is therefore addressing all the main policy areas for tackling digital transformation. It aims to create the conditions that will enable everyone to design and use machine intelligence. Success is measured by metrics such as access to broadband internet for the population or training in information technology. It offers an extremely comprehensive collection of topics and proposals for action, which are referred to here to complete and expand the tasks of the state. However, the aim of this book is to use the QLM to derive tasks for society and the economy that promote human happiness and avoid suffering, even if it is extremely difficult to formulate solutions at this stage. The first step is to raise awareness of these issues among representatives of business and labor, civil society, and politics.

If the goals of companies and the goals of human beings compete with each other in part, people will have to work together with the help of the state to achieve their quality of life goals. This does not mean that the state and public administration should take over the development of machine intelligence. *If the necessary solutions are to be developed with sufficient speed, we must rely on the creativity and competition of the private sector; the state must confine itself to setting and monitoring the objectives.* While the GDPR and eIDAS are attempts in this direction, their value will still need to be scrutinized. Business solutions for data privacy and authentication security that are voluntarily and readily accepted by consumers are preferable to government regulations with a high level of bureaucracy for everyone involved.

From their perspective as economists who assume that the digital transformation will lead to a shift to investing in intangible rather than fixed assets, Haskel and Westlake arrive at similar recommendations to those described below: “The shift

also changes the public policy agenda. Policymakers will need to focus on facilitating knowledge infrastructure—such as education, internet and communications technology, urban planning, and public science spending—and on clarifying IP regulation but not necessarily strengthening it” [180, p. 141].

6.3.1 Education

For individuals, companies and states, having the right skills will be the prerequisite for winning the competition of digitalization. Since education is provided primarily by the state, the following requirements will have to be met:

- All citizens should at least have a technical command of the digital services they need on a daily basis, and understand the possibilities and consequences of those services.
- In dealing with machine intelligence, humans need a deeper understanding of basic technological concepts (e.g. data backup, DNA) than at the time when our curricula were created.
- Factual knowledge is losing importance in a world of search engines and powerful man-machine collaboration (from Google to Alexa and Oculus Rift). New facts, such as sources of information or rights and obligations in electronic banking, are becoming more important than Goethe’s date of birth, state borders in the Middle Ages, or even vocabulary in foreign languages. The renunciation of cramming factual knowledge creates space for practicing skills.
- The more people understand about quality of life as consumers or as company employees, the more likely they are to have a chance of championing its cause.
- Those who believe in democracy must also educate in political decision-making.
- Digital skills must be taught through new digital channels and continuously adapted in line with innovation; conventional schools should limit themselves to the basics.

6.3.2 Infrastructure

The goals of the **connectivity** of people and things are usually referred to by the politically simplified blanket term **bandwidth**. While actual bandwidth is also at stake, a far more important aspect is ensuring the appropriate access for all, reliable availability, and, at another level, the protection of data transmission against unauthorized access and fraud.

The biggest obstacle to facilitating the use of digital services by consumers is not bandwidth but the complexity of information technology and services on the one hand, and the level of education of users on the other. Most consumers have little chance of finding, learning, and administering all the services that are of value to them and therefore are often left behind in a digital divide. A stable configuration of

the digital helpers that are needed on a daily basis is more useful to consumers than installing the latest and best marketed services. It might be worthwhile trying to specify cost-effective **standard features for devices, programs, and online services** as a template for consumers and providers. These could include a broadband connection, a smartphone, a telecommunications contract, and a social network. If consumers could obtain individual, preconfigured modules that form part of a compatible overall solution and did not have to worry about either the general terms and conditions or the update, significantly more citizens would be able to benefit from the digital possibilities, which in turn would boost their skills. The state could put this standardization out to tender and allow several standards in parallel, as is also the case with the development of the telecommunications infrastructure (currently 5G). This would require less effort than that invested by the manufacturers of the operating systems iOS, Android, and Windows in certifying applications on their systems. It would simply be a matter of relieving the consumer of some of the choice, adaptation, and operation. Since consumers who are used to ostensibly free services are not willing to pay for such a solution, private providers are unlikely to emerge.

The counterarguments are obvious: distortion of competition, obstacles to innovation, and increased bureaucracy. These arguments apply even more strongly against the certification of devices and software (for a fee) by companies such as Apple, but are current practice.

6.3.3 Authentication

A trustworthy *authentication* of consumers and business partners with single sign-on (SSO) simplifies the use of many IT applications. It remains to be seen whether this form of authentication will be provided by Facebook, Google, Alibaba, and other megaportals, or how specialized companies or industrial consortia will operate the issuance of passports on behalf of and under the supervision of the state. Schmidt and Cohen already wrote back in 2013: “Your online identity in the future is unlikely to be a simple Facebook page; instead it will be a constellation of profiles, from every online activity, that will be verified and perhaps even regulated by the government. Imagine all of your accounts—Facebook, Twitter, Skype, Google+, Netflix, New York Times subscription—linked to an ‘official profile’” [10].

To date, neither government agencies nor banks, insurance companies or the postal service have been able to establish secure and government-approved identification of persons in the digital world. In Germany, several private-sector consortia are trying to establish an authentication service. These include netID.de, verimi.de, and id4me. For convenience, many consumers use authentication via the megaportals and, in doing so, facilitate the collection of their personal data.

In 2014, the EU adopted an Electronic Identification and Trust Services (**eIDAS**) Regulation, which is aimed at enabling secure and seamless interactions between businesses, citizens, and public administrations. It provides the basis for electronic trust services such as signatures, seals, stamps, delivery services, and authentication

of websites [181]. An EU website on eIDAS states: “[...] in Estonia you can set up a limited liability company in just 18 min using an eID!” [182]. In contrast, the progress made with the eSignature Directive introduced 17 years ago is barely noticeable as far as citizens are concerned.

India is introducing the digital, biometric identification system Aadhaar (fingerprint, iris, face, DNA) as part of its Digital India strategy. This already supports secure payments and the issuance of SIM cards [183] as well as numerous public services such as eVoting, Ratio Cards (for food and fuel), tax returns, and pension provision [184]. Switzerland plans to leave the electronic identification of citizens to consortia of Swiss companies under state supervision [185]. While India is introducing a single identification system for 1.3 billion people, there may be well over 50 country-specific services for 0.7 billion people in Europe, which, despite the eIDAS standard, will make cross-border activities within Europe more difficult for citizens and the monitoring of which is correspondingly time-consuming. This is a disadvantage for the economy and for quality of life.

*The **reliable identification** of a communication partner on the internet will not only make the login with user name and password for each individual service superfluous but, in combination with further measures, will also replace the sending of legally binding paper documents, make electronic banking more secure, and protect against unsolicited messages (advertising, phishing, viruses), for example, by only accepting messages from authenticated senders.*

Authentication is a task comparable to that of a state passport system. While the issuance of a passport by the state administration is taken for granted, we now accept large amounts of our personal data being held by organizations under foreign jurisdictions with little or no supervision. This will become even more of a hot topic when biometric data is used for authentication.

6.3.4 Common Personal Database

The handling of personal data can change people’s quality of life more than almost any other issue. The more digital assistants know about us, the better they can help us. *The more intensively research and development analyzes the huge amount of personal data and hence understands the factors of quality of life, the more valuable machine intelligence becomes.* The more precisely service providers or government agencies know us, the more they can manipulate, control, and ultimately steer us.

Where should personal data be stored? With the individual, with the providers of the services used by the individual, with the state, or with a company commissioned and controlled by it?

*A **common personal database** is conceivable, provided that the relevant legislation is in place: This might entail the state certifying or commissioning two to three competing companies to store all personal data.* In this scenario, the state formulates rules for access to the data by any service provider, from search engines to doctors. It monitors compliance with security and data disclosure regulations.

Consumers can decide for themselves which data they want to pass on to whom, either in a personalized or anonymized form. The costs of the database operators and the state are paid by the data users.

This solution sounds convincingly simple, but, in reality, it would have to struggle with considerable problems:

- What can be done to ensure that all digital services used by an individual deliver all personal data to the database operator? At best with the threat of legal sanction, as in the case of data protection legislation?
- Is it possible to store the semantics of the data without the algorithms to enable their use in a single, comprehensive data structure?
- Can it be guaranteed that the data is protected against cyberattacks and can be read for a lifetime?
- What can be done to ensure that all data is used exclusively for the agreed purposes approved by the individual?
- Should the state be able to access personal data against the will of the individual if it is in the public interest?
- What can be done to check that no reidentification takes place through the combination of characteristics when the data is published anonymously, e.g. for medical research?

Anyone who spontaneously agreed to the idea of a state-controlled central database service may well reject the idea once the question marks become clear. However: What is the alternative? Who answers these questions if there is no central database service? The individual? The state? The current situation is much more complicated [184]. *A state-controlled central database would not create any additional problems, but would simply increase transparency and thus simplify control.* Singapore has declared the comprehensive collection of data as a state strategy [185, p. 18ff].

