

From Open Science to Open Source (and beyond)

A Historical Perspective on Open Practices without and with IT

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ABSTRACT

Openness as organizational philosophy and theoretical concept has continuously gained importance over the past decades. While the adoption of open practices such as open-source development or crowdsourcing is primarily academically observed in the 20th and 21st century, organizational practices adopting or facilitating openness have already been applied before there was an understanding what openness actually depicts. For centuries, public and private stakeholders utilized a broad variety of open practices such as open science, industrial exhibitions, solution sourcing or industrial democracy in order to achieve certain anticipated effects – fully in the absence of IT. Due to the missing historical understanding, this paper provides a first holistic historical perspective on the emergence of open practices, considering the context of the political, technological and societal developments. Utilizing a structured literature review, the paper puts a special focus on the historical narrative and the connection between openness without and with IT.

The paper concludes that open practices are not a recent phenomenon, but were already applied successfully by affected stakeholders in previous centuries, whereas applied open practices partly build upon each other and show resembling patterns. Historically, two central shifts are identified: (1) a shift from government-driven towards organization- and community-driven open practices, and (2) a shift from mainly transparency-oriented open practices towards a stronger utilization of inclusion.

CCS CONCEPTS

• **Professional topics** → History of computing; • **Document types** → General conference proceedings.

KEYWORDS

Open Practices, Organizational Openness, Management History, Historical Narrative, Literature Review

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1 INTRODUCTION – OPEN PRACTICES AND THEIR HISTORICAL CONTEXT

Over the past decades, organizational openness has emerged as academic focal point, questioning and refuting the perception of organizations as fully closed entities without interfaces to their internal or external environment. Openness is associated with certain degrees of transparency and inclusion [85] with regard to organizational elements such as resources, participation processes or democratizing effects [69]. At this, transparency refers particularly to the visual or verbal visibility of these elements, while inclusion is associated with participation respectively involvement. Transparency and inclusion can act intra-organizationally or extra-organizationally [37, 85] and imply information exchange between involved stakeholders and entities, enabling organizational learning [55]. Different theoretical frameworks conceptualize openness, the most prominent being open innovation [17], open strategy [18, 85], open-source [66], open data [44], open education [77] or open government [47].

Nowadays, information technology (IT) plays a major role for organizations applying open practices. The majority of the observed contemporary open organizational practices such as open-source development [66], internal jamming [8], idea platforms [45] or crowdsourcing [1] are either purely IT-based or at least supported by IT. This can be also observed at recent cases such as Wikimedia [25], Daimler [57] or IBM [8], as well as in multiple sectors [65, 76]. Due to the fact that the academic focus on openness emerged particularly in the end of the 20th and begin of the 21st century (where IT has always been a pervasive factor) and that the majority of investigated cases also refers to the same era, the impression occurs that openness is a relatively new phenomenon and that, in turn, organizations were acting as closed entities before.

However, openness can be observed both with and without IT [69]. Including external elements to the own organizational setting respectively applying practices of democratization were already practices applied in times when IT was not the driver for organizational openness yet. Already in medieval and industrial ages, adopted organizational practices such as industrial exhibitions [15], inventing prizes [51], licensing external innovations [59], trade associations [6] or industrial democracy [81] did de-facto break the paradigm of organizations as closed entities which can be perceived as separated from their environment. In academia, open science emerged in the end of the 16th century as relevant philosophy, changing the way how researchers and scientists disclose their findings to the public and collaborate with their peers [21, 23]. All

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these practices exhibit certain degrees of transparency and inclusion, despite of the fact that these practices were not necessarily defined as ‘open’ by practitioners or research.

It strikes that there are no dedicated holistic studies which deal with the historic utilization of open practices and their political, technological or societal context. Existing historic narratives are limited to a brief overview regarding historical manifestations of openness by Schlagwein et al. [69], revealing general historic milestones and their context. Besides, only industry- or subfield-specific narratives are performed, including openness in the computing and mobile phone industry [31] or in education [63]. In order to adjust the wrong perception of openness to be a phenomenon of the 20th and 21st century as well as to close this research gap, this paper intends to take a look back – providing a grand historic narrative on the emergence of open practices and their context.

Closing this research gap, the historic adoptions of openness are enlightened by the knowledge of organizational openness which exists today, enabling to identify trends regarding how open practices developed over time. Moreover, based on the findings regarding the historic development of open practices, an outlook can be derived which considers the context of contemporary open practices. Accordingly, the paper contributes to a better understanding of openness in the course of time as well as to a better understanding of open practices both without and with IT.

2 RESEARCH APPROACH

The paper utilizes a structured literature review, being considered particularly suitable in order to present the historical context and perspective of a respective phenomenon [35]. At this, the study considers the best-practice criteria and underlying principles for transparent historical narratives with regard to credibility, confirmability, dependability and transferability [32]. Due to the nature of the study, it applies an explorative hermeneutical (iterative, circulating) review and literature research approach without predetermined structure or topic setting [10]. With regard to literature search and study selection, the paper applies the recommendations by Kitchenham and Charters [52], particularly when it comes to inclusion or exclusion criteria.

We started the review by identifying and evaluating acknowledged fundamental publications such as Schlagwein et al. [69], David [23] or Ceruzzi [16] as well as the publication record of acknowledged business history journals (e.g. ‘Business History Review’) in order to establish a rough timeline regarding applied open practices. The further evaluation process was particularly focused on establishing a comprehension regarding historical proceedings, whether and how transparency and inclusion were utilized and what the relevant political, technological or societal background factors were. The iterative and circulating approach enabled the identification and evaluation of further publications, sharpening and verifying the picture of the individual open practices. In the case of doubts regarding the relevance or reliability of a publication, the content of the abstract, number of relevant citations as well as the reputation of the respective journal or conference were taken into account. Since several historic open practices are not labelled or known as ‘open’, relevant open practices were chosen based

on the question if and how they made use of transparency and inclusion.

