

Chapter 7 Workplace Information Environment – Challenges and opportunities for research

1. Introduction

Work is central to most of what we care about as individuals and as communities. Work provides a sense of identity expressed through work roles; most of would answer the question ‘What are you’ with a line such as a ‘I am a journalist/doctor/lawyer/regional manager/coastal zone advisor’. It provides a sense of purpose ‘I make sure the public is informed; I save lives; I help create a fair justice system; I make sure the environment is protected; I monitor our coastlines’ that may take years of training to achieve and must be constantly nurtured with new information. Work also provides economic gain that funds education, health services, the arts and most areas of civic life.

Work is central to how we organise many areas of our life. University and college training organise us within disciplines and provide discipline-specific skills. Professional societies, guilds, trades, crafts and unions help us differentiate what is important and different about our work from that of other people. Even specialist buildings such as hospitals or schools encourage us to see some types of work as belonging in different spaces to other types of work. To do our work we need information. The work we do creates a specific filter for recognizing important information for that work even during our leisure time and it creates information-related habits and awareness. A part of a journalist’s identity, for example, is scanning for news, which may happen almost automatically and unintentionally during leisure. A doctor reads medical information with a different pre-understanding than a layperson. A lawyer picks up on-trial-related news, while the regional manager learn to read natural signs that are invisible for someone without that filter. A part of the identity of a coastal zone advisor is an understanding of the natural environment. These information processes are often unconscious and not recognized. For work itself, however, these processes need to be made implicit and managed. Information science works to reveal, understand and implement more efficient information processes.

Information Science studies work in many different ways; sometimes the focus is on higher-level socio-cultural aspects of workplace environments, sometimes the focus is on specific activities of curating or managing information and the systems that we use to perform these activities. In doing so, workplace information research takes influence from many allied disciplines, including management science, organisational studies, computer science, media studies, psychology and sociology.

Our aim in this book is to present the full spectrum of workplace information research, flowing from contributions on the nature of work when viewed from an Information Science perspective, through considerations of the social and cultural environments in which we work, to issues of managing our work and the information we need to do work, to discussions of the information artefacts and properties of those artefacts that enable us to ‘work’ with information to complete our ‘work’. Implicit in all chapters is the worker itself, the person who does the work and interacts with all these levels in doing so. The social, cultural and material environment is a context of which the worker is part, and that is shaping and shaped by all individual players within it. Information management focuses on effective managerial processes so that each employee is able to use information most effectively for his/her work tasks. Artefacts and their properties, in turn, always play out in interaction with the worker and is used by him/her for diverse purposes of work.

One of the motivations for this book is that such topics are often considered separately, by distinct groupings of scholars, and appearing in venues that offer little interaction between these topics. This, in part, comes from the perspective taken by individual authors – our disciplinary backgrounds bring their own theories, models and ways of looking at the world and, hence, different ways of approaching the study of information in the workplace. These different approaches can focus on different objects of study (environments, systems, tasks, objects, practices etc.), some of which are more amenable to certain theories and ways of doing research than others. Each perspective is valuable in highlighting different aspects of what it means to study workplace information. Bringing these perspectives together in one text we hope will show the diversity in this rich area of study and promote new discussions on how we can appreciate these perspectives to create new ways of investigating and understanding different phenomena within the field of workplace information.

In this chapter, we return to Taylor's information use environments and, inspired by the chapters in this book, propose an extended model, the Workplace Information Environment model. In the concluding section, we outline some future direction for workplace information research.

2. Workplace Information Environment

In Chapter 1 we presented Taylor's (1991) model of information use environments (IUE). This model explains the fluid, evolving, temporary and often messy context of information use. Yet the model also highlights tangible aspects and points of departure for dissecting the IUE. This book brings forth different perspectives on information use, from those focused on the actual activities to those concerned with the broader information culture at work. All these aspects highlight specific aspects of the IUE. The complexity of information processes and the increasingly central value of information itself in work calls for an understanding of workplace information from a holistic and integrative perspective.

We regard Taylor's model as remaining highly relevant for understanding the role of information at work. The model is grounded in opposing the assumption "that we can describe information behaviour by starting with the system, the service, the knowledge base, or the information carrier." Rather, Taylor proposes "To use these as definers of useful information is misleading: only the recipient, the user, can define information in his or her context" (Taylor, 1991, p. 250). Another foundation in the model is the identification of the keystones of the context for workplace information and the focus on information use in these contexts. Taylor focuses – and explicitly states so – on groups, not individuals. This can be seen as an early attempt of practice-oriented approaches within information studies by emphasising socially shared understandings as the basis for interactions in the context of work.

Below, we present the Workplace Information Environment (WIE) model. This builds on Taylor's work but updates it to the current needs for studying information at work. We have identified the weaknesses of Taylor's original model and strive to address them in our model. We have recognized some of the key developments in the current workplace, for instance the impact of new technology, and included the implications of these developments in the model.

We begin by presenting a more complex view on the core concepts in Taylor's model, namely information and information use. We move on to show an expanded view of IUE's, acknowledging the existence of several intertwined IUE's within and beyond the workplace.

Information and information use

Taylor (1991) notes, with reference to King (1982) that information to be used may be in form of raw data or interpreted information. Toms, in Chapter 1, is in the same line in her discussion between data, metadata, information and knowledge. She argues that most information used at work is already to some degree processed. Information use is the key foundation of Taylor's model. Taylor

himself, in the concluding section of his article, pondered on the addition of *information* as a keystone of its own. We very much agree with this proposal. In line with Taylor (1991) and Wenger-Trayner and Wenger-Trayner (2014, p. 13) we see information/knowledge or the body of knowledge of any profession being only partially recordable, and that information/knowledge is intertwined with people's continuous engagement within their practice, where information is applied and reconstructed as it is used. Second, we see an inclusion of both verbal and non-verbal formats of information as an obvious aspect of workplace information. However, we do not think that separating information to form its own category is the best way to incorporate information within a new WIE model, but rather that the informational perspective permeates all keystones in the model.

