THE DIGITAL UPGRADE – A NEW OPPORTUNITY FOR GEOTHERMAL ORGANIZATIONS?

Gregor Rumberg[1] and Marit Brommer[1]

[1]International Geothermal Association (IGA), Charles-de-Gaulle-Str. 5, D-53113 Bonn, Germany

gregor@lovegeothermal.org

Keywords: *Digitization, Digitalization, Digital Transformation, Digital Utilization, Organizational Development*

ABSTRACT

Digitalization has been identified as an ongoing trend with significant effects on societies, associations and companies. The way these organizations deal with the fast development of SMAC (social, mobile, analytics, cloud computing) technologies can be a determining factor for their competitivity in the future.

Though digitalization is a scientific field since decades and not a new development, the current digital wave creates challenges and opportunities for the global Geothermal community.

The authors of the paper report on best practices and lessons learned from the digital transformation of the International Geothermal Association (IGA) and covers the many facets that digitalization may offer to other associations wanting to add value to their membership and to capitalise on the many opportunities the digital world offers. Amongst others the following transformative changes and its impacts will be presented:

- how new digital technologies changes the way members get informed, communicate and participate,
- how this changing behaviour requires a new value proposition with smart services and data access, while the same time volume and velocity of data generation increased significantly,
- how these aspects require a new organizational agility with digital operations, services, structures and mindsets.

The International Geothermal Association (IGA) is a worldwide organization that promotes and contributes to the geothermal research, development and utilization since 1988. Being a scientific, educational and cultural organization with non-political, non-profit and non-governmental status, the IGA aims introducing Geothermal to the world as one of the main renewable sources.

1. INTRODUCTION

Digital products and services have been integrated in the daily business of organizations, individuals and society. The impact of digitalization is significant, forcing organizations worldwide to act and react to changing business rules. A digital revolution is taking place, which is frequently referred to as the third industrial revolution, the “information age” (Brown & Marsden, 2013).

Digitalization refers to concepts such as the availability of large amounts of data (big data), increased algorithm-driven analytical capabilities and many other approaches, through which information flows increase. The growing momentum of the digitalization is impacting society and organizations and therefore constantly changes the strategic context of organizations. The consequences of digitalization are not solely felt in the IT department and affect the entire organization.

Digitalization offers many opportunities for organizations but comes with challenges simultaneously. Hence, the authors of this papers present the major implications digitalization has on organizations. This paper shows emerging digital technologies and their impact on stakeholders, considering possible changes in trends and technologies. Finally, this paper introduces examples for potential applications in the geothermal sector as well as applied upgrades at the International Geothermal Association (IGA).

2. DEFINITION

Following the traditional technical interpretation, the term digitalisation refers to the conversion of information from an analog to a digital kind of storage. This digitization process depends on the input and output medium. For example, analog documents are scanned with a digitizer like a scanning device or smartphone camera, processed by an optical character recognition software (OCR) and stored binary in a portable file document (PDF); analog stored images are decomposed into a matrix by the digitizer, captured with each pixel and then stored in a portable network graphic format (PNG). Once the data is available in digital form, it can be transported via different media and presented on different end devices, while analog content is bound to its medium.

Digitalisation has also been equated with the delegation of tasks to a computer, that have been previously performed by human individuals. It refers to a special form of automation, namely partial or full automation by the utilization of information technologies (IT). Until the early 2000s, such digitalisation was relatively limited to repetitive tasks in organizations (e.g. accounting) and always occurred in the same way.

In the meantime, digitalisation has been extended to tasks, that arise for private users or are less strongly structured. Many private individuals manage their bank accounts via online banking applications on laptops or mobile devices. Similarly, many users now use messenger systems to exchange messages in a private context. Organizations also use improved data mining technologies to automatically analyse large amounts of data for anomalies without the need for dedicated hypotheses. The use of technologies based on artificial intelligence (AI) also allows the automation of less structured processes.