Due to the fact that many recent publications on openness are published as conference proceeding, the narrative considers both published journal papers and conference proceedings. Also, acknowledged academic books or further sources (e.g. working papers) are considered if they refer to the original source or provide further relevance. The review focuses particularly (but not exclusively) on academic publications due to the objective to provide an accurate grand narrative of open practices. At this, both historic publications as well as recent studies are taken into account. As basis for the literature review, the following data bases were used: ABI/INFORM, AIS eLibrary, EBSCOhost, JSTOR, ScienceDirect, Web of Science and Google Scholar. Relevant journals were partly accessed directly.

3 OPEN PRACTICES WITHOUT IT – BREAKING THE PARADIGM OF ACADEMIC AND INDUSTRIAL SECRECY

3.1 Open Science: Creating academic transparency

As one of the first structurally observed manifestations of openness, the phenomenon of open science emerged in the late 16th and early 17th century, starting a transition from concealing insights about nature’s secrets towards disclosing new scientific knowledge towards peers and public. Overall, open science refers to “transparent and accessible knowledge that is shared and developed through collaborative networks” [79, p.434] and is embodied in many academic practices which we know today such as publishing academic insights to a wider audience (e.g. via open access), conducting peer-reviews, creating transparency regarding applied research methods or utilizing open knowledge repositories and data bases. However, for centuries scientists typically did not apply these practices of academic transparency which we know today. From the time when academia was founded in ancient Greece by (among others) Aristotle and Plato till the late Middle Ages and early Renaissance, the principles of secrecy in alchemy and science were upheld. Acknowledged scientists or inventors like Leonardo da Vinci (1452-1519) or Galileo Galilei (1564-1642) showed a very reluctant approach of showing their writings to others or even encoded their research results with anagrams, withholding their academic insights from the public [23].

The motives for this closed model of science, which sustained for so many centuries, are diverse: Despite of few exceptions, religious, political and societal norms contributed to withholding knowledge from the ‘unworthy multitude’ both in ancient Greece or medieval times [23]. Also, scientists often wanted to protect and control their knowledge in order to find a way to commercialize their ideas and inventions. The scientists’ dependence from different kinds of patrons (providing political and material support) brought often the necessity of exclusivity: Only if findings were unique and prime, anticipated benefits of the scientist-patron relationship could be achieved [21]. The fact, that the whole academic philosophy and sheer idea of science came from a closed model, did not make it easier for scientists to apply more transparency – there was simply

little understanding how open science could look like and how it could be advantageous. Consequentially, secrecy and informational asymmetries were normal conditions in the world of science.

However, while aristocratic patronage was initially a reason for scientists to sustain secrecy, it can be also perceived as one of the initial promoters of open science. For a long time, secular or religious patrons were historically closely related to European science. At this, nobles typically had two central motives to act as scientific patron: ornamental motives (focusing on self-aggrandizement, status or reputational advantages against other nobles) or utilitarian motives (focusing on the contribution of the research results for economy, military or society) [21]. For ornamental motives, it was elementary for inventions and academic results to be published, in order to be publicly recognized for the achievements and discoveries. For both scientists and nobles, demonstrating knowledge and inventions to the outside world brought a notable raise in societal and scientific legitimacy. However, many utilitarian inventions (e.g. inventions providing superior geographic knowledge regarding important trade routes) demanded a certain level of secrecy [21, 23].

Hence, the question arises, how the patrons' motives contributed towards a more open form of science from the post-renaissance era? The answer is closely related to the implications of the previously mentioned information asymmetries. The more intense use of mathematical methods of post-renaissance scientists and their drive to reveal the 'unfamiliar' created a certain dilemma for potential patrons: Evaluating academic methods and insights was intellectually far more demanding than before, given the lack of specialized expertise among the patrons. In order to protect themselves from embarrassment through sponsoring 'charlatanry', they demanded peer-reviews which could only be conducted by other mathematical-oriented scientists [21-23]. Along these developments, so-called 'cooperative rivalries' between scientists emerged as a functional response to the existing information asymmetries, building up on the insight that the disclosure of knowledge, demonstrating inventions and open inquiries contribute to the generation of new knowledge [22].

The occurring re-organization of European science could be particularly observed in the form of open practices such as "participation in informal networks of correspondence, [...] public challenges and contests, open demonstrations and exhibitions, and the certification of individuals by cooptation and election to 'learned societies'" [21, p.578]. These new practices profited strongly from emerging technologies and regulations such as copyright privileges, postal dispatch systems or Gutenberg's printing press, forming background conditions for diffusion and protection of knowledge alike [23]. The London 'Invisible College' from 1646 depicted one of the first scientific groups representing these aforementioned 'informal networks': Through informal meetings and letter exchange dealing with their scientific insights they thrived on the fundamental idea that the open knowledge exchange contributes to the creation of new knowledge [20]. As one of the consequences, the 'Philosophical Transaction of the Royal Society' introduced the first peer-reviewed journal in 1665, building a milestone regarding academic transparency [9].