There is, however, also a need to problematize the concept of *use*. Kari (2007) regards *use* as the practical impact of information, as separate from information *effect* indicating that information may impact us emotionally and influence us even when we did not actively seek it. In times of social media flows and constant mobile interaction where information, including work information, is constantly pushed at us, the effect-aspect of information becomes more evident. Encountering of such 'unexpected' information may lead to innovation and discovery, or simply information overload and distractions. This again suggests an emotional effect of information, where updates may alter opinions or de-motivate workers. This changes the premises for determining relevance of information and complexity of information itself as discussed by Pennington and Ruthven in Chapter 6.

Information is not the only thing that can create effect, however. In Chapter 5, Byström and Pharo discuss the agency of information artefacts, and suggest that no information artefact is a neutral intermediary of information. Information artefacts have agency of their own and, in a sense, exercise power over what information is highlighted as relevant and "useful" for different work. Widén and Steinerová in Chapter 3 takes a similar stand by indicating that information culture provides a backdrop for which information is value and shared information. In Chapter 4 Thivant and Maceviciute point out that for effective information use in an organization, effective information management is a key. If relevant information is not acquired, organized, retrieved and disseminated, this may lead to erroneous decision-making and information problems in the organization. Information use in a workplace, therefore, is not something that happens spontaneously, instead it is a result of much groundwork, within often almost invisible processes in the organizations, which workers may take for granted.

Expansion of the IUE towards workplaces

A workplace consists of sets of people and most large organisations will contain multiple professional groupings specialising in areas such as finance, human resources, health and safety, legal matters alongside the main area(s) of their business. Taylor (1991) specifically addressed doctors, engineers and legislators as three separate professions with their separate, specific information use environments. Even if there is an implicit understanding that IUEs do not exist in isolation, the relationships between IUEs are not considered in Taylor's work. However, an organisation may have all these professionals and/or representatives of several other professions or occupations among their employees, all with their own IUE's. From a technological perspective, various professions also need various forms of technology, some more advanced, others more fine-grained, for example. This also makes it complicated to develop technology, particularly if we wish it to cater for several groups.

Our main adjustment to Taylor's model thereby concerns the acknowledgement of parallel, heterogeneous professional/occupational groups that interact in a workplace. Wenger-Trayner and Wenger-Trayner (2014, p. 13) notes that "[f]or professional occupations, however, the social body of knowledge is not a single community of practice" but formed as a landscape of practice "consisting of a complex system of communities of practice and the boundaries between them". In Taylor's

terminology, a workplace consists of several IUEs that share some aspects, but differ by others, and more importantly must relate to each other. Turning back to Wenger-Trayners:

“All these practices have their own histories, domains, and regimes of competence. The composition of such a landscape is dynamic as communities arise and disappear, evolve, merge, split, compete with or complement each other, ignore or engage the other. Landscapes of practice are coming into focus as globalization, travel, and new technologies expand our horizons and open up potential connections to various locations in the landscape.” (Wenger-Trayner & Wenger-Trayner, 2014, p. 15)

This means that information, information objects and information artefacts cross boundaries between several IUEs, coloured with possibly different cultural and managerial approaches to information. This creates dynamics as to value of information and granularity of information required. Whereas in one IUE a general idea in form of compiled, overall description is sufficient, a more detailed picture with specified calculations about the same matter may be required in another IUE. Thus in studying a workplace, several IUEs that work in parallel need to be accounted for. Increasingly, accomplishment of work tasks requires expertise from several professions. As the solution unfolds, several professions' IUE's are activated and actualised, including the professionals' views on the problems and their resolutions. Consider, for instance surgery, where the surgeons' specialized information use intertwines with the nurses' and technological experts' in performing an operation. All these professions' IUE's are needed for a successful surgery. This leads us to conclude that the single-profession IUE that Taylor presents provides only a limited view of the actual complexity of information use at the workplace.

Expansion of the IUE beyond workplaces

Taylor (1991) focused specifically on work-related IUEs. He acknowledges how informational aspects of professionals' core work tasks traverse the boundaries of a single workplace. Workplaces are not islands, however. We see a need to expand Taylor's view to acknowledge how work IUEs are interwoven with IUEs outside of work. In a time of ever-more entwined work and leisure enabled by Internet technology work is not enacted separately from other contexts of everyday life. This suggests that the merging of various professional IUEs with ones for other contexts becomes necessary to accommodate situations where information is sought and found from sources in people's larger life-world instead of solely professionally legitimated sources. One example is using the public Internet to find out how to use an information system or information tool, such as the newest version of word processing program, and solving the problem by reading about others' experiences or solutions on a discussion forum or watching a video over internet rather than using the company's IT support.

Expansion towards trajectory of time

Workplaces, furthermore, are not constant. Taylor (1991) did not explicitly address the effect of time on IUEs. We consider this as another major adjustment of the original model. Whereas professions and occupations have traditionally been seen as relatively constant, particularly in defining their core activities, there have always changes in different aspects of work. New knowledge and new technology are two examples of areas that can have a profound impact on how work is carried out and organised in workplaces. In particular, information technology is currently a driver of many changes in workplaces, both by providing access to vast amount of any type of information and by facilitating work from distance. Changes may, moreover, vary across professions, with some changing fast and profoundly, while other evolving at a slower pace. Even in the same organization, some groups' IUEs may change faster or more often than others. This also manifest in more lack of control and uncertainty for some people in the organization as compared to others. This uneven pace and at times, unexpected developments may in turn create tension. For some changes may be welcome, even offering a new exciting work path, while for others they may feel threatening and stressful.