Hence, today in the late 2010s, digitalization is more broadly equated with the introduction of digital technologies as a driver of digital transformation. Digitalization can now be seen in all areas of society and changes the supply and demand on labour markets, political decision-making and the legal framework. Therefore, the digital transformation is especially important for organizations, since they operate in changing societies and structures. Within the framework of the digital transformation in recent years, they have been particularly concerned with changing their core processes (whether in terms of efficiency or customer orientation), their interfaces to stakeholders, customers and members (users), their products and services and their business models in whole (Hess, 2019). For example, popular media companies like Facebook, Twitter and Instagram create no content, accommodation providers like Airbnb own no real estate and taxi companies like Uber own no vehicles.

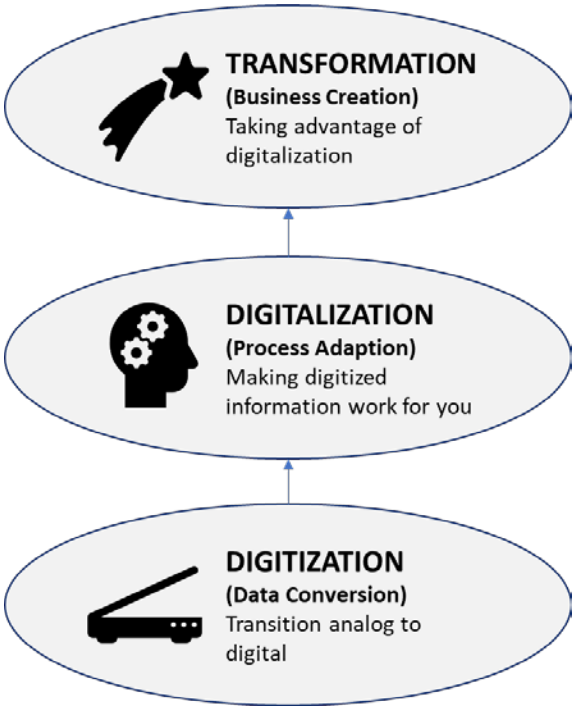

Figure 1: Delimitation of digitization, digitalization and digital transformation (own figure).

In addition, organizations endeavour to set up management structures, that can help them to manage the opportunities and risks of digital change systematically. For example, Horlacher and Hess discussed whether it makes sense to establish the role of a Chief Digital Officer for the definition and implementation of a digital transformation strategy (2016).

Digitalisation and the building upon digital transformation is no new trend. IT-based improvement of business processes has been a topic for organizations for many years. However, due to extensive progress in many technological fields the pressure for transformation has strongly increased in the recent past.

3. DIGITAL TECHNOLOGIES

3.1 Tools and Services

The changes caused by digitalization are driven and enabled by a huge variety of new digital technologies, that became available in the last years. Their relatively rapid growth and spread pushed the speed and impact of digitalization measurable. As an example, today users adopt a new technology much more quickly than ever before. While it took about 38 years for the radio to reach 50 million users, mobile phones reached that number in only 12 years, a service like Instagram was adopted by that number of users in less than a half year and an augmented reality (AR) game recently reached the number within a few days (Figure 2).

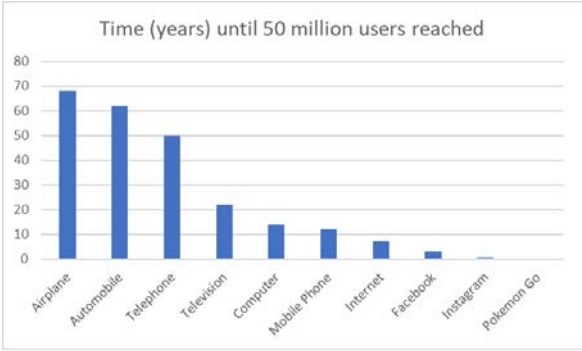

Figure 2: Time until a technology reached 50 million users (own figure).