3.2 Industrial Exhibitions: Publicly showcasing inventions and industrial goods

Comparable to the medieval alchemists and scientists, also the European crafts guild considered their specific knowledge and technological assets worth protecting. While journeymen contributed to the diffusion of industrial craft knowledge on a local level, and first notable medieval trade fairs like the 'Messe Frankfurt' emerged at the hubs of the trade routes, broader transparency was often prevented by economic interests and regulatory factors [23, 68]. However, the rise of open science brought along practical implications for the industrial development of Europe and the way how it showcases technology and new inventions to the public. What we understand nowadays as 'economy' or 'industry' was in pre-industrial times closely connected to the interplay between academia, inventors and patrons – many of the economic-relevant inventions were made by scientists and applied in the non-academic world, particularly after the rise of mathematical methods in science. Accordingly, open science does not only refer to openness in academia which can be separated from economic technological research. As a consequence of the economic- and reputation-driven patronage which facilitated open science and its overarching socioeconomic impact, the emerging open practices regarding public contests, demonstrations and exhibitions provided a basis for the further development of open practices, also in the area of industrial discoveries [21].

Evolving from the aforementioned medieval trade fairs and the new academic exhibition practices, industrial exhibitions provided an opportunity for firms and inventors to exhibit new inventions, technology and industrial goods to a larger audience of interested stakeholders, potential buyers or investors. Taking place since the 17th century (the industrial exhibition in Paris 1683 being one of the first documented organized industrial fairs), the sporadic exhibitions in these early days gained usually relatively little public attention [15, 27]. However, they provided a basis for bigger industrial transparency and established themselves as mass phenomenon in the 19th century (one of the highlights being the international 'Great Exhibition' in London 1851), profiting from the technological advances of the industrial revolution [2].

Resembling the emergence of open science and its motives, also industrial exhibitions were strongly driven by nobles and governmental stakeholders. At this, the exhibitions had multiple objectives: Governments and nobles aimed on facilitating the development of new relevant technologies, increasing the national prestige or stimulating exports, why the expositions were often organized or financed by according stakeholders. As an example, the French government introduced official industrial exhibitions at the very beginning of the 19th century in order to react on the rise of British products which were produced more efficiently as a consequence of the industrial revolution [34]. Exhibitioners on the other hand participated for the monetary value of the exhibition prizes, local pride or the possibility to promote their inventions to a wider audience [15, 34]. As consequence, trade fairs and industrial exhibitions contributed to a switch from industrial secrecy towards more transparency with regard to industrial goods and inventions, leading to more openness both on the economic and organizational level. This is also observed by Landes [53] and Dunham [26], who emphasize the role of exhibitions in diffusing knowledge and technology.

3.3 Inventing Prizes: Between solution sourcing and fostering economic development

Often applied as part of the industrial exhibitions, monetary exhibition prizes were provided as incentive and reward for the best exhibition pieces [34]. However, in the 18th and 19th century this practice was further adapted by governmental entities and organizations in order to source for external solutions and innovations. Inventing prizes and innovation awards induced inventors to deal with a specific problem or subject and reveal their inventions and ideas, facilitating openness. Beside of the offered incentives, the possibility to further commercialize the invention through patents or overlapping awards made it often further attractive for inventors to participate [51].

At this, two main approaches could be observed: The first one being the utilization of inventing prizes in order to source for a specific solution to a particular problem. As popular example, the British parliament publicly announced a notable reward for finding an accurate way of measuring the longitude at sea in 1714. While prizes were particularly promised by national states and other government entities, also private entities such as the billiard table producers Phelan and Collender, who were looking for a cheaper material to produce billiard balls in 1863, were using promised incentives to approach specific organizational challenges. Similar cases were observed all over Europe. Hence, this approach provided certain elements of inclusion through involving external parties into the own solution finding and R&D process [51].

The second form of utilizing inventing prizes was less focused on finding a solution to a particular existing problem, but rather to generally foster economic development by promoting new innovations and overcoming information asymmetries through the diffusion of technological knowledge. Increased transparency of the inventions was an anticipated side-effect, creating the wanted spread of information and innovation for the sake of economic development. Private or governmental prize-granting institutions such as the British RSA (Royal Society of Arts; founded in 1754) or the French SEIN (Society to Encourage National Industry; founded in 1801) are representative entities following this objective [51]. In this regard, the motives for inventing prizes are closely connected to the motives of industrial exhibitions.

3.4 Solution Sourcing: Utilizing external innovations via patents and licenses

The first described approach regarding utilizing inventing prizes (focusing on sourcing for special solutions) was not necessarily a practice applied only in the context of inventing prizes. Craftsmen, merchants and organizations were constantly buying or copying new external inventions in order to apply them on their own. At this, the adoption of new external innovations depicted a logical necessity: If a competitor had a new and better way how to produce or transport a certain good, adaption respectively the integration of new technology was often the only way how to stay in competition. For instance, when the modern magnetic compass emerged in Europe around the 11th/12th century (it is questionable if it came via the sea routes from China respectively Arabia, or was invented

independently), the novelty was quickly utilized by merchants and explorers, despite of the fact that these stakeholders had not necessarily invented it [72]. In the absence of explicit regulations, new inventions could just be utilized as soon the knowledge about the invention was spread via word-of-mouth or if somebody bought it directly from an inventor. However, as long there was no possibility for inventors to protect their inventions and intellectual knowledge, revealing novel inventions included the danger to potentially lose the possibility of future monetization.