The keystone aspects

1 Sets of people in the workplace

Practice-theoretical approaches to workplaces often emphasise that established routines and ways of handling information create unspoken and subtle expertise that newcomers learn as part of participating in work activities with more experienced peers, who already have developed “a way of knowing”, a kind of tacit understanding of codified, embodied and social cues in their context (Lloyd, 2006). As Widén and Steinerová point out in Chapter 2, each employee enters the workplace with his/her own information preferences and patterns based on their personalities and earlier experiences. At the workplace, however, it becomes necessary to adapt to the routines of that particular workplace influenced by their information culture. Both the information practices and the information culture may be explicit but more often they reflect tacit elements in form of norms and traditions that govern the workflow. To work effectively it is therefore necessary to adjust personal preferences to that of the prevailing routines. An information culture as well as information practices, however, are evolving and influenced by workers. Newcomers to a workplace bring with them new knowledge and new skills, which may, depending of the information culture, contest and ultimately change the information practices in the workplace (e.g. Nordsteien & Byström, 2018). Without denying the social nature of an individual, Byström and Pharo in Chapter 5 argue that personal characteristics nuance how the workplace practices play out in activities leading to information use. Wenger-Trayners see, alike many practice theorists, that competence is legitimated in the practice, but that it

“...is not static, however. It shapes personal experience but can also be shaped by it. It is both a stable and shifting as it lies in the dynamic between individuals’ experience of it and the community’s definition of it. Indeed, competence and experience are not a mere mirror-image of each other. They are in dynamic interplay. Members of a community have their own experience of practice, which may reflect, ignore, or challenge the community’s current regime of competence. Learning in a community of practice is a claim to competence: it entails a process of alignment and realignment between competence and personal experience, which can go both ways.” ... “Any new experience that does not quite fit the regime of competence may cause the community to inspect and renegotiate its definition of competence. Or not.” (Wenger-Trayner & Wenger-Trayner, 2014, p. 14).

In defining information artefacts in Chapter 5, Byström and Pharo refer to socially and culturally constructed knowledge, or a ‘regime of competence’, that is communicated by people. They claim that in this intermediary process, a person becomes an information source and thus an information artefact herself; either in her capacity of delivering expertise (e.g., in a role of a doctor) or in her capacity of delivering signs to be interpreted through such expertise (e.g., in a role of a patient). This indicates that there are several sets of people a workplace who interact and bring into interactions knowledge and expertise of various types, and that for a workplace even people who not are employed there can provide useful information.

Thivant and Maceviciute in Chapter 4 present the importance of personal information management, the employee’s own activities to manage tools and information content in the information flow. Each employee continuously receives information, for instance in form of reports, instructional guides, messages, or emails. For effective work performance these need to be managed by the employee. Taylor (1991, p. 250) stresses that information use may be both rational and irrational, but that what seems to be irrational at first sight, may in fact be part of an employee’s personal information management style, and reduce the employee’s information overload. Personal information management may also be a reason why people act against norms and traditions (Huvila, 2013), as well as explain variation and discrepancies in handling information. Workplaces are also

arenas for human elements such as personality, personal habits, and emotional reactions (Furnham, 1994; Muchinsky, 2000), and increasingly so as leisure and work blend. Technologies provide constant access and availability that can be a source of stress (Barley et al., 2011), but flexibility, freedom, saves money and time on commuting and might as a result increase employee wellbeing (Gajendran & Harrison, 2007). Nevertheless, the personal information management becomes an important aspect of work.

2. Work tasks and duties

Taylor's IUE model occasionally makes reference to workplaces but more often operates in the level of professions/occupations. To increase the model's applicability as a conceptual framework for studies on workplace information, we orientate it towards workplaces and work tasks as the main unit of performing work. In Chapter 1, Toms refers to a standard definition of work as "activity involving mental or physical effort done in order to achieve a result" that often is understood as "task or tasks to be undertaken" (Work, n.d.). She furthermore notes that most work today involves tasks that "create, manipulate, interpret and use information". This leads her to propose that work is dependent on data and information that create information flows, on information processes that "act on" data and information as well as interactive activities that connect people and objects. This means that information work can be studied with focus on activities and tasks that are part of workplace as an ecosystem.

In Chapter 5, Byström and Pharo exemplify the use of information artefacts by relating them to information-related activities of information need, seeking and searching. They suggest that these activities and information artefacts have multiple relationships. Information needs are a result of expectations, values and traditions of the context, rather than something solely connected to a present situation or a work task (or the person attending to it). Part of this context is formed by the available information artefacts, which also create expectations to as well as constrains what kind of "answers" are available and preferred, and how difficult or costly the "answers" will be.

These themes are also uncovered in complementary discussions in other chapters. In Chapter 4, for example, Thivant and Maceviciute show how management structures and systems arise to facilitate our work tasks. These solidify existing practices in such a way that we can create a shared vocabulary of tasks, processes, activities and artefacts which allow for shared understandings, differentiation from other organisations and the creation of corporate strategy. In short, they allow people within organisations to answer the question 'How do we do things here'. However, they risk ossification of processes with the result that processes cannot change or improve because 'that's not how we do things here'.