At the same time, the velocity of technical development increases. According to Moore's Law, the number of transistors in a dense integrated circuit doubles about every two years (1965). As an example, in the year 1985 the Cray 2 supercomputer was introduced, which cost 32 million US Dollar. In the year 2011, the iPad 2 was presented, which had roughly the same performance for a price of 500 US Dollar.

As of current, the following technologies are emerging among others:

Next Generation Mobile Networks (NGMN)

While the general operating principle is equal to a classic mobile network, next generation mobile networks (NGMN) like 5G offer significantly higher transfer rates up to 100 Mbit/s (0.75 GB/min), which is crucial e.g. for the usage of video content. Furthermore, the end devices used can be permanently connected to the internet and offer a more efficient use of the available frequency spectrum. The total number of connected internet devices will rise to 25 billion by 2020 and, by far, exceed the world population.

Cloud Computing

Another key pillar of the digital transformation technology ecosystem is cloud computing. Cloud computing is an IT infrastructure, that is made available via the internet, for example. It usually contains storage space, computing power or application software. In technical terms, cloud computing describes the approach of making IT infrastructures available via a computer network without having to be installed on the local computer. These services are offered and used exclusively via technical interfaces and protocols, such as a web browser. The operational model is based on the principle, that the software and the IT infrastructure are operated by an external IT service provider and used as Software as a Service (SaaS) in a licensed model.

Big Data

Digitalization induces great changes in the way knowledge is generated by data made available to organizations. This data driven knowledge built upon "large data volumes generated and made available on the internet and the current

digital media ecosystems" (Constantiou and Kallinikos, 2015) is often referred to as big data. The availability of such data as well as the ability of organizations to process and apply it in an efficient way influences the way, how decision-making is performed in organizations.

Blockchain

A Blockchain is a digital log of records (blocks), where blocks link to one another in a chain. The data in a blockchain is time stamped and the information recorded cannot be altered retrospectively, making records verifiable and permanent. The records are then stored in a transparent, public database or file, where users can view the data, but not edit or delete. The technology enables the direct exchange of assets or tools, such as financial payments, contracts or intellectual property rights in a secure way without the involvement of intermediaries to manage the exchange, like banks, utility companies or governments.

Artificial Intelligence (AI)

Artificial intelligence (AI) is the ability of a computer to go beyond pre-programmed processing and exhibit human-like behaviours, such as reasoning. AI enables computer systems to deal with imprecise problems without the need for programmers to code for every eventuality, applying reason, learning from the environment in which they operate, and improving their performance over time. For example, AI is already integrated in voice-driven assistant systems like Siri or Alexa, autonomous vehicles and personalized recommendations in online shops.

3D printing

3D printing is a manufacturing technique, that creates physical objects from digital models using a range of materials from metals to resins. The 3D printer deposits very thin layers of material from the ground up, side-to-side and backwards and forwards to build the object. The technical foundations for 3D printing have been laid in the late 1980s by the invention of fused deposition modelling, but the increasing sophistication of the technology, advances in digital technologies and lower equipment costs result into a higher distribution and mainstream acceptance. Moreover, because basic patents had expired, the industry was able to double the turnover in 2009 to 2014 from one billion to two billion US Dollar (Daum, 2019).

Figure 3: Example emerging digital technologies and services (own figure)

3.2 Impact and Expectations

These example technologies demonstrate the versatility of digitalization, which challenges established business rules and environments. Current business models must be reassessed, as they potentially become outdated in the future digital economy. Furthermore, traditional organizational structures will erode or come under pressure. Consequently, organizations might have to review their own business models before others do and to come up with digital innovations to participate in the digital race with success.

New digital technologies also significantly change the behaviour of users in terms of how they become informed, evaluate and participate. Digitalization empowers them, e.g. through fast spreading word-of-mouth effects in social media. Users are not only better connected and informed, but also more self-confident. Moreover, digitalization provides the environment to integrate these users into core business processes and data collections using online platforms. Mastering the user interface becomes ever more crucial for organizations and affects established relationships as well as processes. Hence, focusing on users' needs and customer experience is more important than ever. This creates a demand for smart products by integrating physical products in digital innovations like mobile applications and smart services, that are based on or enabled by these digital technologies as well as a communication over new channels like social media.

