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The background of the lower half of the cover features large, faint, stylized letters 'W' and 'I' in a light teal color, which are semi-transparent and overlap each other.

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The European Journal of Workplace Innovation (EJWI) is an open-access, net-based, peer reviewed and English-language journal. The Journal invites research-based empirical, theoretical or synoptic articles focusing on innovation and workplace development.

The aim of the journal is:

- To develop insights into workplace innovation
- Provide case studies from Europe as well as comparative studies from other continents
- Develop and present new theories in the field of workplace innovation
- To increase international publication within the field
- To become an important publication channel for workplace innovation researches as well as the international research community.

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Editorial

Pasts, Present and Futures

Richard Ennals
Editor-in-Chief

The European Journal of Workplace Innovation (EJWI) was launched in 2013, in support of the European Workplace Innovation Network (EUWIN). Hosted by the University of Agder in Norway, and publishing from 2015, EJWI is free, open access and online at www.ejwi.eu. Past issues are freely available at the website. After a decade, it is a good time to reflect on the journey so far.

We have drawn on traditions of past pioneering work by a generation of researchers, including Björn Gustavsen, Morten Levin and Olav Eikeland from Norway. Obituaries of Morten Levin (by Olav Eikeland, Davydd Greenwood, Roger Klev, Ann Martin and Johan Ravn) and Olav Eikeland (by Hans Christian Garmann Johnsen and Richard Ennals) are published in this issue of EJWI. Our thoughts must now turn to successor generations.

EUWIN and EJWI, in combination, have created a fresh present space for ongoing dialogue between previously separate traditions of research and practice. The editorial strategy for EJWI has been pluralist from the start, when it was set out by the first Editor in Chief, Øyvind Pålshaugen. Over the decade we have developed a common language with which to describe diverse experiences. See the paper by Peter Totterdill in EJWI 1.1, introducing “The Fifth Element”, and review articles by Richard Ennals in this issue on books on Workplace Innovation and Gender Inequality.

EJWI has provided a context for publishing a diverse range of current research, including Shruti Raghuraman, Susan Reh, Asa Lundqvist, Emma Jeanes, Laura Trigg and Victoria Tischler, on the experience of older female workers in the European labour market; and Abdulqadir Mohamad Suleiman on work environment development using cognitive work analysis decision ladders.

EUWIN has been created as a ready-made institutional platform to facilitate funded support for collaboration between members. Workplace Innovation has now achieved recognition, for example from the European Commission, with a series of funded collaborative projects, as reported by Frank Pot in this issue. This has culminated in the Bridges 5.0 project, led by Steven Dhondt of TNO: four years of funding began at the start of 2023.

Industry 4.0, a concept first developed based on theory and practice in Germany, provides a suitable focus point for comparing and contrasting alternative converging approaches, with experimental work now being conducted beyond Europe, around the world. See the papers

reflecting on experience in Finland (the evaluation paper by Tuomo Alasoini and Kirsikka Selander) and China (the paper by Yuxin Li, Jiang Yang and Chris Warhurst on measuring innovation in China). See also Peter Totterdill's account of his visit to Korea with Peter Oeij, building on long collaboration, and with a focus on "Learning from Differences: Workplace Innovation, Digitalisation and Working Life".

Current discussion of Industry 5.0 may be a precursor to renewed diversity, as "a hundred flowers bloom". We may expect "several futures". The Swedish tradition of Working Life Research has been strong and cohesive for many decades, and, within a broader European context, provides the framework for a future EJWI special issue on "Green Skills, Workplace Innovation and Just Transition": see the Call for Papers from Kenneth Abrahamsson, Denis Coelho, Steven Dhondt, Ulrika Harlin, Chris Mathieu and Richard Ennals. Following a decade of EUWIN and EJWI, the special issue seeks to be European rather than narrowly Swedish.

Workplace Innovation has been taken up more widely, both in industrialised and developing countries. Thomas Carey, Anahita Baregheh, Felix Nobis and Mathias Stevenson have taken on the important challenge of mainstreaming Workplace Innovation in Business Education, with an account of collaboration between Canadian and Australian universities.

In summary, Workplace Innovation is now a strong focal theme when considering business development and business education. It offers a way forward from the previous orthodoxies based on "seeking competitive advantage", with a unifying vocabulary. The literature has achieved a critical mass, linking academic theory and business practice. There has been a period when the discourse of Workplace Innovation, linked to the orthodoxy of Industry 4.0, has enabled new discussions and collaborations across traditional boundaries in the "present". It may be that we will now need to think in terms of "futures" rather than a single future. New initiatives, such as the special issue on "Green Skills, Workplace Innovation and Just Transition", and possible special issues based on "Bridges 5.0", draw on previous distinctive traditions, from several "pasts".

Obituary

Morten Levin

July 11, 1946 - April 9, 2023

In this text we pay our respects, both professionally and personally, to Morten Levin who passed away this last April 9th, at 76 years of age. We who write this knew Morten from different periods, professional, and geographical distances. Our common ground is our mutual interest in action research and work life research and change, concerns that occupied Morten for decades. We know that Morten's life contained other dimensions, for others to narrate. We knew him as leader, educator, professor, and friend in Trondheim attached to NTNU (previously NTH), the SINTEF-research-foundation, Cornell University, and various national programs such as ACRES and EDWOR. Underlying our professional commonality with Morten are significant overlaps in political concern with democratic institutions generally and with securing and developing work-place democracy as a central feature in Norway and other countries, founded on the Norwegian "Industrial Democracy project" of the mid-1960s. We who write this are: Roger Klev, Davydd Greenwood, Ann Martin, Johan Ravn, and Olav Eikeland, all engaged, as Morten was, in practices related to work life, action research, and relevant educational and extension programs at Masters and PhD-levels. These are the threads that brought us into Morten's orbit.

We each have stories to tell that illuminate Morten's life and contributions, and this shapes the narrative of our tribute. Following a summary of his career, we offer our separate accounts of Morten's gifts to us and his extraordinary professional accomplishments.

Early Career

Morten was educated first as an engineer, but after working as a researcher in engineering he turned to sociology. It was during this turn, in the beginning of the 1980s, that our common history starts.

Morten's early personal and professional journey before that was of course important to become who we met and worked with. He had worked at a process plant in his hometown, studied first engineering and then operations research at NTH, did his diploma work at the Hydro Karmøy plant and worked at FFI (defense technology research) after graduation. This background gave him a deeper understanding of industry, technology and change than many of his contemporary social scientists. Also, his strong engagement in social justice, power and politics may have started early. Not only was he part of a generation where political engagement was stronger than today among students and intellectuals, his background was

also important. His Jewish father, who barely survived a German prison camp in Oslo, came home to be rejected by the local Jewish community because he was married to a non-Jewish woman. Injustice was ingrained in the family history and may have strengthened his engagement in social development and in understanding how processes of power and politics play out in any social system.

Morten's ability to engage with very different issues and questions made him both a widely respected scholar and a popular teacher and supervisor. Some of what he is remembered for at NTNU are his interdisciplinary research projects with colleagues and PhD candidates. Morten guided close to 50 PhD candidates through successful defense, and through that he contributed to an enormous amount of research done by others and to the shape of many professional careers.

Roger Klev

One of my first experiences with Morten was when he gave a course in public governance and planning to a small group of mostly engineering students. I was one of the students, and while most courses from this period are long forgotten – it is more than 35 years ago – I still remember the discussions from this particular class: discussions about theories and models and their relevance to democracy, how ideas, structures and political processes could change or reproduce social conditions, and so on. It was not only important and interesting to me, it was a way of teaching that became a gold standard, in my view, and it was an example of university teaching (or learning) at its very best. It is a practice that is losing ground, unfortunately. Today, every course must have clearly stated "learning objectives" upfront. In Morten's teaching, the "learning objectives" emerged from intense early discussions with the students about why and how the course could become meaningful.

Morten became my teacher, mentor, colleague and friend, both through discussions and as a role model. He influenced who I became and how I worked. I take this opportunity to share with you some of the work Morten did at the university, often paving way for something new. Morten not only researched change and development, he was himself a practitioner of the art of creating change, mainly through initiating and organizing new research and education.

Morten had an exceptionally wide network which included researchers nationally and internationally, top management in large industrial companies, industrial associations, various funding sources, and trade unions and employers' federations. The different actors who wanted to contribute to development of education, research and working life knew Morten and knew that if he took the lead of something, it would be implemented.

Morten discussed challenges and created ideas with key people, formulated concrete solutions, got them funded, and established broad-based teams of colleagues from different disciplines

and institutions to realize ideas together. This was also how he worked when he, together with Max Elden in 1989, created the first action research-oriented doctoral program. This was the SUM program, the "group" or "cohort" of PhD-students that Ann and Davydd refer to in their texts. This was a time when the idea of programs in the field of doctoral education was not yet established, at least not in Norway.

Later, in the early 90s, Morten led the design and piloting of a new and ambitious executive master's program in "Technology Management." "Technology management," a poorly defined term, was in part concept and in part just a phrase hinting at the need for an alternative to current MBA programs. In the 80s, top executives of large Norwegian companies had degrees in business or finance; the dominant idea was that management was a professional field primarily about analysis of economic results, definition of markets, and pursuit of financial success. The understanding of production, operations and technology development was for lower level managers. By the 90s, this perception had begun to change. An executive program in "Technology Management" at the MIT Sloan School was either an influence or an example of this change in emphasis. NTH (Norwegian Institute of Technology) in Trondheim, the leading institution in technological research and education, and NHH (Norwegian School of Economics) in Bergen, with that status in business economics, had not cooperated before this time.

With this as background, Morten took on the task of building a top management program in Technology Management as a collaboration between these two institutions. He asked me to assist him in this work, and thus began an intense learning experience. We travelled between the Norwegian institutions and arranged seminars and workshops with potential lecturers. We also travelled to MIT, Purdue and Texas A&M, inviting cooperation. Morten enrolled a team of experienced professors from a wide range of disciplines, set high academic and operational ambitions and ran the design project with an energy and drive that is highly unusual in academic institutional collaboration. And he succeeded. He established a successful collaboration between these two very different institutions and with the three US universities as partners. Only a few years earlier, no one had heard about technology management. Today, a "Masters in Technology Management" has become an offering at NTH/NHH.

In parallel with this work, Morten took it upon himself to develop another large initiative, to establish a cross disciplinary PhD program in operations and production in the process industry. One year after the idea was initiated, he invited me into the program as coordinator. The program was named "INPRO - Integrated Production Systems for the Process Industry". Again, Morten used his ability to understand industrial and societal challenges, formulate ideas in collaboration with actors from many different sectors, and then organize and lead the implementation of an initiative in line with the ideas. The INPRO program funded nine doctoral fellowships; two in engineering cybernetics, two in chemical engineering and five in organization and management. These PhD candidates and their supervisors worked closely together to develop better understanding of operations in processing plants while also pursuing individual PhD projects. The program included as partners nine of the largest process

industry companies in Norway, as well as the Federation of Norwegian Process and Manufacturing Industries (PIL), the Norwegian Oil Industry Association (OLF). All companies and organizations participated as partners in the doctoral candidates' research and in the academic discussions in the program.

Another way in which Morten's work had great practical impact was in how he transferred ideas and the model of participative action research to organizational development and change management. Today, the concept of co-generative learning, or co-creation, is a widely used idea in development processes, especially in the public sector. Morten might not approve of the practical use of these concepts and models today, but he did know very well that "the fate of an argument is in the hand of its later users." As the faculty member responsible for a course in Organizational Development (later Change Management) at NTH in mid 90's, Morten experienced how mainstream textbooks on organizational development and change barely reflected Norwegian working life and its ideas and values about democracy and participation. Morten decided, and I was very glad to do this work together with him, to develop a textbook that reflected this thinking. The co-generative learning model from PAR we espoused became the core model for leading participatory change and development, a model that has gained considerable influence in parts of Norwegian working life in recent years, especially in the extensive development work in schools and other parts of public sector. This textbook has been revised twice. I get a lot of feedback and requests, and I get to know a lot of new people because of this book. I am reminded every time of Morten and of what I learned from working together with him.

Davydd Greenwood

I don't remember when Morten and I first met. I know we both were at the Thorsrud Memorial Conference, but I don't think we met then. So probably it was at Cornell in relation to Programs for Employment and Workplace Systems in Industrial and Labor Relations Extension.

My first real contact with Morten as a mentor was with the PhD students at NTNU in Johan Elvemo Ravn's cohort. It was a first for me in many ways. It was the first time I had seen a "cohort" PhD program and the first time I had ever seen a group of PhD students actually functioning as a learning community. I was intrigued and fascinated by the process, the dynamics, and the combination of sociability and learning, and, of course, the quality of the students.

Apparently, Morten found my participation worthwhile, and he began engaging me in other projects. Soon thereafter I found myself being mentored by Morten. I was just beginning to teach an Action Research (AR) seminar in those days and was reading voraciously. I had also participated in a couple of search conferences. 1994 my wife had proposed to the socialist mayor of the town she is from in Spain and where we live in La Mancha that I do something of

the sort action researchers do to help her town. The town is almost equally divided by the two political factions that fought out the Spanish Civil War and have never reconciled their differences over the violence they perpetrated on each other. At the same time, the town of 8000 was losing population and provided poor opportunities for young people to develop a meaningful career or profession. With no one to help me, I decided to do a search conference convening representatives from both sides around the question of the future of their children, many of whom would leave them alone in the town and move away. To deal with being on my own, I decided to give a short course in AR to a group of secondary school teachers who I would ask to help me coordinate the process.

The main issue was how to structure and plan such a conference. At that point, Morten weighed in and worked tirelessly with me through schedule, formats, and ideas for structuring the activity. I know from personal experience why his students so much admired his mentoring. The results, by the way, were amazing. A set of working groups were created, a number of people became participatory community leaders, and there was great momentum until the Conservative Party won local elections 3 years later, canceled the project that very day, and even destroyed the archives of the project itself.

Since Morten was a frequent visitor to Cornell, I arranged to have him participate in the action research course I had begun to teach, something he did to very good effect. He also gave feedback to the students when they presented him with the ways they had decided to structure that action research learning community. I particularly remember that when a student group presented a very idealistic democratic view of the process and aims, Morten told them that they sounded like a “bunch of social democrats.” The students didn’t get the joke but it set me to recognizing that AR and social democracy are linked in a way I had only partially perceived.

After this, Morten and I found our working relationship so agile and compatible that we began working on a variety of papers together, punctuated by my increasing participation at his bidding in a variety of the national industrial democracy initiatives and a number of international conference presentations. From that point forward, we were in almost constant contact in a collaboration broken only by his illness.

We found ourselves invited to be staff members of the Scandinavian Action Research Project (ACRES) aimed at promoting the conversion of AR projects into publishable writing. The staff was headed by Hans van Beinum and included Claude Fauchaux, René van der Vlist, Morten, and me. As staff members, Morten and I managed to reproduce the ideological split within the staff between a paternal-therapeutic view of Action Research and a participatory learning community view. Staff relations were rocky throughout but the work with the participants was not just rewarding but taught me enough about the action research writing problem that I was able to edit a book on the dilemmas of “writing action research” with the very staff members with whom we had battled.

With help from William Foote Whyte and Ira Harkavy (head of the Center for Community Partnerships at the University of Pennsylvania), we organized a two-day meeting on action research at Penn which included Björn Gustavsen, Donald Schön, Budd Hall, John Gaventa, Peter Reason, Dan Bar-On, Ann Martin, Peter Lazes, and some others I have forgotten. Don Schön facilitated the meeting and once again, splits between Southern PAR (Participatory Action Research), industrial democracy, and Action Science loomed large in the process. All of this kept bouncing around in Morten's and my head.

When Orlando Fals Borda invited Bill Whyte and me to the Convergence Conference in Colombia, I conspired with Morten to bring both some of the Cornell AR students and some of his PhD students to present our approaches to AR. That was an intriguing learning experience for Morten and for me because the yawning ideological gap between so-called "Southern PAR" and industrial democracy work became apparent, as did the damage this does to AR in general.

Around this time, Morten proposed we write an introductory book on AR. The intense and regular dialogues we had as we figured out how to organize, thematize and select topics deepened our collaboration a great deal and ultimately consolidated our ability to both work and write together. In a way, the book summarized our overview of AR as the only "real" social science, the importance of varieties of ideologies and practices in AR, and the need to structure a book that would leave open the choice of approaches to the readers.

By then, Morten had managed to put together the EDWOR (doctoral) programs and asked me to form part of the staff. I was delighted since I could teach about and learn about work that was basically of little interest to my colleagues at Cornell University. The real champions of AR at Cornell were the students, not the faculty.

Over this long period, Morten and I both increasingly found ourselves fettered by the organizational structures and practices of the "non-learning organizations" called universities. We both saw that what we were teaching and practicing depended on a transdisciplinary, action-oriented, and ethically motivated set of practices that university organization undermines at every turn. As a result, the latter years of our collaborative writing focused on a critique of university structures and practices. In this regard, Morten and I evolved together through reflection on our teaching, research, and learning experiences.

I had managed to get a Ford Foundation grant centering on what we described as the crisis of relevance and engagement of the social sciences. Over the years of that project, we managed together to create a group of some 20 professors from different countries and disciplines to focus on the issues of the domestication of the social sciences into spectator speculation in universities and thinktanks. Morten co-organized these processes and we held meetings in Norway, Spain, and California; many of the ongoing relationships created there have endured.

With Morten it was not all work and no play. Long night walks, trips to Denmark, Sweden, Colombia, and touring in Mexico were a combination of learning, talking, and having fun seeing new things together. The intensity of Morten's curiosity about practically everything made every outing a joy.

Something else I learned from Morten was about what it is to have an "engineer's head". I have no particular technological background though I do like IT and tech "toys" and have gradually become able to more or less manage them. But from the very beginning of our relationship, whether it be talking about the weather, the sails on a boat, or a thermostat, I noticed that Morten always saw the world differently from me. He immediately would talk about how the weather systems work, how the wind worked in the sails, what makes a thermostat go, etc. This was radically different from talking to my anthropology and other social science colleagues at Cornell for whom the causal and mechanical structures of things were an uninteresting mystery. From there, the step for me into socio-technical systems design was actually a short one and working at that balance became central to me in a way it had not been. I also learned to see his cohorts of graduate students as importantly different from many of mine because they generally had a first degree in engineering while most of mine did not. The argument for the socio-technical linkage really made itself when they were able to deal with both the technical and social questions and not just the social ones as so many social researchers do.

Morten was an avid consumer of political news, a sarcastic commentator on the foibles of politicians, a tough critic, and occasionally completely irascible. But what I most liked was that he was as demanding of himself as of others. That, combined with his boundless energy is what makes the world seem a darker and less promising place now that he is gone. We were so different in training and character that our collaboration exemplified to me how and why differences, handled in a learningful way, are essential to what we need to do to survive on this planet.

Morten was already declining seriously when we published our final book together and yet his idea for open and diverse introduction to AR still seemed vital to me. When I found he could no longer collaborate, I proposed doing a new edition with Johan Elvemo Ravn and Koen Bartels, an edition that will be dedicated to Morten's memory. And as Morten would have expected, these two new collaborators have moved the project to an entirely new dimension in which "sustainability" (ecological and social) is the be all and end all of AR. I am sure Morten would have approved of the direction of this new learning arena.

Ann Martin

When I met Morten Levin, it was in the context of Morten as researcher. In 1987 he came to Cornell as a visiting scholar for the express purpose of learning from William Foote Whyte, author of STREET CORNER SOCIETY and LEARNING FROM THE FIELD. By that time Bill Whyte

had removed himself from the academic faculty of the School of Industrial and Labor Relations (ILR) and established a more action-oriented group, Programs for Employment and Workplace Systems (PEWS) in Extension. We were a motley and small group, all except Bill more focused on action rather than research. Bill was no longer active in doing fieldwork. We were a former merchant marine, 1 graduate student, 2 newly degreed Masters in ILR, 1 management educator, and 1 Extension entrepreneur. The latter two had formed the group with Bill because in Extension, we had to earn our keep through fees charged to clients, and because Peter Lazes, the entrepreneur, had the connection with our first and notable client, the Xerox Corporation.

What Morten fell into that year was a crew of enthusiastic facilitators of labor-management cooperation, a far cry from the professionals at Norway's Work Research Institute, as we were doing no "research." We were barely recording what we were doing, although Bill nudged us frequently in that direction. Morten was a different sort. In no time at all, he injected PEWS with his extraordinary energy for learning. He traveled with us; he co-designed a conference; he infused us with inquiry. By June of 1988, he had us committed to publishing a book with analytic chapters on each of our projects. Of course, he was an author of one of the chapters. This was the only book to come out of the PEWS work, per se, although Bill Whyte continued to publish on participatory action research on a theoretical level.

PEWS' next encounter with Morten was in 1989 when he brought a cohort of NTNU doctoral students to the US. They were not just a cohort; they were, as one told me quite insistently, "a group." A group they were, committed to each other and to what Morten would call "co-generative learning" among themselves as well as with members of the organizations with which they worked. Both Roger Klev and Johan Ravn, other authors of this tribute, were part of that group.

Reflecting on those early years knowing Morten, I see clearly that he was an extraordinary teacher. He could be a didact, as when he wrote or lectured on action research. And he was, after all, a "professor" at NTNU. But in my experience, he was equally or even more influential as a provocateur, a role model, and a persistent practitioner of inquiry. (To doctoral students, "What is your argument?" *ad nauseum* until they figured it out.)

In the early 1990s Morten collaborated with others (see Davydd Greenwood) to organize small international seminars to provoke writing and reflection among action researchers. Others write in this reflective piece about the extraordinary educational entrepreneurship this revealed about Morten. I will simply note that while I understood he hoped these seminars would lead to published work, they were all in a manner of collective reflection that I had not experienced in academia or certainly in Extension. The very idea that we could learn from each other rather than prance and preen was new to me and transformational. Ofcourse by that time, we knew the work of Donald Schön, author of THE REFLECTIVE PRACTITIONER, but Morten actually practiced it.

Morten returned to the United States and Cornell a few more times in the 1990s. We always had a desk for him at PEWS, and it never took prodding to get him involved with our work. Two classic Morten “moments” stand out from this period.

First was his follow-up on my invitation as then Director of PEWS to evaluate our organization. Of course he interviewed each of us before making his report in a staff meeting. His analysis? “PEWS is nothing more than a consulting hotel.” THIS was Morten the provocateur at his best. For me it was a great clarifying moment, a moment that shaped career decisions for the rest of my life. Alas, for the organization, it stirred nothing more than acknowledgement that if we didn’t consult, consult, consult, we would not survive financially. Researchers we were not; we did not pick up on the challenge and ask what we might do about this predicament.

The second “moment” developed in the course of Morten’s coaching us in search conference practice. I invited him along to the province of Alberta, Canada, where 100 city engineers, politicians, and concerned citizens considered a second major airport for the province. With Morten’s help, a PEWS colleague and I had designed the conference. Morten took the role of observer and leader of our internal reflection sessions. He gave no direct instruction. However, there were exhausting behind the scenes sessions during which he challenged us with questions about our process and the role we would take as outsider researchers. When I chose to introduce conflict resolution into the search process, Morten resisted the idea, but he left the final decision to us. In the words of a Swedish student I had met in those earlier seminars, he refused to “steal the learning.” He also respected our disagreement.

Before my degree in industrial and labor relations, I was a Harvard trained teacher with some practice in the secondary classroom. I knew that students learned when they were engaged. I knew that when they were active in lively classroom discussion they expanded their analytic capacities in ways that couldn’t be taught directly. But it was watching and working with Morten that taught me how critical open-ended inquiry and reflection were to learning.

The energy Morten had for learning was enormous and magnetic. So, too, was his energy for organizing learning arenas. This energy led to the invention of the alternative doctoral program, EDWOR. I leapt at the offer to be added to the faculty as the writing teacher (rhetoric is what it was, really). I’ll never know whether in his mind Morten also saw my job as pedagogical mentor and interrupter, but by that time, inspired by Morten, I had immersed myself and even received a doctorate in adult learning. Many times during the 10 years of EDWOR, Morten kept silent when I stepped outside of my role as writing teacher to nudge faculty away from lecturing toward a more Socratic practice.

Leading EDWOR was hard work for Morten. He had a group of faculty, but we were not his students, and we weren’t always tolerant of inquiry or available for collective reflection. In spite of this, Morten remained dedicated to this innovative and significant educational project.

Toward the end of his life, as a result of a debate we had about European and US acceptance of immigrants, Morten thought he and I should find a way to address the world's immigration problems with action research. And so we embarked on a study of how that might work. The ostensible goal was, as it always was with Morten, a piece of writing, but what lay behind that was his indefatigable passion for and faith in the power of collaborative inquiry. Unfortunately, Morten's advancing Parkinson's robbed him of the chance to see this project through, and without his vision, I let it rest. I doubt that he would approve.

Johan Elvemo Ravn

It can be said as simply as this: Morten is the reason why I ended up in academia and research. I got to know him through my master's studies at the university in Trondheim. When close to starting to work on the final master's thesis, my fellow Roger and I contacted Morten to ask if he would be our supervisor. His response was: "What do you intend to do afterwards?" He was fishing for potential research talent, I think. Why not, I thought then, without much pause for reflection. This became the start of a relationship, first as a student, a research assistant, then a doctoral student, and eventually a colleague and friend. In the autumn of 1989, six of us were admitted to "SUM", what was to become the first of a whole series of different action research-oriented doctoral programs under the auspices of Morten. He developed this first in collaboration with Max Elden, a close colleague at the time.

It is worth mentioning the extent to which we in SUM were exposed to others in Max and Morten's network within work research and action research, both nationally and globally: collaborators, such as Ann and Davydd, but also people with whom they had disagreements. A good illustration was the ACRES program, with participants from seven countries. The objective of ACRES was to increase among action researchers the will and ability to write. But the program also taught lessons about the dynamics of disagreement and conflict over the role of researchers in action research. Shortly before, Morten had published "Co-generative learning" with Max Elden, in which they wrote, "Our theory, based on our practice, is that we intentionally and strongly influence content." And further: "Results are considered a co-product of the contributions from insiders and outsiders, learning through participating in the co-generative dialogue." The positioning here is clear: the action researcher should not "hold back" in order to make airtime for the insider participants. When the outsider action researcher has relevant knowledge, then he/she should contribute this. Several participants in ACRES disputed this position. Their argument was that this meant the researcher took on a form of expert role and would thereby influence the process too much with his/her model power. Or put in a slightly different way: with a researcher role such as that described by Elden and Levin, one risks that the action research process will not be free, but manipulative.

Now when I reflect on this in the context of my previous experiences with Morten as a teacher and supervisor, the assumed manipulative power argument melts into air. In the classroom, Morten was rarely at the front of the blackboard to convey the key insights. He did not give

lectures. What he did was to give us the syllabus list and ask us to take responsibility for distributing the task of presenting it to the class, asking us to identify learning points, counterarguments, and criticisms. His role was to orchestrate the reflections and discussions between us, and sometimes intervene with open questions. Also, when mentoring thesis writing, he was dialogic and open and inviting in relation to other perspectives, certainly to my frustration on several occasions. In settings like this, he was the superior in terms of experience, professional insight and all other forms of resources or power bases that come into play. Being a 'participant' or 'co-learner' in such situations, being able to participate without dominating, intentionally or unintentionally, was a skill of his. So, when I read that he "intentionally and strongly influenced content" in situations where insiders and outsiders are "learning through participating in the cogenerative dialogue", I don't see a contradiction. He showed with his practice that co-generative learning was a possibility across resource asymmetries.

Morten's moral principles ran deep but could also show themselves directly. When I was a PhD student, Morten and I teamed up with another professor and another student to write an article. We ran several conceptual discussions together. Then it happened that the other professor had to leave for other work, which meant that it was the other three of us who wrote the article. Morten was crystal clear: the other professor was a good colleague and close collaborator, but no one who had not participated in the writing work should stand as an author. But when the colleague was removed from the list of authors, he was angry. I understand his reaction: he had certainly participated in the concept development for the article. But for Morten this was not enough, perhaps an indication of a certain stubbornness and rigidity. (And there were probably a few grams of this that could show at times.) As far as I know, however, the principle worked both ways. Morten did not co-publish with anyone unless he had written his part.