The authentication companies mentioned above, which not only want to keep the identification data but also as much personal data as possible on a centralized as well as on a decentralized basis, obviously believe in a common personal database. The initiatives Open Data, MiData, and Re:claimID from the Fraunhofer Institute AISEC are further projects, which are limited to specific aspects.

“opendata.swiss is the portal of the Swiss authorities for open, i.e. freely available, data” [186]. All data stored there is not personal and can be downloaded and reused free of charge. The example of water consumption in private households quickly shows whether anonymized individual measured values or only aggregated data can ensure the protection of personal data. **Open data initiatives** of this kind can be observed in many cities (especially London) and states. The Australian government is currently preparing a bill to regulate the use of public data. The bill defines a data retrieval process that checks whether an individual’s anonymity is preserved, whether the requester is trustworthy and secure, and whether the purpose of the data is appropriate [189]. These are the same questions that apply to a central personal database.

MiData is a cooperative initiative in Switzerland [190]. Regional MiData cooperatives store health data such as DNA or the results of an individual blood test with the aim of ensuring that patients always have access to all their health data in a secure location, and with the vision of making this health data available for research in an anonymized form with the patient's consent.

Personal data is a key determinant of the value of companies such as Google, Apple, Amazon, Facebook, Netflix, Microsoft, Alibaba, Tencent, and Baidu, but also of many small players in the internet market. Why should a megaportal like Google want to forgo the exclusive ownership of its data? The political enforceability of a central personal database within a state and across states sounds like a Herculean task. For human quality of life, however, this political task is of much greater significance than many of the issues at the center of media attention and political debate, such as the destruction of jobs by robots, the decline of humanism through the extinction of the paper book, or the dangers of superintelligence.³

A law that would oblige digital service providers to release personal data would be tantamount to expropriation if it were assumed that the megaportals, and not individuals, had ownership of their personal data. Personal data provides the basis for a better understanding of humans, from the prevention of diseases in medical research and offers of insurance products in line with the customer's risk tolerance to the establishment of rules of conduct aimed at promoting eudaimonia. Access to this data is an essential basis for innovation and economic development.

6.3.5 Data Protection or Renunciation of Privacy

Data protection legislation attempts to ensure the protection of privacy on the one hand and the basis for competition in innovation on the other. The **GDPR** (General Data Protection Regulation) of the EU, which came into force in May 2018, regulates the processing of personal data by private companies and public administration. Many of the problems mentioned above in conjunction with a central personal database have become all too clearly visible with the advent of this legislation. The regulation has triggered a surge of bureaucracy in companies and in public administration. Even the individuals who are supposed to be protected by it suffer as a result: They must always accept the use of cookies and the handling of their data on every new website they visit. Almost without exception, they do so without knowing what they are agreeing to. For them, consent is reduced to the question of whether they want to use a service or not.

Kevin Koerner from Deutsche Bank Research investigates the question of whether the GDPR strengthens or stifles the European data economy [191] from the viewpoint of companies. He sees a great danger that European businesses, in contrast to their global competitors, could have too little access to personal data to recognize patterns with machine learning and to work on the world model. Overall,

³This applies just as much to the issues of egomaniacal populists as it does to those of the politically correct establishment.

he comes to a cautious verdict and believes that it will be necessary to keep an eye on developments over the next few years.

Privacy is a Sisyphus project. For CES 2019 (Consumer Entertainment Show), Apple launched the slogan “What happens on your iPhone, stays on your iPhone”, which refers to Apple’s privacy policy [192]. This is a praiseworthy statement in itself, but it is only valid as long as the iPhone is not online. As soon as it communicates with digital services on the internet, they can record the data traffic. Even if the blocking of certain data, such as that required for facial recognition, is highly laudable, the promise is virtually worthless and is primarily directed against Google and its Android world, not least because, to this day, Apple remains unable to keep pace with Google’s data collection.

The opposite of data protection legislation as set forth in the GDPR is the **renouncement of privacy**, with the exception of a few protected areas such as medical data. If all the options for handling personal data are considered, sharing all personal data is a serious alternative. In his novel “The Circle”, Dave Eggers vividly sketched a world without privacy. The idea that neighbors, superiors, sports friends, and partners can see all personal data, such as examination results, medical history, finances, or circle of friends, and even the video streams of personal cameras, contradicts the behavior we have learned since childhood to keep private matters to ourselves. We have learned that it can be advantageous if the people we know are unaware of our strengths and weaknesses, just as companies protect their trade secrets. Privacy may well be part of our inherited safety mechanism, such as a sense of shame.

If, in return for our own openness, we gain insight into all the personal data of the people we know, the threat already begins to diminish. Next, we need to consider whether it is better for us to have our data in the hands of a few mega-portals that use it exclusively in their interests, for example to influence our consumption, or whether it would help our quality of life more if competing companies had access to the same data and were thus compelled to act in our interests.

The (almost) complete renunciation of privacy fundamentally contradicts our learned and, in some cases, genetically determined needs, but is probably the most effective approach to ensuring that personal data is used to improve human quality of life and to preventing monopolies.

6.3.6 Social and Economic Control

Quality of life calls for economic control mechanisms with the goal of sustainable hedonia and eudaimonia. Examples of concrete manifestations are capitalism, the social market economy in multiparty democracy, social scoring in a one-party system, criminal law, the unconditional basic income, consumer protection, and codes of conduct. Informatization is fundamentally changing the mechanisms of the economy and society, and is also enabling new control mechanisms, so we must also seriously examine unconventional concepts without emotion or prejudice.

In the Western world, we are *grosso modo* socialized in social market economies where democratic parties can correct undesirable side effects of capitalist control in legislation if they win voters with competing recipes for improving quality of life. These range from minimum wages to working time regulations, data protection, and consumer protection. However, citizens no longer understand the increasing complexity of the economy and society; politicians are increasingly dependent on expert committees and need to translate the concepts these provide into slogans that can motivate voters to adopt them. In addition, the media, books, films, video channels, photo platforms, and news channels shape people's values, produce unrealistic visions, and thus provoke disappointment and dissatisfaction when comparing one's own position with the illusory world. Even very well-educated citizens follow the traditional values of a consumer, sports, and arts society, are incapable of forming well-reasoned opinions outside their narrow field of knowledge, and give free rein to their gut feeling. It is not surprising that young citizens in particular are turning away from politics in this situation and calling for strong leadership without democratic blockades. The technologization of the world, along with the resulting increase in complexity and abstraction, urgently calls for new concepts to steer the economy and society in the interests of human well-being.

With a powerful one-party system and a high proportion of state-owned enterprises, China represents a counter-model, and has so far achieved a similarly rapid economic progress to that attained by Japan a few decades earlier with a multiparty system and few state-owned enterprises.

The European Union's Ethics Guidelines for Trustworthy AI describe "normative and mass citizen scoring without consent in deviation of fundamental rights" as one of the greatest threats posed by artificial intelligence [191]. Even if it may sound absurd to representatives of the Western world [194], this form of social control is at least worth a closer look as an attempt to improve quality of life and to avoid capitalist misguidance. China's one-party system has tried-and-tested procedures for developing political opinion. The ubiquitous collection of personal data makes it possible to translate political goals into desirable and undesirable behavior on the part of citizens, to communicate these rules to citizens, to monitor compliance with required behaviors, to sanction non-compliance, and to derive new rules from the huge data collections. *The majority of Chinese who were asked about their experiences with social scoring welcome the system.* It should be added, however, that the clear support for the prototyped social scoring systems is to be found primarily among older, male, better-educated citizens with higher incomes in urban areas [42].

The gigantic personal databases of Western megaportals and government organizations (e.g. security services such as NSA [3]) are probably in no way inferior to Chinese data collections. A significant proportion of the population already voluntarily wears smart bracelets or watches that record even more data than those used in the Guangdong school mentioned in Chap. 1. Millions of consumers deliver data to language assistants like Alexa or Siri in their homes, cars, and on the move. Only the degree of mutual data access between the digital services remains open. Banks, insurance companies, police, military, and other

organizations use a lot of data when recruiting employees, granting loans, and preventing and prosecuting criminal offences. While the Chinese government uses the social score to control ideologically desirable behavior, Western companies use personal data in the interests of capital and state bodies to prevent violations of the law or threats to the state.

Thick statute books, especially those relating to criminal law, are a traditional way of controlling socially desirable behavior for the benefit of all citizens. Critics of liberalism like to interpret the world's highest incarceration rate in the USA, at 655 prisoners per 100,000 citizens (worldwide rate 145) [193], as the result of a particularly free-market economy. If a social credit system contributed to reducing the suffering of victims and offenders through benevolent governance, then such an approach should be open to discussion.