With the emergence of modern patent and intellectual property law, also the practice of utilizing external innovations evolved. Inventors or organizations could protect their inventions in order to use them themselves, sell licenses to others to further commercialize the patents, or sell the patents. Patent and copyright laws go back to the 15th century, where the Venetian Republic in the effort to attract skilled artisans and inventors was offering exclusive rights for their inventions. Being already an important background factor for open science, the fundamental idea of copyrights and patents was adapted around Europe in order to facilitate economic development. In the US, the first article of the constitution (1789) assured inventors exclusive rights to their inventions [59].

As a consequence of the industrial revolution, the ongoing mechanical progress and the possibilities for inventors to protect their intellectual knowledge, more and more inventions were patented. At this, independent inventors would not necessarily open own shops (also due to the lack of resources) but sell their patents or provide licenses to one or more manufacturers [60]. Organizations were faced with the decision to either develop and manufacture industrial technology and goods themselves or to purchase the external invention from private persons or other organization (e.g. via buying or licensing a patent or contracting the production of industrial good in the form of an outsourcing or procurement agreement). For many firms, like the Draper Company which invented the Northrop loom (becoming the industry's standard in 1895), defending their respective patents and market them in a smart way was key for their economic success – other companies were required to enter licensing agreements to stay competitive [56]. Overall, these forms of external solution sourcing showed certain characteristics of inclusion through involving external stakeholders and their inventions to the own organizational setting.

3.5 Trade Associations & Cartels: Formalized cross-organizational aligning

While open practices like open science or industrial exhibitions focused strongly on increasing transparency and were driven by governmental stakeholders, occurring cross-organizational alignments were often driven by self-interest of organizations, merchants and craftsmen. The history of modern formalized cross-organizational alignments started already in medieval times: Local or alien guilds of merchants and craftsmen used their mutual market power in order to fix prices, lobby at local authorities, restrict supplies and control market entries, hence, enforcing monopolies and oligopolies. So from a pure business model or market entry perspective, the guilds did not promote openness, but rather suppress competition. However, the guilds applied cross-organizational openness

through revealing e.g. prices or operating principles to other members (transparency) and surrendering decision power under mutual regulations for the common benefit (inclusion). At this, the guilds were generally quite restrictive – internal punishment for violating the guild’s regulations assured the integrity of the respective guild [61]. As acknowledged example, the ‘Hanse’ was formed in the 12th century as commercial association of northern German merchants, in order to establish trade route protection and formulate common economic interests. While it existed up until the 17th century, it is commonly considered to be one of the first established trade associations [54].

The modern trade associations emerged in the mid of the 19th century, also as a consequence of the very tight policies of their predecessors and the further institutionalization of companies. While these trade associations had various motives, stricter anti-trust legislation caused a shift towards more individualism within the associations, allowing an enhanced degree of individual business practices and free competition [58]. But still then, these modern trade associations were often acting as a tool in order to create different forms of price cartels and suppress competition: At the end of the 19th century, US hardware wholesalers utilized trade associations in order to stabilize prices and increase the negotiation power against other complementary trade associations [4]. At this, including the other companies into stating prices and negotiating brought two main benefits: First, information asymmetries, which naturally existed with regard to other firms’ prices, were massively reduced. Second, a single company profited from the resources of the network when negotiating with other stakeholders. With regard to both, certain degrees of transparency (e.g. in prices, market positioning, cost of operations) were a key element in order to benefit from the anticipated advantages. With regard to inclusion, companies transferred certain decision and negotiation power to the trade association which, in turn, was then able to establish the strategic positioning of the association.

However, associations were not only acting as a tool for organizations to establish cartels: Berk and Schneiberg [6] observe a development of American industry associations from being cartels to being developmental associations from 1900-1925: In order to achieve organizational learning effects, collaborative associations, committees and deliberative forums were providing a place for representatives to learn from and discuss with external stakeholders from other associations, organizations, governments or agencies. At this, the discussions and thought experiments were facilitating knowledge transfer and information sharing, very often regarding costs and productivity – creating a competitive advantage against non-participating organizations. In comparison to the usage of associations as tool in order to exclusively form cartels and basically suppress competition, the information transparency in these developmental associations is much more related to organizational learning: Using external knowledge in order to improve own production processes and strategic considerations.

3.6 Industrial Democracy: Establishing internal participation and democratization

Till the 19th century, open practices were fairly focused on extra-organizational open practices, being oriented on increasing transparency, utilizing external resources, knowledge or inventions, or establish cross-organizational alignment. Intra-organizational open practices in the form of democratization, common decision making or bottom-up involvement were not applied on the broad scale. While several contemporary open practices involve employees to decision making, such as consultative participation, employee ownership, representative or informal participation, work councils, board level representation or social media jams [29], this was not the case for a very long time. Although several cases of joined negotiations or even what we understand by trade unions can be identified along history [82], craftsmen and journeymen only very occasionally joined forces in order to stand united against their employer in order to demand better wages, working conditions or involvement into decision making.

The emergence of industrial democracy at the begin of the 19th century depicted a paradigm shift towards a stronger (internal) involvement of factory workers. Industrial democracy, a term created and shaped by Webb and Webb [81], refers to employees’ involvement into decision making or collective bargaining, employee representation or further types of employee empowerment. In order to comprehend the emergence of industrial democracy, one must consider the industrial world’s context of the early 19th century: The rapid expansions of the first industrial revolution – facilitated by breakthrough inventions like the steam engine or the power loom – brought huge implications for workers. Previously hand-crafted products could be now produced with mechanical help, changing their job profile towards repetitive work as well as raising the need for more unskilled or semiskilled workers. Child and women labor rose drastically, similar to the need for coal or iron miners [40, 41]. Consequentially, the employer-worker relation in industrial organizations in Europe or the USA was characterized by wage-labor, long working hours, strong hierarchies and little involvement of workers regarding internal participation or democratization. Work conditions, contracts, salaries as well as decision making was mainly in the hand of management respectively owners, resulting in strong power asymmetries [24, 40].