Morten was political. Not in the sense that his research was unduly colored and fraudulent, but in the sense that the projects he undertook were in line with his values. And he could be clear about these values. One of his early projects was called "the trade union's resources for action" (Fagforeningenes handlingsressurser), and it was about just this: how can an action research process contribute to a trade union's capacity to shape conditions for its members. The project was about functional development of strengths and competencies, but it was also about 'meaning construction', and it was based on several of Morten's core commitments, such as participation, democratization, and equal value between participants. We find these same values, and the twin foci of functional analysis/problem solving and sense-making/meaning construction in all his projects, whether it was about unions, technology transfer, business development, industrial relations, community development, or university reform.

Morten published about co-generative learning on several occasions and these texts offer good aid for practitioners and action researchers. But Morten's commitment to co-generation shows itself in everything else he wrote, in respect paid to others, in a pedagogy that is always about staging for participation, in communications that show that others' perspectives are as

legitimate and correct as your own, even if you yourself are a prominent professional and the others are students, engineers, skilled workers or managers.

The last writing project I did with Morten was a book in which Tore Nilssen, Lisbeth Øyum, Morten and I tracked the development of Norwegian worklife, with a particular focus on democratic development and learning mechanisms ("Demokrati i arbeidslivet"/ "Democracy in working life"). The book did well, and recently the publisher has urged us to create a revised edition. We aim to do that over the next year. Morten cannot be part of the writing group this time, and based on his own criteria, he cannot be on the author's list, but his presence will perhaps be even stronger than in the original edition.

Olav Eikeland

My gratitude to Morten is very personal. I met Morten first, probably in 1981 or 1982 at a meeting in Trondheim while I was an elected student leader member of the "central committee" (arbeidsutvalg) of the National Students Union in Norway (NSU), with a strong engagement in (and for a year a formal responsibility for) what in Norwegian was called "fag- og profesjonskritikk", i.e. "the immanent critique" of and also the fight for political reform (or even revolution) of the establishment-integrated roles and tasks of the sciences, universities, research tasks, and professions. At the time I was on with the path to a Masters in Sociology and a member of a group called "Sociology and critique." (I gave up becoming a sociologist the more I learned about so-called "empirical sociology" or "modern empirical social research" in general.) I have always felt that Morten and I had a mutual respect for each other as "fellow travelers and fighters" in this "fagkritiske" (intellectually critical) approach.

As we met again during my time at the WRI, probably first at the Thorsrud memorial conference the summer of 1987, where I also met four NTH-students Sveinung Skule, Øystein Fossen, Roger Klev, and Johan Elvemo, now Ravn. They interviewed me about my role as an "industry-engaged" development consultant-researcher under the first amendment (from 1982) of the negotiated constitution (Hovedavtalen) of Norwegian work-life (in the car-dealers industry). From our very first meeting, Morten always had an eye for what I was working on, even when I left contemporary critical theory and started digging my way backwards in the history of philosophy and science searching for roots of action research and "learning by doing". In this he differed from my colleagues at the WRI, who paid little attention to my philosophical explorations. Had Morten (and Davydd) not mentioned an "Aristotelian approach" to action research in the middle of my WRI-time, I believe it would have been completely and actively silenced ("collegially") at the WRI. Since Morten saw me, however, he invited me to teach in Trondheim, to join others from Trondheim in travelling to Cornell in 1994 (where I by sheer luck happened to share seats with Davydd on the plane from NYC to Ithaca), entrust me with teaching philosophy of science in Trondheim, and more.

In Closing

Action research got a strong foothold in Norwegian universities, research institutions, and the organized work life. This results from the efforts of many, but some will be remembered as particularly important. Morten Levin is one of them. Einar Thorsrud designed and led the Industrial Democracy projects, and Bjørn Gustavsen was instrumental in creating AR-programs in Sweden and Norway. Morten established and led educational programs, PhD-programs and research projects where AR and participatory change were central. He worked directly with counties in local community development and new forms of organizing. He envisioned, created and led PhD-programs based on AR, in close cooperation with industries and research institutions. He left a big footprint also in the international AR network. At home and abroad he engaged in learning processes with a large number of students and researchers who know well that their thinking as well as careers and practices are deeply influenced by working with or being mentored by Morten. The five of us have experienced Morten in one or several of these capacities, and we remember him as always engaged and engaging, always interesting and interested, and as a highly esteemed colleague, mentor, and friend.

Obituary

Olav Eikeland

October 10th, 1955 – September 1st, 2023

Hans Christian Garmann Johnsen and Richard Ennals

It is with great sadness that we received the news that Olav Eikeland, colleague, working life researcher, philosopher and professor, has passed away. He would soon have turned 68. Olav was born on 10 October 1955, died on Friday 1 September 2023. He lived all his life in Oslo, but his interest and influence vent far beyond the city limits. With him Norway have lost one of its most knowledgeable and reflective social scientists.

Olav was educated in philosophy and sociology, and was employed at the Work Research Institute (AFI) from 1985 to 2008, as a researcher and later head of research. In 1993 he became Dr. philos. in Philosophy at the University of Oslo, with the thesis "Experience, Dialogics and Politics: a conceptual historical and philosophical contribution to the reconstruction of empirical social science". The work was inspired by the philosophy of Aristotle.

In 2008, he became a Professor at the then Akershus University College. At the time of his death, he was Professor of Pedagogy and Work Research at OsloMet. There he was connected to the Faculty of Teacher Education and International Studies, Department of Vocational Teacher Education. In that capacity, he was, among other things, involved in what the university describe as "the development of organizational theoretical, didactic models for cooperation between educational institutions and fields of practice". He was also a Visiting Professor for periods and giving lectures at other institutions, among others, NTNU and Aalborg University, as well as Sabanci University in Istanbul.

Olav's academic focus, even early on when he worked at AFI, implied a deep involvement in the relationship between theory and practice. This brought him to his engagement with Aristotle. His book "The Ways of Aristotle" from 2008 was a further development of his PhD work. Richard Ennals often used the phrase "Olav and his friend Aristotle". In fact, one could say that the relationship developed into a real friendship. Olav dwelled into *Corpus Aristotelicum*. He learned Old Greek in order to get closer to Aristotle, but more importantly, as a friend, Olav tried to see through the more superficially, predictable and stereotypical view of Aristotle, looking beyond Aristotle's mistakes and ignoring the mistaken ways in which Aristotle has been misunderstood, in order to get closer to what Aristotle wanted to say.

His latest book "På sporet av en syvende forfatning: Aristoteles og den norske samarbeidsmodellen - makt, dialog og organisasjonslæring" (On the trail of a seventh

constitution; Aristotle and the Norwegian collaborative model - power, dialogue and organizational learning) was published in Norwegian in 2022 and summarised to a large extent the way Olav thought that Aristotle can still inspire us.

Olav was determined to reduce the gap between theory and practice. At the same time, Olav was uncompromising when it came to scientific quality. He wanted to overcome superficiality and the simple, partially misunderstood, use of concepts and theories. That led him into some dilemmas. Even though he wanted to have a dialogue with praxis, his approach became something that had to be expressed thoroughly. So, his latest book, where he expresses these thoughts, is, unsurprisingly, more than 500 closely spaced pages in length!

The problem is not that little happens in our everyday conversation with our fellow citizen, the problem is that too much happens in our everyday conversation with our fellow citizen, too much that we tend to ignore, and that Olav made us aware of. Furthermore, what goes on is essential for the further development of society.

Olav leaves a void for all who were close to him. He also leaves behind an insight and understanding of the basic social and knowledge conditions for our modern life in his books and articles. *Έργο του Eikeland* will be a rich reservoir of thinking and reflections that will inspire future generations of scholars and practitioners.

Exploring the challenges and facilitators that impact the experiences of being an older female worker in the European labour market: Findings from a rapid review of literature

Dr. Shruti Raghuraman

Dr. Susan Reh

Professor Åsa Lundqvist

Dr. Emma Jeanes

Laura Trigg

Professor Victoria Tischler

Abstract

Older women make a significant contribution to the labour market yet still experience negative workplace impacts. We undertook a rapid review of literature to assess the experiences of older female workers in the European labour market with the aim to identify current research gaps. We discuss how current data and future research could be utilized to improve the working lives of older women in Europe.

Electronic databases including Business Source Complete, Social Policy and Practice and PubMed were searched. 4797 records were identified, of which 24 full-text reports were included.

Compared to men, older women were found to experience more adverse health impacts as a result of work-related stress. Older women bear a greater share of caring responsibilities which has a negative impact on their health. A lack of support for menopausal symptoms in the workplace often prompted early retirement for older female workers. Income and role disparities between men and women were identified, with women having relatively discontinuous employment histories and lower pension funds due to a higher burden of unpaid, domestic labour throughout their life course. This has a cumulative effect on their income, their role and position at work, and their ability to retire. Older women also reported experiencing workplace discrimination, a lack of autonomy and job control, and less training and development opportunities. Flexible working was found to be contested terrain, with it being a means to support older women to maintain careers but also resulting in poorer career outcomes.

Keywords: Older women; Older workers; Employment; Workplace well-being; Occupational health; European labour market; Gender wage gap; Gender discrimination

Introduction

The number of people aged 55 years and older accounted for 33.6% of the total EU-27 population in 2019. This percentage is projected to reach 40.6% by 2050, which has raised concerns about the impacts of progressive ageing of the older population (Eurostat, 2020). The need to offset the impact of population aging on public finances and to improve the financial wellbeing of older people has placed extended working lives for older people high on Europe's political agenda (Phillipson, 2019). For example, many EU member states reformed their pension systems to raise the labour market exit age and retirement age, aiming to improve public finances (Economic And Financial Affairs, 2012). This is also true at the individual level, as working longer (and retiring later) is a means of increasing financial security in old-age. In 2019, women and men aged 55 or more accounted for 20.2% of the total population in employment in the EU-27, which reflects a steady growth in their labour market participation since 2004 at 11.9% (Eurostat, 2020).

In specific, the Europe 2020 strategy for growth and employment over the last decade has focused on improving the labour market participation of older women among other specific groups with lower-than-average employment rates (European Commission, 2010). In 2019, the employment rates for men aged 55-64 were still higher at 66% when compared to women aged 55-64 years at 52.6% (European Commission, 2016).

However, despite the growing participation of older women in the workforce, there are well-documented accounts of the challenges they experience in the labour market. These include reduced labour force participation, lesser-grade roles and lower wages (European Commission, 2016; Street, 2017). These issues are exacerbated with increasing age, with research showing higher levels of perceived age-based stereotypes faced by women in work settings compared to men (Manzi et al., 2019). The increasing emphasis on extending the working lives of older people, when considered against the backdrop of inadequate work quality and working conditions which disproportionately and persistently impact older women, highlights the urgent need to explore their labour market experiences in depth (Phillipson, 2019). The significance and persistence of the challenges impacting older women in the workplace make it necessary to examine in greater depth how these barriers affect the working lives and experiences of older women.

The primary objective of this rapid review is to synthesize and review literature that documents the experiences of older female workers in the European labour market with a specific focus on retirement and extended working lives, with the aim to identify research gaps. A key goal is to highlight the experience of older women in the workplace, both in relation to other sub-

groups as well as from a unique standpoint. Therefore, comparisons will be made between older women's experiences and other sub-groups in the findings when available, appropriate or relevant to making the experience of older women salient. In the final section, we discuss how current results and future research could be utilized to improve the working lives of older women in Europe.

We used an interdisciplinary (psychology, sociology, business) lens to explore and understand the mechanisms that support and hinder labour market participation, focussing on data published over the last decade. By reviewing research focussing on Europe, we cover a broad variety of welfare systems that offer insights into different challenges and facilitators but no obvious solutions to the barriers faced by older women. In this paper we focus on the commonalities of the experiences of women rather than the differences between welfare systems.

Method

We conducted a rapid review to explore the challenges and hindrances of older female workers in Europe. A rapid review "is a rigorous and transparent form of knowledge synthesis that accelerates the process of conducting a traditional systematic review through streamlining or omitting a variety of methods to produce evidence for stakeholders in a resource-efficient manner" (Hamel et al., 2021, p. 81). Rapid reviews differ from systematic reviews in that they use various methods to accelerate the review process (see table 1 in Khangura et al., 2012, p. 2). For instance, they often synthesize evidence within a shortened timeframe, typically undertaken between 3 weeks to 6 months, or by introducing restrictions at the search and retrieval stages by including only readily accessible, published literature, using language and date restrictions, narrowing geographical context and setting, or restricting retrieval, assessment and author follow-up processes. Later stage processes can also be adapted e.g., having only one person screen titles and abstracts, conduct full-text review and data extraction and omitting a quality appraisal of the papers (Khangura et al., 2012). In terms of their scope and purpose, they can be classified as a "descriptive" review based on Xiao and Watson (2019). Rapid reviews come with the advantage of providing evidence in a timely and resource-efficient manner, yet, come with the potential drawback that some caution needs to be taken when interpreting the findings as the breadth of findings included is restricted. Importantly, a rapid review does not compromise on quality, as according to Hamel and colleagues (2021) "the term 'rapid' points toward the speed at which the review is performed and not the abbreviation or omission of steps taken to conduct the review." (p. 75). We chose a rapid review over other types of reviews as our aim was to provide a timely account of the field, with a restricted geographical focus, in order to identify research gaps and inform future research, rather than testing specific research questions.

Eligibility criteria

The scope of the review was defined and limited as follows. Publications were included if-

- A. The study sample was aged 55 years or older or reported an average age of 55 or older (this age cut-off was chosen due to the impact of e.g., peri-menopausal symptoms on women <65 years of age, as well as taking into account the European Commission's definition of older women (European Commission, 2016)).
- B. They were conducted in Europe and/or included a European sample
- C. They were published in English
- D. They were published in or after 2010

Publications were excluded if they-

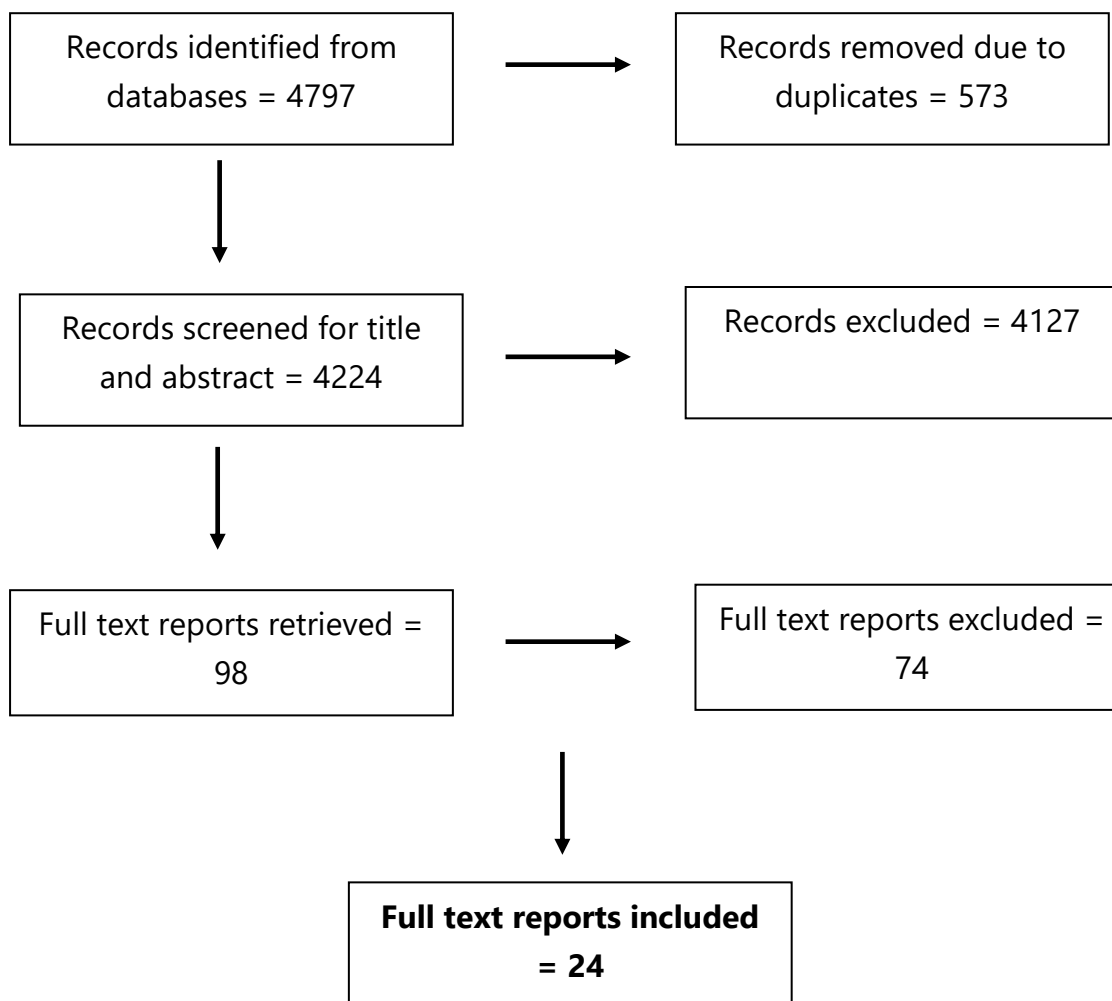
- A. did not focus on older women in the workplace
- B. were books, book chapters, theses or dissertations

Some of the inclusion and exclusion criteria were determined to ensure relevance and timeliness of the review. For instance, publications were limited to those conducted in Europe (i.e., the research was conducted on a European sample) to focus the review on a specific geographical, socio-political and legal context so that any recommendations for policy or practice identified would be relevant. Secondly, the publication date limit was set to papers published in or after 2010; a decision that was made to ensure that findings were applicable and relevant to the current time.

Other decisions were made for pragmatic reasons keeping in mind the expedited time scale such as restricting to English-language publications and excluding books, book chapters, theses and dissertations. We chose to only include sources that had gone through rigorous peer review processes, which would eliminate the need for quality appraisals of the papers.

Search strategy

Figure 1. Flow diagram of search strategy and screening



Two consecutive searches were carried out between April 2021 and July 2021, with a final date of 7th July 2021. In the first, five electronic databases were searched, namely, Business Source Complete, HMIC, PsycINFO, Scopus, and Social Policy and Practice. The search concepts included occupational stress and well-being, gender (female), workplace or work environment, and old age or ageing. 1025 records were identified from these databases, of which only seven publications met the inclusion criteria. Following consultation with library information specialists, a subsequent search was carried out to ensure retrieval of the most relevant results for the review. In addition to the free-text terms used in the previous search strategy, Medical Subject Headings (MeSH) terms were added for each concept to help with better retrieval of relevant publications on two additional databases; PubMed and OVID Medline. This search strategy is presented in Figure 1. A total of 3772 records were identified across both databases of which 16 publications were included in the final dataset. In all, 24 full text publications were included in this review for synthesis. Once retrieved from the database search, the results were imported into the desktop version of Mendeley Reference Manager. Title and abstract screening as well as full-text retrieval was done by two authors. The search and screening processes are illustrated in Figure 1.

Data extraction and synthesis

24 articles were included upon reviewing 98 full-text reports. An electronic proforma was used to complete the data extraction from the included reports. Reasons for exclusion included studies being conducted outside the European area, a lack of data pertaining to older women according to our inclusion criteria of 55 years or older, and a lack of focus on experiences in the workplace. The definition of 'older women' varied across the dataset, which also contributed to the exclusion of some papers in the final stage.

Data was extracted by two authors and audited by a third author. Data comprising the type of publication, study design, study population and setting, outcomes of interest, main findings and limitations were extracted. Data was synthesised by the first author (ShR) and was reviewed by author SR.

Results

Characteristics of Included Studies

The key characteristics of the included studies are presented in Table 1. Studies included in the review were conducted across Europe, demonstrating relatively wide geographical coverage spanning western, central, southern and northern Europe. Most studies had been conducted in the United Kingdom (UK; N=9), followed by The Netherlands (N=3), Sweden (N=2), Finland (N=2), Germany (N=2), and Italy (N=2). Other countries included Portugal, France, Croatia, and Switzerland, each contributing one study to the review.

Table 1 Key characteristics of included reports

No.	Title; Year	Location; Author(s)	Aim; Sample	Study design; Analysis
1	Employment status and other predictors of mental health and cognitive functions in older Croatian workers 2019	Croatia Bjelajac, Adrijana Koščec Bobić, Jasminka Kovačić, Jelena Varnai, Veda Marija Macan, Jelena Smolić, Šime	To examine mental health and cognitive functions in older Croatian workers (50-65 years) taking into account their employment status, self-assessed health, and a set of demographic characteristics. Sample: N = 650 (mixed) % of women: 49 Mean age: Not reported	Quantitative study Regression analysis of cross-sectional survey data from Wave 6 of the Survey of Health, Ageing and Retirement in Europe (SHARE).
2	Hierarchies of health: Health and work-related stress of managers in municipalities and county councils in Sweden 2013	Sweden Björklund, Christina Lohela-Karlsson, Malin Jensen, Irene Bergström, Gunnar	To investigate the risk of poor health and stress among male and female managers working at different levels in the public sector. Sample: N = 1091 (mixed) % of women: 77.6 Mean age: Not reported	Quantitative study Analysis of cross-sectional register data using a modified Poisson regression approach to examine risk of stress and illness in relation to management level and sex.

3	Health subjectivities and labor market participation: Pessimism and older workers' attitudes and narratives around retirement in the United Kingdom 2011	United Kingdom Brown, Patrick Vickerstaff, Sarah	To explore the pertinence of health (in a subjective as well as objective sense) as a factor in the complex decision-making process around retirement planning. Sample: N = 96 (mixed) % of women: Not reported Mean age: 56.9 (women)	Qualitative study Analysis of semi-structured interviews and biographical timelines of work-life histories of individuals and couples.
4	Using digital health technologies to manage the psychosocial symptoms of menopause in the workplace: A narrative literature review 2021	United Kingdom & Australia Cronin, Camille Hungerford, Catherine Wilson, Rhonda Lynne	To identify how mental health practitioners can adapt, utilise or recommend digital health strategies to support older women in occupational settings to manage their psychosocial symptoms of menopause. Sample: N/A	Literature review Narrative synthesis of peer-reviewed research related to the digital health technologies that are utilised to meet the psychosocial needs of women during menopause
5	Social participation among older adults (55+): Results of a survey in the region of South Limburg in the Netherlands 2018	The Netherlands Curvers, Nicole Pavlova, Milena Hajema, KlaasJan Groot, Wim Angeli, Federica	To investigate the level and forms of social participation among older adults in The Netherlands, and their association with socio-demographic and health-related characteristics. Sample: N = 16,291 (mixed) % of women: 52.5 Mean age: Not reported	Quantitative study Analysis of cross-sectional survey data (Elderly Health Monitor Limburg) using descriptive statistics and logistic regression analysis
6	Gender differences in perceived workplace flexibility among older workers in the Netherlands: A brief report. 2020	The Netherlands Damman, Marleen Henkens, Kène	To examine whether access to workplace flexibility differs between male and female older workers and how potential differences can be explained. Sample: N = 4813 (mixed) % of women: Not reported; in majority Mean age: 61.96 (women)	Quantitative study Analysis of questionnaire data from the NIDI Pension Panel Study completed by employees in government, education, care, and welfare sectors using regression analyses.
7	Work-family conflict as a mediator in the association between work stress and depressive symptoms: Cross-sectional evidence from the German lidA-cohort study. 2015	Germany du Prel, Jean Baptist Peter, Richard	To investigate the role of work-family conflict in the well-known association between work stress and depressive symptoms. Sample: N = 6339 (mixed) % of women: Not reported; in majority Mean age: 61.96 (women)	Quantitative study Multiple linear regression analysis of survey data from the "Leben in der Arbeit" (life at work)-study (1st wave)
8	Ill health-related job loss: A one-year follow-up of 54,026 employees 2016	France Dutheil, Frederic Naughton, Geraldine Sindyga, Patricia Lesage, Francois Xavier	To analyse the one-year incidence of an unfit to work diagnosis aimed at prioritizing actions and targeting health promotion in the workplace. Sample: N = 54026 (mixed) % of women: Not reported Mean age: Not reported	Quantitative study Prospective analysis of medical records of employees.
9	Barriers and facilitators to extended working life: A focus on a predominately female aging workforce 2021	United Kingdom Edge, Clare Ellen Coffey, Margaret Cook, Penny A. Weinberg, Ashley	To explore the factors that enable or inhibit people to extend working life in a large UK-based retail organisation. Sample: N = 30 (mixed) % of women: 70 Mean age: Not reported	Qualitative study Framework analysis of semi-structured interviews with a purposive sample of older (> 60) employees (N=15) and their supervisors.
10	Barriers and facilitators to extended working lives in Europe: A gender focus. 	United Kingdom Edge, Clare Ellen	To explore the barriers and facilitators to extended working lives in Europe, particularly those that impact on	Literature review Systematic mapping review process using electronic

	2017	Cooper, Anna Mary Coffey, Margaret	women. Sample: N/A	database search and hand searching.
11	Linked work lives: The interrelation of own and partner's employment history and their relationship with mental health in older European couples 2020	Germany Engels, Miriam de Moortel, Deborah Weyers, Simone Dragano, Nico Wahrendorf, Morten	To test the interdependence of own and partner's employment history and their relationship with depressive symptoms among older couples. Sample: N = 11328 (5664 couples; mixed) % of women: Not reported Mean age: 63.1 (women)	Quantitative study Analysis of retrospective data from SHARE using sequence analysis (to describe individual employment histories and to identify distinct clusters of employment histories) and regression models to test the associations between own and partner's employment histories with depressive symptoms at older age.
12	Exploring the concept of 'positive aging' in the UK workplace-A literature review 2018	United Kingdom Keeble-Ramsay, D	To address questions of what is currently identified as positive aging, and to consider what contributions can be found in the current literature that may represent these changes in the UK. Sample: N/A	Structured Literature Review (SLR) of a scoping review
13	Near retirement age (≥55 years) self-reported physical symptoms and use of computers/mobile phones at work and at leisure. 2017	Finland Korpinen, Leena Pääkkönen, Rauno Gobba, Fabriziomaria	To study the symptoms and use of computers/mobile phones of individuals nearing retirement age (≥55 years). Sample: N = 1226 (older respondents, mixed) % of women: 25 (55 years), 11 (60 years) Mean age: Not reported	Quantitative study Analysis of survey data using Mann-Whitney U-tests to compare independent samples
14	Sleep complaints in middle-aged women and men: The contribution of working conditions and work-family conflicts. 2010	Finland Lallukka, Tea Rahkonen, Ossi Lahelma, Eero Arber, Sara	To examine how physical working conditions, psychosocial working conditions and work-family conflicts are associated with sleep complaints, and whether health behaviours explain these associations. Sample: N = 5819 (mixed) % of women: 53.5 Mean age: Not reported	Quantitative study Analysis of postal questionnaire surveys using logistic regression with age as a covariate in all analyses
15	Gendered variations in the experience of aging at work in Switzerland 2015	Switzerland Le Feuvre, Nicky Kuehni, Morgane Rosende, Magdalena Schoeni, Céline	To examine the 'gendered' process of aging at work by illustrating the mechanisms through which men and women accumulate dis-/advantage across the life course, and the influence that critical events in different life domains have on the conditions under which they prepare the transition to retirement. Sample: N = 63 (biographical interviews; mixed) % of women: Not reported Mean age: Not reported	Mixed methods Statistical analysis of secondary data, expert interviews, company case studies and biographical interviews.