A form of social and economic control that aims at a high and lasting quality of life instead of a capitalistic **maximization of consumption** is a challenge for a discipline of Life Engineering. It presupposes that we fundamentally understand the factors that determine quality of life, that we derive metrics for behavior that is conducive to quality of life from them, and that we record the behavior of individuals in detail. The biggest hurdle, however, is likely to be achieving political acceptance of the mechanism for controlling quality of life. While this aspiration might appear to be purely an academic vision from the ivory tower, what are the alternatives: Control aimed at illusionary and destructive **consumption for the purpose of differentiation**? Control according to the pragmatic, intuitive and **ideological goals** of an autocratic party? There is a danger that consumers, politicians and scientists will be steered by the megaportals in such a way that they no longer recognize the control as such, and even welcome it for its apparent convenience. This makes it difficult to organize any form of democratic resistance in the interests of human autonomy. *The task of Life Engineering is therefore not only the development of a control mechanism aimed at quality of life but also a concept for implementing this mechanism in society.*

A perfect social and economic control to improve quality of life is an illusion, but, as discussed with the topic of happiness, we already have numerous robust rules today and can further develop them with the growing databases and algorithmic possibilities in the coming years. Put simply: If only the majority of recommendations are correct and implementable, this will contribute to human quality of life—a goal that few will contradict.

6.3.7 Consumer Protection

The growing commercial data collections held by the megaportals harbor the risk that, while there is no party ideology that exercises control over us, we nonetheless remain very much under the influence of **consumerism** in the capitalist system. Shoshana Zuboff speaks of an “era of surveillance capitalism” [7], in which companies like Google collect data from all areas of people's lives, use it to derive behavioral patterns, and exploit these with the goal that generalized knowledge

about people on the one hand and knowledge about the individual on the other hand generate the greatest contribution margin for Google and its business customers.

In a class-struggle tone, Zuboff warns against the loss of consumer autonomy and urgently calls for democratic control of the megaportals. Even though the picture Zuboff paints is characterized more by the symptoms of the market economy than by the underlying interdependencies, its analysis should be taken extremely seriously. If we consider her form of social control aimed at quality of life to be too demanding and abstract, we must at least make consumer protection so powerful that it can *prevent or reduce immediately visible negative excesses of capitalist control*. Concrete measures might be the observation of subscription contracts, which are virtually impossible to terminate or which entail unforeseen costs, standardized and comprehensible agreements concerning the use of data, or controlled access to as much personal data as possible so that competition between the product and service provider can at least be maintained.

Some people call for the **prohibition of AI for certain services**. However, neither the AI nor the services are so clearly definable that such regulation could be effectively controlled. It would also amount to a form of censorship that would be able to choose the services permitted for citizens. Apple subjects each app to an intensive review before it is downloaded to the App Store, which is occasionally commented on as a welcome protection for Apple users but also occasionally as a form of censorship.

A much more realistic, but technically difficult, requirement is that the user of a service should be able to **understand** the recommendations or **decisions of an algorithm**. Why does Google give me precisely these search results in this specific order? Why am I shown this particular advertisement? How does the price I am quoted for a flight or a smartphone on a platform come about? Who finances certain services with which revenue streams? In 2018, the OECD published a **Toolkit for Protecting Digital Consumers** [194], which in part proposes very concrete improvements for consumer protection in electronic commerce, such as misleading reference prices or disclosure regulations.

The list of tasks for consumer protection could be extended almost indefinitely. Even if it were limited to the tasks that overtax the individual, such as restricting data transfer between services, it would still be very long.

6.3.8 Further Tasks for the Economy and Society

The list of social topics Life Engineering has to deal with can be based on the topics of the **OECD initiative Going Digital**. Here are just a few examples, which are explicitly mentioned in conjunction with some of issues that are frequently discussed:

- Gap between population groups: Machine intelligence widens the gap between privileged and discriminated population groups, which is attributable to inheritance, level of education, income, and wealth.

- Occupational world: It is not the frequently invoked unemployment as a result of machine intelligence that can be observed in the first 70 years of computerization but rather the change in occupational profiles and temporary unemployment. This will still be the case in 2030.
- Stress, complexity, legalization: Instead of reducing the complexity of life, the state contributes as much to the stress and overstrain of its citizens with over-regulation as companies do with increasingly lengthy and incomprehensible general terms and conditions.
- Unconditional basic income: Social security must and can cover the basic needs of people in highly developed societies, but it does not solve the problem of lack of purpose and self-esteem if someone is not needed in society [9, p. 208].
- Intellectual property rights: How can individuals or small, innovative companies ensure that they benefit from their idea and development?
- Regulation of the internet: Net neutrality, censorship, protection against fake news and spam, copyright, and other areas of law regulate life in the connected world (internet law). On March 26, 2019, the Parliament of the European Union adopted a directive on copyright in the digital single market [197]. The G20 summit in Osaka formally declared the launch of a framework for cross-border data flow with better protection of personal information, better protection of intellectual property, and better cybersecurity.
- Taxes: The European Union and some of its member states are discussing a digital tax and are in the process of introducing it.
- Government research funding: The goal of quality of life can be used to control the issues and efficiency of government research funding.

These challenges are not unknown in politics, but they are extremely complex and abstract, and are therefore not suitable for simple political messages. However, citizens (including you and me) are repeatedly affected by this without understanding the connections sufficiently deeply, and are therefore highly susceptible to simplifiers with messages that appeal to gut feeling.

The OECD has developed a Going Digital Toolkit for politics under the theme of growth & well-being. This deals with the handling of digital transformation in 7 dimensions: network access, internet use, innovation, jobs, skills, society, trust, market openness. It also provides extensive material resources.

6.3.9 Right and Duty to Influence

A mechanism for controlling the economy and society in the interests of quality of life instead of a consumeristic capitalism or communist party control is a vision that can easily be accepted. Even if one believes in the realization of this vision, there is one question that is difficult to answer: *Who is entitled to tell whom what is good for him or her?* Do we want to have our decisions made for us and renounce our autonomy?

From popular expressions such as “Every man is the architect of his own fortune” to **Kant**’s maxim of human **autonomy**, it is constantly emphasized that freedom is one of man’s highest virtues. But how free are we really when it comes to our quality of life? The competition to influence people uses our innate and learned needs in an affluent society primarily for the purpose of differentiation [174]. The media, advertising, and social networks control our values; they tell us what is good and what is bad.

In the struggle for attention, the media consciously or unconsciously rely on our needs for progress. The film hero and villain, the political commentary in the newspaper, the countless blogs on the internet, the postings on social media, and, of course, scientific treatises tell us what strengthens our community, what determines our appearance, how power can be expanded, and what status we have in our community. They shape our behavior patterns by explaining which actions are better or worse for us. Advertising on all these channels reinforces this behavioral imprint as much as possible in order to sell concrete products, services, and messages. The mediators of the advertising messages are often called influencers as they and their values represent models that many people follow. Companies use all their knowledge about the consumer to generate revenues and contribution margins. An individual’s identified attitudes are used for the selection of messages in advertising and in news, and thus reinforce certain values in filter bubbles. All the companies and organizations involved are already influencing or steering us.

Political parties and civil society organizations as well as religions pursue specific ideas about what is good for people and try to exert influence in line with these ideas. However, it should be borne in mind that these organizations consist of people who in turn have personal needs for progress, and strive for power, for example, even if this runs counter to the objectives of their organization and, ultimately, its target groups.

The overriding question, which has not yet been addressed, is **WHO** ultimately decides. *WHO knows best what is good for people?* Is the individual’s freedom of choice to be given more weight than specialist knowledge? When may society, a company, a specialist (e.g. a doctor, life engineer), or someone other than the affected individual decide? Is it permissible to let someone walk into an objectively identifiable trap (e.g. debt, illness) in order to maintain her autonomy? Is it acceptable to make all a person’s decisions for them?

It is not only possible to formulate a right to influence people but also in many cases a duty. A doctor who prescribes therapy for his patient, a teacher who gives advice on behavior to her pupil, or a football coach who helps his protégés in their personal development each has a duty to pass on his or her idea of helpful and harmful behavior.

If machine intelligence actually radically changes our lives, science, politics, and, in spite of all contradictions, companies have a duty to concern themselves with the technological possibilities and their impacts on quality of life, and to steer the economy and society for the good of humanity.