In Chapter 6, Pennington and Ruthven, show how the information objects we use to do our work have properties that can be used to differentiate each other and their value or potential for work. They discuss how the same criteria may be used in radically different settings, e.g. we all want high quality information for our work, but how we assess quality, novelty or reliability may differ in work settings. Just as some information artefacts have taken on particular forms over years to fit with certain tasks (menus, instruction manuals, newspaper articles, etc.), other artefacts are evolving in form to fit with new tasks or tasks that are themselves changing. A rich area for workplace information is then in this space of change where our tasks are changing at the same time as the artefacts we use to complete the tasks are also changing.

3. Settings within the workplace

Today work that is undertaken by on-demand workers and in temporary teams are becoming increasingly common alongside traditional, occupation or profession bound employment. This means that the relevance of professions and long-term contracts are diminishing, and that projects conducted by time-limited teams are becoming a more common way of organising a workforce.

Such team-based views on work differ when compared with traditional department-based views by placing short-term goals at the forefront, creating altered requirements for information cultures and information management. Moreover, work carried out by temporarily assembled teams emphasises different aspects of information artefacts and information attributes to facilitate collaboration. Information processes are ever more collaborative, increasing the importance of interactive information retrieval and collaboration in information creation and use (Shah, 2014). Technology permits new working practices with cloud-services allowing team-work across time zones and virtual reality applications creating realistic spaces for business meetings (Colbert, Yee & George, 2016). Collaborating across company borders and networking across work contexts may at times be more important than connecting to the next-door colleagues. Global multilingual companies create new challenges for information sharing with colleagues (Ahmad, 2018). Diversity and its implications for teams and hence information culture, management, artefacts and attributes will need further investigations.

In Chapter 3, Widén and Steinerová underline how the concept of IUE highlights the complexity of information processes where different entities constantly and evolvingly interact. They notice that Taylor's IUEs focus on mostly on concrete entities, such as "the actual information landscape, the tools, objects, and actors", whereas values, attitudes and traditions at the workplace are less focussed upon. Placing more emphasis on information culture model enriches our understanding of workplace information environments by illuminating how values and traditions shape workplaces, as for instance by providing and constraining information access. As underlined by Widén and Steinerová, the pervasive effects of information culture on workplace information use makes it central to our understanding of workplace information environments.

Byström and Pharo take a practice-oriented approach to a workplace as a setting. Most activities in the workplace, including use of information and information artefacts as well as their associated strategies and goals, relate to formal and informal social norms and conventions of the workplace (cf. Salancik & Pfeffer, 1978; Giddens, 1984). In due course, the most regular information is made readily available in order to make work flow efficiently, and as a consequence some knowledge gets prioritized. Furthermore, they become part of the activities learned in relation to general and local work practices (e.g., Taylor, 1991; Wenger-Trayner & Wenger-Trayner, 2014). All participants, as well as the material and intellectual objects of the practice, including information artefacts, carry with them traditions, values, expectations and an agreed-upon set of facts that form the specific work context. In addition to rules and norms that regulate and guide the activities in a workplace, there are a number of information tools that affect what kind of working is possible.

Organizations of today are challenged in controlling and managing information flows. Telecommuting has developed fluid organizational structures where communication is rather peer-to-peer and task-based than management-ruled. Security risks are increasing as workers might work on insecure networks outside an employer's control. Control over data, information and information flows is changing. Cloud-computing suggests open questions on who controls data and for what purpose information may be collected. Byström and Pharo discusses how tools for collaboration are increasingly merging with tools for storage and how cloud storage makes the data accessible from anywhere, which dramatically changes the possibilities for working outside the traditional physical workplaces. At the same time, this creates challenges for secure and ethical handling of information (cf. Lindh and Nolin, 2016). The rapid technological development requires also change management. For instance, communication technology allows the tracking of employee activities and performance prompting new ethical and managerial challenges.

Openness to innovation and technology may in times of rapid change provide an important business edge. At the same time, organizations also need to consider the added value of technology in itself. In Chapter 4, Thivant and Maceviciute explain the concept of information management. Information

management concerns the management of information content, processes and tools for effective information use, both from a perspective of reaching organizational goals but also considering the employee as implementing processes and tools. Thivant and Maceviciute point out, in line with Taylor (1991), that it is humans who decide the usefulness of information system. Technology lacks value in itself and needs to be curated for the employees. New information tools and processes such as artificial intelligence, social media and tools we may not yet even foresee puts pressure on effective information management of and with these tools. Artificial intelligence may, however, also develop forms of automatic information management supporting the managerial process.

4. Resolutions in the workplace

Taylor's final keystone was on resolutions, that is, what is perceived as potential solutions to work problems. Our reorientation of Taylor's work problems to workplaces and work tasks calls for a reorientation of resolutions as well. What do we use for work tasks and from where do solutions to work tasks come?

A traditional view is that resolutions are information and information sources. In Chapter 5, Byström and Pharo take an advanced position and define information artefacts as means that mediate information work and means for resolution within workplace environments. They identify several conceptualisations that information artefacts are granted in workplace information studies. Information artefacts can be sources and channels of information, the first being an intermediary of information/knowledge sought for and the second providing access to the information source. Information channels have been seen either as means to allow communication (e.g., a mobile phone or virtual meeting room) or as means to find a source (e.g., a colleague or enterprise search engine to locate project documentation). Information tools and information systems, including enterprise social media and intranets, are addressed to as more general terms capturing multiple informational activities. Each information artefact can furthermore be described by a number of scalable features that have an effect on how information-related activities, such as information needs, searching and seeking, play out in performing work. For instance, an information artefact can be, to differing degrees, persistent or formal; used for several purposes, even other than informational ones; it can be digital or physical, static or constantly revised etc. Examples that Byström and Pharo provide of information artefacts are tools that support core information practices at the workplace, such as searching and seeking for information, information sharing and collaboration from the perspectives of workers; and from the of perspective workplaces, that is taking more managerial view, tools for governing, systematizing and managing information. This highlights that information artefacts both provide access to information for the workers and also keep track of the tasks and processes. In other words, they harmonize the content and coordinate the temporal diversity among participating professionals' work tasks.