Under these circumstances, several societal and political impact factors are considered to have led to more industrial democracy. Weighing up existing historical investigations, Hyman [46] identifies a multi-step process to have consequentially led to the emergence of industrial democratization, consisting out of (1) the achievement of political democracy, (2) the accompanying impact on workers with regard to ideas on social democracy and representation, (3) the demand that this social level of democracy and voice also accounts at the work place and (4) the overarching impact of economic democracy, leading to organized workers’ unions, shop committees or even self-governing workshops. In Europe, this ‘politicization’ of the factories was also facilitated by arising socialist/communist (e.g. Karl Marx or Friedrich Engels) respectively liberal (e.g. John Stuart Mill) thought leaders who questioned the power distribution in the factories [19, 46] as well as the described negative working conditions. Also, certain economic factors played

a relevant role: In the USA, declining economic conditions led to a mutual dependency between employers and workers, which further supported the formation of common employer-worker committees. Examples of these employer-worker committees are observed in the US woodworking industry, where these committees elaborated and published in a cooperative effort price books and quality standards for new products during the 1820's [33].

Although employers and governments often reacted harshly and repelling to first structured formations of shop committees or trade unions (e.g. at the formation of the 'Grand National Consolidated Trades Union' in the UK in 1834), internal participation and democratization established themselves as practices in the industrial world [24]. With the further growing importance of trade unions and shop stewards in the 19th and 20th century, also employee representation became more important with regard to collective bargaining when it came to protect working practices, receive better wages and improve existing working conditions [19].

4 OPEN PRACTICES WITH IT – THE COMPUTERIZATION OF OPENNESS

Until mid of the 20th century, openness by transparency or inclusion happened purely in the absence of information technology (IT). This does not mean that technology did not facilitate openness before: As indicated, breakthrough inventions such as the printing press, postal services, telegraphy or new transportation technology were used before in order to promote open practices by enabling diffusion of knowledge or enabling inclusion of other stakeholders [23, 87]. However, physical limitations for involved stakeholders, resources or processes always provided certain restrictions regarding potential anticipated outcomes. The exchange of information and the interaction of affected stakeholders, which are both embedded in the very nature of openness, was always limited to the technological possibilities of the respective time. With the emergence of commercial computers in the 1950's, also the history of applied open practices entered a new era by overcoming step-by-step these physical limitations. The newly created context of physical hardware devices (e.g. mainframe computers or later PCs and mobile devices) and particularly software (e.g. applications, data bases or operating systems) provided possibilities which enabled the opening of organizational elements via new ways of coordination or facilitation.

4.1 Open-Source Development: Opening software's source code

World War II, which facilitated advances in technological areas like code breaking activities, electronic calculations or material research as well as produced skilled engineers for the civil market, created a broad basis for the emergence of the modern age of computerization, particularly in the United States. Consequently, computers like the 'UNIVAC', which was released in 1951 by the Eckert-Mauchly Computer Corporation, or IBM's more successful '701' from 1952, started the effort to manufacture and distribute commercial computers, offering the promise of huge speed advantages compared to non-electronical calculators [16]. Along with the new possibilities, commercial use cases were identified in all possible fields such as in data analytics [48], biological taxonomy [74] or

mechanical engineering [64]. While users appreciated the new possibilities provided by computers, there was no clear differentiation between hardware and software to that time. Hardware and software were typically provided by the same supplier. The code for the software itself was usually accessible and changeable for the users, who simultaneously were also acting as programmers. Accordingly, open-source code was an early reality. This also brought along first cross-organizational collaborations like PACT (Project for the Advancement of Coding Techniques), where software engineers of multiple companies used the open code and mutually programmed a shared set of tools in order to create common value [83].

With time and new emerging use cases, more and more programming languages such as FORTRAN or COBOL emerged, providing possibilities for companies to code on a higher level. However, with the software environment getting more complex and diversified and due to the nature of many emerging compilers (which translated the software's source-code into binary computer-readable machine code), possibilities for computer and software suppliers emerged to only release the binary code of a software, making it difficult for other programmers to read or use it. As a result, the period from the 1960's till 1980's brought an increasing number of stand-alone software products with closed source code, Microsoft being a well-known representative of this development [16, 83].

However, the principles of open-source software were upheld by the IT community itself: In 1969, Ken Thompson and Dennis Ritchie from the Bell Telephone Laboratories (the former research department of AT&T) started to develop the UNIX operating system. Up until the 1980's, UNIX was particularly used at US universities as open-source solution. Although it was commercialized by AT&T in the 1980's, it had remarkable impact on the programmers' community and provided a basis for future open-source operating systems [16]. Also, in response on the trend towards closed software, Richard Stallman (an acknowledged programmer from the MIT) started the 'free software movement' in 1985, focusing on establishing a legal and practical framework for free access to software and its source code. The movement built up on the idea that software authors could use copyright and licensing law in order to preserve the status of their software to be 'free' [39]. This community-based idea was shared among relevant parts of the IT community: open-source-based operating systems such as GNU or BSD evolved in the 1970's and 1980's as part of a practitioner movement of software programmers and engaged communities [13, 83].