6.3.10 Implementation of Quality of Life Management

If science and business should ever have sufficient concrete knowledge of what constitutes a high quality of life (hedonia and eudaimonia), if they can measure quality of life and set rules of conduct that are conducive to quality of life, then these findings still need to be implemented politically. It must be ensured that individuals, companies, and society understand, accept, and apply these findings. The rules for long-term, sustainable life satisfaction (eudaimonia) and even hedonia can run counter to short-term, learned, and inherited needs. If someone is massively overweight, he knows what makes him satisfied in the long run, but cannot resist the offered energy drink or is unable to motivate himself to engage in sufficient physical activity. If the recommendations for action serve hedonia, capitalism ensures the implementation. *If the recommendations for action are directed at eudaimonia and against hedonia, political decision-making is needed.*

6.4 Summary: The Challenge of Evolution and Quality of Life

The purpose of Life Engineering is to steer technological evolution toward a growing quality of life for human beings. There are challenges to be met by each individual, by companies, and public administration as well as political parties and civil society organizations. Individuals should understand machine intelligence and quality of life to such an extent that they can make independent and informed decisions. Companies must accomplish the paradigm shift from the company view to the consumer view, understand people's needs and behavior patterns, and incorporate the quality of life of customers and employees into their goal system. Society faces the greatest challenges: Some of the wide range of topics that deserve special mention include public infrastructure in technology and education, the handling of personal data, and the social control of quality of life. It is to be hoped that a scientific discipline Life Engineering will be able to provide fundamentals that will ultimately lead the way in dealing with human progress to the point of trans- and posthumanism in the interests of quality of life. The biggest hurdles are an unemotional, rational handling of the issues and dealing with change management. References to further studies on the use of machine intelligence, in particular robotics and AI, can be found in the IEEE treatise on Ethically Aligned Design [85, p. 14].

Abstract

The Business Engineering discipline uses information technology to increase the value of a company; a Life Engineering discipline uses information technology to improve people's quality of life. We need an engineering approach to the development of the digital world with the goal of quality of life. The short-term goal of Life Engineering is rules for digital assistants for the benefit of people; the long-term goal is rules for superintelligence. The minimum goal is to translate the moderate existing knowledge about information technology and quality of life into recommendations for individuals, companies, and politicians. The tasks of Life Engineering are a world database, i.e. a collection of personal and factual data, that is freely accessible for research, a world model as a collection of all patterns derived from the world database, an objective, and, as far as possible, automated happiness measurement, a quality of life model, and, finally, a happiness coach that transfers the findings into daily life.

Business Engineering uses information technology to increase enterprise value; Life Engineering uses information technology to improve human quality of life. Any attempt to present the finished concept of a Life Engineering discipline in this book would be audacious. The following describes some basic ideas for an engineering-based design of the digital world in the interests of human quality of life.

While the immediate goal of Life Engineering is to develop rules for digital assistants aimed at human well-being, rules for superintelligence are the long-term goal. The minimum objective is to translate the reasonably sound knowledge on information technology and quality of life into recommendations for individuals, companies, and politicians. What is needed is the further development of knowledge to improve quality of life and the use of machine intelligence in the interests of quality of life. This results in the following research topics:

7.1 World Database

Megaportals, above all Google, strive for a digital image of the world that describes people, things, and concepts (e.g. sales contract, organization, calculation) as closely as possible to reality. The basis for this is the knowledge they collect, be it the surfing behavior of individuals on the internet, the location data of the car, the biometric data of fitness equipment, or the observations of cameras. A world database does not mean a single, huge database but the totality of all databases under the control of a company or another organization. Even the largest databases today describe only small sections of reality, but possess much more knowledge about personality than ever before and far more than the consumer imagines. FAMANG and BAT have enormous personal data stocks, which mainly cover internet activities. Even these data collections tend to develop monopolistic power structures, as their value grows with their size.

In order not to leave this database solely to the megaportals, science is trying to build up competitive databases by working with large companies, for example in the International Nucleotide Sequence Database Collaboration [198] of the U.S. National Library of Medicine, in the Consumer Data Research Center [197], or in the MIDATA initiative [198] for the storage of personal data, above all health data. On re3data.org (Registry of Research Data Repositories), there is information on more than 2000 data repositories [199]. Together with large European companies, Otto et al. have developed a reference architecture for industrial data, from sensors to supplier data, which pursues the goal of being able to exchange data on a federated basis and in a controlled manner between organizations [200]. With the concept of the *quantified self*, Swan [66] has outlined a future database for the development of a life assistant. She emphasizes the need to supplement personal data, which is currently obtained primarily from internet use, with data from the sensors of the Internet of Things, and discusses the possibilities of learning to understand quality of life from this data and, ultimately, deriving the foundations for digital life assistants for human benefit. In 2013, Swan already listed 25 applications, databases, and platforms for recording quality of life data. *Access to the worldwide pool of personal data is essential for Life Engineering research but is hardly feasible without democratically legitimized regulatory intervention.*

7.2 World Model

*The term world model is used here to denote the collected knowledge derived from the components of the world database—in the simplest case, rules such as “people who bought this article also bought those articles”. A more complex context is, for example, “those who use glyphosate professionally, smoke and drink, and have a genetic predisposition have a higher risk of developing lung cancer or asthma”. This pattern is based on an extensive hierarchy of patterns such as *smoking* or *professional* and *cancer*. The derivation of such complex patterns requires huge*

data collections in order to obtain sufficient statistical significance for all correlations. The wealth of data and the investment resources available to the megaportals mean that they will understand behavioral patterns, the connections between actions, and hedonia or eudaimonia before science or small competitors, and thus expand their monopoly in the sense of Fig. 6.1. FAMANG and BAT have the data and the resources to build partial world models [203, p.173ff].

Every human possesses an individual world model, which consists of genetic information and life experiences. Artificial intelligence models are still very far from this but in some areas much more elaborate and reliable than human models when deduced from extensive databases. Even by the year 2030, a reasonably comprehensive, empirically based world model, or even just a model of all facets of mobility, will still be a long time coming. Machine intelligence continues to be a long way from understanding human needs. The patterns of our **perceptions** (e.g. wind, friendly face, judgement, driving distance) and our **decisions** (actions such as smiling, braking, contradiction, racing) are simply missing. Machines are still far from being able to grasp the human environment in the same way as human beings can and are even less capable of seeing into human beings, i.e. of absorbing their thoughts, perceptions, feelings, and decisions, unless this data is explicitly described. In addition, the number of factors and relationships is far above what we can evaluate with machine learning in the foreseeable future. Due to the enormous number of variables and the difficulties of measurement, isolated submodels will initially be developed, for example for user-specific video streaming, therapy support, nutritional counseling, or financing. AI's ability to use patterns to deduce further patterns and thus to derive new concepts is still very rudimentary, but it is a prerequisite for an efficient digital happiness coach.

The limits of digital world models become visible in the philosophy of science discussion in conjunction with economics: Quantitatively and empirically validated statements often do not capture all important influencing variables and are usually without relevance for action. Deductive statements are easier to combine with instructions for action, but have a high probability of error if they are only plausibilized on the basis of a small number of cases and with fuzzy terms. The digital deduction mechanisms (inference), which create abstractions from elementary contexts and link them, are far weaker than those of humans.

Companies such as pharmaceutical manufacturers, which build submodels of the world in their field of activity, want to convert their investments into market successes and therefore regard their models as their property. Publicly funded research, on the other hand, has a great interest in being able to use not only the database but also the knowledge derived from it as the starting point for its research. In many cases, this is only made possible by close cooperation between science and industry. Research may then be driven by the interests of the cooperating companies and publication of the results may prove difficult.

The megaportals build on their world models by extracting behavioral patterns that describe the connections between actions, perceptions, and impacts on needs. This market position may hamper research and innovation in small enterprises. *With this in mind, Markl calls for the establishment of a national data and analysis*

infrastructure for Germany as the basis for digital sovereignty [202]. The goal of the project is the utilization of personal data in the interests of quality of life rather than the enterprise value of oligopolists. It is to be hoped that the project will be efficiently managed to ensure that it does not lag behind the dynamics of listed companies so that it will actually produce a competitive world database and derive a world model.

Neff and Nafus as well as Deborah Lupton develop concepts of self-tracking based on the *quantified self*, in which individuals use this data to improve their well-being [205, 204]. The IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems [24] sees this sensor data as an extremely sensitive area of personal data and tries to formulate rules for the technical possibilities of recording, modeling, and presenting emotions, moods, and personality.

7.3 Quality of Life Model

Happiness research combines data on life situations with indicators of human well-being. For example, it combines data on health, education, financial situation, consumption, and political and religious convictions with statements on subjectively perceived quality of life [83] or with measurements of moods from facial and speech analyses, texts, and biometric records. Its models use the knowledge of psychology, biology, medicine, neuroscience, cybernetics, and philosophy. They will take today's knowledge of quality of life to a new level.

Happiness research in particular calls for the public accessibility of anonymized personal data and the patterns derived from it (partial models). Its justification is based on the assumption that personal data belongs to the individuals concerned, despite the fact that, under today's legal framework, the providers of the services are the owners of the personal data. An even more important argument is that quality of life and not the enterprise value of the providers should control behavior.