16	The domestic and gendered context for retirement 2013	United Kingdom Loretto, Wendy Vickerstaff, Sarah	To explore how the timing, nature and meaning of retirement and retirement planning are played out in specific domestic contexts with a specific focus on gender. Sample: N = 96 (mixed) % of women: Not reported Mean age: 56.9 (women)	Qualitative study Analysis of semi-structured interviews and biographical timelines of work-life histories of individuals (N = 31) and couples (N = 26).
17	Gender, age and flexible working in later life 2015	United Kingdom Loretto, Wendy Vickerstaff, Sarah	To explore the pertinence of health (in a subjective as well as objective sense) as a factor in the complex decision-making process around retirement planning. Sample: N = 96 (mixed) % of women: Not reported Mean age: 56.9 (women)	Brief overview of literature and qualitative study Analysis of semi-structured interviews and biographical timelines of work-life histories of individuals (N = 31) and couples (N = 26).
18	Associations between work-related stress in late midlife, educational attainment, and serious health problems in old age: A longitudinal study with over 20 years of follow-up 2014	Sweden Nilsen, Charlotta Andel, Ross Fors, Stefan Meinow, Bettina Darin Mattsson, Alexander Kåreholt, Ingemar	To explore the associations and sex differences between self-reported measures of work-related stress in midlife and serious health problems in old age. Sample: N = 1502 (mixed) % of women: 52.3 Mean age (total): 55.6 (baseline), 80.6 (follow-up)	Quantitative study Longitudinal analysis of two, linked nationally representative surveys using ordered logistic regression; Level of Living Survey (LNU) and the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD).
19	Older women, work and health 2010	United Kingdom Payne, S Doyal, L	To review the various influences on older women's health and the ways in which paid and unpaid work impact on physical and mental wellbeing. Sample: N/A	Literature review Analysis of national and international literature on the health of older women workers.
20	Work participation and risk factors for health-related job loss among older workers in the Health and Employment after Fifty (HEAF) study: Evidence from a 2-year follow-up period 2020	United Kingdom Syddall, Holly E. D'Angelo, Stefania Ntani, Georgia Stevens, Martin Clare Harris, E. Linaker, Catherine H Walker-Bone, Karen	To investigate the risk factors for health-related job-loss over 2 years of follow-up. Sample: N = 8134 (mixed) % of women: Not reported Mean age: 61.7 (women, no work) 57.2 (women, any work)	Quantitative study Analysis of population-based cohort study (Health and Employment After Fifty) using a multiple-record Cox proportional hazards model to explore risk factors.
21	Fostering work ability among menopausal women. Does any work-related psychosocial factor help? 2020	Italy Viotti, Sara Guidetti, Gloria Converso, Daniela Sottimano, Ilaria	To identify work-related psychological factors associated with work ability in a sample of menopausal working women. Sample: N = 1069 % of women: 100 Mean age: 56.24	Quantitative study Analysis of questionnaire data using correlation analyses and multivariate linear regression.
22	Stress, work ability, and an aging workforce: A study among women aged 50 and over. 2017	Italy Viotti, Sara Guidetti, Gloria Loera, Barbara Martini, Mara Sottimano, Ilaria Sara, Converso	To understand the role of work ability in the Job Demands–Resources model and, specifically, to establish whether and through which mechanisms it operates as a personal resource in the health-impairment process. Sample: N = 202 % of women: 100 Mean age: 55.89	Quantitative study Structural equation model (SEM) and moderated regression analyses of questionnaire data.
23	Gender differences in paid employment after retirement: Psychosocial working conditions and well-being 2019	The Netherlands Weber, Jeannette de Lange, Annet Müller, Andreas	To examine gender differences in working conditions and well-being of workers in paid employment after retirement (PEAR) Sample: N = 784 (mixed) % of women: 25.2 Mean age: 69.7 (total)	Quantitative study Prospective analysis with 1-year follow-up of standardized online questionnaire data using Chi2, repeated measures ANOVA, and ANCOVA.

24	Workplace well-being, gender and age: Examining the 'Double Jeopardy' effect 2013	Portugal Wilks, Daniela Carvalho Neto, Félix	To examine the effect of age and gender on work-related subjective well-being, looking at job-related affective well-being and job satisfaction. Sample: N = 446 (mixed) % of women: 52 Mean age: Not reported	Quantitative study Analysis of survey data using ANOVA to measure effects of age and gender on job-related affective well-being and job satisfaction.
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The study designs of included papers were predominantly quantitative (N=16). This included analyses of publicly available cross-sectional and longitudinal survey data (e.g., Survey of Health, Ageing and Retirement in Europe; SHARE) and questionnaire data. Four papers were literature reviews and two papers used qualitative methods to analyse interview and case study data. Two papers were mixed methods studies, one of which used both quantitative and qualitative methods and analyses, and the other used review methods and a qualitative design. The included papers had varying foci of interest, including but not limited to the gendered process of aging and positive aging at work, the effects of unpaid and paid work on physical and mental well-being of women, the impact of job demands, job strain and job resources on older women’s health and well-being, work-related psychological factors associated with work ability in menopausal women, workplace flexibility and access to workspace, and barriers and facilitators to extended working lives for women.

Key themes

A review of the data synthesis was followed by a discussion between the authors to produce a narrative summary of the literature. Through further discussion among the authors, the narrative summary was organised across three main themes to encapsulate the experiences of older female workers in the European labour market with a focus on their experience of retirement and retirement-related decision-making, as well as extended working lives. Each main theme was further divided into sub-themes. This is illustrated in Table 2 and is presented in detail in the following section.

Table 2 Experiences of older female workers in Europe: key themes and sub-themes

Main theme	Sub-themes
Experiences of gender inequalities	Gendered inequalities and employment
	Heterogeneous employment histories
	Work-life conflict and unpaid caring roles
	Sexism, ageism and isolation
Older women’s workplace health and well being	Job demands and work-related stress
	Health impairments
	Menopause
Sustainable workplaces for older female workers	Autonomy and job control
	Choice and flexibility
	Training and development opportunities

Theme 1: Experiences of gender inequalities

In this theme, experiences of gender inequalities documented in the work lives of older women in the European labour market is presented across four sub-themes.

Subtheme 1: Gendered inequalities and employment

Although growth in numbers of women in the workforce aged 55-64 has been more rapid than for men since 2002 (Eurostat, 2015), older women are still underrepresented in the workforce (Edge, Cooper and Coffey, 2017). Engels et al. (2020) found that on an average, women spent about half as many years in full-time employment than men, while spending more time in part-time or domestic work. The gender employment gap could also be attributed to the fact that women tend to retire earlier than their male counterparts (Edge, Cooper and Coffey, 2017; Diane Keeble-Ramsay, 2018). In their longitudinal study, Weber et al. (2019) found that men are more likely to participate in paid employment after retirement compared to women, despite equivalent baseline educational levels.

Women were found to have a lower gross income compared to men (Payne and Doyal, 2010; Edge, Cooper and Coffey, 2017; Weber, de Lange and Müller, 2019). Edge et al. (2017) used Eurostat data to demonstrate an average gender pay gap of 16.1% in EU-28, which takes into account factors such as lower hourly earnings, lower paid employment and lower employment rates in its calculation of gaps (Eurostat, 2016; as cited in Edge et al., 2017).

Older women were found to be less likely to occupy managerial positions when compared to men of the same age. In a survey on the job strain and coping of baby boomers, Wanka et al. (2015) found only 12% of female baby boomers occupied a managerial position compared to 34.4% of males in the study. They also found significant social disadvantages among female baby boomers compared to males, including lower educational status, fewer cumulative hours of work and lower wages. In another study, managerial levels of men and women in the workplace seemed to affect their health and work-related stress (Björklund et al., 2013). Women in lower managerial positions were found to report significantly increased risk of poor health and exhaustion, and women in general reported a higher likelihood of experiencing work-related stress when compared with higher-level male managers. This highlights the that women are more vulnerable to ill health and work-related stress, even when they don't reap the benefits of managerial status and position in the workplace. The study also found that the reverse was not true, in that women in higher level managerial positions were not better off in terms of their health status and work-related stress levels when compared to lower-level male managers. In fact, they reported similar health and stress-related patterns compared to men in lower-level managerial positions, suggesting that women, regardless of their managerial position were vulnerable to the negative health-related impacts of work, whereas men reported relatively lower work-related stress and ill health as they progressed in their managerial status.

A mixed methods study found that women were more likely than men to experience unequal returns for elevated levels of effort and commitment to their jobs, resulting in feelings of frustration and perceived discrimination (Le Feuvre et al., 2015). The authors argued that the experience of aging at work was marked by gendered variations between men and women and that the dis-/advantages experienced accorded by gender had a cumulative effect on employees' wellbeing over the life course. The authors developed a typology of four deal-types to describe the experience of ageing at work, i.e., confident, resentful, determined and distressed. They found that women who were 'aging with resentment' perceived poor returns at work, such as a lack of guarantee that they will be rewarded for their continued commitment to their work as they move towards retirement. This ideal-type was also characterised by women's low satisfaction with both professional and personal lives, and poor health and work-life balance. In comparison, men were found to be 'aging with confidence', in conformity with the gender-normative script of the 'male breadwinner' who is well-qualified, has achieved managerial status, has a typically upward career trajectory and secure financial status to support a smooth transition to retirement.

Subtheme 2: Heterogeneous employment histories

The reports reviewed showed that women had more heterogeneous and non-continuous employment histories when compared to men, as a result of enforced choices around work and retirement. In this context, 'heterogeneous' is used to illustrate employment histories that are marked by part-time work, fewer hours of work, more contract jobs and voluntary positions, all of which women in this review were more likely to have reported compared to men (Payne and Doyal, 2010; Curvers et al., 2018; Weber, de Lange and Müller, 2019). For instance, Engels et al. (2020) found that women in their sample (using SHARE data) were more likely to be engaged in domestic work, be working part-time or not working at all when compared to men, and almost half as likely as men to be engaged in continuous full-time employment. There may be several reasons for this. One study found that negative workplace experiences such as lower than average wage levels, isolation and experiences of sexism in the workplace and fewer training opportunities were likely to drive women out of employment, resulting in long-term unemployment and gaps in employment history (Keeble-Ramsay, 2018). Edge et al., (2017) found evidence of employers' holding stereotypical beliefs that women preferred part-time work, which may explain the likelihood of women adopting this working pattern.

Several studies reported that women shoulder the burden of caring and domestic responsibilities such as raising children or looking after elderly relatives; all of which contribute to them 'fitting' work around these unpaid responsibilities, resulting in more heterogeneous career trajectories, career breaks, and in some cases, early retirement (Edge et al., 2017; Keeble-Ramsay, 2018; Loretto & Vickerstaff, 2013, 2015). Conversely, some studies found evidence of women returning to full-time employment after years of un-/part-time employment for due to the financial pressures of bearing caring responsibilities (i.e., children or elderly parents) (Loretto and Vickerstaff, 2013; Edge et al., 2021). For instance, Le Feuvre et al.'s. (2019) ideal-

type 'aging with determination' refers to women whose choice of having a family-centred life was thwarted due to financial and other pressures, forcing them to re-enter the labour market and extending their working lives to the extent possible. This highlights a finding from this review, in that older women's work histories tend to be non-continuous, i.e., marked by a trajectory of labour market exits and re-entries, often as a result of enforced choice. As a result, women's choices around extended working lives and early retirement are often complex and tenuous. The overall effect is that older women's career trajectories are less linear and progressive, and more impacted by external economic, social, and domestic constraints when compared to the market-driven trajectory typically observed among older men (Loretto and Vickerstaff, 2013).

The review also highlighted the long-term impact of older women's heterogeneous and non-continuous employment histories on their ability to make decisions around retirement or extended working lives. One of the reasons for older women's enforced choice to extend their working lives is financial pressure. This financial pressure is induced by a lack of adequate personal pension rights, typically resulting from previously low-paid or insecure work (Edge et al., 2021; Le Feuvre et al., 2015). Since pension rights are determined by the number of years in employment as well as pre-retirement salaries, women with previously heterogeneous work histories, low pay, and non-continuous career trajectories are driven back into the labour market so that they can build up an adequate pension pot to secure their financial future in their old age. This demonstrates how previous flexible or non-continuous career trajectories often drive women back into the labour market in their later years. Damman & Henkens (2020) reported that older women close to retirement age are often in a more disadvantaged position compared to older men due to the lack of workplace flexibility. We augment this argument by highlighting that older women's disadvantaged position approaching retirement may also be a result of their enforced choice for flexible work over their life course, for the reasons stated above.

Subtheme 3: Work-life conflict and unpaid caring roles

As noted above, older women are more likely to assume responsibility for caring, family, and domestic tasks when compared to men (Diane Keeble-Ramsay, 2018). Several studies reported on older women's disproportionate share of domestic and caring responsibilities. In feminist research this has long been termed a 'double burden', faced by all women in the labour market. Studies show that the 'double burden' also affects older women's experiences, as they are more likely to be undertaking paid work and unpaid caring roles simultaneously (Edge et al., 2017; Le Feuvre et al., 2015; Keeble-Ramsay, 2018; Payne & Doyal, 2010; Wanka et al., 2015). Interestingly, Loretto & Vickerstaff (2015) reported that the boundaries between paid work and unpaid domestic labour become less clear in later life for women, who made explicit choices around fitting their paid work commitments around their caring responsibilities, thereby opting for flexibility in their work. Furthermore, this study found that older working women's unpaid caring responsibilities often extended beyond their own children to caring for their grandchildren, older relatives, neighbours and friends, which also prompted them to

opt for flexibility at work, the definition of which is wider than the standard labour market definition for these reasons (Loretto & Vickerstaff, 2015). The authors highlighted that the care responsibilities shouldered by older women are less visible compared to younger women in the workplace, because caring for elders or grandchildren may be viewed as less legitimate than caring for small children. This further reinforces the disproportionate impact of unpaid caring responsibilities on older women's choices around working.

Caring responsibilities were found to lead to greater stress exposure (Payne and Doyal, 2010), as well as to deteriorating health, especially when remuneration and job satisfaction in their paid work were not perceived as being worth the stress experienced (Brown and Vickerstaff, 2011). As previously discussed, qualitative studies reviewed in this study also reported that the burden of caring responsibilities led some women to extend their working lives due to financial pressures (Brown and Vickerstaff, 2011; Loretto and Vickerstaff, 2013; Edge et al., 2021), which further underscores the impact of disproportionate care burden on women's working lives.

In many cases, the dual role of paid work and unpaid, domestic labour in combination with ageing also led to work-family/life conflicts, with women being disproportionately impacted. For instance, Viotti et al., (2020), found that work ability was negatively associated with work-family conflicts in a sample of women experiencing menopause. Full-time older female employees in Baptist et al.'s, (2015) analysis of survey data reported higher scores on work-family conflicts due to a higher load of family obligations compared to men. Moreover, in this study, work-family conflicts played a major role as a mediator in the association between work-related stress and depressive symptoms among women sampled. Work-family conflicts were associated strongly with older workers' sleep in an analysis of survey data by Lallukka et al. (2010), with women reporting a higher number of sleep-related complaints than men. Managing caring responsibilities and having a good work-life balance emerged as an important factor in older women's decisions around extending their working lives in a literature review and a qualitative study by Edge and colleagues (2017, 2021). In fact, in Loretto & Vickerstaff's (2013) study, women viewed retirement as an opportunity for freedom from one part of their gender contract; i.e., the dual commitments of paid work and unpaid domestic responsibilities (which they acknowledged they could never retire from). Loretto & Vickerstaff's (2015) study highlighted the importance of viewing work-life conflicts as a societal issue and not a personal one, by drawing focus away from individual strategies used to resolve issues and highlighting how flexible work and affordable care (for children, partners or elderly family members) can improve the working lives of older women.

In an alternate perspective, Brown & Vickerstaff (2011) and Loretto & Vickerstaff (2013) reported that some older women made a conscious choice to invest time and resources in family life, while supporting the advancement of their male spouses' careers, which is in conformity with the modified male breadwinner model. This aligns with Le Feuvre's (2015) 'aging with confidence' ideal-type, and highlights the complex nature of older women's choices around flexible working, unpaid labour, and paid work.

Subtheme 4: Sexism, ageism and isolation

Older women reported more incidents of discrimination in the form of sexism and ageism, in the workplace across reviews of studies compared to men (Payne and Doyal, 2010; Wilks and Neto, 2013; Edge, Cooper and Coffey, 2017; Diane Keeble-Ramsay, 2018; Edge et al., 2021). This was linked to perceptions of views held by others regarding older women's incompetence and inability to cope with challenges and advancements in the workplace (Payne and Doyal, 2010). The negative consequences of these misperceptions are that women seek early retirement as their aspirations are diminished by views about their abilities to work, learn and develop in the workplace (Keeble-Ramsay, 2018). Older women also reported feeling more isolated in the workplace, compared to both their younger as well as male counterparts. In a qualitative study with retail workers (Edge et al. (2021), older women reported higher instances of intergenerational conflicts due to negative and stereotypical perceptions of older women in the workplace held by peers and colleagues when compared to men. This was connected to feeling disconnected to their younger co-workers, poor communication and staffing problems. A cross-sectional analysis of SHARE data by Bjelajac et al. (2019) reported similar findings with women in their sample experiencing more symptoms of loneliness than men.

Theme 2: Older women's workplace health and wellbeing

In this theme, the interactions between job demands, work-related stress, health impairments and menopause are presented as they impact on women's working lives. Although presented as sub-themes, these factors are not mutually exclusive, but produce interrelated, cumulative effects in their impact on older women's experiences of employment.

Subtheme 1: Job demands and work-related stress

Over 27% of older women in Wanka et al.'s (2015) study reported psychological stress in the workplace within the past week. Additionally, female respondents reported relatively higher physical complaints including pain in the past week, which was attributed to higher work-related stress than men. In Björklund et al. 's (2013) study, female employees reported higher stress than male employees, particularly if the women were in low-managerial positions. The adverse effects of increased stress in paid work were found to have detrimental effects on older women's health (Payne and Doyal, 2010). Work-related stress was found to be significantly associated with depressive symptoms for women in both full- and part-time employment, with an overall higher depression score reported by female workers compared to men, with women in the sample reporting more symptoms of depression (Bjelajac et al., 2019). In another study, work-related stress was significantly associated with sleep complaints among older women, with women reporting more sleep complaints when compared to men (Lallukka et al., 2010). Nilsen et al. (2014) found that high job demands were associated with

higher odds of serious health conditions among women when compared with men. Job demands such as long hours, shift work, and lack of breaks were barriers to older women's extended working lives in a study with older retail workers (Edge et al., 2021). In Weber et al.'s (2019) study, emotional exhaustion was also seen to increase for women over time, but not for men, underlining the relatively unfavourable working conditions of older women.

Subtheme 2: Health impairments

Being employed was found to be a protective factor for good mental health in a study of older workers, half who were women, with a greater proportion of employed respondents rating their health positively compared to unemployed respondents (Bjelajac et al., 2019). But high job demands have been associated with relatively higher odds of serious health problems and exhaustion for older women (Payne and Doyal, 2010; Viotti et al., 2017), when compared with men (Nilsen et al., 2014).

Ill health as well as the negative impacts of work on health were found to be significant barriers to the extended working lives of older women (Edge et al., 2021), often prompting their early retirement (Edge, Cooper and Coffey, 2017). Often, this is related to perceptions about older women's health, as opposed to their actual health-related barriers to extended working lives. For instance, perceptions about menopause have been found to limit older women's career progress, resulting in early retirement (Keeble Ramsay, 2018).

On the other hand, there is a body of literature linking personal ill health to early withdrawal from the labour market, (Bound, 1991; Phillipson and Smith 2005; as cited in Brown & Vickerstaff, 2011), often overriding other determinants of early retirement such as financial factors and caring obligations. In a survey of employees across diverse sectors in France, older women were found to most frequently receive unfit-to-work diagnoses following occupational health evaluations (Dutheil et al., 2016), prompting the need to prioritise health promotion and workplace safeguarding for this group. A study on the risk factors for health-related job loss among older women found that occupations in the educational, health and social care sectors such as teaching, nursing, midwifery and caring personal services were most likely to lose employees due to health-related reasons (Syddall et al., 2020).

Studies also found that older women were more likely to suffer negative physical outcomes at the workplace such as physical pain compared to men (Nilsen et al. (2014) found that high job demands, specifically time pressures at work were associated with worse health in older women in terms of musculoskeletal pain but better health in older men. In Korpinen et al. (2017), the use of digital technology such as computers and mobile phones has been found to result in greater physical symptoms in their wrists, fingers, elbows, forearms, shoulders and feet, greater exhaustion as well as more sleep disorders and disturbances for individuals over 55 years (compared to those under 55 years). The same study also found that female daily occupational use of desktop computers reported more physical symptoms in the neck compared to non-users of digital technology (Korpinen, Pääkkönen and Gobba, 2017).

As previously noted, two studies linked work-related stress to higher likelihood of depression in older women (du Prel and Peter, 2015; Bjelajac et al., 2019). In their qualitative study, Brown & Vickerstaff (2011) found that mental health problems were a barrier to continued labour participation. Women in their study reported the emotional toll experienced as a result of 'caring' work roles posed a threat to their health and wellbeing, such as witnessing bereavement at work.

These findings demonstrate the reciprocal relationship between physical and mental ill health, and older women's decisions about retirement and extended working lives. While in some cases, ill health hindered older women's participation in the labour market (i.e., their health affecting their work), in other cases work-related stress negatively impacted the health and wellbeing of older women.

Subtheme 3: Menopause

Keeble-Ramsay (2018) found that menopausal women have been identified as being placed on the "sticky floor", which is a discriminatory employment pattern that keeps a certain group of people at the bottom of the job scale. In the case of older, menopausal women, this is linked to the previously discussed issue around comparably lower and non-managerial roles that they are placed in. Understandably, the 'sticky floor' phenomenon is a perceived limitation to older women's careers and has often led to them giving up full time employment prematurely.

The adverse effects of work-related stress on menopause health were documented by Payne & Doyal (2010) and were associated with detrimental effects on the physical health of older women. The health-orientation of the employing organisation was found to be significant to work ability among menopausal women, with higher managerial attention to employee health associated with higher levels of work ability (Viotti et al., 2020). There are guidelines and recommendations in place to support the introduction of menopause policies to support transitions in the workplace. Despite this, research and practice supporting menopausal women in the workplace is being addressed very slowly (Targett & Beck, 2022). For instance, in this review Cronin et al. (2021) reported a dearth of research on the use of digital health technologies to support older professional women in managing the symptoms of menopause in the workplace. This is supported by Beck et al. (2021) who through the implementation of a menopause policy at the University of Leicester found that menopause policies and academic activism, although vital, are insufficient when it comes to normalizing menopause at work and tackling the issues of gendered ageism.

Theme 3: Sustainable workplaces for older femworkers

Building a sustainable, productive and viable workplace is crucial to the overall profitability and success of the whole organisation, which can be hindered by negative workplace culture. Corporate sustainability covers not only the environmental and financial impacts of work

practices and culture, but its social impact as well. This is concerned with an organisation's social responsibility to develop practices that prioritise its employee's welfare in addition to consumers and the wider community. In this theme, we present research findings on some of the structural barriers to older women's positive workplace experiences owing to harmful and unsustainable work cultures.

Subtheme 1: Autonomy and job control

Older women have reported a relative lack of autonomy and control in the workplace compared to older men, which could result in workplace stress. This may refer to the lack of opportunities to be involved in decision-making or the intensity and/or conditions of work (Payne and Doyal, 2010). In a sample of older men and women, high job strain and low job control were found to be associated with complex health problems, i.e., reporting serious health problems across multiple domains including diseases/symptoms in the last 12 months, problems with cognition and communication or mobility issues (Nilsen et al., 2014). When taking into account that women experience lower job control, this finding could be detrimental to their experience of work. The same study also found that high job demands were associated with higher odds of serious health problems among women but not men, suggesting that women may be more susceptible to psychological impacts of job demands than men. Weber et al. (2019) found that conditions for work after retirement in the form of job control and job demands seem more favourable to men when compared to women, with women in their study reporting significantly less job control and higher job stress.

Subtheme 2: Choice & flexibility

Previous literature has demonstrated the benefits of workplace flexibility for late-career employment and retirement. Damman & Henkens (2020) found that women report lower workplace flexibility in terms of their work schedule when compared to men, which led them to conclude that women approach retirement in less favourable conditions. In a similar vein, Edge et al. (2021) found that flexibility and choice were key facilitators to extended working lives for older women. This pertained mainly to decisions regarding shift patterns, hours of work and work-life balance. This study also highlighted the importance of older women's choices regarding the kind of roles and tasks that they perform to ensure that these are aligned with their health and capacity.

Viotti et al. (2020) found that work hours flexibility did not have an impact on the work ability of older workers. However, flexibility and choice in the workplace can counteract the adverse effects of work-family/life conflicts which older women are disproportionately faced with (du Prel and Peter, 2015; Edge et al., 2021) and this can transform the experience of older female workers in a positive way.

Loretto & Vickerstaff (2015) offered a different perspective to the concept of flexibility by challenging some of the notions of flexible work for older women. Based on their qualitative

research with couples and individuals, they found that flexible work was highly gendered in later life. For men, flexible work such as self-employment was characterised by high skill, choice, autonomy and control. For women, especially those from financially and educationally disadvantaged backgrounds, flexible work was associated with low skilled work and a lack of job choice and autonomy. They also found that choice in their study typically meant women rejecting flexible working, who viewed their later lives as an opportunity to rebuild their careers or seek full-time employment. In contrast men viewed their later years as an opportunity to wind down and re-connect with their family. This was especially relevant to women, whose experience of flexible work comprised of less secure forms of work which were taken up in order to 'fit' employment around caring and domestic responsibilities. These findings reinforce the dangers around the stereotypical notions around women's preferences for flexible working, often leaving them professionally and financially disadvantaged in their later working lives.

Finally, Loretto & Vickerstaff (2013) reported the need to recognise the limitations faced by older women when making choices around retirement and extended working lives. They suggested that choice regarding extended working lives or retirement may be constrained by a range of structural and contextual factors that determine the working lives of older people such as health, financial stability, gender roles, and partnerships.

Subtheme 3: Training and development opportunities

Previous reviews found that older women reported fewer opportunities for on-the-job learning and training activities when compared to men (Payne and Doyal, 2010; Diane Keeble-Ramsay, 2018). Wilks & Neto (2013) argued that implementing age-relevant training programmes for staff could be key to improving job-related subjective well-being. This was reiterated in Edge et al.'s (2021) study on facilitators of workplace health and wellbeing. Similarly, better opportunities for vocational training and enhanced roles at work were associated with extending the working lives of women and delaying retirement (Edge, Cooper and Coffey, 2017; Edge et al., 2021). Viotti et al. (2020) also discussed the need for implementing organizational policies, training and activities that were specifically targeted at improving the wellbeing of menopausal women in order to foster their job sustainability across the work-life span.

Discussion & recommendations for future research

The key aim of this review was to examine the current research on older women in the European labour market, with a specific interest in literature focusing on their extended working lives and retirement, in order to identify research gaps. The key themes identified in this paper represent the experiences shared by many women across different cultural, social and political and welfare contexts within Europe and offer an important starting point in identifying policy and practice gaps. We have synthesized and presented the results from a

pan-European perspective addressing the lack of comparative analyses of older women's experiences. While such a comparative study loses some of the depth of engagement with the effects of welfare and labour market practices achieved through national-level studies, the comparative study points to the ubiquity of experiences despite these variations in context. In that regard it illuminates the specific challenges faced by older women that endure despite a variety of policies and practices. In the rapid review, we identified a number of themes representing the experiences of older women in the European labour market. These are summarized below describing experiences of gender inequalities, structural labour market barriers and workplace health and wellbeing, and organisational and cultural factors. The summary is followed by a section in which we highlight current research gaps and how research might support and improve older women's working conditions in the future.

Overall, our findings support and extend the well documented disadvantaged position of women in employment, by incorporating the detrimental impacts associated with aging. The review found evidence for a continued gender wage gap as well as a lack of opportunities to assume higher-level positions available to women when compared to men of a similar age (European Commission, 2016). Older women are faced with age- and gender-based stereotypes, especially regarding assumed lack of competences in the workplace when compared to both men and younger women (Kornadt, Voss and Rothermund, 2013).

The review found that women have relatively discontinuous and heterogeneous employment histories marked by higher part-time work undertaken, more breaks in employment, and greater participation in unpaid and voluntary work. This is mainly attributed to their greater share of domestic labour and care responsibilities compared to men, which persists into older age with women undertaking caring tasks for older relatives, grandchildren, neighbours, and friends. High childcare or long-term care costs associated with these activities have been found to deter women's continued employment (European Commission, 2016) so it is essential that policy to support older women recognise the knock-on effects of the wider social system. Accessible, affordable and high-quality care services can incentivise older women to stay in employment, pursue full-time paid work, utilise their expertise and experience, and extend their working lives. Currently low enrolment of young children in formal childcare and the lack of quality long-term care services in many EU member states present obstacles for older women's participation in the labour market (European Commission, 2016).