Bigger achievements were particularly accomplished in the 1990's with the development of the Linux open-source operating system by Linus Torvalds [13] or of the open-source data base MySQL by Michael Widenius and David Axmark [86], still being today among the most popular solutions of their kind. The aforementioned 'free software movement' also provided the intellectual and legal basis for Bruce Perens and Eric Raymond who did start the so-called 'open-source software movement'. Building up on similar legal licensing principles, the 'open-source software movement' emphasizes the actual commercial and practical benefits of open-source software [62]. In his acknowledged conference submission 'The Cathedral and the Bazaar', Raymond [66] provides a baseline idea how to perceive open-source and which benefits

publicly available source code provides. Since then, the term ‘open-source’ is used in the academic and professional context. While the emergence of open-source solutions was particularly driven by engaged communities, a switch towards a more commercialized approach could be observed in the 2000’s, being characterized by a stronger emphasis on product delivery and support [28]. Remarkably, the adoption of open-source software practices had also relevant impact on inner-organizational openness initiatives: Labelled by Tim O’Reilly in 2000, ‘Inner Source’ brought open-source principles such as open communication, open development artifacts (e.g. source code) or open collaboration into organizations, facilitating inner-organizational transparency and inclusion via open-source practices and culture [14].

4.2 Crowdsourcing, Jamming, Idea Platforms and Co.: The rise of internet- and intranet-enabled open practices

The rise of the internet from the mid of the 1990’s brought along a variety of new possibilities how people collaborate and exchange knowledge. Among others, it provided a further boost for the open-source movement with its ability to simplify the sharing and accessing of source code as well as enabling collaborations with low transaction costs for involved stakeholders [5, 78]. However, the emergence of internet respectively intranet technologies and the simultaneous rise in wide-ranging private and professional IT device usage (also due to cheaper prices and better user interfaces) had much broader implications: It both enabled a much broader involvement of contributors as well as recipients. Suddenly, not only a limited group of internal employees could be involved into development or content creation, but everybody who had a device with an intranet or internet access. Also, the transaction costs for potential contributors were reduced drastically: Accessing, sharing and collaborating via the own computer was often cheaper and less coordination- or time-intense than physical person-to-person alignments. Accordingly, the possibility to access quickly all kinds of available knowledge made the internet a melting pot for entrepreneurs, knowledge seekers and ordinary people alike.

The consequence was a boost for various open practices which built on the principle of mass participation. The case of Wikipedia (which was founded in 2001 as free internet encyclopedia) shows, how the internet facilitated openness and freedom for involved (external) stakeholders when it came to involvement, access and control of the content [67]. IT had become a tool and facilitator to support openness, enabling involvement of people who were not necessarily IT-affine before. This can be also observed at the practice of online crowdfunding campaigns (raising money in order to finance a certain purpose or project), where the internet in combination with innovative IT solutions enabled open inquiries and open contributions by private or organizational stakeholders [38].

The advantages of the networked world and the reduction of the transaction costs for involvement also enabled organizations to approach the more IT-affine part of the internet community by considering their contributions in crowdsourcing initiatives: As solution-oriented alternative to internal sourcing or utilizing a supplier, crowdsourcing (referring to the inclusion of mostly external

crowds into solution, idea, content or product generation) acted as further sourcing option regarding bringing external knowledge, skills, solutions or unbiased opinions into the organization in order to solve certain problems in a collaborative effort [1]. When Howe [43] labelled crowdsourcing as a term in 2006, the practice was already commonly applied in multiple IT-related cases. At this, people engaging in crowdsourcing campaigns are largely professionals and experts, while the received recompense from the crowdsourcing arrangements is usually small compared to the invested work and expert knowledge, making it particularly attractive for companies to make use of the crowd [11]. A specific sub-type of these popular expert-directed crowdsourcing campaigns are the so-called bug bounty programs, representing a modern form of the previously introduced inventing prizes. Gaining broader relevance in the 2010’s, organizations and software developers challenge external experts from the hacker community to identify security-related software bugs and vulnerabilities, often under the promise of certain incentives [75].

Intranet and platform technologies also contributed to various emerging intra-organizational open practices: In a world-wide (150.000 employees from 104 countries) internal project, IBM conducted in 2006 an internal ‘innovation jam’ which was performed in two 72-hour sessions. Interlinked bulletin boards and intranet pages enabled internal cooperation and coordination in order to facilitate brainstorming and idea generation [8]. Also internal [45] or external [42] idea platforms emerged, encouraging the involvement of staff or customers into product development, knowledge exchange or common decision making.

5 TRENDS, OUTLOOK AND RESEARCH LIMITATIONS

The continuous emergence of open practices along the centuries brought groundbreaking and defining changes towards how we understand organizations today – be it practices like open science, exhibitions or trade associations which still can be observed today, the lasting implications of industrial democracy or the pervasive open practices with IT which still shape the economy more than ever. Freeman [30, p.40] observes that industries continuously co-evolve in a complex interrelated process “between science, technology, economy, politics and culture” – and so does openness. Figure 1 provides a simplified timeline illustrating the historical emergence of open practices.

Analyzing the historic timeline, the narrative reveals certain trends and shifts which occurred along the centuries, providing a basis how open practices can be perceived in the context of the times.