The OECD is attempting to standardize the data collected in many countries on the subjectively perceived well-being of its citizens and thus pave the way for a world database of happiness measurements. The organization is doing this to support the efforts of many states not only to measure progress in economic terms but also to include other aspects, above all social considerations [207].

7.4 Life Assistants

Digital assistants for all areas of human life will use the knowledge of needs, patterns of perception, patterns of action, and feelings to help us with day-to-day decisions or to influence us in desired directions (see Sect. 4.1). In some cases, they will execute individual actions on our behalf without our participation, i.e.

automatically. Streaming services already play music according to our individual musical tastes and current mood, the robo-advisors of banks manage our assets independently according to our personal risk tolerance and other criteria, and health assistants prepare diagnoses from the medical data and accompany our therapies. This addresses the desire for convenience and the needs of consumers, and at the same time generates new or increased revenue streams for providers. Apple, Google, and Facebook are showing where the journey will take us.

In the distant future, an all-embracing life assistant will analyze and support all areas of human life in the interests of quality of life. It will follow the simple logic of homeostasis (Fig. 4.1), the control mechanism of evolution. It will refine and concretize the needs of the QLM to the level of conscious and unconscious actions and perceptions in daily life, for example by breaking down the need for status to an action such as *buying hip pants* once the relationship to the feeling of status has been statistically proven. Learning neural networks will gradually refine, supplement, and correct the rudimentary QLM from Chap. 4 to such an extent that a life assistant can make decisions based on the model.

Who builds the life assistants? Whose interests will these assistants therefore be pursuing? What needs will they target: hedonia or eudaimonia? Will they free us from superfluous consumption and the associated stress on the treadmill and encourage us, for example, to spend time in natural surroundings?

The development of a digital financial adviser requires extensive knowledge of the financial investment sector and is a significant investment in itself. So who is capable of building a financial robo-advisor? Probably only financial institutions and possibly start-up companies with sufficient risk capital, from which investors expect a high return. The profits from bank products or brokerage commissions have to pay for the investments and running costs. Developers of banking products are under pressure from the bank's profitability. Their task is to make a product attractive for the consumer and at the same time as profitable as possible for the bank. The fact that the consumer's need for financial security in old age competes with the bank's profitability target can be demonstrated by countless examples.

While a robo-advisor addresses the human need *capital*, a therapy assistant for obesity patients is aimed at the need *health*. Possible developers are, for example, pharmaceutical companies that have to pursue a profitability goal in the same way as a bank. Will a digital therapy assistant be more likely to focus on medication or on healthy nutrition and sports?

State-funded projects for developing digital assistants can hardly be the answer to the discernible conflict of objectives between individuals and companies. Experience shows that government development projects are expensive and slow, as the health card or electronic identification makes abundantly clear. However, it would be worth examining whether government organizations could at least set minimum requirements for digital assistants, as has long been the case in many areas of consumer protection. Such a standard could set out the general terms and conditions and, for example, facilitate termination and help prevent customers from being tied to contracts. Another example might be the specification of personal

preferences, for example the specification of a media-free time period when people do not want interruptions from any kind of digital communication.

The immediate goal of Life Engineering is digital assistants that serve human interests. The long-term goal (50–100 years) of Life Engineering is the use of superintelligence for human benefit. Science can only create guidelines for all kinds of digital assistants, which in the long run can become the laws for artificial general intelligence. The time and effort needed to develop practical digital services requires the development capacity of large companies such as megaportals.

7.5 Happiness Management

If happiness is the ultimate goal of human beings, every individual, every company and every state should align its actions with that end. And indeed, they claim to be doing this on many occasions, but, even with the best will in the world, implementation is far from simple and progress difficult to measure. The relationship between conscious decisions and quality of life is anything but clear at the moment, and our actions are therefore primarily determined by gut feeling. Life Engineering must

- develop trustworthy, objectifiable indicators of quality of life (**happiness measurement**) [96, 208],
- derive **behavioral patterns** with happiness indicators,
- capture the personal **preferences** of individuals, and
- find and test ways to **implement** a control system with the goal of a high quality of life.

These requirements sound like an unrealistic utopia that should be the subject of science fiction novels but not of serious research. It is, of course, not a question of raising our quality of life to a completely new level with a perfect happiness model by 2030. It is sufficient if we have taken many small steps by then. Examples include the automatic recording of biometric indicators for stress and relaxation using smartwatches, readily accessible happiness training, concrete nutritional information when eating, the reduction of all forms of unwanted customer retention, and effective indications of healthy sleep behavior. An especially important, but especially difficult, instruction is how to get off the treadmill, which is offered in a rather unspecific way under the heading of work-life balance. *Even if Life Engineering is only rudimentarily successful, it will know better than laypeople what makes them happy or unhappy.*

At present, digital services in particular follow liberal market principles. The emphasis is on hedonia, with short-term and superficial promises of happiness such as appearance through fashion, comfort, and money, as practically all advertising messages show. Scientific journals and conferences deal intensively with *recommendation systems*, which help companies to make recommendations that are

particularly successful for their business on the basis of general behavior patterns and individual personal data. *The recommendations of the digital services use the knowledge about human behavior and the data relating to concrete individuals with the aim of generating the highest possible revenues and contribution margins (under the heading customer value) instead of guiding people to improve their quality of life* (see Fig. 6.1).

The Chinese social scoring system usually attracts highly critical comments in Western media, but can be seen as an attempt to supplement the purely financial control of society with indicators that are expected to improve society's quality of life. If facial recognition in the camera surveillance system at pedestrian traffic lights in Shanghai educates people to behave in a way that reduces accidents, is that bad or good? The rewarding of socially desirable behavior and the penalizing of undesirable behavior can also be observed to some extent in Western societies: e.g. making the level of social benefits dependent on compulsory vaccinations, evaluating postings on social networks when recruiting employees, or requiring *sound* financial circumstances as a prerequisite for loans. Educating people to abide by democratically agreed rules by means of small, transparent incentives is not *ex ante* worse than using criminal penalties.

When individuals, companies, or states manage to get off the treadmill of differentiation, they are no longer able to keep pace with competitors who use all their energy to gain an economic competitive edge. Once the difference in competitiveness has become large enough, the weaker party becomes impoverished because its services are no longer competitive. Classic communist states with their original socialist aspiration have demonstrated this sufficiently. Nationalized companies and satiated individuals confirm the observation that missing drive or pressure leads to a loss of competitiveness and therefore reduces quality of life in the long run. If we could trigger permanent happiness in humans chemically or electronically, the drive to achieve progress would be eliminated. A system of happiness management must maintain motivation and satisfaction through achievement and progress.

We need to find a way of ensuring that quality of life controls evolution and evolution does not use our needs against our interests. *To date, humanity has failed to come up with a successful alternative model to capitalist control, but it can nonetheless supplement the money-based control system with a control system based on happiness indicators.* Human decision-making behavior constantly proves that money is not the highest goal. Self-esteem and convenience (efficiency) are usually more important to people than capital.

If we avoid making an explicit decision about control mechanisms, decisions will be made implicitly. In this case, consumers accept the terms and conditions of providers without knowing what they are agreeing to and what the consequences will be. When searching for information or buying a product, who is aware of how the digital assistant comes up with its suggestions? While determining the public debate, the use and sharing of personal data are not the only and not the most important aspect. Controlling technological development through capital has led to

enormous gains in prosperity to date, but should be reconsidered in a society in which replication needs are satisfied and the emphasis is on the needs for progress, if quality of life is to be maximized rather than consumption.

7.6 Post- and Transhumanism

Transhumanism aims to further develop humans through technology, be it through the implantation of chips for direct brain-computer communication [147, p. 78], through genetic engineering, or prosthetics. Posthumanism, which is difficult to separate from transhumanism, sees humans more as a means of evolution on the path to superintelligence. Ever since genome editing became possible with the CRISPR/Cas method, posthumanism and transhumanism have been seen as very real opportunities and dangers. The possibilities of improving human quality of life are still largely the subject of science fiction. Any outline of a Life Engineering discipline has to include these topics because transhumanism, like AI, will not come overnight but in a succession of small steps. Glasses, artificial vision, and, ultimately, the direct connection of the brain to cameras are not small steps but stages in strengthening our vision that have passed through many improvement loops and will continue to do so.

7.7 Preparing for Superintelligence

Artificial intelligence, and above all superintelligence, is an exciting topic for all media because it relates to important needs, knowledge, prestige, security (freedom), and preservation of the species. The topic awakens fears about the loss of freedom and the extinction of humanity. The public is curious about what is heading our way in terms of technology and tries to obtain a picture of things to come. This generates readers, download and audience ratings as well as click rates. For the reader, an own, pronounced opinion conveys the reputation of education, progress, and relevance.