Older women's role in providing care and undertaking unpaid, domestic labour presents the pertinent issue of work-life conflict. Work-life conflicts have a range of negative effects including poorer health and wellbeing and early retirement. They also deny older women the opportunity to pursue personal career ambitions, often leaving them with flexible working as the only option. This is especially relevant in a modern work context, where flexibility in the form of remote or hybrid working is viewed as an opportunity for accessible and inclusive employment for groups such as older women (Meagher, 2019). Findings indicate that women and men employ flexible working arrangements differently; while men use it to increase work commitments, women tend to use autonomy over working hours to resolve work-life conflicts

(Hofäcker and König, 2013). There are concerns that work-life conflicts which are experienced disproportionately by women will worsen without a clear strategy in place to equitably support choices about flexible working for everyone (Chung et al., 2020; Hobbs, 2021).

The current review highlighted the relatively lower positions occupied by older women compared to men. We also found that women reported lower perceived flexibility in the workplace, therefore, flexible work has the potential to introduce novel inequalities, while widening existing ones. A 2019 Chartered Institute of Personnel and Development (CIPD) survey found that access to flexible work was not equitable, with employees in lower-level positions or occupations having fewer opportunities. Similarly, previous research has documented the over-representation of women in flexible work that is typically characterised by insecure and precarious employment conditions as opposed to the type of work that corresponds to the flexibility needs of women (Buchholz et al., 2009)

Mallett et al. (2021) have questioned abstract notions of flexibility at work, calling for greater representation of diverse perspectives on how flexible working should be designed to be equitable. Our findings, based on the limited qualitative research included in the review, reinforce this perspective and call for a re-examination of the needs and preferences for flexible work as perceived by older women, whose perceptions and experiences of flexibility (insecure, precarious or forced part-time work) may not align with the ideals of flexibility (secure, flexibly organised work that is characterised by choice).

Early retirement emerged as a key issue in in this body of literature. The main factors associated with women's early retirement include lower socio-economic status, negative impact of work-related stress and shift work on health, perceptions of, and the poor experiences associated with menopause, the physical and emotional impact of disproportionate caring responsibilities, and the lack of choice and flexibility in job roles to name a few. Women were also more likely to cite personal reasons for early retirement compared to men (Edge, Cooper and Coffey, 2017) which implies that they differ from the more 'traditional' career trajectory of their male counterparts, wherein end-of-career decisions typically tend to be for professional reasons (i.e., 'winding down'). In many cases, the male partner's retirement decisions determined or precipitated their female partner's retirement decisions, leading to joint decisions around retirement (Loretto and Vickerstaff, 2013).

Our findings show that ill health, in many cases as a result of work-related factors such as stress and physical demands is one of the key reasons for women choosing to retire early. The lack of support available at work to manage menopause symptoms also forces women out of employment prematurely. Choice regarding extending older women's working lives is required, in line with employment strategy targets.

Our review found a myriad of reasons why women retire or extend their working lives; often not borne out of choice. Demographic aging has prompted pension reform in several European countries in order to achieve sustainability of public pensions. Raising the retirement

age has been one of the key reforms, which means individuals must work longer for their pension (Fric, 2015). However, the reasons for supporting extended working lives have been critiqued by Phillipson (2019), who also highlighted the increasingly fragmented nature of work in later life. This is supported by the findings in this review. Due to their heterogeneous employment histories, caring responsibilities and financial pressures in later life, women are professionally disadvantaged and forced to work longer to achieve an adequate pension. The possible financial ramifications of this disadvantaged position include a lower gross income, lower length of paid employment and a smaller pension pot before retirement. These factors have a detrimental impact on women's working lives as they are often reasons that compel older women to accept jobs or contracts with unfavourable working conditions.

Future research topics

More qualitative research into first-person accounts of being an older woman in employment are needed to inform better policies, working closely with stakeholders who have policy and decision-making capability. Our review has identified a number of areas that warrant specific attention. Overall, we need a better understanding of why women make the choices they make and what needs to change to empower them.

We need a better understanding of what is meant by 'flexible working', its specific nature and the value attributed to it. As the review has demonstrated, it has the potential to be a support but also a detriment to career and health outcomes. Flexibility can enable autonomy or it can mean precarity, it is often associated with part-time work which is in turn linked to lower rates of pay. Flexibility at work has the potential to be a blunt tool unless the experience of it is fully understood. Better understanding of the realities of flexible working (and why it is chosen or not) will support policy and practice

We need to understand the gendered differences in experiences of pain and stress at work, particularly in light of their role in shaping working patterns. Such research would need to consider factors beyond the workplace, to include work/family and other health or physical factors between and within welfare states. Work design, ergonomics, societal expectations as well as external factors and personal differences may all play a role. But the evidence points to consistent gendered differences that suggest that structural, political and social contexts and factors rather than just individual differences play a role here, in line with the 'socio-ecological systems' model of work, home and community (Pocock et al., 2012).

Without adequate support and intervention to improve working conditions for older women, their experience of labour market participation may become increasingly negative. Our review identified a lack of publications focussing on interventions or programmes targeted at improving the working lives of older women, despite the documented challenges they are faced with at work. Examples of support and intervention include giving women access to better training and development opportunities at work, facilitating their role progression, and

provision of appropriate and effective health and wellbeing support in the workplace. Understanding their effectiveness will inform improvements in practice.

For the purpose of this review, older women were defined as those 55 years and above. Several publications were excluded due to not meeting this age cut-off. We found a greater share of research on the labour market participation of 'middle-aged' individuals, i.e., between 45-60 years of age. Augner (2021) has highlighted the lack of research on the psychological and health issues in working 'old-old' population, i.e., 75 years and older). If extending the working lives of older people is a political, social and economic priority, more research on the labour market experiences of individuals 55 years and older is required.

We also found a paucity of qualitative research on the experiences of older female workers in Europe. Most of the included publications employed quantitative statistical analyses of large, publicly available datasets, surveys and questionnaires. Considering the diverse needs of older women in the workplace, in-depth, first-person accounts can provide a more nuanced understanding of challenges and facilitators related to older women's employment and may reveal important ideas for innovation and change.

Future research must consider the complex definitions around what constitutes an 'older' worker in the labour market. As Phillipson (2019) argues, the label of 'older worker' needs revisiting, as the experiences of sub-groups such as women, men, and individuals from different ethnic backgrounds, are highly unique and individualised. In light of the increased movement of political and economic refugees and migrants into Europe since 2015, as well as the outbreak of the war in Ukraine, older female migrants inevitably participate in the labour market and contribute to economic growth. There is a need to undertake research into employment needs and experiences of individuals at the intersections of race and ethnicity, in order to inform policy and practice that is generalizable and applicable to everyone who is economically active. The impact of COVID-19 and the role of digital and hybrid working should also be considered in future studies. This has longer-term impacts on perceptions of flexibility, work-life balance, and what constitutes and enables inclusion and equity in the workplace.

There are also policy implications. Firstly, many of the drivers of inequality for older women are cumulative over time. Career breaks and the burden of domestic and parental responsibilities at a younger age impact throughout the working life. Tackling barriers faced by older women at the point at which they face them is too late to remove the cause. Support for women during career breaks and their return to work, more support and encouragement of shared parental leave, tackling assumptions about who should take on domestic responsibilities and specific support for returning parents would address root causes. Secondly, and related, is the need identified above to recognise that older women are directly and immediately impacted by policies targeting younger women, such as childcare support. Taken together they point to complexity-based approaches to tackling these challenges.

The evidence also points to vicious circles. If women are paid less than men, it is unsurprising that they take on more of the childcare and domestic burden to enable the better paid partner to continue earning, which in turn leads to ongoing and long-term gender wage disparities. Bold policy is needed to break these cycles, including tackling the gender pay gap and its causes.

Organisations can also play a role in overcoming inequality. The limited support available in the workplace for women going through menopause is remarkable given the significant proportion of the population that will experience it during their working lifetime (Beck et al., 2020). Atkinson et al. (2020) have outlined the social responsibility of organisations, as well as the business and legal case for instituting menopause-related support for women in the workplace. Organisations can also play a substantial role in breaking the vicious cycles, through training, reviewing and tackling gender pay gaps, return to work support, childcare support, reviews of workplace design and wellbeing at work, career support and promoting equality at work (to name a few). Further research on the effectiveness of interventions would underpin these initiatives.

Conclusion

This rapid review identified a variety of complex issues impacting negatively on older women's participation in the European workforce. Our findings highlight some key considerations for policy when considering extended working lives for older women: 1) the importance of a longitudinal perspective; the working lives of older women can only be fully understood in the context of their career and life history. Our review points to the compounding effects of disjointed careers that start from early in a woman's employment. Policy intervention therefore needs to start early and should be focused on the longer term for sustained equality; 2) the importance of understanding working lives in the context of the demands placed on them outside of work and how policy aimed at supporting the lives of older women outside work impacts employment, including welfare state variations; 3) the need to give more attention to the experiences of women that impact their health and wellbeing (e.g. menopause) and shape attitudes towards them; 4) decisions and policies focused on extending older women's working lives must not blindly address employment strategy targets, but instead consider the diverse and individualised needs of older women in the workplace across diverse cultural contexts by better understanding their experiences

This review demonstrates that generalisations about the need to extend working lives of older people, or framing policies and interventions that aim to keep older women in the labour market are not straightforward and require a more nuanced perspective that takes lived experience (of being an older female worker) into account. In-depth, first-person accounts in collaboration with key stakeholders are needed to inform better policies that are impactful.

Future research should address this, including studies using a range of methodologies to explore a diverse range of experiences, and focussing on innovation and improvement in policy and provision that will benefit older female workers, as well as all workers in Europe. The review had some limitations. Some of the studies were reviews of previously published literature or performed secondary analyses of available data. Although these studies met the criteria for our publication date (in or after 2010), some of them included research and data published or collected before 2010. While we have included these studies in this review, we acknowledge that some of this data should be interpreted with caution when it comes to informing current employment practices and policy directives. The review process was expedited in line with rapid review methods, therefore limiting the scope of the findings. Further, previous researchers have acknowledged the challenges with performing keyword searches in this area, due to the use of varying terminology (Granville and Evandrou, 2010; Payne and Doyal, 2010). As a result, it is likely that some relevant references and data may have been missed, despite our attempts to run multiple database searches to address this. Several of the included studies focused on a specific industry or profession such as education, nursing, or retail. This restricts the ability of the findings in informing policy development and services for older working women in general. Importantly, defining 'older women' is challenging. For instance, experiences such as menopause may also affect those younger than 55 years of age, but due to the definition of older women in this review as those above the age of 55 (or a mean sample age of over 55), we had to exclude several studies that did not meet these criteria. In excluding research on these populations, we might thereby omit those women's experiences of wellbeing and aging at work. Future studies could adopt a life-course perspective when studying labour markets and the workforce, as opposed to a young-old dichotomy to define age brackets. A pan-Europe literature review could have potentially excluded some contextualised specifics in terms of challenges, barriers and facilitators to older women's employment such as a detailed analysis of welfare systems, their similarities and differences. This prevents us from making country-specific policy or practice recommendations from the findings. Finally, by narrowing the scope to 'women' in our search criteria, we may have excluded research on diverse sub-group populations with different sexual and gender identities. Individuals who identify as non-binary or are from LGBTQ+ communities make up a significant proportion of the labour market, and their views, perspectives and experiences are crucial in informing policy innovations or interventions that could improve their working lives

Statement of ethical approval

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Declaration of contribution of authors

The authors confirm contribution to the paper as follows: study conception and design: V.T., S.G.R., A.L., E.J.; data collection: S.R, L.T.; analysis and interpretation of results: S.R., L.T., S.G.R, V.T. A.L., E.J.; draft manuscript preparation: S.R. All authors reviewed the results, edited and approved the final version of the manuscript.

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Work environment development using cognitive work analysis' decision ladders

Abdulqadir Mohamad Suleiman

Introduction

1.1 Background

When asked to define "work environment," a group of safety professionals agreed on "the place where workers perform their work and the overall work conditions." One can say that definition is rather simplistic. A more comprehensive elaboration is that work environment is "a combination of job characteristics defining the setting where workers operate [...] and encompasses a broad range of nonpecuniary characteristics of a job, ranging from the nature of the work tasks assigned to each worker to the physical and social conditions under which these tasks are carried out. In addition, further to the tasks is the characteristic of the firm or organisation where the work takes place, and includes the scheduling of working time, the prospects that the job provides to workers and the intrinsic rewards associated with the job" (OECD 2017, p5).

Work and occupational safety and health (OSH) changes affect managers' organisational context and workplace risks. Workplace management is responsible for overseeing work performance and controlling the work environment. The management must keep pace with OSH developments to ensure continued improvement of workers' safety and well-being (Henshaw et al. 2007). A combination of leadership styles and characteristics contributes to developing and sustaining a healthy work environment (Pearson et al. 2007). In addition, developing managers' OSH competencies and resources support promoting workers' occupational well-being, innovativeness and performance (Tappura et al. 2014).

There have been several studies on intervention programs to promote occupational health. Various studies showed low to moderate interventions effectiveness (Kordsmeyer et al. 2022; Diaz-Benito et al. 2020; Schliemann et al. 2019; Oakman et al. 2018), with low worker participation, lack of resources and management support as the challenges of implementation (Kordsmeyer et al. 2022). Reluctance to change behaviour among older workers is reported as a barrier to the success of the programs (Magnavita 2018). On the other hand, Smith et al. (2015) reported how "culturally compelling" interventions fit well with workers' immediate good work environment conceptualisation, while for managers' the attention is on flexible interventions in the organisational environment. Further, Gray et al. (2019) identified skills/knowledge and leadership development, communication, team building, and employee's

involvement as the basis for promoting mental health and well-being, with cohesive work groups, good communication and agreement harnessing collective resources and employees' participation (Perä et al. 2021).

That said, a functional definition of work environment development is conceptualised here as implementing management practices and interventions designed to positively impact workplace working conditions and improve the existing OSH status and workers' well-being. This functional definition lays the groundwork for workplace intervention programs that effectively improve the OSH paradigms and workers' well-being. However, Hasle et al. (2017) noted that despite several efforts to prevent occupational diseases and accidents, with strong legislation and extensive enforcement resources, the number of cases remains relatively constant. Hence, in designing the content for workplace interventions, it is vital to include the different aspects of the work environment and address workers' and management's responsibilities and role contributions and the regulatory dimension. First, a detailed comprehension of work environment challenges and what would move the management, and the workers, is crucial.

Acquiring such knowledge entails evaluating the work environment practices of different workplaces with a critical point of view, as is the case during regulatory inspections. Reports from inspections provide an empirical elucidation of the work environment systems actuality from which one can determine the changes necessary to improve the conditions. These changes would require both management decision-making and workers' input. With this change requirement in mind, the main research question was, what would be the content of requisite changes in the physical and social conditions and management practices at a given workplace to spearhead work environment development?

The development process is complex due to the multi-dimensional aspects of work environment, i.e., the socio-organisational context and work system (Carayon et al. 2015) and requires a whole system-thinking approach. Enehaug (2014) indicated that different perspectives collectively give a more refined understanding of how the organisation, the individual and the structure interact across different conditions. It is, therefore, crucial to look at the different dimensions of the work environment development together as a complete system.

This study, with the change requirement as the starting point, is built on the work on exploring work environment management boundaries which identified the functional aspects of work environment development (Suleiman 2023). The primary aim of this study was to create content that would be the basis for decision-making on interventions to develop the work environment. Further, as workplaces in different sectors have varied work environment challenges, the next important assessment was on the relevance perception of the identified intervention decision-making content by workers and managers in various sectors. Thus, the study's secondary aim was to conduct a limited evaluation of the identified content to determine its perceived relevance in different sectors.

The change content is designed using control task analysis which is the activity dimension of the cognitive work analysis (CWA), through preparing decision ladders for work functions previously identified as work environment development purpose-related functions (Suleiman 2023). A description of CWA is provided briefly in the next section, detailing on use of decision ladders as a knowledge-based tool to support decision-making through a series of cognitive states and processes.

1.2 Cognitive work analysis (CWA)

CWA is a formative framework for work analysis (Naikar 2013) first developed by Rasmussen and his colleagues at Risø National Laboratory in Denmark (Rasmussen et al. 1994, Rasmussen 1986). CWA supports understanding humans' interaction with complex systems, aiming to describe how the work domain can proceed (Jenkins et al. 2010). Looking into constraints, CWA attempts to support the needs of workers in improving efficiency and safety (Stanton et al. 2013) and promotes adaptation design (Naikar 2011). Naikar (2013, p5) defined constraints as "limits on behaviour which must be respected for a system to perform effectively." Constraints on workers' behaviour are the central unit of design analysis in the CWA framework instead of the workers' behaviour (Vicente 1999, Rasmussen et al. 1994, Rasmussen 1986).

The five phases of CWA, each with its modelling tool, focus on different constraints. The first is work domain analysis (WDA) which identifies the information one may require to deal with various situations, including those not anticipated a priori (Naikar 2013). WDA is often presented as a five levels abstraction in the vertical dimension with varying degrees of decomposition on the horizontal (Lintern 2013a). Structural links from nodes on one level to the other illustrate the path from a specific functional artefact to the overall primary purpose it serves in the organisation structure (Naikar et al. 2005; Porter et al. 2003). Purpose-related functions (PFRs) in the middle of the abstraction hierarchy connect the value measures constrained by the domain purpose on the upper part of the hierarchy to the lower object-related functions afforded by the physical objects/resources, the domain's artefacts useful in conducting the work (Lintern 2013a, Lintern 2013b).

The second phase is the control task analysis (Vicente 1999), also known as activity analysis (Naikar 2013) or work task analysis (Lintern 2010). This phase involves identifying the constraints related to the necessary activities within the available resources. Control task analysis arising from work situations transforms inputs such as the current state into outputs as decision and control action (Sanderson 2003). One of the modelling tools used for activity analysis is the decision ladder, a template for mapping task trajectory, portraying knowledge states, and information-processing activities involved in task execution (Lintern 2013a). A Series of sequential knowledge states and cognitive processes characterising knowledge-based behaviour define the decision ladder, as shown in figure 1.

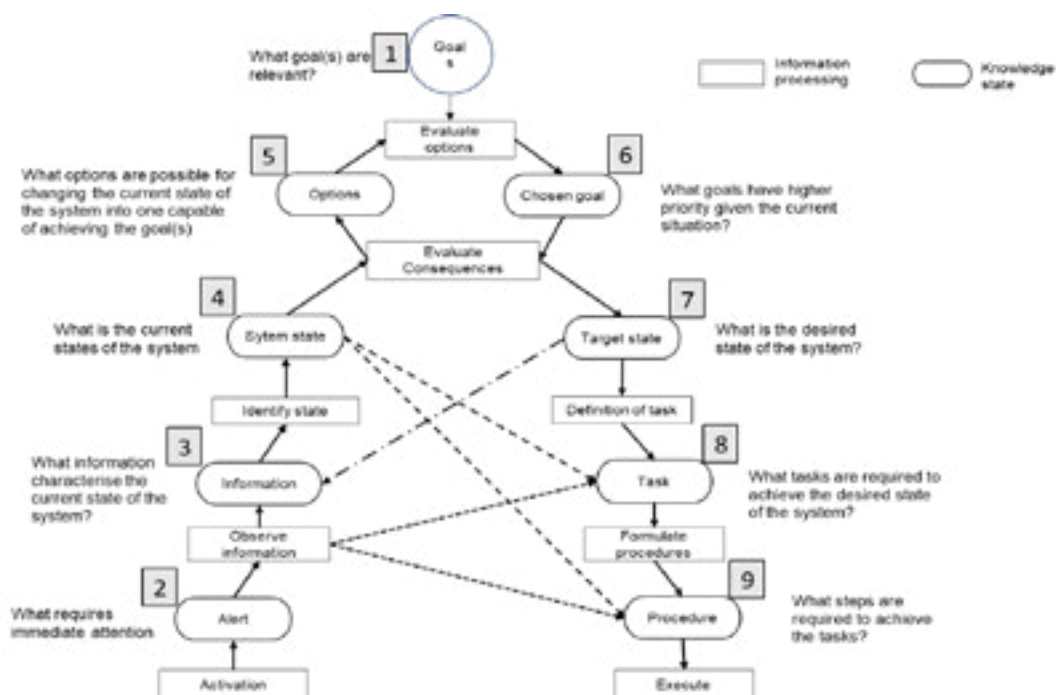


Figure 1: Generic decision ladder (adopted from Elix & Naikar with slight modification) [Elix & Naikar 2008]

The left side of the ladder represents situation analysis and diagnosis, while the right side represents planning, scheduling, and execution, with evaluation between the two (Lintern 2009). The sequence depicted with solid arrows, starting from activation through the steps to execution, would be adopted in instances such as when experts meet unfamiliar tasks or when non-experts are engaged in specific task performance. On the other hand, experienced workers performing familiar tasks may bypass some parts of the decision ladder (as shown by the dotted lines), start at different parts of the ladder, and may move from left to right and right to left (Naikar 2005). The decision ladders embed the complete decision-making activities rather than just the options (Jenkins et al. 2016) and help to think about different work methods (Hassall and Sanderson 2014).

Populating the decision ladder template starts with defining the goal of the system and the constraints that affect the goal. Questions reflecting the actors’ recurring concerns can be used to annotate the decision ladder (Elix and Naikar 2008). Answers to the questions framed by actors in situational context indicate the states of knowledge, with the possibility for combinations of work situations, work functions, and control tasks, placing clear demands on actors (Naikar 2013).

The subsequent dimensions of CWA include strategy analysis which identifies the strategies one can employ to achieve the necessary system activities; social organisation and cooperation analysis, involving analysis of work allocation and distribution within the system; and workers’ competencies analysis, dealing with how to meet the system demands given human cognitive capabilities and limitation.

1.3 Functional aspects of work environment development

In the study on exploring boundaries of work environment management (Suleiman 2023), six PRFs were identified. PRFs are necessary to attain the work domain purposes (Naikar 2013). For example, in a process industry setting, process preparation and start-up, system cleaning and disturbance analysis would be typical process purpose-related functions (Naikar 2013). Similarly, in a healthcare system, prescribing and patient assessment would be purpose-related functions pertinent to maintaining patients' health (Burns 2012). Figure 2 shows a part representation of the abstraction hierarchy from the analysis of work environment management boundaries focusing on the functional purpose "work environment development".

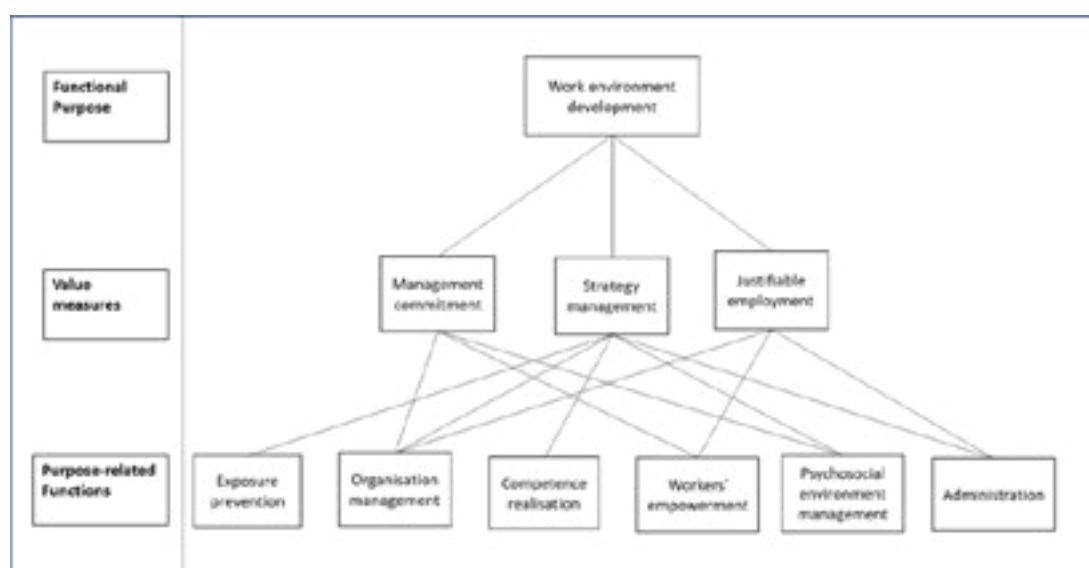


Figure 2: Part abstraction hierarchy focusing on work environment development [from Suleiman 2023]

The identified work environment development PRFs are Exposure Prevention, Organisation Management, Competence Realisation, Workers' Empowerment, Psychosocial Work Environment Management, and Administration. When reading the hierarchy using the "why-what-how" triade, the value measures in the middle (*what*) are connected to the functional purpose (*why*) from above and the PRFs (*how*) from below. These three levels of the WDA allude to humans' functions, whereas the next two (not included in Figure 2) allude to the physical resources and the process these resources afford. Workplace variations and the management's resources may mean different physical resources and processes. However, the purpose-related functions remain the same despite differences in the workplaces.

From the OECD's contextual work environment elaboration (OECD 2017) mentioned above, the functions for work environment development, *Exposure prevention* and *Psychosocial environment management* address the "physical and social conditions" under which the workers carry out the assigned task. *Organisation management* and *Administration* deal with the "characteristics of the organisation where the work takes place." Finally, *Competence*

realisation and *Workers' empowerment* cover the "prospects that the job provides to workers." The juxtaposition of the work environment definition elements to the work environment development PRFs asserts the functions' relevance in developing the work environment. The work functions may be performed in different work situations and are accordingly characterised as activities (Naikar, Moylan and Pearce 2006).

2 Method

2.1 Information gathering and processing

This study's primary source of information was reports from concluded onsite inspections conducted by the Norwegian labour inspection authority (NLIA). Inspection areas covered in the investigated reports included the health and social care sector (n=365), building and construction (n=271), and industrial activities (n=132) for the period 2019-2021 from one of NLIA's geographical regions. Criteria for inclusion were that at least one enforcement/administrative order was decreed in the decisions in the inspection report due to the companies' non-compliance with regulatory requirements and that the company had responded to the orders. The listed orders were aggregated according to the intended purpose and put under the work function that best described the decision's intention, as shown in Table 1.

Table 1: The work functions and the orders aggregated under each function.

Work functions (purpose-related functions)	Areas orders decreed
Exposure prevention	Biological hazards; ergonomics; indoor climate; explosion hazards; measurement taking; use of work equipment; evacuation pathway; noise hazards assessment; chemical substances inventory; ventilation; personal protection; Safety data sheets; work at height; hazards mitigation
Organisation management	Periodic control of machines/work equipment; risk mapping and management; implementation of safety action plan; routines for reporting safety shortfalls; accidents reporting; risk assessment of solo work; workstation safety; resting and restitution; internal control; labelling of stored chemicals; needs adaptation; work plan; areas classification and demarking.
Competence realisation	Workers' training; training documentation; information requirement; work instructions; employers' training
Workers' empowerment	Safety representatives; safety committees; contribution of workers' representatives
Psychosocial environment management	Follow-up on threats and violence; work and emotional load; equal treatment
Administration	Support from occupational health services; work time; employers' OSH responsibilities; routines updating; average time determination; overtime and other types of compensation; disclosure duty; permits; health controls; workers' contracts

Populating the decision ladders started with establishing a primary goal for each of the six work functions, focusing on changing the physical and social conditions and organisational/management practices. For each goal, at least two constraints are required (Elix and Naikar 2008). The subgoals of the prerequisites for effective OSH inspection performance (Suleiman 2022) were applied as the goals' constraints with slight modifications where necessary. This approach aligned the work environment development activities with targets of inspection performance, ensuring regulatory compliance in performance. The orders formed the foundation for existing situational analysis, reflecting on the state of the workplace during the inspections and providing the content for populating the *System* and the *Information* (set of observations) states in the decision ladder for each work function.