As digitalization has the power to rewriting the processes and rules of business, the associated effects provide major opportunities, but also contain challenges. As an example, digitalization creates an increased demand for storage, bandwidth and computational power, but also a high energy consumption, so the objective of a sustainable and efficient energy consumption is opposed, like for crypto-coin mining (Stoll, 2019).

Besides, the fast development of new technologies can rise too high expectations and lead to a conditioned behaviour, where a new technology is expected to be the overall solution solving all problem definitions of a certain field. As an example, Daum (2019) demonstrates by the field of 3D printers, in which expectations have been and are still relatively high: At the beginning of the year 2011, many business magazines announced, that the third industrial revolution was very close due to the 3D printer, proclaiming the end of the era of mass production. The idea of the "factory in every house" was born and the emancipation from big industry seemed within reach.

Such high-flying expectations, however, contrasted with the poor quality of the printed products, since they still looked rough and were hardly suitable for more than prototype usage. In addition, the printing process took a relatively long time. Apart from a few applications, that were widely used in the media, there was hardly any breakthrough on a broad front.

Retrospectively considered, a period of exaggerated expectations of new technologies has been relatively often followed by a period of disillusionment. This is the basic idea of Fenn's "hype cycle" (2018) as shown in Figure 4: a "technological trigger" is quickly followed by euphoria, at whose "peak of exaggerated expectations" of the innovation unimagined market potential and almost miraculous characteristics are attributed. Soon, however, this high phase is replaced by a sudden crash into the "Valley of

Disappointments" - the bubble bursts, disillusionment sets in and the audience largely turns away. In a third phase, on the "Path of Enlightenment", real applications begin to succeed on the market and conquer their place in the technological landscape. On the "plateau of productivity", everyday life finally returns: the technology is integrated into daily business.

This cycle is also exemplary for the 3D printer. However, in the meantime, the devices have found their professional niche in prototype production, e.g. in the aircraft and aerospace industries, though mostly in much more expensive variants. The printing speed in 2019 has also more than doubled compared to 2014 and the size of the possible models has also increased.

4. UTILIZATION

4.1 Application at the Geothermal Sector

When considering the potential application of new digital technologies on activities in the geothermal sector, the example of 3D printers stated the importance to be aware, that a fast utilization is not always feasible. However, to push geothermal in the energy mix in general and in the renewable energy sector specifically, it would be negligent not to consider applications or potential scenarios.

As an example (and away from organizational administration and management), many field activities of a geothermal project create relatively big amounts of data from e.g. exploration loggings and drilling activities, that can be uploaded immediately to the cloud via a fast 5G network. AI systems can tackle problems, that have previously required human deliberation, especially when supporting information for those problems is not precise or conflicting. Systems with AI can learn strategies to respond with different approaches to changing situations and then recommend corrective actions. This can be visualized on site through augmented or virtual reality. Stakeholders and public audience can participate in latest project developments in a timely manner via live-streaming, social networks and other online channels. Missing parts on site can be created by 3D metal printing, while new gained knowledge can immediately flow into design corrections of parts to enhance efficiency, reliability or safety and reduce delivery time and costs.

In a further stage with a commissioned geothermal plant or active direct use, the blockchain offers an opportunity to create disruptive business models in trading, supply chain management and retail. The technology could facilitate smart contracting and payments directly from a house owners blockchain to the plant operator, without the need to transact through a third-party like a bank. Customers might source their power directly from a geothermal energy supplier. Together with virtual power plants, blockchain could also be a powerful tool allowing consumers to trade any excess power generated from their e.g. solar photo-voltaic home, without the need to use a utility or centralized grid.