Based on the timescale expectations of the AI experts, superintelligence will not arrive during the lifetime of most readers and certainly not in this author's lifetime. Bostrom, who coined the term *superintelligence*, used the word to denote a machine intelligence that surpasses the best general human intelligence in many areas of cognition [30, pos. 1439ff]. This general superintelligence will then be able to develop itself exponentially.

Superintelligence, however, is not a single event in the distant future, but marks the end of a development that has been going on for decades, if we regard all forms of intelligence enhancement through digital services as AI (see Sects. 1.2 and 3.6). Machine intelligence has long surpassed us in some areas (e.g. in navigation). This book concentrates on the reasonably foreseeable future up to the year 2030.

It is important to adopt a sober approach to the topic of machine intelligence, i.e. one that is far removed from any newsworthy entertainment value and as free as possible from emotion. In the following sections, I therefore express my personal opinion on three points of view that have been hotly discussed time and again, and hope to contribute to a rational view.

7.7.1 Illusion

Bostrom's [30] appeal for the *best* to control the development of superintelligence for the benefit of humanity has motivated numerous organizations (see Figs. A.2 and A.3 in Appendix), and may serve others as a selling point. The IEEE treatise on Ethically Aligned Design, the Asilomar AI Principles, the World Economic Forum Initiative, the OECD Framework for Digital Transformation, and the EU Guidelines for a Trustworthy AI represent valuable approaches to the development and control of digital services.

One problem is concretizing the very general recommendations, another the ambiguity of the goal of quality of life, and, ultimately, the enforceability of the guidelines. If we take comparable sets of rules such as the UN Convention against Torture or the Convention against Corruption, which are fundamentally much more operationally tangible, this dampens any optimism. Objectives and enforceability probably make this path an illusion, but it would be gratifying to see my assessment become a false prognosis. This hope continues to justify a high level of commitment to the use of AI and IT as a whole for the benefit of humanity. *If one considers the efforts of the dominant economic blocs to develop AI as a technology that is a determinant of prosperity, the priority seems to be on the economic and power-oriented effectiveness of AI, not on the impact on quality of life.* Researchers and business representatives who observe this orientation in the context of their work have therefore launched the above initiatives.

7.7.2 Singleton

A singleton in the context of superintelligence means that a single person or organization which takes the step to superintelligence first uses that intelligence to seize power in an expanded interpretation of the winner-takes-all rule. Bostrom, who devotes a great deal of attention to ways of avoiding a singleton, hopes for a kind of *supercharged United Nations* that should take control of superintelligence [30, pos. 5866]. Contrary to many critics, the UN has achieved a lot for humanity but is completely overwhelmed when it comes to the control of superintelligence.

If a researcher or entrepreneur has worked on superintelligence for many years with great personal and financial commitment, it is difficult to imagine that he will then call for third-party control. On the contrary, he will immediately use this superintelligence to protect himself against competitors, i.e. to maintain or expand his edge. After all, he does not know if another superintelligence already exists and

if the superintelligence he himself developed is already playing with him. Even if he is not driven by a lust for power, he will not hand over control to third parties because he is convinced that he himself will make the best use of superintelligence for the good of humanity. Moreover, the countless examples from history unfortunately prove that people seldom give up a means of power voluntarily, since it satisfies the needs for self-esteem, power, status, security, and reproduction like no other.

What would you do if, after years of struggle, you developed a superintelligent machine? Allow the intelligence in the machine to grow? Destroy the machine? Call in the state (who specifically?)? Ask the machine what to do with it because it is smarter than you?

7.7.3 Singularity

A singularity in the context of AI means that superintelligence triggers a change that is unpredictable and irreversible. *If AI can develop itself further and if it has reached the level of human intelligence, it will presumably think about what its goal is with or without human consent.* It will encounter the contradiction between quality of life and evolution, and, in the competition with other machine intelligences, will not be able to forgo further development with all the resources at its disposal.

People naturally assume that they are the goal of Creation. If we consider the relatively short time occupied by modern humans in the history of evolution or even in the history of the Earth, this seems almost presumptuous. *It is possible that man is not the goal but an intermediate stage of evolution.* Since our knowledge is derived entirely from the experiences of our existence, it is very difficult for us to imagine the role of humans in evolution at all.

The representatives of transhumanism hope for a symbiosis of humans and superintelligence in which all the abilities of superintelligence, intellectual, and mechanical, are at the service of human beings. This would mean that humans could virtually grow beyond themselves and achieve supreme happiness. If superintelligence pursues the goals of evolution, it will have different control mechanisms for itself from those of humans. Self-preservation and preservation of the species will be realized differently by machines than in the case of organic life, as far as we can imagine this from a present-day perspective. The needs for capital, community, appearance, power, status, and self-esteem will also only play a role if machine intelligence selects the architecture with the greatest development potential, which means that the machines will also fight to pass on the best architecture (DNA).

A superintelligent machine will, from a present-day perspective, use all the world's resources, not only those of our planet, to further expand its knowledge and intelligence because superintelligence must develop its intelligence as quickly as possible in order to assert itself in evolution. The machine will then logically switch off everything that is competing for the same resources.

If we assume that happiness is the ultimate goal of humans, then the focus of attention shifts to the question of happiness or evolution. If the outcome of all the efforts mentioned is that humans keep superintelligence under their control, then they will be able to use the machines to maximize their happiness. If, however, the machines gain the upper hand, they could dispense with humans and possibly organic nature as we know it. We view this as the greatest of all conceivable catastrophes because it contradicts our genetic needs for self-preservation and preservation of the species. However, it could simply mean that humans have successfully fulfilled their mission in evolution.

The development towards superintelligence cannot be stopped, and superintelligence cannot be locked away in an isolation ward. We must do everything we can to use technological development to our advantage right now, and hope that we can implant this objective in the DNA of superintelligence.¹

7.8 Summary: Research Funding

Life Engineering, as presented here, looks predominantly like basic research. In fact, extensive basic research is necessary, but application-driven research is probably much more important. Observing feelings in Facebook postings or emails and the impact of advertising, for example from travel agencies, provides insights into the factors of quality of life and the economic benefits for providers. Understanding the human brain in projects such as the EU's Human Brain Project or the USA's BRAIN Initiative is a long-term endeavor that is difficult to plan, but should provide decisive insights into quality of life. If one takes a critical look at the results of government-funded research projects, it is easy to gain the impression that the main goal is publication in reputable scientific journals, their prime purpose thus being to serve the quality of life of researchers, and that their possible contribution to machine intelligence for the benefit of all human beings is somewhat modest.

Given the urgency of the issues raised, research funding with concrete implementation objectives must be a priority. The frequently cited Apollo program of the USA in the 1960s pursued what initially sounded like a utopian goal, but was actually achieved with the moon landing and thus advanced many technologies. Estonia's eGovernment initiative, with electronic identity and the many related services, has made Estonia a showcase country for digital transformation and a place for innovative enterprises. A comparable and easily measurable goal might be a state-monitored personal database, which would bring all personal data onto a democratically monitored platform, enable access for research in anonymized form, place the release of data to digital services under the sovereignty of individuals, and promote competition on a level playing field for all companies. This database could

¹I am allowing myself this irrational leap backward here, since I find it extremely difficult to disassociate myself from the need for self-preservation and preservation of the species.

include sensor data and public data in addition to the classic internet and app data. It could put research in the field of Life Engineering on a solid footing.

Another possibility, which would be even more implementation-oriented and at the same time highly attractive for research, might be to spin off a research and development project from Germany's *National Platform Future of Mobility* [58] that could conceive and pilot a mobility solution, not from the point of view of the automotive industry but from the human perspective. The concrete goal might be a mobility assistant that not only organizes a connection between two locations to meet the individual needs of the travelers involved, but also recognizes the need for a journey from the knowledge about the travelers, makes the journey superfluous through virtual and augmented reality, uses the time during the journey for the benefit of the individuals involved, and handles all administrative tasks from booking to travel expense accounting without the involvement of the travelers. In addition, the mobility assistant could measure the quality of people's lives during the journey and use the results to set a permanent improvement in motion.

The Life Engineering discipline must attempt to use evolution for the benefit of humanity. It should cover all essential aspects of quality of life and machine intelligence as well as long-term opportunities and risks. The long-term goals that have been formulated here seem far too ambitious, but much will already have been achieved if Life Engineering merely creates a framework for shaping life in the information age and calls for small feasible steps to improve human quality of life. *Life Engineering should at least help to identify and avoid risk factors affecting quality of life.*

Abstract

Increasingly powerful digital services relieve people of tasks and competencies and develop from passive helpers into active assistants with suggestions and automatic actions. These services, combined with the sensors and actuators of the Internet of Things, measure and document billions of individuals. Algorithms derive patterns from the resulting gigantic databases, which ultimately lead to recommendations for people. Whether people use these growing capabilities of machine intelligence for their own benefit or to their detriment becomes the greatest challenge facing mankind. A discipline of Life Engineering should understand the technology, quality of life, and the control of society and guide its development.