The author and three long-serving and experienced NLIA OSH inspectors formulated the content of the system and the information states (nodes 3 and 4) from the regulatory decisions and the questions on inspection checklists. The *Options* (node 5), i.e., what would be necessary to change the system state to attain the identified goals, were then structured based on the content of the system and the information states. The content of the planning, scheduling, and execution processes (nodes 6-9) on the right-hand side of the ladder was then built from the list of options identified.

2.2 Content evaluation

All the *Options* constructs for each work function were put together in a questionnaire designed to evaluate the perceived relevance of the identified content in developing work environments in different work areas. A 1-5 Likert scale was used, with 1 = least important and 5 = most important. The questionnaire was sent to workplaces in different sectors, as presented in Table 2. The management of participating companies had the discretion to identify the participants to participate in the survey.

Table 2: The work areas of the participants in the content evaluation

Sector	Occupation/pursuit
Health	Dental surgery staff Ergo therapists Training and rehabilitation
Technical	Electrical workers Internal structures installation Building construction/maintenance
Service	Sales and customer relations Legal advice
Manufacturing	Prosthetics production Paints formulation Unspecified production
Management (various)	General management Project management
Others	Grocery retailers Janitor and renovation services

Workers from the various work sectors (n=33) evaluated the relevance and importance of the constructs. Participants' demographics, i.e., age group and gender, were also obtained from the data collected. Responses were analysed to determine differences in perceptions of the content for developing work environments in the different work sectors. In general, high average values on the Likert scale would be a positive indication of the perceived relevance and importance of the constructs. Further, the sectors' agreement on constructs' importance in their work environment development would provide some level of validity of the identified content for work environment development in different sectors.

Statistical analysis was used to make sense of the results. Kruskal-Wallis' test was used to compare the indicated perceptions from work areas and age-groups perspectives, while Mann-Whitney U-test was for gender perspective. The gathered data's internal consistency was controlled using α -Cronbach.

3. Results

A decision ladder for the work function "Exposure prevention" with the identified content of each knowledge state is presented in Figure 3. Similarly, the contents of all decision ladders for the other five work functions presented in Table 1 were prepared accordingly.

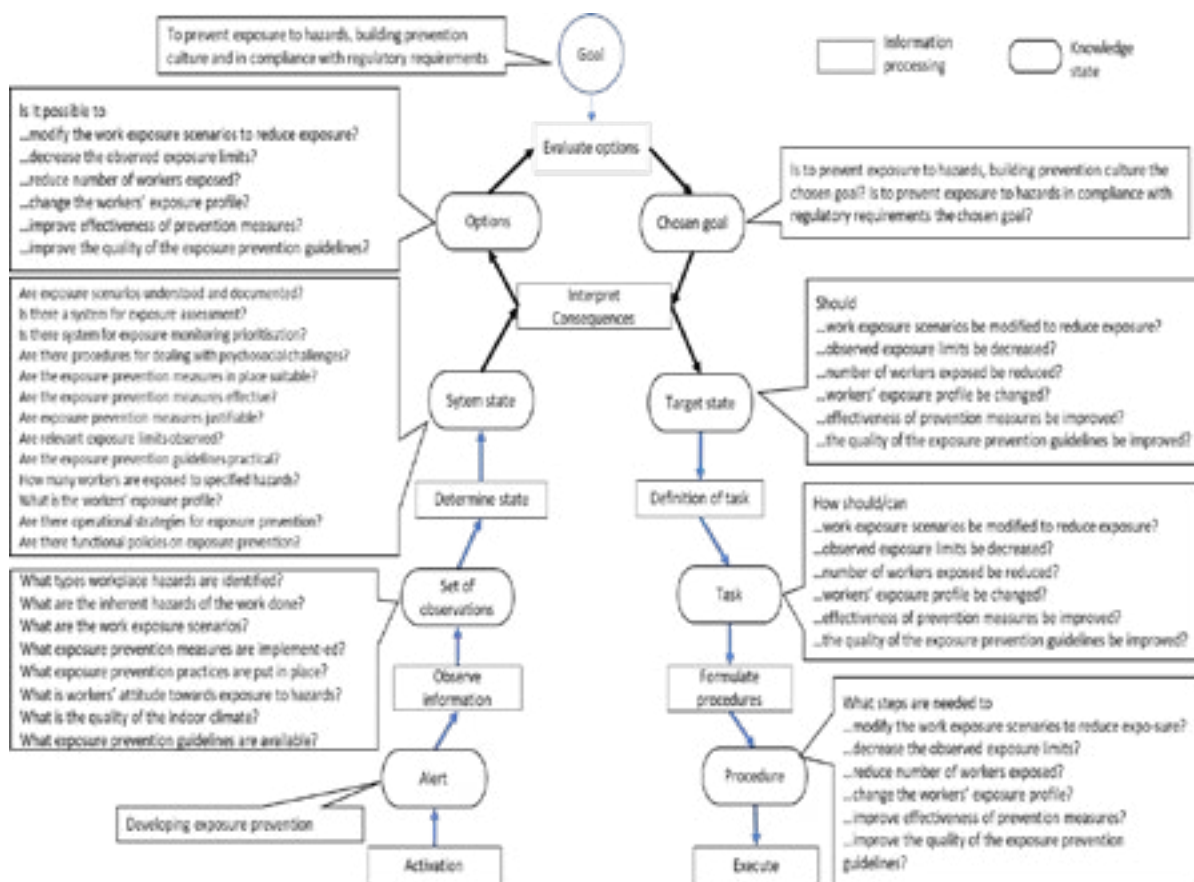


Figure 3: Decision ladder for work function' Exposure prevention.

The knowledge state "Options" is characterised by the constructs that provide for changing the existing state. All the constructs identified under *Options* are added to the question phrase "Is it possible to...," giving questions on the possible change alternatives. These alternatives are processed further on the right-hand side of the ladders, and under the knowledge state "Procedure", are preceded by the question phrase "What steps are needed to..." forming the decision-making content. Collating the constructs from all the decision ladders for the six work functions gave 29 items considered as the content for work environment development per the study objective.

Three categories of requisite change content were envisaged in the research question, i.e., physical and social changes and changes in management practices, with each of the 29 items falling under one or more of these categories. For example, the question "What steps are needed to modify the work exposure scenarios to reduce exposure" (see Table 3) gives the basis for decision-making on the work program to reduce workers' exposure to hazards, giving decision-making content on physical change. On the other hand, the question "What steps are needed to enable work within established OSH standards" as part of the function "organisation management" falls under change in management practice, whereas "What steps are needed to have arenas for workers' cooperation" under the function "psychosocial work environment management" exemplify social change. The same applies to all the constructs listed in Table 3, each falling under one of the change categories as indicated in the table. A bold (✓) shows the main change category for that construct, and a light one (✓) shows that the construct is also relevant in that change category.

Table 3: Presentation of the constructs under each work function with attribution of whether it is a physical change (PC), social change (SC) or management practice (MP)

Work functions	Work environment development constructs:	Change types		
	(Procedures): What steps are needed to...	PC	SC	MP
Exposure prevention	modify the work exposure scenarios to reduce exposure?	✓		
	decrease the observed exposure limits?	✓		
	reduce the number of workers exposed?	✓		
	change the workers' exposure profile?	✓		
	improve the effectiveness of prevention measures?	✓		✓
	improve the quality of the exposure prevention guidelines	✓		✓
Organisation management	design alternative work organisations to emphasise prevention culture?	✓		✓
	enable to work within established OSH standards?	✓		✓
	operationalise management accountability?			✓
	design strategies for regulatory compliance?			✓
	improve the OSH practices?			✓
Competence realisation	enhance workers' OSH competence?			✓
	adapt work instructions to advance good OSH practices?	✓		✓
	establish a system for acquiring new knowledge?	✓		✓
	enhance management's competence on OSH responsibilities?			✓
Workers' empowerment	organise workers' involvement in work environment decision-making effectively?	✓		✓
	enhance workers' comprehension of their work environment responsibilities?	✓		✓
	involve workers in the internal control process?	✓		✓
Psychosocial environment management	have arenas for workers' cooperation?	✓	✓	
	have regular programs for promoting welfare?	✓	✓	
	have a proactive approach to tackle social hazards?		✓	
	use normal management processes to monitor workers' well-being?			✓
	change performance context?	✓		✓
	adapt the workplace to accommodate for diversity?	✓	✓	
Administration	amend the roles and responsibilities to promote belongingness?		✓	✓
	upgrade the type of workers' support?			✓
	improve workers' level of support satisfaction?		✓	✓
	enhance needs adaptation routines?		✓	✓
	widen the scope of workers' cooperation?		✓	✓

Note: PC – Physical change; SC – Social change; MS – Management practice

The different activities the workplace management needs decision-making on to change the work environment cover all the change categories.

In evaluating the relevance and importance of the 29 items, Table 4 shows the results of the statistical analysis of the evaluation.

Table 4: Results of statistical analysis of the constructs for work development intervention content.

Work functions	Work environment development constructs:	Scores		Anova (Sig. level)		Mann-Whitney U test (Sig. level)	Kruskal-Wallis test (Sig. level)	
	<i>(Procedures): What steps are needed to...</i>	Mean	SD.	Age-group	Work sector	Gender	Age-group	Work sector
Exposure prevention	modify the work exposure scenarios to reduce exposure?	4.18	1.131	0.939	0.615	0.683	0.734	0.569
	decrease the observed exposure limits?	4.15	1.149	0.800	0.215	0.763	0.422	0.151
	reduce the number of workers exposed?	4.03	1.287	0.430	0.106	0.581	0.622	0.131
	change the workers' exposure profile?	3.70	1.237	0.798	0.288	0.465	0.862	0.182
	improve the effectiveness of prevention measures?	4.42	0.751	0.690	0.221	0.817	0.746	0.180
	improve the quality of the exposure prevention guidelines?	4.27	0.839	0.266	0.018	0.557	0.288	0.021
Organisation management	design alternative work organisations to emphasise prevention culture?	3.91	1.071	0.763	0.250	0.790	0.624	0.186
	enable to work within established OSH standards?	4.21	0.696	0.209	0.121	0.102	0.202	0.163
	operationalise management accountability?	4.09	0.765	0.401	0.517	0.631	0.193	0.383
	design strategies for regulatory compliance?	4.03	0.918	0.303	0.275	0.191	0.288	0.308
	improve the OSH practices?	4.09	0.879	0.950	0.699	0.231	0.829	0.436
Competence realisation	enhance workers' OSH competence?	4.27	0.761	0.307	0.106	0.345	0.204	0.148
	adapt work instructions to advance good OSH practices?	4.15	1.064	0.835	0.943	0.873	0.853	0.921
	establish a system for acquiring new knowledge?	3.94	1.059	0.178	0.556	0.309	0.112	0.666
	enhance management's competence on OSH responsibilities?	3.97	0.810	0.185	0.188	0.326	0.188	0.193
Workers' empowerment	organise workers' involvement in work	4.36	0.742	0.755	0.347	1.000	0.713	0.277

	environment decision-making effectively?							
	enhance workers' comprehension of their work environment responsibilities?	4.52	0.667	0.629	0.102	0.581	0.688	0.222
	involve workers in the internal control process?	4.39	0.659	0.548	0.558	0.179	0.538	0.452
Psychosocial environment management	have arenas for workers' cooperation?	4.42	0.792	0.922	0.190	0.191	0.958	0.100
	have regular programs for promoting welfare?	4.30	0.770	0.897	0.464	0.231	0.634	0.584
	have a proactive approach to tackle social hazards?	4.61	0.659	0.904	0.683	0.488	0.635	0.577
	use normal management processes to monitor workers' well-being?	4.39	0.704	0.817	0.310	0.901	0.795	0.326
	change performance context?	3.70	0.883	0.351	0.944	0.817	0.325	0.939
	adapt the workplace to accommodate for diversity?	4.03	1.380	0.482	0.207	0.217	0.345	0.219
Administration	amend the roles and responsibilities to promote belongingness?	4.06	1.029	0.712	0.166	0.683	0.457	0.083
	upgrade the type of workers' support?	4.21	0.820	0.576	0.800	0.873	0.616	0.757
	improve workers' level of support satisfaction?	4.39	0.704	0.680	0.446	0.929	0.648	0.418
	enhance needs adaptation routines?	4.00	0.829	0.697	0.085	0.581	0.785	0.341
	widen the scope of workers' cooperation?	4.18	0.727	0.417	0.155	0.488	0.326	0.184
Note: SD = Standard Deviation; Sig. Level = Significance level								

The mean scores for all the constructs fall in the range of 3.70 – 4.61, with only 5 (17.2%) constructs having mean scores below four (4). The standard deviations suggest variations in the data, with some of the constructs having a high variance coefficient. These variations are not unexpected due to the numbers and variations of the workers who participated in the evaluation process. However, ANOVA showed no significant differences in the constructs when comparing age groups, as shown in Table 4. On the other hand, a comparison of the work sectors showed a significant difference ($p=0.018$) for the construct "...improve the quality of

the exposure prevention guidelines (under work function *Exposure prevention*) with Tamhane's T2's multiple comparisons showing differences between Manufacturing-Management and Management-Others (see Table 2), both with $p=0.017$.

Similarly, Kruskal-Wallis test showed a significant difference for the same construct ($p=0.021$). Pairwise comparison showed differences between Manufacturing-Technical ($p=0.040$), Service-Management ($p=0.041$), Services-Other ($p=0.031$), and Manufacturing-Management ($p=0.008$). Meanwhile, the Man-Whitney U test showed no significant differences between the constructs from the gender perspective.

An α -Cronbach analysis showed good internal consistency with a high value of 0.910 rating from age group, gender and work sector.

4 Discussion

4.1 Methodology considerations

The primary aim of this study was to design decision-making content for work environment development using decision ladders, with reports from workplace regulatory inspections as the primary source of information. Applying the formative decision ladders and using regulatory decisions from workplace inspection to develop work environment is a novel strategy that deviates from the more traditional prescriptive pragmatism of OSH professionals, as Zanko and Dawson (2011) noted. Added to the regulatory decisions were aspects of the identified inspection effective performance prerequisites (Suleiman 2022), intertwining workplace OSH management practices and inspection goals. These are two areas customarily dealt with from different perspectives. For example, inspections by national OSH enforcement authorities are typically understood as regulative, while OSH management practices may require line managers to incorporate safety and health into regular business strategies (Mellor and Webster 2013). The merit of using regulatory decisions from inspection reports is in presenting the fundamental aspects the inspectors had identified as insufficiently practised or were non-compliant with regulatory requirements and required correction by the workplace management. Addressing these shortcomings is essential to work environment development. The outcome was identifying 29 items of content for work environment development that can be applied to workplaces across different sectors.

The reports were selected based on the significant work environment challenges workers in the three sectors may experience. Workers in the health and social care sector are reported to have a high prevalence of musculoskeletal disorders, headaches, stomach ailments, mental disorders, physical and mental exhaustion, and the highest incidences of sickness absence (AT1). Building and construction is a high-risk sector with several hazardous activities requiring comprehensive work environment supervision. For industry, workers are particularly exposed to accidents in connection with using and maintaining machines and equipment and ailments

due to chemical and biological hazards, noise and vibration, and high fatalities (AT2). These three sectors comprehensively encompass the most critical work environment challenges. Orders decreed following inspections in these sectors represent the high-end work environment challenges, and effecting work environment development from this perspective also suffices for the other less challenging sectors.

4.2 Development constructs

The decision ladder goal established for the function *Exposure prevention* was “to prevent exposure to hazards, build a prevention culture in compliance with regulatory requirements”, the need to build a prevention culture and comply with regulatory requirements being the goal constraints. Progress in exposure prevention is essential and attainable by continuously applying the identified constructs as part of the workplace culture. Moreover, the measures must fulfil regulatory requirements, such as observing the regulatory exposure limits. The development constructs are thus intended to provide content supporting this goal attainment.

The goal for *Organisation management* was to manage work organisation within a prevention culture framework and regulatory compliance. This goal is essential in facilitating the prevention culture development and working according to the regulations. Therefore, the work plans, organisation, and practices must accommodate work environment structures that support the prevention culture and maintain compliance with regulatory requirements. Further, workers have a vital role in the development process, and developing workers’ competencies to identify and correct deficiencies in the work environment and as a means of workers’ support becomes an important goal of workers’ *Competence realisation*.

Furthermore, *Workers’ empowerment* is vital in work environment development. Workers’ empowerment involves including workers in work environment decision-making, correcting deficiencies and building workers’ confidence in the whole development process. The workers need to embrace the process, be part of it, and make contributions to the development process, which in turn, helps in facilitating the goal of the next work function, the *Psychosocial environment management*, where the goal set is to safeguard workers’ dignity, supporting well-being and breed mutual confidence. The workplace should have policies against threats and violence; the workers should be content with their work engagement and control their work, with both physical and mental well-being. The policies should help tackle social hazards (Krieger 2012; Krieger et al. 2006) and avoid relations misconceptions (Byron and Landis 2020).

The work function *Administration* puts together all other work functions discussed. The goal set for this function was to promote belongingness, corroborate justifiable organisational and psychosocial measures and improve cooperation. Hagerty et al. (1999, p173) described belongingness as “the experience of personal involvement in a system or environment so that persons feel themselves to be an integral part of that system or environment.” Therefore, workers need to have a sense of belonging to their work environment. Lambert et al. (2013)

showed that a sense of belonging was a robust predictor of meaningfulness, and according to Sargent et al. (2002), sense of belonging provided a buffer against depressive symptoms. This work environment development strategy applies similarly to different workplaces. The results from the evaluation process, showing no significant differences in the relevance and importance perception, indicated the validity and applicability of the content of work environment development at diverse workplaces.

4.3 Execution of the decision-making process

The work environment development constructs would be typically more relevant in the different stages of the intervention process. Table 5 shows under which intervention stage the different constructs would typically be most practical (dark-shaded cells) and when they give additional support (light-shaded cells).

Table 5: Work environment development constructs coded according to the stage of the intervention process.

Work functions	Work environment development constructs:	Intervention cogitation	Intervention management	Intervention evaluation
	<i>(Procedures): What steps are needed to...</i>			
Exposure prevention	modify the work exposure scenarios to reduce exposure?			
	decrease the observed exposure limits?			
	reduce the number of workers exposed?			
	change the workers' exposure profile?			
	improve the effectiveness of prevention measures?			
	improve the quality of the exposure prevention guideline			
Organisation management	design alternative work organisations to emphasise prevention culture?			
	enable to work within established OSH standards?			
	operationalise management accountability?			
	design strategies for regulatory compliance?			
	improve the OSH practices?			
Competence realisation	enhance workers' OSH competence?			
	adapt work instructions to advance good OSH practices?			
	establish a system for acquiring new knowledge?			
	enhance management's competence on OSH responsibilities?			
Workers' empowerment	organise workers' involvement in work environment decision-making effectively?			
	enhance workers' comprehension of their work environment responsibilities?			
	involve workers in the internal control process?			
Psychosocial	have arenas for workers' cooperation?			

environment management	have regular programs for promoting welfare?	■	□	□
	have a proactive approach to tackle social hazards?	■	■	□
	use normal management processes to monitor workers' well-being?	□	■	■
	change performance context?	■	■	□
	adapt the workplace to accommodate for diversity?	■	■	■
Administration	amend the roles and responsibilities to promote belongingness?	■	■	■
	upgrade the type of workers' support?	□	■	■
	Improve workers' level of support satisfaction?	□	■	■
	enhance needs adaptation routines?	□	■	■
	widen the scope of workers' cooperation?	■	■	□

Considering a case, such as when using chemicals in cleaning work as described by Suleiman and Svendsen (2017), answers to the question of “What steps are needed to modify the work exposure scenarios to reduce exposure” (under Exposure prevention) involves considering the work method, use of tools-of-trade, and changing the work ambience. In addition, changing workers’ exposure profiles, such as in the case of exposure to high noise at different workstations, may involve mapping noise sources and controlling the noise levels from the source as appropriate.

The listing of the work development content constructs, as presented in the tables above, is neither indicative of the order of performance nor a compelling checklist for what needs to be included in the intervention process. The order of the constructs’ applicability may become apparent during the intervention cogitation stage, and this may vary from one workplace to another according to the workplace challenges. For example, the steps needed to reduce the number of workers exposed (under Exposure prevention) may be preceded by designing alternative work organisations to emphasise prevention culture (Organisation management). For organisation management, steps needed, for example, to design alternative work organisation, would depend on consideration of the practicality of the alternative organisation out from the workers’ cognisance, their number, ability and safety paradigm. Hence, before implementing the alternative, it may be necessary to enhance the OSH competencies of the workers and the management on their responsibilities, which are constituents of competence realisation. The constructs' applicability concurs with workplace strategic management.

4.4 Practical implications

Applying the 29 items content for decision-making provides for a system-thinking approach that fosters a complete work environment development process. The level of detail of the change content gives a discernible effect on the management practices and the strategies for effectively changing the tangible work environment practices (physical changes), such as changing work procedures to reduce exposure to workplace hazards and change in interpersonal relationships, well-being and welfare of the workers (social changes), such as by

providing arenas for workers cooperation (also as a physical change). The changes in workplace management practices cover aspects such as “use normal management processes to monitor workers’ well-being.” The management is responsible for all the work functions and the changes impacting the physical, socio-organisational, and psychosocial aspects of the workplace work environment. Such a holistic approach to work environment development would lead to changes in workplace OSH policies, compliance with regulations and standards, procedures and guidelines, and workers’ welfare, effectively impacting both the physical and social changes.

Moreover, implementing the described change content in workplace decision-making sets the groundwork for enhanced cross-sectional internal cooperation, as different content elements may fall under different workplace sections. The generated cross-sectional interdependence to achieve a common workplace objective brings forth effective OSH resource management.

4.5 Limitations

One limitation of the study is that, in aggregating the enforcement/administrative orders to connect with the change work functions/activities, some orders were precise to concrete workplace situations and were not reported repeatedly. Consequently, such could neither be included in aggregates nor was it considered purposive to prepare questions for them. However, comprehensive coverage of the main work environment development functions, as achieved by the content of all the work functions’ decision ladder, also affected such isolated outlying aspects.

For each of the goals identified for the preparation of the decision ladder, only two constraints were identified in this study which may have limited the number of outcome content constructs. However, since different subgoals of the prerequisite of effective inspections (Suleiman 2022) were used as constraints for the different goals identified from the work functions, a broader constraints application was possible. Most sub-goals were all the same and reasonably applied in the work environment development.

Another limitation is the small number of participants in the content evaluation process. Although the evaluation results showed high scores for all 29 constructs and no significant differences were identified, the number was small to allow for extensive application of the outcome. However, the consistently high mean scores with no significant differences between the work sectors and high internal reliability strengthen the validity and usefulness of the content constructs for work environment development in different sectors.

Conclusion

The study outcome, in the form of constructs from the decision ladders, provided the content for developing the workplace work environment by creating the basis for changing the existing system status and attaining the goals identified. The 29 constructs provide a foundation for

workplace management's decision-making to develop the work environment. The constructs apply despite the variabilities of workplaces, where making the decisions related to that workplace is made possible for each workplace. The high rate of data internal consistency from raters from the different sectors substantiates the utility of the work environment content across different workplaces. Furthermore, the content constructs designed to attain the goals identified for each decision ladder combine workplace management practices and regulatory requirements, which support applying workplace-specific OSH strategies.

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Employee Participation, Digital Sophistication and Innovation Performance: Analysis Based on the Finnish MEADOW Survey

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Abstract

The results of the Finnish MEADOW survey of 2021–2022, comprising responses of management from 1,106 companies, show that nearly half of Finnish companies employing ten or more people had produced a new or significantly improved product or service during the last two years. Of these companies, almost half had produced products or services new also to the market. Both the level of digital sophistication and the extent of employee participation in development are positively associated with the company's innovation performance after all other factors in the multinomial regression analysis are controlled. The odds ratios in the regression models are higher for innovations new to the market than innovations new only for the company. Broad employee participation shows the highest odds ratios of all variables included in the regression models for both types of innovation. As also companies' cooperation networks and customer involvement can play a role in innovations, we analysed the combined effect of the above four factors on innovation. A clear positive combined effect for both innovations new to the market and new only for the company was detected, suggesting that it is difficult for companies to build innovation superiority based on technological ability alone – or any other single factor – and that broad employee participation in development is an essential part of the portrait of an innovative company also in the digital age.

Keywords: Data analytics, digitalisation, innovation, participation

Introduction

Innovations are important for companies to achieve a competitive advantage in the market. In advanced industrial nations, innovations are needed to create the conditions for economic growth and, especially in the long run, for economic renewal and meeting the new challenges arising from the digital and green transitions. Innovation research has long been characterised by an emphasis on the importance of advances in natural and engineering sciences and the resulting technological innovations. However, in recent years, this view has been increasingly challenged in innovation research, giving more emphasis on the role of social and other non-technological innovations alongside technological innovations. The ways of producing innovations also have diversified as the economies of advanced industrial nations have become more information- and service-intensive and the education level of their population has risen. The role of companies' customers, users of their products and services, and their employees in innovation has become more important and at the same time an increasingly interesting object of research.

There are different types of innovation. Innovations can target, for example, products, services, operational processes, business models, sales and marketing strategies, organisational forms or management. The novelty value of innovations ranges from incremental reforms to radical and even revolutionary changes that disrupt accustomed rules and earnings logics in the market (e.g., Fagerberg et al., 2005; Tidd & Bessant, 2018). The diversity of innovations and the resulting incommensurability make it difficult to comprehensively compare the innovation performance of companies. Most often, the object of comparative company-level innovation research has been innovations in products and services, as also in this paper.

This paper examines the factors associated with the activity of Finnish companies to produce product and service innovations. We focus on both companies that have produced new products or services for the market during the last two years and those that have only produced new products or services for the company itself, and how both groups differ from companies that have not produced any kinds of product or service innovations. We are particularly interested in the significance of the level of companies' digital sophistication and that of employee participation for differences in companies' innovation performance and how and to what extent digital sophistication and employee participation are linked to each other. Our research interest stems from recent discussions on the deepening of digital divides between companies in productivity research (Andrews et al., 2016) and of people in communications research (Ragnedda & Muschert, 2018) and the economic and social implications of the divides, as well as studies on the impact of high-involvement work practices on organisational performance in management and organisation research (e.g., Wood, 2020). As data, we use the Finnish MEADOW employer survey funded by the WORK2030 programme (2019–2023), conducted as part of the government programme of Prime Minister Marin.

The next section includes a review on previous literature, with a focus on the role of digitalisation and employee involvement in innovation. This is followed by a description of the

data, variables and methods. Thereafter, the results are presented. Finally, the results and limitations of the study are discussed, and conclusions are drawn.

Review of the literature

In today's innovation research, two modes of innovation are distinguished. The first of these – the STI-mode of innovation (STI = science, technology, innovation) – is based on the advancement made in science and technology. The second mode is based on learning by doing, using and interacting, called the DUI-mode of innovation (DUI = doing, using, interacting). Here, learning is typically based on the company's own experiences, feedback received from customers on the use of the company's products and services, or other ideas received from different partners in the company's business or innovation networks (Jensen et al., 2007; Parrilli & Heras, 2016).

Companies rarely innovate in isolation. The company's cooperation networks are already definitionally important in the DUI-mode of innovation. On the other hand, cooperation networks are also important in science- and technology-based (STI) innovations (Powell & Grodal, 2005). Many of these innovations require combining different scientific and technological knowledge, and an individual company often does not have sufficient special expertise in all the necessary areas. In practice, the difference between the STI-mode and DUI-mode is a sliding one, and the two modes often appear in a mixed form in real life.

The role of employees is especially important in the DUI-mode of innovation. While the STI-mode relies heavily on the utilisation and elaboration of explicit and global knowledge, the DUI-mode emphasises the role of locally embedded tacit knowledge, often attached to team-based and learning-oriented forms of work organisation. Such a view that stems from innovation research (e.g., Jensen et al., 2007) has a close connection to discussions in management, organisation and working life studies about the significance of the role of employees in companies' innovation and development activities. The discussions have taken place under such concepts as "high-commitment management" (Walton, 1985), "high-involvement management" (Lawler, 1986), "lean production" (Womack et al., 1990), "high-involvement innovation" (Bessant, 2003), "employee-driven innovation" (Høyrup et al., 2012), "practice-based innovation" (Melkas & Harmaakorpi, 2012) or "workplace innovation" (Oeij et al., 2017; 2023). All concepts emphasise – albeit from somewhat different perspectives – the communal nature of the creation of innovations and the importance of employee participation opportunities.