5.1 The Shift from Government-driven towards Organization- and Community-driven Open Practices

As indicated by the historic narrative, different stakeholders were adopting or facilitating open practices in order to utilize them for their own motives. When it comes to the driving forces behind their emergence, research claims that early open practices such as open science, industrial exhibitions or inventing prizes were often driven or at least promoted by governmental stakeholders and nobles with

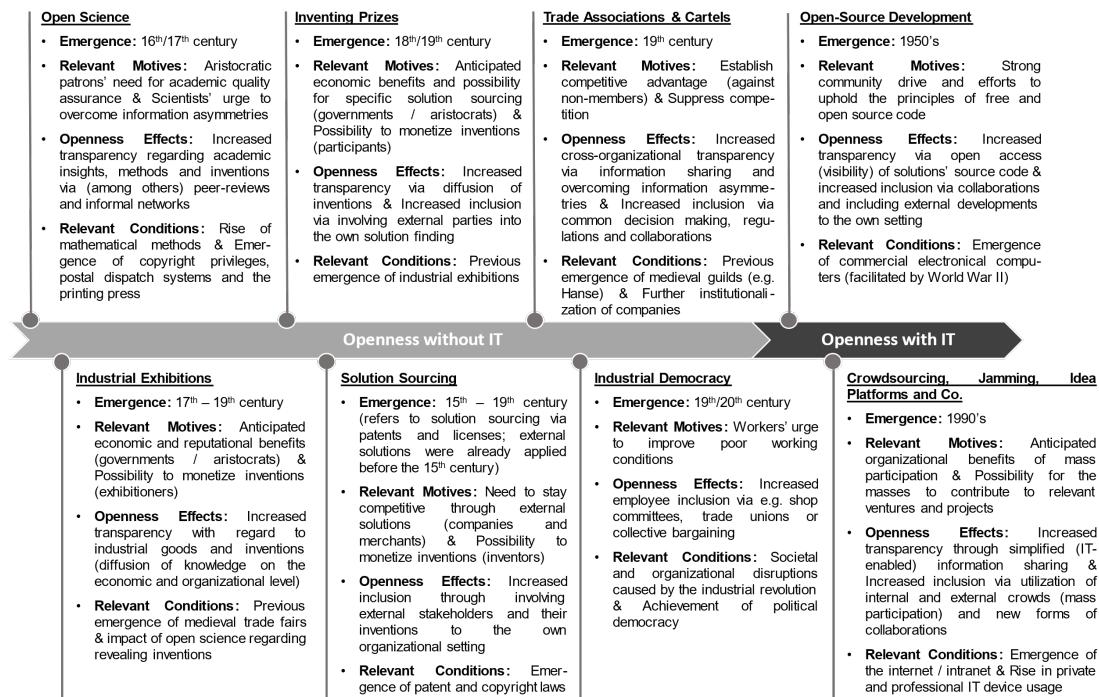


Figure 1: The Emergence of Open Practices – Simplified Historical Timeline. (Own Figure).

economic and reputational motives [15, 23, 34, 51], indicating the strong role of patronage, aristocracy and governmental influence on scientific and economic developments. The necessary networks and monetary resources which were used in order to facilitate these open practices were often occupied by nobles or governments, making it easier for them to follow their particular motivations. Despite of the fact that on a smaller scale also very early organization-driven open practices are observed such as early forms of solution sourcing or the formation of the local guilds, the structural capabilities and available resources of inventors or companies did often not provide the possibility for broad-scale openness. The described information asymmetries between involved stakeholders did certainly not make it easier for them to exchange information, considering the danger to lose competitive advantages. Hence, it is indicated that early forms of structured open practices were fairly often promoted by nobles or governments.

On the contrary, the narrative implies that later open practices without IT such as trade associations or industrial democracy exhibit a higher degree of self-motivation of the organizational stakeholders. While governmental stakeholders still influenced regulatory and economic conditions, the further formal institutionalization of companies as corporations contributed to competitive situations and organizational structures which facilitated the emergence of organization-driven open practices. In this context, it is argued that what we understand as modern corporations emerged from the 17th till the 19th century, which included huge implications regarding structural changes and economic power [49]. The

original motives of nobles and governments to promote open practices (economic development and reputational effects) were partly substituted by motives of organizations to apply openness for their own sake, respectively by employees who strived for democratization. Particularly the community-driven emergence of open practices with IT such as open-source development finalizes this shift: In many cases, IT has become an enabler for self-driven engaged communities facilitating open practices. However, while the community-factor plays a huge role in almost all contemporary IT-enabled open practices, a clear differentiation between community-driven and organization-driven open practices is hardly possible or even sensible – organizations, communities and individuals are closely linked and so is the drive behind their actions.

Accordingly, this shift must be interpreted with care since historic mechanisms are highly complex. Ultimately, the driving forces and motivations behind emerging open practices cannot be comprehended independently from the historic dynamics of the contextual technological and societal developments. These dynamics have reciprocal implications on how people and organizations communicate, how organizations are structured and how power is distributed among involved private, organizational and governmental stakeholders. Hence, stakeholder motivations and actions cannot be evaluated in an absolute manner.

5.2 The Shift from Transparency towards Inclusion

Similar to the shift of the driving stakeholders, the narrative indicates a historical shift from open practices utilizing transparency towards utilizing inclusion. Early open practices such as open science or industrial exhibitions were particularly focused on information sharing via presenting new insights, inventions or products [23, 34]. Similar to the observation with regard to the shift towards more organization- and community-driven open practices, inclusion in the form of participation at cross-organizational alignment (trade associations), decision processes (industrial democracy) or product development (solution sourcing) became a bigger factor in the later era of openness without IT and particularly at openness with IT. The fact that the rise in inclusion went along with a rise in organization- and community-driven openness indicates that inclusion is an element which is closely connected to a self-driven motivation – collaboration, involvement of stakeholders and democratization imply a certain element of active contribution which typically requires motivation to act accordingly.