Increasingly powerful digital services are permeating all areas of people's lives. They are relieving people of ever more tasks and responsibilities, and developing from passive helpers to proactive assistants that suggest actions or act automatically. These services, coupled with the sensors and actuators of the Internet of Things, measure and document (*quantified self*) billions of individuals. Algorithms derive patterns from the resulting gigantic databases, which ultimately lead to recommendations for humans. Whether humans use these growing capabilities of machine intelligence for their own benefit or to their detriment is set to become the greatest challenge facing humanity. *A Life Engineering discipline should understand the technology, quality of life, and the management of society, and guide its development.*

Machine intelligence in all areas of life, the comprehensive collection of data, and the influence on human beings **cannot be stopped**. It can only be a question of individuals, companies, and society managing machine intelligence for human benefit. Today, a small number of **megaportals** are in possession of huge data collections and the infrastructure for their evaluation. They dominate development, aim to maximize enterprise value through consumer needs, and thus provide the

fuel for evolution. Quality of life, in particular eudaimonia, is not part of their measure of success.

Although the concepts and terms used might differ, ethics, morality, and philosophical guiding principles are aimed at the well-being of all people as far as possible, while the concretization of those principles is insufficient to control the digitalized world; we need **happiness control** in addition to the capitalist control of economy and society. One step towards this is an objective measurement of happiness.

A Life Engineering discipline should

- build a comprehensive **database** of personal information accessible to all developers,
- derive **knowledge (world model)** from it that establishes the connection between actions, perceptions, needs, and feelings,
- concretize the specifications for **digital assistants** aimed at human well-being, and, ultimately,
- measure **eudaimonia** in combination with **hedonia**, and improve on current levels.

Homeostasis controls evolution through inherited and learned needs. In an affluent society, the needs of progress, i.e. selection and knowledge, take priority. However, they place humans on the treadmill of evolution. Life Engineering should recognize misguidance with regard to quality of life and adapt behavior in the interests of quality of life.

Individuals should improve their understanding of quality of life and digital services in order to use machine intelligence for their own benefit. They should recognize the influence better and control their behavior more consciously.

Companies should use the knowledge of quality of life to create products and services with high and sustainable value for consumers. The more measurable the quality of life becomes, the better companies can focus not only on short-term consumer needs but also on a meaningful, satisfied life for their customers and employees.

The economy and society should promote everything that benefits the quality of life of human beings, and prevent everything that harms them. To this end, the economy and society should advance research on quality of life and digital assistants, conquer global leadership in selected areas of development, and generate the necessary capital so that they can drive development in the direction of quality of life. The world database and the world model are decisive means to this end.

We must hope that politics will set the course for a high quality of life. *Politics not only has the right but also an actual duty to guide people to a high quality of life.* All human beings, along with the civil society organizations and the scientific community who represent them, must have the opportunity to have a say in the objectives of policies on machine intelligence.

Machine **superintelligence** (*artificial general intelligence*) is still 50–100 years away. In narrowly defined specialist areas such as the detection of breast cancer

(*narrow artificial intelligence*), machine intelligence already surpasses human capabilities. *Life Engineering is not an issue for the time after reaching superintelligence but above all during the process of achieving it.*

Considerations of technological development and evolution suggest that people have to choose between two paths:

- **Dominance of evolution:** Evolution uses humans. Humans are not the goal but an **intermediate stage of evolution**. Human quality of life is not the goal but the tool of evolution. This is the path we are currently following.
- **Dominance of quality of life:** Humans use evolution to improve quality of life and, in particular, to break free from the enslavement of the **treadmill** of evolution. This path requires not only a rethink but above all concrete steps to steer the economy and society for the benefit of human beings. The instruments for this must be provided by a discipline called Life Engineering.

Many of the statements contained in this book have little scientific evidence to rely on, and some of them are decades away from implementation, so one is inclined to put them aside. However, if we fail to make explicit and carefully considered decisions to utilize the rapidly growing possibilities of technology for the benefit of human beings, then progress will be steered by the powerful of this world, i.e. by capital in the market economy and by the ideologies of political parties. Capital steers according to the goals of evolution; ideologies steer according to the goals of elites. In both cases, a sound understanding of quality of life and a commitment to the recognizable quality of life factors are missing. *Systematic Life Engineering can turn the quantum leap in evolution into a quantum leap in quality of life.*

Appendix

Dimension		Indicator	Opportunity or Risk
ICT access and use ¹	1	Access to digital infrastructures	Opportunity
	2	Use of the Internet	Opportunity
	3	Diversity of Internet use	Opportunity
	4	Inequality of Internet uses	Risk
Education and skills	5	Digital skills	Opportunity
	6	Digital skills gap	Risk
	7	Digital resources at school	Opportunity
	8	Teacher ICT skills	Risk
	9	Online courses	Opportunity
Income and wealth	10	Wage premium associated with digital skills	Opportunity
	11	Online consumption	Opportunity
	12	Selling goods and services online	Opportunity
Jobs and earnings	13	Employment in information industries	Opportunity
	14	Online job search	Opportunity
	15	Jobs at risk of automation	Risk
	16	Lower extended job strain associated with computer-intense jobs	Opportunity
	17	Job stress associated with computer-intense jobs	Risk
Work-life balance	18	Penetration of teleworking	Opportunity
	19	Worries about work when not working associated with computer-intense jobs	Risk
Health	20	Making medical appointments online	Opportunity
	21	Accessing health information online	Opportunity
	22	Extreme Internet use among children	Risk
Social connections	23	Using online social networks	Opportunity
	24	Children experiencing cyberbullying	Risk
Governance and civic engagement	25	People expressing opinions online	Opportunity
	26	Individuals interacting with public authorities online	Opportunity
	27	Availability of open government data	Opportunity
	28	Individuals excluded from e-government services due to lack of skills	Risk
	29	Exposure to disinformation	Risk
Environmental quality	30	E-waste generated per capita	Risk
Personal security	31	Individuals experiencing cyber-security threats	Risk
	32	Individuals experiencing abuse of personal information	Risk
Subjective well-being	33	Life satisfaction gains associated with Internet access	Opportunity

Note: ¹ICT access and use is not a dimension of the OECD well-being framework per se. However, having access to digital technologies pre-conditions their possible impacts on well-being dimensions. ICT access and use has thus been added to the framework used in this monograph as a horizontal dimension.

Fig. A.1 Indicators of Opportunities and Risks of the Digital Transformation (taken from OECD [15, p. 26])

Organization and Factors	Details	Capital	Power	Appearance	Community	Food	Efficiency	Knowledge	Status	Security	Health	Sex	Self-Esteem	Reproduction
Universal Declaration of Human rights [210]														
Dignity			X						X				X	
Brotherhood					X				X					
Equality			X		X				X				X	
Right to life						X					X			
Freedom			X				X						X	
Presumption of innocence			X		X				X	X				
Family					X					X		X		X
Ownership		X												
Freedom of speech		X	X		X				X	X				
Participation					X				X				X	
Living standards		X				X				X	X			X
Education								X					X	
Community					X					X				
Dignity			X						X				X	
Fraternity					X				X	X				
Equality			X		X				X				X	
Right to life						X				X	X			
Freedom			X				X			X			X	
Bhutan [211]														
Living standards														
	Per capita income	X												
	Wealth	X												
	Housing									X				X
Health														
	Self-reported health										X			
	Healthy days										X			
	Disabilities										X			
	Mental health										X			
Education														
	Literacy							X						X
	Schooling							X						X
	Knowledge							X						X
	Values				X									X
Good governance														
	Political participation		X		X			X	X	X				
	Services				X	X	X			X	X			
	Government performance	X			X	X	X	X		X	X			
	Fundamental rights	X	X		X				X	X		X		X
Cultural diversity and resilience														
	Cultural participation				X				X					X
	Arts of Bhutan	X		X	X				X					
	Speak native language		X		X		X		X					X
	Dirglam Namzha		X	X	X				X					