Digitalisation is currently one of the most important – if not the most important – force of change affecting the business operations of companies. The digital transition affects all industries and all types of companies in one form or another and at varying speeds. It can be assumed that the centrality of a company's position in the digital transition of its own industry or market is positively associated with a company's activity to develop new products and

services (e.g., OECD, 2017). This can be assumed to also affect the role of employees in innovation within companies.

In the 2010s, the debate about the effects of digitalisation on work and employment was dominated by arguments about the massive job-displacing effects of technological development (e.g., Brynjolfsson & McAfee, 2014; Ford, 2015; Frey & Osborne, 2017; Schwab, 2016; Susskind, 2020). In these views, the effects of digitalisation on jobs, employment and work contents were often unilaterally derived from – realised or anticipated – advances in digital technologies. At the same time, the role of economic, social, cultural and institutional conditions that shape the actual changes in working life had a weaker footing in such analyses. In the view about the omnipotence of new technologies is nothing new. Technocentric concepts have dominated both public discussion and business management thinking also in connection with previous technological upheavals in history, as, for example, Kopp and his associates (2016) aptly present in their critical essay of the German-origin Industry 4.0 concept. Following their line of argumentation, digitalisation changes the landscape in which companies innovate, but does not displace employees or their knowledge and skills as unnecessary for innovation (see also Govers & Van Amelsvoort, 2019; Totterdill, 2017). The kind of role employees play in renewed work contexts is not so much technologically determined than socially constructed or shaped, reflecting managerial considerations, industry and workplace cultures and power relations between management and labour (e.g., Briken et al., 2017; Zuboff, 1988). To form a realistic picture of the impact of digitalisation on employees' role in innovation in digitalised environments, targeted empirical studies that help to understand both the specific technological and *non*-technological mechanisms characteristic of different industry and workplace contexts are needed.

Jensen and his associates (2007) highlight an inherent tension between the STI-mode and DUI-mode in company operations. The tension is seen in the need to reconcile knowledge management strategies based on the utilisation of codified knowledge with strategies emphasising the role played by informal communication and the mobilisation of tacit knowledge for problem-solving and learning. A special challenge for companies is combining these two modes and developing practices to promote their mutual complementarity.

This tension and challenge form the starting point for this paper's question setting. We ask to what extent the level of digital sophistication alone differentiates companies in terms of innovation performance, and to what extent the level of employee participation in development, customer involvement and companies' cooperation networks strengthen the disparities while controlling different company-level background factors. The research material does not allow us to study the differences separately for the STI-mode and DUI-mode of innovations. However, we assume that the importance of DUI-type features, and thus the participation of employees, is highlighted more in innovations new only for the company itself than in innovations new also for the market. The assumption is based on the fact that the importance of local knowledge is emphasised in the DUI-mode of innovation, whereas the STI-mode is more based on global knowledge, including advances in technologies.

Research methods and data collection

The data

The paper analyses the data obtained from the Finnish MEADOW employer survey, using the methodology developed in the European MEADOW project in 2008–2009 (The MEADOW Consortium, 2010). The guiding idea in MEADOW is to collect part of the data from employer representatives and part from employees working in the same organisations. Here, we will focus on the employer survey, but as we also make references to results of the employee survey, both surveys are described below.

Statistics Finland and Finnish Institute of Occupational Health conducted the employer survey as a stratified sample in terms of industry and organisation size. Based on the information from the Business and Place of Business Register of Statistics Finland, companies and public entities employing at least 10 people were selected for the target population, of which we will limit ourselves to companies in this paper. Data collection was carried out as a web survey between October 2021 and January 2022. Those for whom an e-mail address was available were primarily approached by e-mail. For those who had mail address but no e-mail address, a letter containing instructions for answering the web survey was sent. Finally, those for whom neither was available were contacted by telephone. The respondent was a person in charge of the organisation, such as the owner, managing director, or financial or human resources director, who would be best able to answer questions about the company. Several reminder messages about the survey were sent by e-mail and in paper form, and telephone interviews were also used.

The survey was sent to a total of 3,376 companies, of which 1,106 responded (response rate 33). The response rate varied by industry and by the size of the company. Response activity was highest in large companies employing at least 250 people, while it was clearly lower in small companies with less than 50 employees. There were also differences in response rates between industries. The bias caused by the loss of responses was corrected with the help of weighting coefficients, so the results can be generalised to Finnish companies with at least 10 employees.

In the second phase, between March and June 2022, an employee survey was carried out. From the organisations that had responded to the employer survey, a sample of four to eight people was taken, to whom the online survey was sent. The survey was sent to 5,110 employees working in companies, of which 1,263 responded (response rate 25). The most active response was among women, university graduates and older workers. Among industries, the response rates were highest and lowest in the same industries as in the employer survey, which causes a double bias in the data. The loss of employee data was also corrected with the help of survey weights, so the results can be generalised to employees working in the companies that participated in the employer survey – not to all Finnish private-sector employees.

The variables

We use the following variables obtained from the employer survey in the analyses:

Innovation performance. We asked the management whether the company had developed a new or significantly improved product or service during the last two years (yes/no). In addition, from those who announced that they had developed such a product or service, it was further asked whether any of these products or services were completely new to the market (yes/no). With the help of these questions, we formed a variable that divided the companies into three categories: those that had not developed new products or services (48%), those that had developed a new or improved product or service only for the company itself (28%) and those that had developed a new product or service for the market (23%).

Digital sophistication. The versatility of using data analytics was used as an indicator of the company's digital sophistication. The ability to compile, model and analyse various data in development and decision-making can be considered a key distinguishing feature of companies' level of technological sophistication in the digital transition (e.g., Lehrer et al., 2018). We first asked the management whether the company uses data analytics (yes/no). Those who answered positively were further asked whether it is used to a) develop the production or service process, b) increase customer satisfaction, c) develop work content, d) monitor work performance or e) improve employee well-being or occupational safety (yes/no). A sum variable was formed from the answers, which received values from zero to five according to the number of application areas. More than half of the companies did not use data analytics at all, but those that did mostly applied it for more than two purposes. For the analysis, the companies were split into three groups. The first group included those that do not use data analytics (56%). The rest were divided between those that use data analytics for one to four purposes (22%) and those that use it for all the five purposes (22%).

Employee participation. Employee participation was measured using two questions. At first, the management was asked whether, in addition to management, the staff regularly participate in groups or tasks related to operational development (yes/no). Those who answered positively were further asked about the percentage of participating personnel. For the analysis, the companies were split into three roughly equally sized groups: those where non-managerial personnel do not participate at all (35%), those where less than 30% of personnel participate (32%) and those where 30% or more of personnel regularly participate in operational development (33%).

Networking. We examined the versatility of companies' cooperation networks by asking whether the companies had used (yes/no) eight different types of ways to acquire expertise for the development of their operations during the last two years. The subjects of the questions were a) other companies in the industry, b) other companies in the value or production chain, c) consultants, d) universities, e) other educational institutions, f) authorities, g) labour market or entrepreneur organisations or h) new expertise is obtained from acquisitions or recruitment. A sum variable was formed from the answers, which received values from zero to eight

(mean=3.40, sd=2.09). There were 9% of all companies that did not mention a single partner or a way to acquire expertise from the outside. At least five of the eight items were answered positively by 28% of the companies.

Customer involvement. We asked the management whether customers participate in the design or development of the company's products or services. The answer options and response distributions to them were: "regularly" (15%), "sometimes" (47%), "hardly at all" (24%) and "not at all" (14%). For the analysis, the two last categories were combined into one.

The following variables were used as control measures in the analysis:

Company size. The companies were divided according to the number of employees into three groups: small (less than 50 employees), medium-sized (50–249 employees) and large (at least 250 employees) enterprises.

Industry. Using the international Standard Industry Classification (TOL 2008 in Finland) and combining some categories with each other, the companies were divided into eight groups. After the mergers, the size of the groups varied from 78 (business services) to 413 (industry and infrastructure maintenance) companies.

Export share. The company's export share was measured by the management's estimate of how much turnover had come from sales outside of Finland in the last two years. The companies were divided into exporting companies and those operating only domestically. We also used non-responses (n=278) as a separate category in the analysis to avoid a drop of sample size in the multivariate logistic analysis.

Staff structure. The employer survey did not include a question about the company's staff structure. The staff structure was estimated with the help of Statistics Finland's register material, which contains information on the entire company's payroll and working hours. We classified the companies into two groups according to their average salary calculated per working hour and assumed that the size of the average salary is connected to the share of employees working as managers or professionals. Those whose average salary level was above the mean were classified as professional-dominated companies and the rest as non-professional-dominated companies.

The data analysis

At first, we investigated the connections between individual variables and companies' innovation performance using descriptive methods and cross-tabulations. We tested differences between groups using the chi-square (χ^2) goodness-of-fit test. In evaluating the differences between classes, we used row percentages and standardised residuals calculated from cross-tabulations.

After this, we combined the individual examinations by building two multinomial logistic regression models. Companies that had not produced new products and services in the last two years were set as the reference group. They were compared to companies that a) had introduced a new product or service to the market and b) that had only produced a new product or service for themselves. No weight coefficients were used in the multinomial regression models, as the variables used to form the weights are part of the model.

Finally, we used two multinomial regression models to investigate the combined effects of the level of digital sophistication, employee participation, networking and customer involvement on companies' innovation performance. The formation of the variables is described in the results section.

The results

The innovation performance of companies is associated with many background variables (Table 1). Among large companies, the proportion of firms that had produced product or service innovations both for the market and only for the company itself is higher than in small and medium-sized companies. There are also significant differences between industries. In the software industry and ICT services, the shares of companies that had produced innovations both new to the market (44%) and new only for the company (41%) are higher than in all other industries. The other extreme is represented by construction, where the respective shares are 8% and 16%. The company's staff structure is connected to the company's innovation performance. The companies, where a larger than average number of employees work in various expert positions, are ahead of the others, especially in their activity to produce innovations new to the market. Moreover, exporting companies are more active innovators than companies operating only in the domestic market.

Table 1: Innovation performance according to background variables: direct distributions (weighted figures).

		No product or service innovation	Product or service innovation new only to the company	Product or service innovation new to the market
Size of company ($\chi^2=196.29$, $p<0.001$)	Small	50%	29%	22%
	Medium-sized	45%	25%	30%
	Large	31%	34%	36%
Industry ($\chi^2=2428.05$, $p<0.001$)	Manufacturing	39%	31%	29%
	Construction	76%	16%	8%
	Trade, accommodation and catering	44%	38%	18%
	Business services	42%	31%	27%
	Education, health care and welfare	36%	26%	37%

	Transport and communication	68%	18%	14%
	Finance, insurance and real estate	58%	23%	19%
	Software and ICT services	15%	41%	44%
Staff structure ($\chi^2=829.51$, $p<0.001$)	Professional-dominated	57%	27%	16%
	Non-professional-dominated	37%	33%	31%
Export share ($\chi^2=763.96$, $p<0.001$)	Domestic market	56%	26%	19%
	Exporting	35%	35%	30%
	Information missing	42%	27%	31%
Digital sophistication ($\chi^2=1399.36$, $p<0.001$)	No data analytics	59%	25%	16%
	Data analytics for few purposes	35%	37%	28%
	Data analytics extensively	35%	29%	37%
Employee participation ($\chi^2=1540.82$, $p<0.001$)	None	64%	22%	14%
	Less than 30% of personnel	42%	36%	22%
	30% or more of personnel	36%	29%	35%
Customer involvement ($\chi^2=1112.79$, $p<0.001$)	Hardly/not at all	62%	25%	14%
	Sometimes	40%	32%	28%
	Regularly	37%	29%	34%
Networking ($\chi^2=2106.62$, $p<0.001$)	No external partners	84%	13%	3%
	One external partner	48%	37%	15%
	Two external partners	57%	27%	16%
	Three external partners	46%	28%	26%
	Four external partners	42%	33%	25%
	Five external partners	40%	29%	32%
	Six external partners	44%	36%	20%
	Seven external partners	22%	28%	49%
	Eight external partners	23%	33%	44%

We continued the analysis with two multinomial logistic regression models, where we examine how different variables are associated with innovation performance, when the connections of other variables are controlled. Table 2 presents the results of the multinomial logistic regression analysis that differentiate companies in terms of innovation performance. The table shows odds ratios and their 95% confidence intervals. Odds ratio greater than one indicates that odds for the event is increasing, and less than one that odds is decreasing. The connection of variables to innovation performance is statistically significant, if the confidence interval does not include one.

Table 2: Variables associated with innovation performance based on multinomial logistic regression analysis, with the odds ratios and their 95% confidence intervals.

		Product or service innovation new only to the company	Product or service innovation new to the market
Size of company	ref.=Small	1	1
	Medium-sized	0.86 (0.57-1.27)	1.21 (0.81-1.82)
	Large	0.81 (0.46-1.39)	1.13 (0.65-1.99)
Industry	ref.=Software and ICT services	1	1
	Manufacturing	0.58 (0.31-1.09)	0.69 (0.36-1.32)
	Construction	0.24 (0.10-0.59)**	0.24 (0.10-0.61)**
	Trade, accommodation and catering	0.88 (0.41-1.89)	0.51 (0.22-1.16)
	Business services	0.37 (0.16-0.86)*	0.37 (0.16-0.89)*
	Education, health care and welfare	0.42 (0.15-1.21)	0.49 (0.16-1.52)
	Transport and communication	0.33 (0.15-0.73)**	0.33 (0.14-0.76)**
	Finance, insurance and real estate	0.24 (0.11-0.56)**	0.28 (0.12-0.65)**
	Staff structure	ref.=Non-professional-dominated	1
	Professional-dominated	1.65 (1.14-2.40)**	1.88 (1.28-2.76)**
Export share	ref.=Export	1	1
	Domestic market	0.81 (0.53-1.24)	0.59 (0.38-0.92)*
	Missing information	0.97 (0.60-1.58)	1.15 (0.72-1.85)
Digital sophistication	ref.=No data analytics	1	1
	Data analytics for few purposes	1.13 (0.74-1.72)	1.15 (0.74-1.79)
	Data analytics extensively	1.71 (1.10-2.66)*	2.40 (1.53-3.78)**
Employee participation	ref.=None	1	1
	Less than 30% of personnel	1.82 (1.17-2.84)**	1.37 (0.85-2.20)
	30% or more of personnel	2.43 (1.51-3.91)**	2.56 (1.57-4.18)**
Customer involvement	Ref.=Hardly/not at all	1	1
	Sometimes	1.47 (0.99-2.18)	1.59 (0.92-2.74)
	Regularly	1.55 (0.92-2.60)	1.70 (1.11-2.60)*
Networking		1.17 (1.07-1.28)**	1.13 (1.03-1.25)*

Goodness of fit: deviance=1678.40, p=0.384, Pearson=1687.26, p=0.384. Pseudo R²: McFadden=0.115, Nagelkerke = 0.249, Cox and Snell=0.221. *** p<0.001, ** p<0.01, * p<0.05.

Companies that use data analytics extensively have produced both types of innovation more often than companies that do not use data analytics at all. The odds ratio is higher for innovations new to the market. On the other hand, companies that use data analytics more narrowly do not statistically differ from non-users in either type of innovation.

The regular participation of personnel in development also has a positive association with the company's innovation performance. Here, again, the odds ratios are highest for those companies in which staff participation is most extensive. In fact, broad staff participation shows the highest odds ratios of all variables included in the models for both types of innovation.

The versatility of company networks also has a statistically significant connection to both types of innovation. As the network diversifies, the company's opportunities to produce new innovations increase.

Customer involvement also is positively associated with innovation performance. However, the association is statistically significant only for innovations new to the market and in cases where customer involvement is regular.

Furthermore, most of the previously noted disparities in background variables persist even after controlling for other variables. The only exception is that small and large businesses no longer differ in terms of innovation performance.

The last part of the statistical analysis focuses on the combined effect of the four variables that were selected for the actual target of our study.

As Table 2 shows, extensive use of data analytics, regular and broad employee participation in development, regular customer involvement and versatile networking are all positively associated with the company's innovation performance in one way or another. Next, we analyse how different combinations of these four factors affect the odds ratios for the two types of innovation separately. In order not to have too many combinations, we dichotomised each variable. The cut-off points were between companies that use data analytics extensively (for all five purposes) vs. others, companies where 30% or more of personnel participate regularly vs. others, companies where customers involve regularly vs. others, and companies that are networked with at least five of the eight partners vs. others. Based on the dichotomisation, 40% of companies remained below the cut-off point for all four variables. 32% were above the cut-off point for one variable, 20% for two variables and 8% for three or four variables. The four categories that were formed were mutually exclusive.

The positive combined effect between these four variables comes out clearly in the two multinomial logistic regression models, where the reference point was companies that did not exceed the cut-off point for any variable (Table 3). The odds ratios increase consistently depending on how many variables the company exceeds the cut-off point. The odds ratios are higher across the board for innovations new to the market than for innovations new only for the company itself.

Table 3. The odds ratios and confidential intervals of the combined effects of extensive use of data analytics, employee participation, networking and customer involvement on innovation performance: multinomial logistic regression models (company size, industry, staff structure and export share adjusted).

	Product or service innovation new only to the company	Product or service innovation new to the market
ref.=None	1	1
Extensive use of one factor	1.47 (0.98-2.20)	2.18 (1.40-3.40)**
Extensive use of two factors	2.54 (1.59-4.06)***	3.65 (2.21-6.03)***
Extensive use of three or four factors	5.55 (2.91-10.59)***	8.23 (4.25-15.95)***

Goodness of fit: deviance=672.24, $p=0.002$, Pearson=609.58, $p=0.122$. Pseudo R^2 : McFadden=0.098, Nagelkerke = 0.216, Cox and Snell=0.192. *** $p<0.001$, ** $p<0.01$, * $p<0.05$.

Discussion and conclusions

In this paper, we were interested in the connection between the company's digital sophistication and its activity in producing product and service innovations. It has often been said that "data is the new oil" in the digital economy. For this reason, we measured the company's digital sophistication by how extensively it utilises data analytics in its operations. The results showed that extensive use of data analytics is positively related to innovation performance when the effect of all other factors in the multinomial logistic regression analysis was taken into account. Our original assumption was therefore clearly supported.

OECD researchers have found that differences in the productivity of companies in industrial countries have grown in recent years. They suggest that divergence in measured multi-factor productivity may reflect technological divergence between companies (Andrews et al., 2016). In the MEADOW survey, in addition to the current use of data analytics, we also asked the management companies' intentions to expand the use of data analytics in the future. There was a clear positive correlation between current use and the intent to increase the use of data analytics, indicating that the digital divide between companies in Finland is still widening rather than narrowing (Alasoini et al., 2023). The widening digital divide threatens to further exacerbate difference in innovation performance and, in this way, opportunities for productivity growth between companies. Growing differences in productivity can still have negative labour and social consequences in the form of, among other things, growing wage differences and other increasing inequalities in working conditions and terms of employment.

Another key area of interest in our paper was the significance of employee participation for the company's innovation performance. The extent of employee participation in development activities had an independent positive connection after all other factors were controlled, both to innovations new to the market and to innovations new only for the company itself. Our original assumption was that employees' participation would have played a more important

role in innovations new only for the company itself. However, contrary to our expectations, the odds ratio was higher in the case of innovations new to the market. Our cut-off point for “broad” employee participation was relatively low (30% or more of staff participate regularly). We also did the analysis using 50% as a cut-off point for “broad” employee participation without this having significant effects on the results.

Our original assumption was based on the view of the similar role of the local knowledge of the company’s customers, users of their products and services, and personnel, especially in DUI-type of innovations. However, Kesting and Ulhøi (2010) claim that innovations that can be considered employee-driven are often more radical than user-driven innovations. The authors’ argument is not based on empirical research, but on their theoretical framework and a number of anecdotal examples. In any case, our results can be considered in line with the authors’ claim. In the multinomial regression model, the odds ratio of broad and regular employee participation in innovations new to the market was clearly higher than that of regular customer involvement, suggesting a more prominent role for employee participation compared to customer involvement in radical (new-to-the-market) product and service innovations.

It is possible to give different theoretical interpretations to the observation of the positive connection of broad and regular employee participation to innovation performance (cf. Wood, 2009, pp.66–67). One possible interpretation is that participation in itself helps companies produce more product and service innovations. Another, more cautious interpretation is that broad and regular participation of personnel does not necessarily have direct and demonstrable effects on innovation performance as such, but broad and regular participation rather reflects an inclusive and high-trust company management style, which can have positive effects on innovation performance through *many* different mechanisms, such as increased personnel initiative, information sharing and dialogue between management and personnel. Our data do not allow us to give a definite answer to this issue, but intuitively we consider the latter explanation to be more realistic.

In addition to the fact that broad and regular employee participation in development can be considered an indicator of high trust between management and personnel, high trust in itself can also have a positive connection with the company’s innovation performance. This view is supported by the MEADOW employee survey, in which employees were asked about their view on the outcomes of their participation in development activities. The results showed that in high-trust companies, employees not only participated more actively in development, but also saw the benefits of participation clearly more positively than others, regarding both improvements in products, services and operations as well as employee work well-being (Alasoini et al., 2023). Without trust, employees’ participation in development may have rather negative than positive consequences for the organisation. Participation without trust and perceived opportunities to influence can increase employees’ workload, frustration and cynicism, as well as tensions and conflicts within the organisation, leading to a weakening of cooperation and even a decrease in productivity. The phenomenon is already familiar from previous industrial relations literature (e.g., Fox, 1974).

Finally, in our paper we were also interested in how and to what extent the level of employee participation in development strengthens the effect of the level of digital sophistication on innovation performance. As, according to innovation research, also companies' cooperation networks and customer involvement can play a role in both STI- and DUI-type of innovations, we included both in the analyses in which we examined how different combinations of these factors affect companies' innovation performance. A clear positive combined effect for both innovations new to the market and new only for the company was detected. The results suggest that, even in the digital age, it is difficult for companies to build innovation superiority based on their technological capability alone – or any other single factor. The ability to produce innovations is the sum of many intertwining factors. Our results show that broad employee participation in development is an essential and perhaps even inevitable part of the portrait of an innovative company. Future research with longitudinal study design is needed to make more confident conclusions about causality.

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The approach to and challenges in measuring innovation in China

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Abstract

In China and elsewhere, innovation features strongly in government policy as a key driver of economic development. Being able to measure innovation performance is therefore important. This article analyses China's approach to measuring the country's innovation performance. In doing so and using documentary analysis, it evaluates the conceptualisation and data collection that underpin and support that measurement. The findings show that China focuses on a science and technology approach to measuring innovation. The weaknesses of this approach are identified: first, the conceptual scope is too narrow due to its exclusion of non-technological innovation; second, relatedly, data gathering is limited quantitatively and qualitatively in its coverage of types of innovation; and, third, the sample population is biased, acting to excluding a significant number of firms and employees. These weaknesses undermine understanding of innovation performance in China. With this analysis, this article provides the first evaluation of China's innovation conceptualisation and measurement and, based on the findings, provides suggestions to address these weaknesses and improve the measurement of innovation performance and which have applicability beyond China. For China and other countries such as those which are members of the OECD and EU, the evidence provided in this article suggests that there is a pressing need to adopt a broader policy approach and support it through the development of appropriate measures and data collection.

Keywords: China; innovation conceptualisation; innovation data; innovation measurement; innovation policy; non-technological innovation; technological innovation

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Introduction

Governments worldwide are being urged to develop their countries' innovation performance as a route to attaining economic growth and competitiveness (EC, 2010; OECD, 2010). China too has adopted this strategy as it looks to shift from a cost-competitive economy to one in which innovation is central to its economic development (State Council, 2011). Over the last twenty years China has introduced a series of policies to drive this shift. Both the Chinese government and firms attach high importance to innovation and are pursuing growth and competitiveness through it (Ding & Li, 2015; Yang, 2020). Given that improving innovation requires its measurement, China has also introduced a number of innovation measures. Significantly, not only has China adopted similar innovation policy positions as the OECD and EU countries, it has also adopted the same measures. This article examines and evaluates those measures and their supportive data.

The article draws on a documentary analysis of Chinese governmental policy documents. This documentary analysis of innovation policy and data collection in China reveals three weaknesses with its approach to innovation measurement: the scope of measurement is too narrow; the questions in the measurement are too blunt; and the range of organisations covered is too limited. The outcome is that current data collection fails to capture the full extent of innovation in China and hampers not only assessment of innovation performance but also policy actions that might improve innovation performance. Some of these weaknesses are specific to China, others however resonate with critiques made about current evaluation of innovation performance in the EU (e.g. Makó et al., 2016). As this article points out, the China-specific weaknesses can be remedied. However, given that China is not alone in its approach to measuring innovation, our findings confirm the need for a rethink from policymakers more widely. In the EU, for instance, the importance of workplace innovation has been highlighted as it not only plays a significant role in connecting different policy agendas such as economy, innovation, social dialogue and social rights, but also helps achieve best possible human potential along with technological innovation. Furthermore, it has been strongly argued that policymakers should not only enhance the awareness of workplace innovation but also expand the related measures in wider fields such as industry, employment and policy research. (Totterdill et al., 2022).

The next part of this article outlines the conceptual approach to innovation as expressed in and underpinning Chinese government policy. The following section then outlines the resulting measurement of innovation in China, including its supportive data collection. The subsequent section then considers how the weaknesses in China's innovation measurement might be addressed and improved. The article makes three contributions to understanding. First, it is a first evaluation of the innovation measurement in China that links conceptualisation and data collection. Secondly it makes suggestions about how data collection in China might be improved. Third, in its conclusion, it relates this evaluation and suggestions to approaches to measuring innovation beyond China.

China's approach to innovation from a policy perspective

According to the IMF (2022), China is now the world's second largest economy. Its economic development has been rapid and marked by clear policy stages, within which innovation has become a key part. China's policy support for innovation has also evolved as the country has passed through three stages of economic development: the state-led formative period (1949-1977), the market-oriented transition period (1978-2005), and the indigenous innovation-oriented development period from 2006 onwards (Ding & Li, 2015). In this latest stage, China has sought to develop a supportive institutional environment for innovation (Fu, 2015).

The first indication of the shift away from the cost-based economic growth and competitiveness that marked the second stage of development to innovation occurred in 2001. *The Tenth Five-Year Plan Outline* proposed building a national innovation system and innovation-delivering projects. The emphasis was explicitly science and technology focused. The Plan promoted technological upgrading generally and enterprises as the site of technological innovation implementation as the basis for sustainable economic development. It also urged the fostering of collaborations between industry, universities and research institutions. Since the launch of this Plan, scientific and technological innovation has been further promoted nationally, with China committed to building technological capacity to deliver indigenous innovation to support its economic transformation.

This support for indigenous innovation development is evident in two subsequent policy documents: *The Decision on Implementing the Outline of the Scientific and Technological Plan and Enhancing the Independent Innovation Capacity* and *The National Guideline for Medium and Long-term Plan for Science and Technology Development (2006-2020)*, both published in 2006. These documents regard science and technology as strategically fundamental to improving indigenous innovation and the core of China's competitiveness. The documents list "original innovation", "integrated innovation" and "re-innovation" as the three fundamental forms of indigenous innovation. Original innovation refers to basic research breakthroughs in leading-edge and core technologies. Integrated innovation means the creation of new products by utilising and integrating existing technologies. Re-innovation is defined as major innovation breakthroughs based on imported technology. These policies target science and technology intensive industries such as information, biology, new materials, aerospace, energy and oceanography. The documents further specify that the Chinese government would increase its financial investment in science and technology, with the ratio of it to GDP increasing annually: 2% by 2010 and over 2.5% by 2020. According to the Chinese National Bureau of Statistics, this ratio was 2.4% in 2020 then rose to 2.55% in 2022.