Their broad definition acknowledges both material and non-material formats as well as including entities that are not originally created as information artefacts, but have been used for informational purposes. Essential to their definition is that any entity that is used for mediating knowledge can be viewed as an information artefact. This has powerful implications for how we see resolutions within workplaces as human agency can reconfigure and re-construct information artefacts in practice. This means that information artefacts are not primarily or only static, storable and findable information objects, but entities that evolve over time, affecting and being affected by the context of their use. Thus, both a record in an organisational archive *and* a colleague in the next-door office may both be considered as information artefacts, the former more constantly so (although it may be used for different ways and for different purposes over time), the latter in certain situations (for example, when they are turned to in their capacity of an expert). This makes information artefacts plastic, flexible to changes in their context and gaining purpose through their use.

The space of resolutions is rapidly changing also from new functions for technology in workplaces. The role of Artificial Intelligence in communicating information is already evident in automated translation, chat services and data-driven narratives. Analysing information quality may, therefore, move onto programming of algorithms that pick up e.g. fake news or translation errors. Increasingly machine learning may develop competencies to create more reliable information than human intelligence that may be biased, subjective or driven by an agenda. Equally, such techniques may have their own biases and agendas that are far more difficult to spot. How information that is automatically created changes the way we employ concepts such as cognitive authority could result in profound changes to our work information environments. Machine learning is also overtaking analytical information tasks such as classification and tagging and becoming the default solution for such tasks. Therefore, our default assumptions about what resolutions are human-mediated and which are machine-mediated are shifting rapidly.

As described in Chapter 6, the highest level of relevance from Saracevic’s classification was motivational relevance which incorporates notions of the user’s goals and preferences. Already we are seeing in areas such as Proactive Information Delivery (Holz et al. 2005; Vuong et al., 2017) systems moving towards detecting information needs before a user is consciously aware of the needs. Therefore, we are moving towards resolutions being offered without us having to ask for them. Such systems may also take into account our preferences for form, source, and other attributes of information. The extent to which we can develop machine learning algorithms that also cater for analytics of less tangible forms of information such as pictures and communication tone, for instance irony, remains to be seen but again there seems a shift to machines not simply supporting resolutions but creating these resolutions for human choice.

Information is increasingly mediated through new formats such as images, short messages in tweets and tags. Increasingly, many employers are encouraging employees to be both consumers and creators of ‘social’ information whilst other employers create strict rules about social media use to retain their brand image. How to create good information cultures whilst retaining management over information in such a fluid information space is pre-occupying many corporate minds.

New workplace environments will nearly always mean using new tools each of which have their own affordances and offer different (parts of) resolutions; sometimes these tools are only available in that workplace, sometimes they are a choice from a range of similar-ish alternatives. Using modern communication tools is becoming a key workplace literacy. With so many tools are available, and our understanding of how to best use them only gradually emerging, our literacy has to start with asking what tools are available before asking how best to use them to achieve resolutions. As tools change and become obsolete, so may our repertoire of resolutions forcing us to create new ones.

Workplace Information Environments

From the discussion above, we present our modified version of Taylor’s IUE in Figure 1 below. The workplace information environment needs to be considered as a complex environment where information comes in various formats and with a variety of uses. The workplace information environment (WIE) consists of several intertwined IUE’s which represent the professionals at the workplace or the work tasks and their requirements. The WIE moreover expands beyond the workplace, including also the activation of out-of-work IUE’s to complete work tasks.

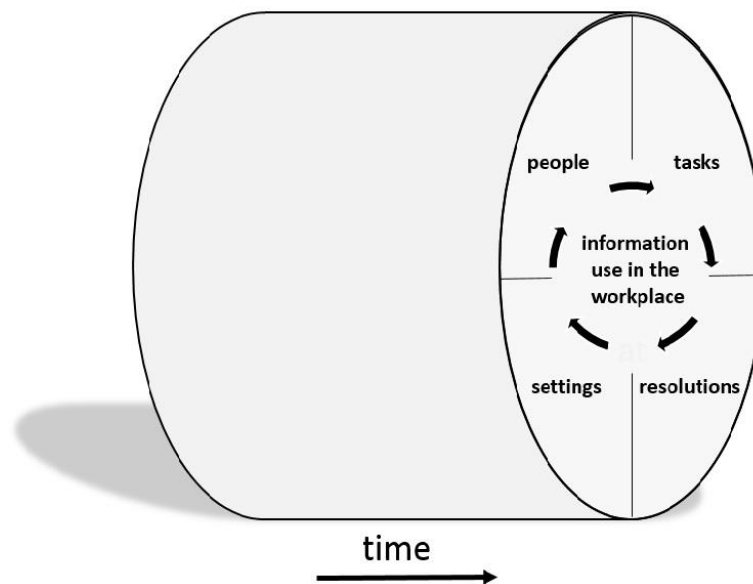
Figure 1. Workplace information environment (WIE); a modification of Taylor’s IUE (1991)