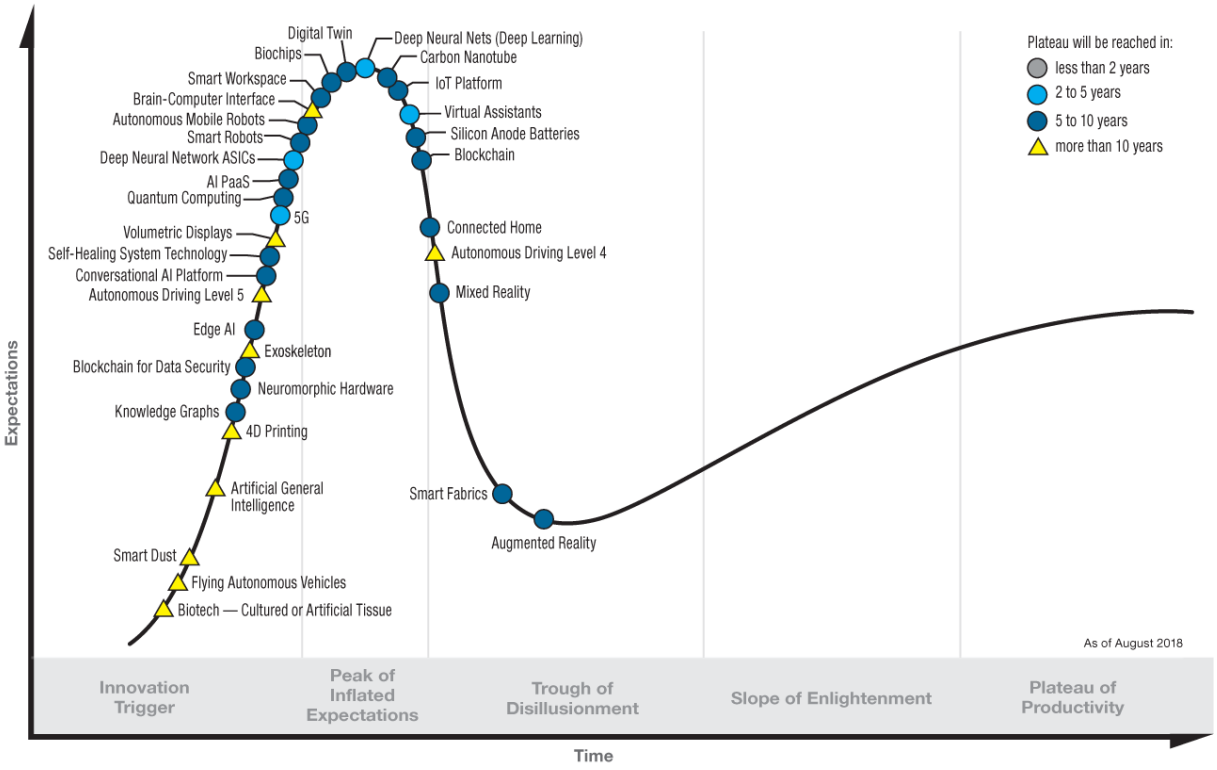

Figure 4: Hype Cycle for Emerging Technologies 2018 (Fenn, 2018)

4.2 Application at the IGA

To apply the digital upgrade in a real-world-scenario at the IGA, it was necessary to point out the structure of the organization a priori. The IGA is represented by a Board of Directors (BoD) with 30 persons and operated by its Executive Director (ED) and a secretariat team. The members of the board as well as the administrational and executional staff are residing and operating in a wide number of cities, countries and continents. This requires a time and location independent communication of a virtual network of people, collaborating according to a dynamic board agenda based on global and organizational challenges and opportunities. The agenda is built around learning and knowledge management and is reflected in a structure with committees for their key activities, like education, information and membership. The IGA is the voice of 5000 members worldwide, including members from corporations, institutes and individual members. The majority of the IGA member are members through their national geothermal association, who are an affiliated member of the IGA. In the year 2019, these national affiliated associations covered 30 countries worldwide, covering most countries and regions with geothermal activity. The digitalization changed the way, how the IGA members gather and evaluate information. They connect relatively more often with mobile devices, expect online access to data and want to be included in social media channels.