To guide and accelerate China's innovation, *The Twelfth Five-Year National Indigenous Innovation Capacity Building Plan* was issued in 2013. It is so far the most comprehensive innovation policy to date in China and outlines five key objectives. First, to enhance construction of critical national infrastructure in, for example, energy, life, environmental and materials sciences as well as space sciences and engineering. Second, to promote technological innovation capacity in key industries including agriculture, manufacturing, strategic emerging

industries, and energy and transportation. Third, to increase technological innovation capacity amongst business enterprises and research institutions, and build a number of world-class research institutions. Fourth, to establish a regional innovation system covering the country's eastern, central and western regions and to exploit each region's potential based on their distinctive resource advantages. Fifth, to improve the environment for innovation, including support for talent teams and protection of intellectual property rights and patents.

The Thirteenth Five-Year National Plan (2016-2020) and the recently released *Fourteenth Five-Year Plan (2021-2025)* show continued emphasis on improving the national innovation system through strengthened basic research, cross-disciplinary collaboration, enterprise innovation capability, and cooperation between academia and industry. *The Fourteenth Five-Year Plan* made it clear that science and technology independence is the core driver for indigenous innovation development and re-emphasised the importance of enhancing the technological innovation capability of enterprises as the route to a sustainable economy. It announced that China would establish a series of national innovation laboratories in strategic areas such as quantum information, artificial intelligence, biomedicine, modern energy systems.

To ensure effective implementation of its innovation policies, the Chinese government strengthened its guidance, improved laws and regulations, refashioned industrial and fiscal policies, increased government investment, and introduced a new supervision and evaluation system (State Council, 2013). For example, innovative enterprises enjoy favourable tax policies and privileges, and research institutions can retain all income to reward researchers and fund future research projects. In 2015, the Central Committee of the Communist Party and the State Council co-published a document called *Opinions of the CPC Central Committee on Deepening the Reform of the Institutional Mechanisms to Accelerate the Implementation of Innovation-Driven Development Strategy*. It stated that by 2020 an institutional and legal framework conducive to innovation-driven development would be established, allowing free movement of talent, capital, technology and knowledge across the country. This policy is intended to increase the efficiency of resource allocation and encourage coordinated innovation across regions (Gov.cn, 2015).

China has thus attached new, strategic importance to innovation as a driving force for its economic development and has moved through a series of policies intended to improve the innovation performance of the country. Its approach to building an innovation-led country is reflected in both national policy and infrastructure development. At the core of both lie the promotion of science and technology as the driver of innovation (Schot & Steinmueller, 2018). This conceptualisation of innovation as driven by science and technology in turn has shaped data collection to measure innovation performance in China.

Measuring innovation in China

China conducted its first nationwide innovation survey in 2007. It was based on the EU's *Oslo Manual*-influenced (OECD, 2005) Community Innovation Survey (CIS), though it included some China-specific questions about the behavior of enterprises in the Chinese economic and policy context. The Oslo Manual outlines two types of innovation: technological and non-technological. These two types are each broken down into two further types – within technological there are product and process innovations, and within non-technological there are organisational and marketing innovations. The Chinese survey, however, focused only on technological innovation and three industries. The brief focus on non-technological innovation that features in the CIS in the EU (see Makó et al., 2016) was ignored. Data collection was subsequently revised to extend the scope of the survey and to establish the architecture for regular innovation surveys (Statistics Sweden, 2008; Schaaper, 2009).

From 2013, the *National Innovation Investigation, Monitoring and Assessment System* was adopted that measures innovation at three levels – national, regional and enterprise – as well as innovation-intensive industries and localities (Ministry of Science and Technology, 2013). The purpose of this system is to establish the innovation capability of China compared to other countries at the national level while also assessing regional differences in innovation capability within China at the regional level. The enterprise data collection focuses on firms' innovation activities. The focus on innovation-intensive areas ranges from typically innovative industries to high-tech zones and innovation cities.

The measurement of innovation has three features: first, statistical investigation of innovation activities; second, innovation capability monitoring; and, third, innovation capability assessment (Ministry of Science and Technology, 2017). The statistical investigation collects data of innovation activities at the three levels – national, regional and enterprise. The monitoring phase then focuses on the input and output of innovation as well as overall innovation capability at national, regional, enterprise levels and innovation-intensive industries and localities. Finally, the assessment analyses and compares innovation capabilities at the respective levels. Measurement at the different levels involves different assessment frameworks and uses different data sources. Details of the data sources are presented in Appendix A.

Following the *Oslo Manual* guidelines, China adopts a range of innovation indicators for the different levels of measurement. The Chinese National Innovation Capability assessment comprises 33 indicators across five main categories: innovation resources, knowledge creation, enterprise innovation, innovation performance and innovation environment (see Appendix B). The Regional Innovation Capability assessment has 53 indicators ranging from innovation environment, innovation resources, enterprise innovation, innovation outputs to innovation effects (see Appendix C). The Enterprise Innovation Capability assessment includes 24 indicators divided into four areas: innovation inputs, collaborative innovation, intellectual property rights and innovation incentives (see Appendix D). The three-level assessment has different foci: while all three cover enterprise innovation, the regional and national-level assessments also measure wider social and macroeconomic items as well as the policy

instruments relating to innovation, thus enabling an evaluation of innovation performance and effectiveness in wider context.

Despite these differences, as the appendices show, the indicators used in the three levels of assessment only relate to technological innovation, focusing on indicators such as R&D, human resources and expenditures, patents applications, scientific papers and publications, and science and technology activities and collaborations with various aspects of R&D, technology and patents commonly measured. They are what Taques et al. (2021) call input and output indicators. Indicators of non-technological innovation, either marketing or organisational, are not included in national and regional data collection.

In terms of the data sources, the national measurement draws mainly on data from the National Bureau of Statistics which covers economic, scientific, technological and societal aspects. Other data includes scientific papers and patents to enable international comparisons. Data sources for regional measurement are more concentrated, mainly from the *China Science and Technology Statistical Yearbook* and *China Statistical Yearbook*. By contrast, enterprise level measurement draws on both existing secondary data and an enterprise level survey. The existing data comes from the *Statistics Yearbook on Science and Technology Activities of Industrial Enterprises* and *China Industry Statistical Yearbook*, while the new data is generated through the *China Enterprise Innovation Survey* (CEIS).

The CEIS was first conducted in 2014 and since 2016 has been conducted annually. It comprises two parts with two separate questionnaires. The first part collects basic background information on the enterprise (e.g. employee numbers, financial turnover, sector), innovation activities and the four types of innovation: product, process, marketing and organisational. The second part focuses on the employer, collecting information on their background (e.g. gender, age, education), impact of innovation on their enterprises and factors for successful innovation (Chinese Academy of Science and Technology for Development & School of Economics in Central University of Finance and Economics, 2016). While other levels' data collection focuses exclusively on technological innovation, a distinctive feature of the CEIS is that it covers both technological innovation and non-technological innovation. Nonetheless, technological innovation remains the main focus of the CEIS, asking detailed questions on product and process innovation such as innovation activities and expenditures, sources of information for product and process innovation, the mode and the importance of partnership in innovation cooperation, factors hampering product and process innovation, and intellectual property rights protection. By contrast, questions on non-technological innovation are very limited in number and nature. A single 'yes/no' question asks only if enterprises have marketing or organisational innovation. As a result, the survey captures only the percentage of enterprises reporting having such innovation (either marketing or organisational, or both) and their distribution by industry and region.

China's approach to measuring innovation thus involves data collection at three levels but which almost exclusively focuses on technological innovation. The exception is the CEIS at the

enterprise level which includes both technological and non-technological innovations, though data collection and measurement of the latter is very limited.

Weakness in the measurement of innovation in China and how it might be improved

The conceptualisation and measurement of innovation in China has resulted in three weaknesses in data collection. This section outlines those weaknesses and offers suggestions as to how they might be addressed.

The first weakness is that the scope of measurement is too narrow. Reliance on input and output indicators alone as measures of innovation has been criticised as too narrow by Taques et al. (2021). We argue that this narrowness stems from the conceptualisation of innovation in Chinese policy. Jensen et al. (2007) distinguish between two modes: Science, Technology & Innovation (STI) and 'Doing, Using and Interacting' (DUI). China's measurement rests on the first mode, which is based on 'know what', regarding the driver of innovation as 'the production and use of codified scientific and technical knowledge' (p.680). It assumes that innovation is linear, passing through various stages of scientific discovery, development, production and marketing (Fagerberg, 2005). The result is an emphasis on measuring technological innovation – the product and process innovations outlined in the Oslo Manual (OECD, 2005). Although limited data is collected through the CEIS on non-technological innovation at enterprise level, the dominant focus at all three levels of assessment reflects the STI mode.

The problem for China is that this emphasis on technological innovation is neither efficacious – it fails to capture the range of innovation in China – nor delivering the expected benefits for China. With respect to the first issue, and reflecting its focus on input and output variables, measurement of product innovation as a type of technological innovation uses, for example, patents as an indicator of innovation performance. While patents and R&D data tend to be useful in reflecting innovations in manufacturing industries, these technological innovation indicators lack the capacity to capture innovations in the service industries which emphasise marketing or organisational investments over formal R&D investments (Taques et al., 2021). This problem is particularly poignant for China as it is transitioning from a manufacturing-heavy economy to a service-led economy. The aspiration is to build an economy in which the tertiary sector contributes most to economic output (as measured by GDP) and most employment compared to the primary (e.g. agriculture) and secondary (e.g. construction and manufacturing) sectors (National Bureau of Statistics, 2021). With respect to the second issue, Chinese firms struggle to lever growth and competitiveness through new product innovation. In 2021, the total number of invention patents applications in China rose to 1.6 million and utility model patent applications increased to 2.9 million, of which 55 per cent were approved and awarded (China National Intellectual Property Administration, 2022). However, the rate of patent conversion to commercial use in China is less than 10 per cent (China National Intellectual Property Administration, 2019; State Council, 2019a). In the US it is around 40-50 per cent (National Science Board, 2018). These figures would suggest a low return on

investment in technological innovation in China. Such figures reveal that the STI mode alone has created low returns on innovation investment.

It is not that China does not recognise non-technological innovation. As we note, the Oslo Manual covers two types of innovation – technological and non-technological – and China draws on this Manual in its measurement of innovation. The problem is that China places overwhelming emphasis on only one type – technological. Accepting both types means accepting the broader conceptualisation of innovation that includes the DUI mode. This mode of innovation relies on informal processes of learning and experience-based know-how and know-who which is often highly localised (Jensen et al., 2007). In this mode innovation is fostered by building structures and relationships which promote learning. Innovation performance can then be enhanced by organisational practices such as project teams, problem-solving groups and job and task rotation (Lundvall & Nielsen, 1999; Michie & Sheehan, 1999; Laursen & Foss, 2003; Lorenz et al., 2004; Lorenz & Valeyre, 2006). Crucially, as Jensen et al. point out based on their Danish research, innovation performance is improved by strategies that combine the STI and DUI modes. Controlling for sector, firm size and ownership, firms combining the STI and DUI modes are more innovative than firms biased toward one mode. Recent research not focused on China shows that a full return on investment is unlikely to be achieved by organisations unless they considered both technological innovation and workplace innovation, a mechanism that can embrace and maximise technological innovations through synergies with human potential (Totterdill et al., 2022). New empirical research indicates that versions, at least, of DUI exist and do make a difference to innovation performance at enterprise level in China (Yang, 2020; see also Wang et al., 2019). Moreover, Yang (2020) also notes, deteriorating working conditions in China have triggered a growing need for improvements in job quality, and practices associated with good job quality often overlap with DUI practices. Consequently, China would benefit from better recognition and inclusion of both STI and DUI modes and the innovation potential in their dual use, not only because doing so would provide a more comprehensive understanding of the range of innovation in China but also highlight the points where intervention policies can be implemented to improve innovation performance and capability, as well as employees' wellbeing – if that wellbeing is a function of job quality (see Muñoz de Bustillo et al., 2011). As such, it would help policy development and a more efficient allocation of state resources.

Broadening conceptual understanding of innovation would have implications for data collection. The second weakness is that, even when included in the CEIS, the questions used to collect data on non-technological innovation are currently limited quantitatively and qualitatively, disabling detailed understanding of this type of innovation. As a consequence, the CEIS generates limited understanding of non-technological innovation. The sole question about each form of non-technological innovation simply reveals the number and proportion of enterprises that report having marketing or organisational innovations in China. Even basic, but what would still be useful, information on what kind of marketing innovation or organisational innovation is present in these enterprises is absent. Consequently, China needs to expand the scope of its data capture of non-technological innovation.

Taken together the two limitations create a significant understanding deficit about the types, nature and extent of innovation in China. More and better questions related to the DUI mode and marketing and organisational innovations are needed, particularly at enterprise level. In developing these new questions, it would be important to draw on existing theoretical and empirical research. In the case of DUI and organisational innovation, there is much research, past and more recent, about leveraging innovation in workplaces (e.g. Burns & Stalker, 1961; Lorenz et al., 2004; Exton & Totterdill, 2019; Putnik et al., 2019). In addition, there are useful literature reviews focused on this type of innovation (e.g. Armbruster et al., 2008; Kesselring et al., 2014; Kibowski et al., 2019; Alasoini, 2022). Some of this literature advocates the concept of 'workplace innovation' to provide better detail to what is argued to be the poor operationalisation of organisational innovation (Coriat, 2000). This concept rests, as Kesselring et al. (2014) state, with human resource management and organisational development functions within workplaces (see also Pot et al. 2016) and is not unlike the DUI mode of innovation outlined by Jensen et al. (2007). Referencing it would help develop new measures of organisational innovation within Chinese enterprises or, better perhaps, replace organisational innovation with workplace innovation. Likewise, in the case of marketing innovation, there is research showing innovations achieved through different marketing methods such as market research, orientation and segmentation, and more recently, consumer behaviors and digital marketing (e.g. Doyle & Bridgewater, 2012; Gong et al., 2021; Saura, 2021). Again reference to this literature would help develop indicators of this type of innovation and generate more and better data on it within Chinese enterprises. Theoretical and empirical resources thus already exist from which China might draw to help improve its measurement of non-technological innovation.

The third weakness is the biased sample population. The innovation data released by the Chinese government (see Appendix A), including the *Chinese Statistical Yearbooks* and the CEIS, focuses only on those enterprises 'above a certain scale' (Statistics Division of Social Science and Cultural Industry of the National Bureau of Statistics, 2016, p.449). This scale typically refers to a particular level of revenue or employee headcount. For revenue, the level can vary by sector – more than 20m yuan per annum for enterprises in the industrial and wholesale sectors, more than 10m yuan for service sector enterprises (or more than 50 employees) and more than 5m yuan for retail sector enterprises – but which, in each case, classifies these enterprises as medium-sized for that sector. Thus, given this threshold, only medium to large sized enterprises are included in the data collection in China. This sample presents a representativeness problem because small enterprises dominate the Chinese economy both in terms of the number of enterprises and employees. In some regions, the number of small enterprises is double that of large and medium-sized enterprises (National Bureau of Statistics, 2021). Data from the National Bureau of Statistics show that China's micro, small and medium-sized enterprises (MSMEs) contribute more than 50 per cent of the country's tax revenue, more than 60 per cent of GDP, more than 80 per cent of urban employment and more than 90 per cent of new jobs. Amongst MSMEs, the contribution of small and micro enterprises is particularly salient. Small and micro enterprises account for more than 97 per cent of all

enterprises and provide 54 per cent of all jobs (Fudan-Ping An Research Institute for Macroeconomy, 2020). It could be argued therefore that, on a general level, these smaller enterprises are the main driver of national economic development in China. Nonetheless, they are ignored in the measurement of innovation.

It is recognised that smaller firms generally, are less likely to innovate (Taques et al. 2021), a situation that also holds for China. In China, most small enterprises are in industries with a relatively low level of technology, have smaller scale investment, less clear market prospect and less fast cycles of return on investment. As such they lack the incentives and capacities to innovate (Xie et al., 2013; Newman et al., 2015; Naradda Gamage et al., 2020). As a consequence, most small enterprises rely on importing rather than innovating technology (Wonglimpiyarat, 2015; Alqahtani, 2016; Chu & Tan, 2019). For these reasons and in the absence of supportive policy, it is difficult to release the innovation potential of small firms in China.

Recently, the China State Council (2019b) has at least acknowledged micro and small enterprises as the new driver of economic development and employment and the important potential source of innovation. It would make sense therefore to include these firms in innovation measurement. In doing so, China would be able to capture their current innovation performance and identify how it might improve that performance. In not doing so, China is likely to be left with a long tail of under-performing enterprises and employees which might then constrain further economic growth and competitiveness. Data collection therefore needs to be more comprehensive in China and include smaller enterprises to reveal their contribution to and potential for innovation.

Although from 2016 the CEIS survey sought to include small enterprises, limitations still exist in terms of industry coverage and questions compared to medium and large enterprises. Small enterprises in the construction, wholesale and retail industries are omitted from the survey population. Moreover, the questions for small enterprises are shortened, again only covering product and process innovations. However, and echoing the findings of Jensen et al. (2007), recent research by Zhang (2022) indicates that the performance of small and medium-sized enterprises (SMEs) in China improves when organisational innovation is introduced simultaneously alongside the above-mentioned technological innovations, thus suggesting the importance of using and combining different types of innovation within SMEs. The exclusion of non-technological innovation questions for small enterprises in the current CEIS generates a knowledge gap in fully capturing and understanding the innovation capability of small enterprises in China. Further improvements are therefore needed in the collection of innovation data from these small enterprises.

These three weaknesses matter: they created a skewed dataset that disables comprehensive evaluation of China's innovation performance, capability and potential. Not recognising these weaknesses also hampers China's policy aim to improve innovation and thereby improve the country's economic growth and competitiveness.

Concluding remarks

As with many other countries worldwide, China's economic development and competitiveness has shifted to emphasise innovation. A range of policies now support the improvement of innovation capacity in China. This article has outlined how that innovation is measured, examining that measurement's underpinning conceptualisation and supportive data collection. The document analysis identified three resulting weaknesses in China's approach to innovation measurement. These weaknesses mean that understanding of China's innovation performance is limited. However, as this article has argued, the measurement of innovation in China can be improved by, firstly, widening the scope of measurement beyond the STI mode to recognise and include the DUI mode of innovation; secondly and relatedly, by extending the collection of data on technological innovation to improved data collection of non-technological innovation; and, thirdly, by better reflecting China's enterprise and employment composition and thereby capturing data on innovation in small enterprises.

We note though that the weaknesses in China's conceptualisation and measurement of innovation are not China specific, which is not surprising given that China's measures of innovation are drawn from the OECD's *Oslo Manual* (OECD, 2005). Because it too adopts the Oslo Manual, the first two limitations that we identify in China's measure of innovation also exist in EU innovation measurement. Whilst both China and the EU recognise the four types of innovation as outlined in the *Oslo Manual*, their approaches to measuring innovation both privilege the STI mode and so are dominated by a focus on technological innovation. Even where they are included, survey questions and statistical indicators of non-technological marketing innovation and organisational innovation are weak and need to be better developed and given more prominence in analysis of innovation (for an evaluation of EU innovation measurement, see Makó et al., 2016). Non-technological innovation needs to be given more attention. In order to boost innovation, it is not sufficient to target higher levels of R&D expenditure at national level, Arundel et al. (2007) argue. Instead, more attention needs to be paid, they state, to organisational (or, we suggest, workplace) innovation at the enterprise level for two reasons: one, it is easier to affect and, two, it provides greater effect. Studies show that failure to implement such innovation is associated with a lack of knowledge and relevant skills, rigid organisational structure, short-term low road company strategy and market failure (Totterdill et al., 2022). Finland, a leading innovator, has adopted a 'broad-based innovation policy', which incorporates this approach, 'expanding the target of innovation policy to give more significance to non-technological innovations and increasing the positive joint impacts of technological and non-technological innovations' (Alasoini, 2013: 1). For China and other countries such as those which are members of the OECD and EU, the evidence suggests that there is a pressing need to adopt this broader policy approach and support it through the development of appropriate measures and data collection.

The argument for China and other countries continued use of existing measures is that they enable cross-country and, in the case of China, within-country cross-regional comparisons.

Whilst international comparisons based on conceptual commensurability are undoubtedly useful, what is captured by this conceptualisation and measurement is partial at best and, at worst, generates data bias because of the innovation within any country and its firms is overlooked and unrecorded. Although devising new innovation measures based on broader conceptualisation will not be a trivial task, it is a task that is urgently needed (Taques et al. 2021). Without better measurement that incorporates the DUI mode and non-technological innovation, not only is understanding of innovation performance impaired but policy development is also likely to falter in its objective to improve innovation performance. In this regard China is emblematic of both current innovation measurement more widely and how that measurement might be improved. If the example of China has resonance elsewhere, having that more comprehensive understanding and measurement of innovation will help other countries, not just China, develop better policy and interventions within their national innovation systems that will improve the efficiency of resource allocation as well as innovation conversion rates.

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Appendices

Appendix A. China’s approach to measuring innovation

Framework		Data sources
National	Assessment framework of national innovation capability	<i>China Statistical Yearbook; China Science and Technology Statistical Yearbook; Statistical Bulletin on National Economy and Social Development; Statistics and Analysis of Chinese Science and Technology Paper; Annual Report of Patent Statistics; World Development Indicators; Main Science and Technology Indicators; IP statistics; Global Competitiveness Report; Science and Engineering Indicators; SCI Journal Database; National Science Library, Chinese Academy of Sciences; China Research Institute for Science Popularization; Torch High Technology Industry Development Center, Ministry of Science and Technology; Overseas Institutes of the Ministry of Science and Technology.</i>
Regional	Assessment framework of regional innovation capability	<i>China Science and Technology Statistical Yearbook; China Statistical Yearbook; Statistics and Analysis of Chinese Science and Technology Paper; China Torch Statistical Yearbook; China Statistics Yearbook on High Technology Industry.</i>
Enterprise	Assessment framework of enterprise innovation capability	<i>CEIS; Statistics Yearbook on Science and Technology Activities of Industrial Enterprises; China Industry Statistical Yearbook.</i>

* Authors’ summary.

Appendix B. Assessment Framework of China's National Innovation Capability

1 st level indicators	2 nd level indicators
Innovation resources	1. R&D expenditure input intensity
	2. R&D human resource input intensity
	3. Scientific human resource training level
	4. Information development level
	5. The ratio of R&D expenditure to that of the world
Knowledge creation	1. Number of citations of scientific paper funded by over one million R&D expenditure
	2. Number of scientific papers per ten thousand scientific researchers
	3. Number of internet users per one hundred people
	4. Number of patent applications per one hundred million USD economic output
	5. Number of patent authorisations per ten thousand researchers
	6. The ratio of scientific papers to that of the world
	7. The ratio of trilateral patents to that of the world
Enterprise innovation	1. The ratio of enterprise R&D expenditure and industrial value added
	2. Number of PCT patents per ten thousand enterprise researchers
	3. Autonomy rate of comprehensive technology
	4. The ratio of new product revenue to enterprise' main business revenue
	5. The ratio of high-tech industry value added to whole manufacturing
Innovation performance	1. Labour productivity
	2. Economic output per unit energy consumed
	3. Life expectancy
	4. The ratio of high-tech industrial exports to manufacturing exports
	5. The ratio of knowledge services value added to GDP
	6. The ratio of knowledge-intensive industry value added to that of the world
Innovation environment	1. Protection of IPR
	2. Governmental regulation impact on enterprise's burden
	3. Macroeconomic environment
	4. Professional research and training service
	5. Effectiveness of antitrust policy
	6. Relation between employee's income and performance
	7. Difficulty level of enterprise innovation project receiving venture capital support
	8. Development of industrial cluster
	9. Coordination level between enterprise and university
	10. Impact of government procurement on technological innovation

Source: National Innovation Capability Assessment System (2013).

Appendix C. Assessment Framework of China’s Regional Innovation Capability

1 st level indicators	2 nd level indicators
Innovation environment	1. Population with higher than college degree per ten thousand people
	2. The ratio of enterprise R&D expenditure deducted in tax to that of whole country
	3. The ratio of fixed asset investments in Information transmission, computer services and software to total fixed asset investments
	4. Number of landline and mobile phone users per one hundred people
	5. Number of internet users per ten thousand people
	6. Number of trademarks per one million people
	7. Regional per capita GDP
Innovation resources	1. The ratio of R&D expenditure to regional GDP
	2. The ratio of financial education expenditure to regional GDP
	3. The ratio of local financial expenditure on S&T to local financial expenditure
	4. The ratio of local financial expenditure on S&T to regional GDP
	5. The ratio of national innovation funds to R&D expenditure
	6. The ratio of funds of national industrialization project to R&D expenditure
	7. The ratio of enterprise financial institution loan to enterprise R&D expenditure
	8. Number of R&D personnel per ten thousand people
	9. The ratio of tax deduction in high-tech enterprise to that in whole country
	10. The ratio of newly-added fixed assets in scientific research and comprehensive technical services to newly-added fixed assets in whole society
	11. Number of national papers per ten thousand people
	12. Number of international papers per ten thousand people
Enterprise innovation	1. The ratio of enterprise R&D expenditure to R&D expenditure
	2. The ratio of enterprise R&D expenditure to main business revenue
	3. The ratio of enterprise technology acquisition and improvement expenditure to enterprise main business revenue
	4. The ratio of enterprise trust fund investment to research institution and university R&D expenditure
	5. The ratio of enterprise scientific research expenditure to enterprise R&D expenditure
	6. The ratio of R&D expenditure from enterprise to R&D expenditure of university and scientific research institution
	7. Enterprise average trading volume of technology
	8. The ratio of enterprise R&D personnel to people employed
	9. The ratio of enterprise having R&D institution to total enterprises
	10. Number of patents per ten thousand enterprise employees
Innovation outputs	1. Number of patent applications per ten thousand people
	2. Number of patent applications funded by one hundred million CNY R&D expenditure
	3. Number of patent authorisations per ten thousand people
	4. Number of patent authorisations funded by one hundred million CNY R&D expenditure

	5. Number of patents per ten thousand people
	6. Technical contract turnover per ten thousand people
	7. The ratio of authorisation of new agricultural plants to value added in agriculture
	8. Technology international revenue per one million people
	9. The ratio of value added in high-tech industry to GDP
	10. The ratio of sales revenue of new products to main business revenue
Innovation effects	1. The ratio of commodity exports to regional GDP
	2. The ratio of exports of high-tech products to commodity exports
	3. The ratio of value added in tertiary industry to regional GDP
	4. The ratio of high-tech enterprise to industrial enterprise
	5. The ratio of employees in high-tech industry to those of whole society
	6. Labour productivity
	7. Capital productivity
	8. Gross production per unit energy consumption
	9. Proportion of days with air quality above level 2
	10. The percentage of complying with the oxygen emission legislation in waste water
	11. The percentage of complying with sulfur dioxide emission legislation
	12. The decreased rate of water usage per industrial production
	13. The percentage of complying with ammonia and nitrogen emission legislation in wastewater
	14. Comprehensive treatment rate of solid waste

Source: Regional Innovation Capability Assessment System (2013).

Appendix D. Assessment Framework of China's Enterprise Innovation Capability

1 st level indicators	2 nd level indicators	3 rd level indicators
Innovation inputs	1. Innovation expenditures	(1) The ratio of innovation expenditure to main business revenue
		(2) The ratio of R&D expenditures to main business revenue
	2. Innovation human resources	(1) The ratio of R&D personnel to employed population
		(2) The ratio of doctorate graduates to employed population
	3. Research institutes	(1) The ratio of research institute's R&D expenditure to enterprise's R&D expenditure
		(2) The ratio of research institute's R&D personnel to enterprise R&D personnel
Collaborative innovation	Industry-university-Research cooperation	(1) The ratio of enterprises participating in industry-university-research cooperation to total enterprises
		(2) The ratio of R&D expenditure on university and research institutes to enterprise's external R&D expenditure
	5. Innovation resource integration	(1) The ratio of technology import expenditure to R&D expenditure
		(2) The ratio of technology digestion and absorption expenditure to technology import expenditure
	6. Innovation cooperation	(1) The ratio of enterprise with innovation cooperation to total enterprises
		(2) The ratio of collaborative patent applications to total patent applications
Intellectual property rights	7. IPR creation	(1) The ratio of enterprise patent applications to total patent applications
		(2) Number of patent applications funded by 100 thousand CNY (16 thousand USD equivalent) R&D spending
	8. IPR protection	(1) The ratio of enterprises having patent to total enterprises
		(2) Number of patents per 10 thousand employed population
	9. IPR utilisation	(1) The ratio of patents implemented to total patents
		(2) The ratio of revenues of patent licensing and transfer to sales revenues of new products
Innovation incentives	10. Innovation value realisation	(1) The ratio of marketing expenditure on new products to total marketing expenditure
		(2) The ratio of sales revenues of new production to main business revenues
	11. Market influence	(1) The ratio of PCT application to patent application
		(2) The ratio of enterprises with independent brands to total enterprises
	12. Economic and social development	(1) Labour productivity
		(2) Gross production per energy consumption

Source: Enterprise Innovation Capability Assessment System (2013).