At this, IT (particularly the internet/intranet) as enabler of inclusion shines out due to its ability to enable mass participation for practices like crowdsourcing, innovation jams or idea platforms. It strikes that many open-source projects emerged as part of programmers' movements. All IT-related open practices have a very strong community character, emphasizing the social aspect of the collaboration. This reveals a certain insight: Openness with IT lives from engaged people and communities – openness becomes a social practice [73]. In this context, the resembling patterns of certain open practices without IT and open practices with IT exemplify the inclusion-enabling role of IT: Solution sourcing (without IT) and crowdsourcing (with IT) build up on the same fundamental principle to include external resources like inventions or knowledge to the own organizational setup. Industrial democracy with its fundamental idea of codetermination and workers empowerment (without IT) resembles on a smaller scale and in a different context what we can observe today with bottom-up approaches like innovation jams or internal idea platforms (with IT). Inventing prizes (without IT) and bug bounty programs (with IT) both utilize incentives in order to reveal and solve certain problems with the help of external stakeholders. Accordingly, the utilization of IT in the form of digitized practices enables enhanced inclusion-potentials when it comes to factors like range, participation outcomes, location and time flexibility [36]. To that regard, IT enables a much simpler and easier access to relevant resources (such as code) and lowers transaction costs for participation. Whittington [84] refers here to the 'massification of strategy', raising the fact that mass-produced hardware, software tools and connectivity facilitate the strategic participation of people beyond the hierarchical elites. Hence, also the transaction costs for inclusion drop, which further facilitates inclusive practices.

5.3 Outlook – Future Indications for Open Practices

The historic narrative has shown how open practices continuously evolved up into the 21st century. With regard to the continuation of the history of open practices and related further research, Hautz

et al. [37] illustrate that new forms of open practices are constantly emerging along with the development of new types of information technology – an insight which is also indicated by this paper. The interplay of this ongoing technological progress with the current societal and economic disruptions which e.g. go along with the COVID-19 pandemic will certainly be a major research field with regard to the historic development of open practices – Particularly since the current COVID-19 related developments indicate that uncertainty and the inter-connectivity of industries with their environments are challenges which potentially affect all sectors [3] and imply extensive social and economic consequences for individuals and organizations alike [12].

While disruptive events of this scale affect the diffusion of knowledge as well as how stakeholders interact with each other or with technology, emerging IT-based or IT-supported open practices could potentially reflect this change. This paper has shown how open practices emerge in the context of political, technological or societal developments along the centuries. Current ongoing economic meta-trends such as platform economy [50], intra- and extra-organizational social media usage [7] or work flexibility [80] could act as a further facilitator of open practices. Accordingly, future research could investigate how open practices emerge as a consequence or under the impact of these ongoing societal disruptions and meta-trends.

Also, the emergence of new open practices without IT would be a particular interesting field for further research. While this paper indicates that the emergence of IT depicted a paradigm change for open practices, this does not exclude the possibility for new open practices which do not use IT as facilitator. New forms of inter-organizational strategy workshops [71] or of local open innovation labs [70] do not necessarily build up on IT which enables (virtual) mass participation. On the contrary, physical attendance might be an important anticipated factor in a world which has become more and more connected by IT. Investigating these (physical) open practices in the context of the societal disruptions resulting from the COVID-19 pandemic (which currently promotes a stronger virtualization) and the mentioned meta-trends, it might be interesting how these practices adapt, if they disappear, or if organizations actively promote them in order to achieve certain anticipated outcomes.

5.4 Research Limitations

It should be stated that this study exhibits certain research limitations: The narrative does not claim to consider all impact factors or to reveal all possible interrelated mechanisms which played a role in the emergence of the open practices. Historical mechanisms between political, societal, economic or technological factors are highly complex, creating always questions like "What caused what?", "How strong was the impact of factor a) on phenomenon b)?" or "How did factor a) impact phenomenon b) under the circumstance of c)?" – Revealing causal relations is an intricate field. Hence, the paper targets clearly on the logical narrative and the key mechanisms, without intending to provide an in-depth overview. Moreover, the study focuses particularly on Western regions (Europe and USA) when it comes to the historic emergence, neglecting e.g. developments in Asian countries.

6 CONCLUSION

Overall, the historic narrative reveals that open practices are certainly not a recent phenomenon of the 20th and 21st century, but have been applied by organizations and individuals since centuries: Open practices which facilitate transparency or inclusion are perpetually utilized by organizations and practitioners as consequence of the ongoing political, technological and societal developments. With the emergence of IT as pervasive socioeconomic factor of the 20th century and the later emergence of internet, intranet and platform technologies, also open practices entered a new era towards what we understand today by the term ‘openness’.

The historic timeline reveals two central shifts, the first one being related to the driver behind the open practices: While early open practices such as open science or industrial exhibitions were strongly government-driven, organizations and individuals emancipated and formally organized themselves along the centuries, resulting in more organization-driven and (IT-related) community-driven open practices. The second identified shift refers to the change from mainly transparency-oriented open practices towards a stronger focus on inclusion, being rooted in an interplay of changing motivations and emerging technological possibilities. At this, particularly the emergence of IT and internet/intranet technologies acted as facilitator for inclusive practices due to the way how they enabled access to and diffusion of knowledge through the masses as well as their connective social nature – Open practices have taken a long road, emerging around a circle of continuous change and adaptation. Considering the interplay of the ongoing development of new technological solutions and its societal and economic implications, there is no doubt that this story is going to be continued.

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