1. Sets of people in the workplace <ul style="list-style-type: none"> • Professions and occupations 	2. Work tasks and duties <ul style="list-style-type: none"> • Continuously evolving (within-task and
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<ul style="list-style-type: none"> - Defined by formal standards and education • Defined by divisions/teams • Personal information management • Individual characteristics, e.g.: <ul style="list-style-type: none"> - Demographic variables - Attitudes, experiences - Individual differences - Irrationality, emotions • Workplace information literacy 	<p>between-tasks)</p> <ul style="list-style-type: none"> • Single-IUE: Each involved IUE has discrete classes of tasks and duties • Multi-IUE: Involved IUEs create/adjust/interact with shared classes of tasks and duties • Problem dimensions, e.g.: <ul style="list-style-type: none"> - Well structured/ill structured - Complex/simple - Assumptions agreed/not agreed upon - Familiar/new patterns - Task categorisations
<p>3. Settings within the workplace</p> <ul style="list-style-type: none"> • Organisational structure • Domain of interest • Change over time • Information culture • Collaboration • Information management 	<p>4. Resolutions in the workplace</p> <ul style="list-style-type: none"> • Data, Information and Knowledge • Textual, Social, Corporeal • Information artefacts: Information sources, channels, tools, systems and objects • Information attributes: relevance, metrics, object properties • Information uses: Enlightenment, Problem understanding, Instrumental, Factual, Conformational, Projective, Motivational, Personal or political • Information-trait continuums: Quantitative, Data, Temporal, Solution, Focus, Specificity of use, Aggregation, Causal/diagnostic continuum

Adding in the concept of time, we arrive at the representation of WIE shown in Figure 2, where the four components of the WIE are presented as developing over time. This implies that any WIE is a dynamic entity, typically coming from previous WIEs but also heading towards new WIEs.

Figure 2. WIE over time



Future directions for workplace information research

As suggested in the first chapter, work and workplace information has changed radically in recent years, not least due to changes in the technology that supports our work. In this section we conclude with some thoughts on useful topics for future research in this area, inspired by the Workplace Information Environment model described above and by the chapters contributed to this book.

Our integrated view on workplace information environment helps us see the different perspectives one may take in the study of workplace information. It illuminates how a particular perspective may shed in-depth light, while a more holistic view in turn may reveal wider connections. Dependent on which of these perspectives one chooses for studying information use at work, a particular aspect is explored. Traditionally these perspectives also result in particular research methods. In this book the chapter authors call for the use of non-traditional methods and breaking boundaries. A productive, even if demanding and complex, research agenda for moving research on workplace information forward would be a combination of these different perspectives, both by combining theoretical perspectives and methodology. By focusing on e.g. a certain activity within complex decision-making tasks, one could study how information artefacts and attributes play out in the process of information use, relating these aspects to information culture and information management in the organization. On the other hand, already by being aware of the other perspectives and aspects that play in on workplace information environments, even the more focussed research designs may be better informed about their delimitations, which increases the quality and comparability of research in the area.

If we take Ann, our cardiologist, as an example, one could explore a challenging task where a patient has been wrongly diagnosed. Will the information sources that led to the wrong diagnosis lose legitimacy, or does she find her information need insufficient, or is there a new discovery embedded in the problematic diagnosis? Why did the information artefacts provide her no warning about possible wrong diagnosis? To which information source will she turn for information this time, and for what reason? How much attention will she pay to the reliability of the information she finds, does she seek additional verifications? How is her choice of information source and her attention to information quality related to the information culture of her team and the hospital in which she works and the way information flow is managed therein? Studies like these would show how these

various aspects of workplace information interact and might reveal unexpected patterns for further research.

We may also look at how Liila, our journalist, faced with an unexpected scoop will use information in the process of validating the information she has encountered. Will the fact that she is working for a newspaper with traditional information culture deter her from publishing the scoop? Will the efficient management of digital information sources within her newspaper help her to more quickly identify the validity of what she has heard? Will she turn to alternative channels, and search for unvalidated reports online by competitors? How will all these factors play out in her ultimate decision to trust this scoop or to determine that it is based on rumours only? Turning to a more holistic research approach will help us understand her decision-making process more in depth.

Johan, our lawyer, has hired an assistant to help him manage the information he needs for his cases. Johan is independent minded, and likes to trust his own instinct and experience. Will he challenge the information management system and the information culture at his law firm, when he unexpectedly run into a case which confirms his independent thinking, contradicting that of information sources brought forth by his assistant and the opinions of his team. Will he challenge the information management system and the information culture at his law firm? His assistant underlines that he has carefully identified key sources, the team is firm on their opposite decision. Johan, however, hesitates. What will he do and why? Will the source be decisive for his possible rebellion? Has the case been entrusted upon him by an experienced colleague or is it something he runs into online? Will the complexity and richness of the information influence his thinking and provoke him to take an independent risk? How will the levels of workplace the various aspects of workplace information interact as Johan ponders this step? The information culture, how information is managed, the information artefact that brought this information, or the information attributes? Likely a good explanation is to be found by exploring how these aspects interact. By only focusing on one aspect/conceptualisation, we can only understand one part of Johan's decision, while the decisive feature might have been another aspect or an interaction amongst two or more of them. We thereby suggest that research directions forward would account for as many various aspects as possible, by employing a complementary array of methods.