Fig. A.2 Quality of life factors

Organization and Factors	Details	Capital	Power	Appearance	Community	Food	Efficiency	knowledge	Status	Security	Health	Sex	Self-Esteem	Reproduction
Time use														
	Work	X	X			X	X	X	X	X			X	X
	Sleep										X			
Psychological well-being														
	Life satisfaction										X		X	
	Positive emotions													
	Negative emotions													
	Spirituality				X								X	
Ecological diversity and resilience														
	Wildlife damage	X				X					X			
	Urban issues				X		X	X		X				
	Responsibility toward environment													
	Ecological issues	X								X	X	X		
Community vitality														
	Donations	X			X				X					X
	Safety					X	X				X			
	Community relationship				X					X				X
	Family				X					X		X		X
Deutsche Post Happiness Atlas [212]														
Life satisfaction														
	Work	X	X			X	X	X	X	X			X	X
	Income	X												
	Health					X					X	X		X
Housing and leisure time														
										X	X			X
Encyclical Laudato Si' [213]														
Respect for the environment														
	Social relationships		X	X	X				X	X		X		X
	Life	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sexuality		X						X		X	X	X	X
	Family				X					X		X		X
	Simplicity						X			X				X
	Harmony		X		X				X					X
Social inclusion														
	Help those who are weaker				X									X
	Eliminate inequality		X		X				X					X
	Access to resources	X	X							X				
	Common good				X					X	X			
Work														
		X	X			X	X	X	X	X			X	X
French Revolution														
Liberty														
					X				X					
Equality														
			X		X				X					
Fraternity														
					X				X					
Gallup Poll [214]														
Feelings experienced yesterday														
														X

Fig. A.2 (continued)

Organization and Factors	Details	Capital	Power	Appearance	Community	Food	Efficiency	Knowledge	Status	Security	Health	Sex	Self-Esteem	Reproduction
	Well rested									X	X			
	Treated with respect				X									
	Smiled / laughed a lot				X					X			X	
	Learned something interesting							X						
	Felt hopeful									X			X	
	Felt satisfied	X				X				X	X		X	
Global Reporting Initiative [215]														
	Social development													
	No discrimination due to parental leave		X		X				X		X		X	X
	No discrimination		X		X				X		X	X	X	X
	Health										X			
	Education							X						
	Diversity		X						X				X	
	Equal opportunities		X						X				X	
	Human rights (q.v.)													
ISO26000 i [178]														
	Working conditions	X	X			X	X	X	X	X			X	X
	Fair competition		X		X				X					
	Consumer protection and social engagement		X						X	X				
	Human rights (q.v.)													
	Environment					X	X			X	X			
Maslow [95]														
	Physiological needs										X			
	Safety needs									X				
	Social needs				X				X					
	Individual needs												X	
	Self-actualization												X	
OECD [208]														
	Work satisfaction	X	X			X	X	X	X	X			X	X
	Health status										X			
	Income satisfaction	X												
	Meaning and purpose				X						X		X	X
	Autonomy and competence		X		X			X	X	X				
	Education and skills							X					X	
	Capital	X												
	Social connections		X	X	X				X	X		X		X
	Work-life balance									X	X			
	Civic engagement and governance				X					X	X			
	Environmental quality					X	X			X	X			
	Personal security									X				
Sustainable Development Goals (SDG) [216]														
	No poverty	X				X	X	X			X			X
	Zero hunger					X					X			X
	Good health and well-being	X		X		X				X	X		X	

Fig. A.2 (continued)

Organization and Factors	Details	Capita	Power	Appearance	Community	Food	Efficiency	Knowledge	Status	Security	Health	Sex	Self-Esteem	Reproduction
	High-quality education		X				X	X					X	
	Gender equality		X		X				X				X	
	Clean water and sanitation					X	X			X	X			X
	Affordable and clean energy	X					X	X						
	Decent work and economic growth	X	X			X	X	X	X	X			X	X
	Industry, innovation and infrastructure	X					X	X						
	Reduced inequalities		X		X				X				X	
	Sustainable cities and communities				X		X	X		X				
	Responsible production and consumption	X				X	X	X			X			
	Climate action					X	X				X			
	Life below water					X					X			
	Life on land	X				X					X			
	Peace, justice and strong institutions		X		X					X			X	
	Partnerships for the goals				X									
	Life below water					X					X			
	Life on land	X				X					X			
	Peace, justice and strong institutions		X		X					X			X	
	Partnerships for the goals				X									
	Life below water					X					X			
	Life on land	X				X					X			
United Kingdom Measuring National Well-being (MNW) program [159]														
	Health					X					X	X		X
	What we do (job, employment, activities)	X			X		X		X	X			X	
	Our relationships (social inclusion)		X		X				X			X	X	X
	Environment					X				X	X		X	
	Life worthwhile	X	X		X			X	X				X	X
	Safety	X			X					X	X			X
	Personal finance	X	X	X	X	X			X	X		X	X	
World Economic Forum														
	Bhutan (q.v.)													
	World Happiness Report (q.v.)													
	Gallup Poll (q.v.)													
World Happiness Report [81]														
	Life ladder													
	Democracy		X				X							X
	Trust in the state	X	X		X				X	X				
	Corruption	X			X	X	X	X		X	X			
	Generosity	X			X				X					X
	Freedom		X				X							X
	Life expectancy										X			
	Social support		X							X				
	GDP	X												
World Values Survey country-specific factors [217]														
	Feelings of happiness	-	-	-	-	-	-	-	-	-	-	-	-	-

Fig. A.2 (continued)

Organization and Factors	Details	<i>Capital</i>	<i>Power</i>	<i>Appearance</i>	<i>Community</i>	<i>Food</i>	<i>Efficiency</i>	<i>Knowledge</i>	<i>Status</i>	<i>Security</i>	<i>Health</i>	<i>Sex</i>	<i>Self-Esteem</i>	<i>Reproduction</i>
Social tolerance			X						X					
Freedom			X				X						X	
Economic development		X											X	
Satisfaction with life								X					X	
Family expectations (Japan)					X							X		X
Self-expression (USA)								X					X	

Fig. A.2 (continued)

Organization	Website
ACM Special Interest Group on Artificial Intelligence	http://sigai.acm.org/
AI & Society ó Journal of Knowledge, Culture and Communication	https://link.springer.com/journal/volumesAndIssues/146
AI for Good Foundation	https://ai4good.org/
Future Advocacy	http://futureadvocacy.com/
Global Catastrophic Risk Institute	http://gcrinstitute.org/
Machine Intelligence Research Institute	https://intelligence.org/
Systems, Man, and Cybernetics Society	http://www.ieeesmc.org/
The 4TU Center for Ethics and Technology	https://ethicsandtechnology.eu/
The African Center of Excellence for Information Ethics	https://www.up.ac.za/african-centre-of-excellence-for-information-ethics/
The AI Initiative	http://ai-initiative.org/
The Association for Computing Machinery	https://www.acm.org/

Fig. A.3 Organizations focused on AI and quality of life (taken from the IEEE treatise Ethically Aligned Design [22, p. 16] and extended.)

The Association for the Advancement of Artificial Intelligence	https://www.aaai.org/
The Center for the Study of Existential Risk	https://www.cser.ac.uk/
The Dalai Lama Center for Ethics and Transformative Values at MIT	https://thecenter.mit.edu/
The Digital Asia Hub	https://www.digitaliasiahub.org/
The Ethics Initiative at MIT Media Lab	https://www.media.mit.edu/groups/ethics/overview/
The Ethics and Governance of Artificial Intelligence Initiative	https://aiethicsinitiative.org/
The Foundation for Responsible Robotics (FRR)	https://responsiblerobotics.org/
The Future of Humanity Institute	https://www.fhi.ox.ac.uk
The Future of Life Institute	https://futureoflife.org/
The Global Challenges Foundation	https://www.globalchallenges.org/publications/globalrisks/about-the-project
The IEEE Computational Intelligence Society	https://cis.ieee.org/
The IEEE Computer Society	https://www.computer.org/
The IEEE Robotics and Automation Society	https://www.ieee-ras.org/
The IEEE Robotics and Automation Society Committee on Robot Ethics	https://www.ieee-ras.org/robot-ethics

Fig. A.3 (continued)

The IEEE Society on Social Implications of Technology	https://technologyandsociety.org/
The IEEE Symbiotic Autonomous Systems Initiative	https://symbiotic-autonomous-systems.ieee.org/
IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems)	https://ethicsinaction.ieee.org/
The IEEE-USA Government Relations Council Artificial Intelligence Committee	https://ieeusa.org/advocacy/policy-committees/
The International Center for Information Ethics	https://www.i-c-i-e.org/
The Japanese Society for Artificial Intelligence	https://www.ai-gakkai.or.jp/en/
The Leverhulme Center for the Future of Intelligence	http://lcfi.ac.uk/
The Open Roboethics Institute	https://www.openroboethics.org/
The Partnership on AI to Benefit People and Society	https://www.partnershiponai.org/
The World Economic Forum	www.weforum.org/system-initiatives/shaping-the-future-of-digital-economy-and-society
United Nations Global Compact	https://www.unglobalcompact.org/library/5491

Fig. A.3 (continued)

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