To utilize the potential of new digital technologies, the IGA had to create a comprehensively connected, smart, and fast network, integrating all affected partners, stakeholders and members by integrating IT enabled systems, that are scalable on a growing association. Resources, services and data must be exchanged seamlessly, end-to-end. To apply the new digital IT strategy, the entire IGA information system had to be reviewed for the strategic fit, while respecting legal, administrational and financial constraints: The new IGA information system needed to operate location independent with easily accessible and administrable services and file resources, while data protection, security and authority had highest priority. Furthermore, contracts for new external services must be held at a relatively short-term range to be more agile in case of incompatibilities between systems or non-acceptance of the users.

Hence, the adequate technology is provided by cloud computing, specifically SaaS. New services and membership benefits have been provided relatively fast, without implementing self at possibly high development time and costs. The former IGA information systems have been checked for their future usability and, if necessary, alternatives researched, tested and decided. A local based data storage and management has been replaced by a scalable and self-managed cloud storage with custom access rights for the different stakeholders like the executive team or members of the Board of Directors as well as project partners.

While the global spread of some “old-fashioned” services like e-mail is still relatively high and continued of course, the IGA integrated several cloud services covering cloud storage as well as video conferences and messenger, supporting a synchronous and asynchronous communication. Activities on social media have been increased significantly and with Facebook, Twitter, LinkedIn, Instagram and YouTube, the IGA reaches its members and the public on the most popular social media services.

As another result of the service relaunch, a Member Management System (MMS) supports the administrational processes of the IGA team, automizing membership applications and renewals, the registration for events as well as online payments for membership or event fees.

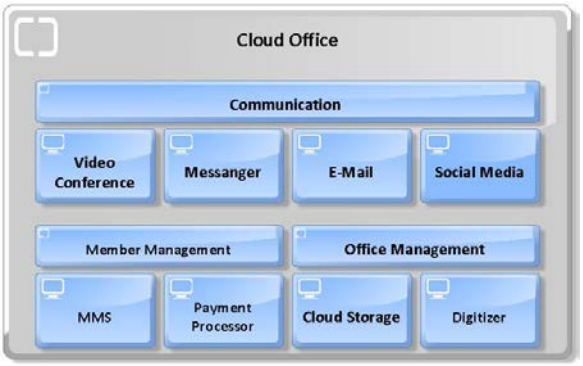

Figure 5: Simplified IGA cloud office structure

The integration of these cloud services saved costs in terms of staff and hardware. This also means, that no long-term capital commitment is required, since the costs for all the services are billed on a monthly base and can be easily calculated. In addition, the costs for renting a cloud solution are generally much lower than the costs for purchasing own hardware and software, which correspond to the desired service. The fact, that hardware requires regular maintenance and upgrades in order to remain up to date with the latest technology is also a significant factor for the limited administrational capacities of the IGA. The amount of storage space, computing power and software package can be adapted to current requirements at any time. In addition, several branches or external partners can be easily connected to the IGA IT infrastructure.

5. CONCLUSION

The aim of this paper was to introduce the many facets of digitalization and the challenges and opportunities, that it may offer to the geothermal community in general and the IGA representing an international organization specifically. Hence, this paper presented emerging digital technologies and the major implications digitalization has on organizations and the way stakeholders and users are involved, how this changing behaviour requires a new value proposition with smart products and services and data access and how these aspects require a new organizational agility. Furthermore, this paper showed potential application in the geothermal sector with reference to realistic expectations of an instant utilization and sketched the impact of digitalization on the IGA, though the resulting changes and integrations are the first phase in a longer process of the digital transformation only. However, for further steps it is fundamental to have set the digital foundation of the organizational infrastructure.

In this process it is crucial to consider the lessons learnt from the past, but in a more dynamic and faster changing world it might be even more important to think ahead and identify the upcoming topics of importance. Hence, the authors invite the audience to pick up the ideas from this paper and to contribute to a joint understanding of how digitalization can be utilized to meet the future challenges and to support introducing geothermal to the world as one of the main renewable sources.

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