As we noted above, extending IUE into workplaces requires us to acknowledge that individual IUEs will interact and studying these interactions can be a very fruitful area of study. Mary, who we met in Chapter 2, is our regional manager whose agency deals with environmental problems, and Bill, our coastal zone advisor, work for the same agency and therefore may be seen to have very similar IUEs. In one sense, their work is both environmentally focused, both roles require working with, aggregating and assessing multiple information sources and both, ultimately, make recommendations based on their information interpretations. Both may use very similar information and make their recommendations on similar professional knowledge. However, other aspects of their IUE may be very different; Mary has a much wider remit than Bill, she has more autonomy over her actions than Bill, whose work is very goal-oriented. In addition, her work is more policy-oriented, which brings in many considerations beyond the purely scientific. This can raise interesting questions about how they each deal with the same information and how different elements of their IUE influence their final decision-making. We may ask, for example, about the degree to which Mary's policy agenda influences her recommendations versus the targeted instructions given by Bill's superiors. Or we may ask how the different information they are using lead them to similar or different decisions. Can we develop robust ways to compare IUEs, within and between workplaces, and the influence of their components that go beyond the purely anecdotal?

In order to further research on workplace information environments we, moreover, see the need for the following developments: up-to-date models for a changing work environment, a careful consideration of perspectives, conceptual clarity, considerations for the influence of new

technology, technology-enabled research methods and working in tandem with artificial intelligence. We will argue for each in the following sections.

3a. Models for a changed work environment

A first direction is how we can develop workplace information models that are more realistic to how people conduct their work in modern workplaces. Our journalist Liila was characterised as someone working in a fast-paced information environment which prioritises speed, both to gain and to disseminate information. Liila has to manage her own sources but also react to changing sources and deal with the almost instant feedback she receives on her own information creation. Johan's workplace information is not so frenetic but his information sources are more often digital, he deals more frequently with clients by email than face-face and he has to learn about new sources of evidence (such as the data provided by new technology) to perform his duties. At one level, the 'work' of being a lawyer or journalist is the same as in previous generations but how the work is conducted and how the information environments change how the work is done is radically different. A fruitful area of research may then be in considering what kind of models are suitable for explaining how such work is done and whether different models are necessary for different workplace situations?

3b. Perspectives

As noted above, workplace information studies can take alternative perspectives on the same workplace phenomena which may lead to different conclusions about the phenomena being studied. If we study how people work, for example, what do we learn about working in comparison of focussing on certain work-tasks and how they are performed? What does focussing on the role of technology in the workplace explain differently than focussing on the people using the technology? The way we pose our questions often leads to the choice of one perspective over others, however a focus on one aspect of information workplace environment does not imply that other aspects are somehow out of focus or less interesting to answer. A focus on technology, for example, may not consider the human aspects of using that technology whilst a focus on the individual worker may not consider wider issues of organisational efficiency and effectiveness. How, therefore, can we balance the need for specificity within workplace information studies, which argues for a narrower focus, against the desire to be able to compare and integrate studies, which argues for more holistic approaches?

3c. Conceptual clarity

In many chapters we see discussions about conceptual clarity, or more often the lack of conceptual clarity, with different names being attached to what is effectively the same concept. Pennington and Ruthven in Chapter 6 conclude that the very central term in all workplace information studies, information itself, is hard to define, which consequently makes it a challenge to define the characteristics of information. This challenge is equally valid for the other information dependent conceptualisations in the other chapters in this book. Sometimes the research literature shows an almost carefree indifference to defining important terms in such a way that they can be precisely studied, regardless of the perspective of study. One step forward may be in developing more formal vocabularies and categorisation schemas to compare studies and be able to investigate concepts across studies that use different theories and methods. As the chapters of this book have shown this may be difficult due to different ways of viewing a workplace and the information-related activities taking place there within. Thus, trying to force a single definition for instance on "information" may delimit the phenomena to be studied, and be contra productive to a holistic study of the phenomena of the workplace. So rather than aiming to a single formal vocabulary, a "thesauri" of vocabularies from different perspectives bridging the perspectives could be a long-term goal for conceptual clarity. In order to work towards this, the value of clear definitions used in individual workplace information studies cannot be underscored enough.

3d. Influence of technology

As new technologies develop, the need for research on the impact and role of these technologies increases. New technologies may create whole new industries (social networks, ecommerce, etc.) or they may be simply complementary to existing modes of work. It is notoriously difficult to predict whether an individual technology will be a game-changer or simply another fad that increases volume of work temporarily whilst nothing substantial changes in how we work. Nevertheless, technology studies will no doubt form a significant branch of workplace information research. The introduction of new technologies, such as virtual reality for example, will continue to raise questions about how to incorporate new affordances and potentials into workplace environments. New ways of creating data, from life-logging to wearable devices, also suggest interesting developments where organizations potentially may access personal data of employees. How this is best managed, and the ethical implications, however, is little understood.

As technology evolves so does also research methodology. In recent years we have seen a surge of research analysing big data, applying recording devices, on the go data collection through mobile technology, use of EKG, brain waves, skin conductance etc. All these methods enable detection of patterns across a wide population, revealing large scale trends that remained hidden before the evolution of data collection. Physiological measures enable a more concrete understanding of the mind-body interconnectedness. The flow of information itself is also more easily detected through automated data collection. All these innovations enable both a wider quantitative understanding of trends and a more in-depth understanding of the human element. The influence of bodily reactions in times of work stress may be a more powerful argument for management to intervene. Large-scale patterns of software use or reactions to Twitter feeds may result in more informed decision-making. We may also detect surprising patterns by the employment of new research methodology resulting in innovation and discovery.

3e. Working in tandem with Artificial Intelligence

Artificial Intelligence (AI) as a particular form of technology is currently raising many questions including the extent to which AI and increasingly advanced algorithms can replace human workers but also can they mimic emotional and intuitive sources of information. Some of the chapters have identified specific areas of future study. Thivant and Maceviciute in Chapter 4 envision AI components to be used to increase the efficiency of connection management according to the workplace needs and organizational decision making by seamless transmission of information. Toms in Chapter 2 concludes that technology will increasingly cause redesign of work and deliberates on future allocation between human and robotic workers. The automation of information-related activities raise ethical questions in cases where robots will aid the human, and handle or partially handle much of this interaction. In the same line of reasoning, Byström and Pharo in Chapter 5 ponder of changes that “algorithmic expertise” may cause in workplaces. Pennington and Ruthven in Chapter 6 identifies this very same issue in automatically defining information attributes, with the interference of human domain knowledge. Is there a limit where AI cannot reach or can AI be programmed to pick up even more subtle signals than humans? The increasing role for AI in workplaces create new demands for workplace information literacy and communication skills, at times facilitating information access, transfer and sharing when the human element of being e.g. distracted, tired or not able to decipher information disappears.

3g. Individual and social change of working

The rapid and voluminous technology development is likely not only causing changes in the ways we work with the technology, but how we work in general. Thivant and Maceviciute in chapter 4, make a point of including the new tools and methods into the fabric of organizational information structures as a future task for information management. Toms refers to automation in Chapter 2 as does Byström and Pharo in Chapter 5. Toms concludes in Chapter 2 that new technologies are now part of the fabric of the digital workplace which is shifting what we mean by work. Byström and

Pharo refer to information artefacts that do the work tasks on behalf of the people, which changes what work we do, but also the prerequisites for working itself. Widen and Steinerová view the changing informational circumstances challenging for a common information culture, shared values, and common information practices, and an area of future research. They also emphasise the question of how professional information literacy is developed in digital environments. For workplace information studies this opens new venues of is the role of information. How will the information culture be formed for a digital workplace? What kinds of requirements it sets for information management? How can information artefacts facilitate or hinder the bridging between physical and digital workplaces? Does this alter how information attributes are considered? Many workplaces still rely heavily on the physical proximity of their workforce to coordinate and consolidate the work activity and relationships between the peers. Such socio-cultural tradition of “going to work” is strong and changing this is a major adjustment for individual and social work environment. It will be a challenge to both employees and employers to find socially acceptable and individually rewarding alternative ways of working and building work communities.

3. Concluding words

Thivant and Maceviciute concluded Chapter 4 by stating “It [information management] takes a managerial perspective that includes such aspects as ownership, costing and pricing of information resources, security, relevance to organizational goals, effectiveness of information use in decision making, reduction of equivocality, and reduction of stress in the workplace.” This wide-reaching power of good information management to improve our work and working lives lies at the very heart of this book and the research it encapsulates.

The increasing mechanisation of our work may provide some answers to important questions of ‘who does what work’ and ‘how is this work done’. However, technological solutions can only provide partial answers. Work is a central theme of human existence; it can be a place for experimentation, creativity, inspiration and achievement but also has the potential to be a place of de-humanised, dispirited endurance. The difference can come from the knowledge of how to craft good workplace information environments and this knowledge demands input from many areas of academic research and practice. This text promotes research into positive workplace information environments as a component to positive human existences.

4. References

- Ahmad, F. (2018). Knowledge sharing in a non-native language context: Challenges and strategies. *Journal of Information Science*, 44(2), 248–264.
- Barley, S. R., Meyerson, D. E., & Grodal, S. (2011). E-mail as a source and symbol of stress. *Organization Science*, 22(4), 887-906.
- Colbert, A., Yee, N., & George, G. (2016). The digital workforce and the workplace of the future. *Academy of Management Journal*, 59 (3).
- Furnham, A. (1994). *Personality at work: The role of individual differences in the workplace*. Psychology Press.
- Gajendran, R. S., & Harrison, D. A. (2007). The good, the bad, and the unknown about telecommuting: Meta-analysis of psychological mediators and individual consequences. *Journal of Applied Psychology*, 92(6), 1524.
- Holz, Harald; Maus, Heiko; Bernardi, Ansgar; Rostanin, Oleg (2005). "From Lightweight, Proactive Information Delivery to Business Process-Oriented Knowledge Management". *Journal of Universal Knowledge Management*. 0 (2): 101–127.

- Huvila, I. (2013). Meta-Games in Information Work. *Information Research*, 18(3).
- Kari, J. (2007). Conceptualizing the personal outcomes of information. *Information Research*, 12(2).
- King, L. S. (1982). *Medical thinking: A historical preface*. Princeton, NJ: Princeton University Press.
- Lloyd, A. (2006). Information literacy landscapes: an emerging picture, *Journal of Documentation*, 62(5), 570-583. <https://doi.org/10.1108/00220410610688723>
- Muchinsky, P. M. (2000). Emotions in the workplace: The neglect of organizational behavior. *Journal of Organizational Behavior*, 21(7), 801-805.
- Shah, C. (2014). Collaborative information seeking. *Journal of the Association for Information Science and Technology*, 65(2), 215–236.
- Vuong, T., Jacucci, G. & Ruotsalo, T. 2017. Proactive Information Retrieval via Screen Surveillance. In *Proceedings of the 40th International ACM SIGIR Conference on Research and Development in Information Retrieval (SIGIR '17)*. ACM, New York, NY, USA, 1313-1316. DOI:
- Wenger-Trayner, E., & Wenger-Trayner, B. (2014). Learning in a landscape of practice: A framework. In Wenger-Trayner, E, Fenton-O'Creevy, M., Hutchinson, S., Kubiak, C., Wenger-Trayner, B. (Eds.) *Learning in Landscapes of Practice: Boundaries, identity, and knowledgeability in practice-based learning*. Routledge, London, 27-44.
- Work. (n.d.). In Oxford English Dictionary Retrieved from (<https://en.oxforddictionaries.com/definition/work>).