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Leveraging a Diverse Collaboration in Tertiary Education to Develop Graduate Capability for Workplace Innovation

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Mathias Stevenson

Abstract

Recent developments in tertiary education are demonstrating teaching and learning methods to develop students' capability for employee-led Workplace Innovation. In this article, we describe an international collaboration to develop shared learning resources and activities in workplace innovation for adaptation in diverse tertiary education contexts. We are intentionally seeking out additional collaborating institutions that differ in mission, size, location and student demographics, to leverage our team's diversity and encourage innovation.

When shared learning resources and activities are to be used in diverse contexts, some core principles underlying instructional success must also be shared in order to ensure adaptations do not remove key properties. We outline four instructional principles underlying the learning design and illustrate how these principles are applied in our current learning resources.

We then describe some of the ways that these shared resources have been adapted for different tertiary education environments. We also discuss some of the benefits emerging from the collaboration, including the inclusion of new resources targeting specific work domains and the transfer of new teaching and learning ideas across contexts.

We conclude by describing some of the ways we are also collaborating with workplace partners, to ensure that our graduates have the capabilities needed to contribute to workplace innovation practice and to help advance the workplace innovation capability of their own employees.

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Developing Capability for Workplace Innovation in Tertiary Education: An Overview

Employee-led Workplace Innovation engages employees from across an organization in “a participatory process of innovation, leading to empowering workplace practices and continuing learning and reflection” [Totterdill et al 2022]. Employee-led workplace innovation expands an organization’s innovation mandate beyond traditional boundaries, e.g., where innovation may previously have been thought of as limited to Research and Development or Information Technology units. The importance of workplace innovation lies on its positive impact on employee’s quality of work life and improved performance benefiting the employer [Pot et al 2016].

While teaching and learning for Entrepreneurship capability is an established activity in tertiary education [Bischoff et al 2018], teaching and learning for capability in employee-led Workplace Innovation is a more recent development. Initiatives to develop workplace innovation capability in tertiary education reflect a growing recognition that “innovation and entrepreneurship are not only distinct concepts, but they also play out in postsecondary institutional contexts in different ways” [Swayne et al 2019, p. 738]. Tertiary institutions are beginning to recognize that all students should have opportunities to engage with innovative and entrepreneurial workplace activities [Hamouda 2018; Hero & Lindfors 2019], as a core graduate attribute for the future of work.

A Diverse Collaboration to Develop Graduate Capability for Workplace Innovation

Our use of “collaborating” follows the distinction frequently made in tertiary education between collaborative learning and cooperative learning: collaborative learning as joint work toward shared outcomes (which may involve working separately on parallel activities) and cooperative learning as working together to develop parallel outcomes in their own projects [adapted from Davidson & Major 2014]. While we have initiated co-operative work to share ideas with some of the other initiatives cited above, our collaborating institutional partners are developing and sharing a body of learning resources and activities designed to be adaptable for a diverse set of institutional contexts (with projects at individual institutions deciding when closer cooperation with other teams would be of value).

There have been other collaborative efforts in tertiary education to develop graduate capability (e.g., FUSION [Blueprint 2022]) and recent collaborations to develop capability in workplace innovation (e.g., FINCODA [Pérez-Peñalver et al 2016]). These collaborations have typically brought together institutions with similar characteristics in terms of mission, program range and student demographics, with the rationale that sharing learning resources and activities would be simpler for similar institutions.

Our collaboration is based on a different rationale, adapted from exemplary practices for innovation projects: the likelihood of breakthrough innovation is higher when the team is more diverse [Garcia Martinez et al 2017]. We have intentionally sought out collaborating institutions that differ in mission, size, location and student demographics. We have also encouraged them to plan for a diverse mix of course unit and program contexts: curricular and co-curricular, short credentials and program concentrations, etc. Finally, we have built shared learning resources and activities which can be used by a diversity of tertiary educators: if capability for workplace innovation is to become an attribute to be achieved by all graduates – in parallel with other Power Skills [Paterson 2019] such as critical thinking, teamwork, etc. – we will need to find ways for a broad range of educators to become involved.

When shared learning resources and activities are to be used in a diverse set of contexts, some common understanding of the core principles is required to ensure that adaptations do not remove the key properties for success (a requirement that we reinforce in one of those shared resources, on Innovation Adaptation, described below). In the next section, we outline the four common principles underlying the learning design of our shared resources and activities, which are intended to allow them to be adapted across tertiary education contexts (and re-purposed for a variety of work domains). We also illustrate how these principles are applied in our current learning resources.

That discussion is followed by a section in which we describe some of the ways that these shared resources have been adapted for different tertiary education environments. We also discuss some of the benefits emerging from the collaboration, including how the design for adaptability has facilitated inclusion of new resources targeting specific work domains or program needs, and the transfer of new teaching and learning ideas across contexts.

Our concluding section relates some of the ways we are also collaborating with workplace partners, to ensure that our graduates have the capabilities needed to advance workplace innovation practice and impact and to help them advance their own capability development for innovation. These vignettes from our work are examples of the multiple opportunities for tertiary education and workplace partners to share research insights, resources and exemplary practices for developing workplace innovation capability.

Shared Principles Enable Development of Adaptable Learning Resources and Activities

Three academic initiatives have played significant roles in the development of our adaptable instructional design and learning resources to date:

- Some initial ideas were pilot tested within a Faculty of Arts at a regional polytechnic university (dual sector) in Canada [Dastur et al 2019], with collaboration from the Faculty of Design. Further work in this institution was suspended during the pandemic. As a result, the rest of this discussion will focus largely on two other institutions who followed up with adaptations and extensions of the resources and activities in that original pilot.
- Building on that initial work, further development in the Faculty of Arts at a major urban research-intensive university in Australia resulted in a new course unit, *Understanding Workplace Innovation* [Nobis et al 2022], and a new work-integrated learning *Innovation Project* course. Enrolment in the first unit has grown from the 2020 pilot offering for 40 students to 360 students in 2023.
- Significant change to an existing course unit on *Creativity and Innovation* in a School of Business at a regional teaching-intensive university in Canada, including replacing half of the previous content with adaptations of the shared learning resources and activities for workplace innovation [Nobis et al 2022].

More information about Learning Outcomes and Student Reflections is available in publications from these three overlapping developments [Dastur et al 2019; Nobis et al 2022; Baregheh & Carey 2022]. The ongoing emergence of employee-led workplace innovation as a graduate capability was highlighted when our collaboration won an award in the 2022 annual Innovation and Entrepreneurship Teaching Excellence competition in Europe [WINCan 2022].

Another Canadian research university recently began collaborating with us on new offerings – launched in 2023 – within their innovative format¹ for preparing students for internship work placements; in parallel, we are in the process of adding more diverse institutions (e.g., technical colleges) and additional formats (e.g., as part of management training programs for Skilled Trades graduates²) to further expand our collaboratory. Individual instructors have also begun to adapt specific topics and tasks for their institutional contexts.

In addition to these partnerships to create and share adaptable learning resources and activities, a collaboration with a National Teaching Fellowship project in Australia on The Future

1 <https://www.artsci.utoronto.ca/faculty-staff/experiential-learning/arts-science-internship-program>

2 E.g., <https://tradesecrets.alberta.ca/become-certified/business-competencies-blue-seal/>

of the B.A. [Gannaway 2020] contributed to the rationale for interdisciplinary teaching and learning of innovation capability within the context of a Faculty of Humanities, Arts and Social Sciences [Gannaway & Carey 2019, 2022]. This also led directly to our Minimum Viable Prototype course unit and eventual full Implementation in the Faculty of Arts outlined above.

Shared Principles, Local Adaptation: four shared principles have provided a framework to encourage multiple adaptations of our resources and activities for diverse contexts:

1. A progression of innovation activities, growing in complexity, diversity and uncertainty
2. Online learning resources with example innovation cases across multiple work domains
3. Innovation activities to develop capability via project tasks, within our own 'workplace for learning' in tertiary education
4. A shared framework for the capability required in workplace innovation, including Skills, Knowledge, Mindsets (e.g., Identity, Self-Efficacy and Motivation) and Experiences.

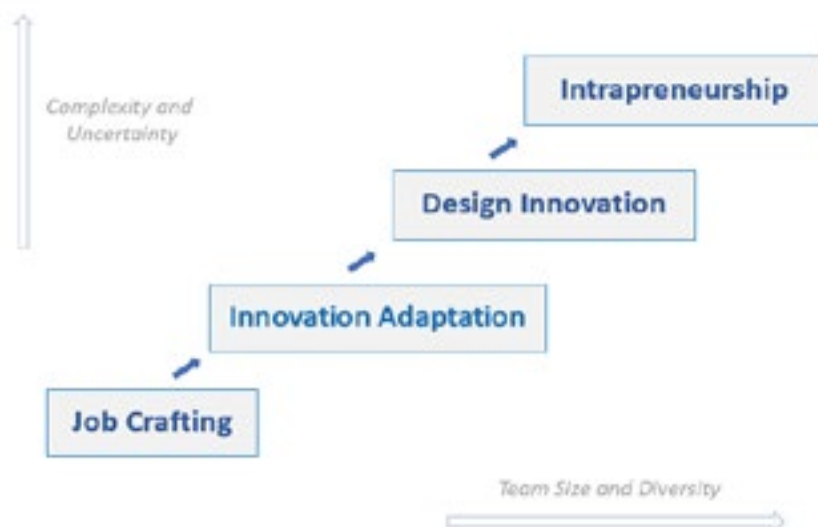
We next describe each of these shared principles in more detail. This is followed by a section which highlights the adaptations developed for different contexts and shows how those adaptations can lead to new insights applicable elsewhere.

Principle 1: Workplace Innovation Experiences as a Progression of Learning Activities

All of our collaborating institutions apply a common core instructional design, where students move progressively through a sequence of innovation experiences (see Figure 1) in two stages:

- Working through an online learning resource on a particular workplace innovation activity, including a conceptual introduction and multiple example case studies.
- Engaging in an applied project to develop, demonstrate and document their understanding, skills and mindsets for workplace innovation.

Figure 1 illustrates the sequence of innovation experiences described and illustrated in the online learning resources, which address progressively more complex innovation challenges involving larger and more diverse project teams. The selected innovation experiences in the sequence have been identified from past workplace innovation research – e.g., [Oeij & Dhondt 2017] for Job Crafting – and from our own ongoing academic-workplace collaborations (described in the concluding section of this article).

Figure 1: A Progression of Experiences in Workplace

Job Crafting [Berg et al 2008, 2013] has been extensively applied as a way for employees across sectors – Business, Public and Community/Social – to innovatively rethink their workplace activities, aiming to improve both organizational performance and their own quality of work life. Viewed as a simple instance of Workplace Innovation [e.g., Oeij & Dhondt 2017], the social process of Job Crafting typically involves only an employee and a direct manager.

Innovation Adaptation is an analytical and redesign process through which an innovative work practice from a different workplace context is assessed by workplace teams for potential applicability within their own specific workplace context. Workplace teams engaging in Innovation Adaptation – sometimes referred to as Open Innovation [Serrat 2017] – must consider Adherence to the core principles for success of the innovation as well as Adaptation to the specific needs of their new context (a balance also referred to more formally as Fidelity of Implementation [Leko 2015]). The social process involves a local work team, representing those directly affected by the proposed innovative practice, and one or more of their managers.

Design Innovation: For more complex or novel Design Innovation challenges where no known solutions suffice, our shared learning resources outline the process of Design Thinking as a ‘social technology’ [Liedtka et al 2021] for Design Innovation activities by cross-functional workplace teams to Discover, Define, Develop and Deliver innovative solutions (which can often include a reframing of the original challenge statement).

We should note here that Design Thinking is often the starting point for learners to engage with innovation activities within other tertiary institutions seeking to develop innovation capability across a broad spectrum of students [e.g., Hamouda 2018; Selznick 2019; Hero & Lindfors 2019]. Our decision to provide instead a gentler “on-ramp” to workplace innovation for our learners was driven by the following considerations:

- At our institutions, students across a broad range of program areas could choose the course units to develop innovation capability as an elective option (i.e., they were not a requirement of their program). We needed to engage students whose conceptions of innovation – and of themselves as innovators – could otherwise have been an obstacle to their full engagement. We expand on this concern in the Mindsets discussion below for Principle 4.
- The stepwise progression outlined above also fits well with workplace sectors where economic constraints require integration of the “think outside the box” strengths of Design Innovation and the “don’t reinvent the wheel” strengths of Innovation Adaptation (e.g., in the Public sector [Stanhus & Nielsen 2021] and the Voluntary and Community sectors [McMurray et al 2013; Svensson et al 2020]).
- A progressive development of innovation capability supports the strategy of workplaces seeking to engage employees in personalized selection of employee innovation activities (or “routes” [Renkema et al 2021]) suited to their own strengths and developmental trajectories. For example, our approach for using Innovation Adaptation capability as a step toward Design Innovation capability – outlined in the next section – reflects the innovation challenges shared with us by a public sector agency in Canada aiming for “Every Employee” engagement with workplace innovation [Baregheh & Carey 2021].

Intrapreneurship (sometimes referred to as internal Corporate Entrepreneurship) is “the process of developing new products, services, and enterprise opportunities within existing organizations” [adapted from Hill 2012]. The social process of Intrapreneurship includes Innovation Adaptation or Design Innovation activities, but is frequently more diverse, complex and uncertain because it can be perceived within the organization as a challenge to existing products and services:

“The journey can be fraught with dangers, including the one that blindsides most intrapreneurs: the danger that comes when your innovation moves from a proof-of-concept stage, to becoming a viable business, product or service within the larger organization. As your carefully selected, nurtured and launched plan gets going – and should you be fortunate to have success – expect politics, battles, war for talent and good old fashioned petty jealousy, to come into play. Understand the dynamics and be ready for them. Know you will need protection and freedom long enough for your innovative virus to spread.”

[Skelley 2015, p. 1, describing the adaptation of an innovative service offering into a new corporate environment].

Considering Intrapreneurship as an instance of employee-led Workplace Innovation is a relatively new perspective – but a natural one because of the similarities in the organizational conditions in which they flourish. For example, research on Intrapreneurship emphasizes the same elements of employee engagement often cited as prerequisites for employee-led

Workplace Innovation: “discretionary autonomy, a human centred management philosophy (i.e., bottom-up space for voice), a culture that stimulates learning and self-managing behaviour, and thus leadership styles that enable innovative behaviour of employees” [Oeij et al 2021, p. 89-90].

In addition to the considerations listed above for engaging students in a progression of innovation activities, our choice of these particular dimensions and activities as the focus for our shared learning resources was influenced by the feasibility of hands-on activities for learners in our tertiary education environment as outlined below for Principle 3. Other Workplace Innovation activities which could be added to this space include Team Job Crafting [Tims et al 2013], Open Innovation Networks [Bigliardi et al 2021], and Employee Idea Management systems [Mikelson et al 2022]. There are also other choices of dimensions within which to organize a progressive sequence of activities in an innovation space, e.g., the roles of Discovery-Incubation-Acceleration involved in Strategic Innovation for mature companies [O'Connor et al 2018].

Principle 2: Online Learning Resources with case stories across work domains

Our online learning resources emphasize the integration of conceptual content with real-world cases to expose learners to the many contextual issues which affect employee-led workplace innovation. Implementing Workplace Innovation successfully is highly dependent on the situation, the context and the history of any given organization. Any presentation of the concepts and principles of employee-led Workplace Innovation must include case stories of exemplary practice in order to be useful to practitioners [Vaas & Žiauberytė-Jakštienė 2017]. In addition, our case stories are intended to support learners in understanding and developing their own capability for workplace innovation.. As illustrated in the next section, we encourage adaptation to specific work domains or higher education programs in part by creation of new cases with which specific types of learners can easily relate.

Job Crafting learning resources and cases: Job Crafting is by definition a very personal activity and can involve details of a particular job role. Typical illustration cases are taken from examples where the aspects of the job can be readily understood by learners who may not have performed that role themselves but are likely to be familiar with similar situations (particularly through their own interactions with such employees in their roles as customer or client). Examples include a front-line service worker, a salesperson, and an online customer service representative. There is also a specific case study related to the work of tertiary learning: a workplace learner explaining the use of Self-Directed Learning to improve performance and work quality, which provides a convenient preface to the Project Task outlined for Job Crafting below.

The case stories are also selected to reflect the Job Crafting skills areas described in the Human Resource Management profession and cited by our workplace partners: crafting Job Tasks, Job

Relationships and Job Purpose and Meaning (often referred to in the Human Resources profession as Cognitive Crafting, from the seminal research of Wrzesniewski & Dutton [2001]).

The extensive use of case stories is intended to make it easier to adapt the shared learning resources for learners in specific work domains and contexts. We include one example in the discussion of Principle 3 below: the development of Job Crafting case stories in Accountancy for the School of Business adaptation (in part to address the common perception amongst students that innovative work is not an expectation for Accountants!).

Innovation Adaptation learning resources and cases: The concepts of Innovation Adaptation and related methods such as Fidelity of Implementation have been applied extensively in adaptations of workplace innovations in healthcare [Harrison & Grantham 2018], human services and education [Leko 2015]. Application in other domains has emerged more recently [e.g., Laureani & Antony 2021].

For the conceptual content on this topic, we adapted workplace approaches for Innovation Adaptation in the healthcare domain [e.g., Brach et al 2008] into the Four Key Questions format for Design Thinking [Liedtka et al 2018], in order to prepare learners for the project task associated with this activity and for the Design Innovation to follow (as discussed further in the next section). We also provided two generic case stories of the technical and social processes for workplace teams to adapt an innovation into their own contexts.

The first case story for Innovation Adaptation focuses on the Red Box method developed by Adobe Inc. [Morgan 2015] which has since been adapted for use in numerous other workplaces. We used one of those adaptations, the Orange Box adaptation by Mastercard Inc. [Innolead 2016] to demonstrate the practical methods which can be used to determine which core features of the innovation should be preserved and which can be modified to better suit local conditions.

As a practice exercise, learners are asked to compare the two corporate environments to assess which aspects of each context would fit best with their own working styles and strengths. Two aspects of this case provided relevance for the learners: they already were familiar with the products and services of the two companies involved, and the actual innovation was a process to support workplace innovation by employees.

Our shared learning resources also contain a second generic case of Innovation Adaptation set in a tertiary education context [e.g., Reis 2017], which highlights how an innovation adaptation can fail when the core features which led to its original success are 'adapted out'. Since the innovation involves new ways of teaching in a hybrid online and in-class setting, learners can also relate easily to the design choices involved. The case story explores how an innovative teaching method in Science teaching [Mazur 1997] was adapted by a wide range of instructors with varying degrees of fidelity to the core principles which led to its initial success [Dancy et al 2016]. One of the results from this case study was a set of guidelines for documenting the

essentials of an innovative instructional method to increase the chances of success for future adaptors in tertiary education [Khatri et al 2016].

These generic case stories can be easily replaced with other cases of particular relevance in a specific work domain or professional setting, as described in the next section.

Design Innovation learning resources and case stories:

The Arts students are provided with opportunities to adopt a designers' mindset from the outset and to apply such a mindset to all stages of their learning. For instance, design expert Tim Brown argues that "visual representation helps ... see the relationships between different topics ... (and provides) a more intuitive sense of a whole" [Brown 2009]. In an early exercise on *Illustrate your Learning*, students work in teams to design and illustrate new connections across their learning. The materials of this illustration are found in a selection of terms from across a range of introductions to the concepts of Innovation and Design Thinking itself:

- *Three Spaces of Innovation*: 'Inspiration', 'Ideation' and 'Implementation' as used in [Brown 2009];
- *Four Questions of Design Thinking*: 'What Is?', 'What if?', 'What wows?', 'What works?' as used in [Liedtka & Ogilvie 2011]; and
- *Five Modes of Design Thinking*: 'Empathise', 'Define', 'Ideate', 'Prototype' and 'Test' [d.School 2018].

Across these twelve terms supported by associated readings, student teams design a model that connects the terms conceptually and practically. The *Illustrate your Learning* task produces a range of paper and virtual designs, punctuated with arrows, graphs, SmartArt or interactive links, that identify overlaps and distinguish more nuanced differences in concepts and terms. The task provides the first of several opportunities for students to bring a designer's mindset to think innovatively about the way they receive and process knowledge.

Similarly, the Business unit highlights the importance of User Centered Design and introduces various approaches to Design Thinking as discussed above [Brown & Katz 2009; Liedtka & Ogilvie 2011; d.School 2018]. Various case stories are then presented to showcase application of Design Thinking in diverse contexts, for example a demonstration of social change through design thinking from [Brown & Wyatt 2010]. This module further focuses on empathy and storytelling to humanize design [Lee & Benza 2015]. When students reach this module, they have already started working on their innovation adaptation assignment; consequently, they are invited to view their assignment from the lens of user-centered design and reflect on users to better identify the problem in the context of the Four Questions of Design Thinking [Liedtka & Ogilvie 2011].

Intrapreneurship learning resources and case stories: Given the complexity of innovation activities in Intrapreneurship as outlined above, there is no assigned task during the course units which involves students in such complexities. However, the learning resources and case

stories can still be relevant to students within their workplace for learning. For example, in the Monash Arts unit, the first week's online learning resource lesson explores the etymology and meaning of the term before outlining how intrapreneurship operates both within the broader social innovation field – through examples and stories from the League for Intrapreneurs³ – as well as within the learners' own educational ecosystem through the example of the Monash *BorrowCup*⁴ initiative to reduce paper-cup waste on campus. (We explore this learning resource further in the next section, highlighting why it was particularly well-suited to this Monash Arts context.)

In the School of Business course unit, on the other hand, the shorter time allocated to workplace innovation required a different approach. An introduction to Intrapreneurship and its social aspects appears in the final week's module for students and they are invited to take a Directed Studies or Special Project course if interested in learning more via intrapreneurial experiences in a workplace.

Principle 3: Project tasks within our own 'workplace for learning'

Hands-on projects are pivotal in our model of developing workplace innovation capability. In order for these to be authentic examples of workplace innovations, students are encouraged to view our higher education learning environment as their 'workplace for learning' in which they can improve both organizational performance (i.e., achievement of institutional learning outcomes) and quality of work life (i.e., the experience of learning and its value to them as students). Over a series of project tasks, they are supported in developing an increasingly complex understanding of the implications and opportunities associated with workplace innovation – beginning with asking meaningful and challenging questions about themselves and their work as learners

Job Crafting: Projects for students to engage with Job Crafting in the teaching and learning environment fall under the well-established educational approach of Self-Directed Learning [Robinson & Persky 2020], in which students improve their learning outcomes (the organization's goals) and their learning experiences (i.e., quality of work). For example, in the Monash Arts Context, an online module on Self-Directed Learning as Job Crafting was developed to demonstrate the applicability and value of job crafting to the student experience.

Starting with their own motivations, ambitions and strengths, students begin to recognize the importance of empathy by building a better understanding of their own needs, requirements and pain points. This process is documented in an e-Journal, which not only serves as an e-introduction to other students but allows students an opportunity to gain a deeper understanding of themselves and their 'job' as students. Once this foundation stone is laid, students innovate from the inside out, practicing first-hand the skills of identifying challenges,

3 <https://vimeo.com/leagueofintrapreneurs>

4 <https://www.youtube.com/watch?v=j1GI6fJF9TU>

and asking what is preventing them from achieving their best results, before proposing innovative solutions.

In the adaptation for a School of Business context, students engaged in a two-part applied assignment, first establishing personal goals in their learning or professional roles followed by a plan to adopt Job Crafting to reach these goals. A subsequent report submitted later in their study term detailed their implementation of Job Crafting and its results. Fulltime students practiced Job Crafting in their student roles to develop better relationships with instructors and peers and to improve study habits (as in the Australian course unit). In parallel, the working learners in the student cohort – half of the class, most of whom were completing Business degrees online – worked with their managers to apply Job Crafting in their professional roles to create a more positive and meaningful experience for them and more value for their employers.

Innovation Adaptation: In the Innovation Adaptation project task, students assist in an institutional project addressing a specific educational challenge. For this task students work in teams to examine case-studies of similar problems in other teaching and learning workplaces and probing deeply into how the circumstances and contexts of the innovative solutions arising elsewhere are similar and dissimilar to their own. Whereas the Job Crafting task ensures students think deeply about the importance of developing an understanding of specific worker needs before proposing solutions, the Innovation Adaptation task allows student teams to take time to understand the challenge as perceived by a diverse set of stakeholders.

In the Monash Arts context, students have worked with co-curricular programs in areas such as developing student leadership abilities and fostering connections between domestic and international students. Students are guided to selected readings about successful innovations in such programs in other institutions and asked to evaluate the key factors determining ‘if it works there, will it work here’.

Holding students back from proposing innovative solutions too early in the process – asking ‘What Wows’ before asking ‘What Is’ and ‘What If’ [Liedtka et al 2018] – will be a familiar challenge to tertiary educators developing innovation capability. The Innovation Adaptation task purposely does not ask students to propose solutions, but rather to develop capabilities in identifying the potentialities and limitations around understanding a design challenge from multiple viewpoints.

In the Business context, Innovation Adaptation was implemented by evaluating an existing innovation that originated at another institution to the context of their own University. Student teams were able to exercise creativity techniques together with problem solving skills in evaluating the adaptability and fit of the subject innovation at a large urban research University to the context of their own smaller teaching University in a regional city hub.

Design Innovation: Across both contexts, students collaboratively explore the key questions approach and implement the first four stages of the design thinking process (empathize, define, ideate, and prototype) to develop and pitch a prototype for their client.

In our progression of tasks, it is not until the **Design Innovation Task** that students apply their capabilities in the practice of ideation. We explore Design Thinking more fully as a 'social technology' [Liedtka et al 2021] that supports collaborative student teams to Discover, Define, Develop and Deliver for internal university clients in response to existing, complex, and unresolved challenges. The Four Key Questions approach to frame Design Thinking [Liedtka et al 2018] – is used to emphasize the progression toward more complex innovation activities, as it was also applied in the Innovation Adaptation resources and activities outlined above.

For example, student teams in the Monash Arts course unit select from institution-level challenges relating to areas such as student leadership, intercultural collaboration and campus sustainability. In these tasks students have the opportunity to test and explore the full range of workplace innovation strategies and apply the capabilities they decide as a team are best suited to the task. A typical output for the Design Innovation task is an 8-minute What If–What Wows 'pitch presentation' to justify investment in prototypes to test What Works, supported by a 1000-word, 'What Is' document outlining the evolution of the problem framing.

In the Business School context, learners worked in teams to apply Design Thinking with an internal university client, to explore new ways to support integration of International Students within the University and civic communities. Despite the time limitations in the unit structure, the resulting client presentations effectively conveyed the potential of the Design Thinking process and outlined plans for prototypes.

Intrapreneurship: Intrapreneurship is the one workplace innovation activity in the progression for which students are exposed in case studies in the learning resources but do not engage in an assigned project task. (However, some of the Innovation Adaptation or Design Innovation projects may relate to intrapreneurial activities of others within our institutions, such as the BorrowCup initiative cited in the section below on Including case stories from local contexts).

Principle 4: Workplace Innovation Capability as Skills, Knowledge, Mindsets and Experiences

We mentioned above the framing of innovation in student work for learning as addressing both organizational goals (i.e., institutional learning outcomes, in the case of tertiary institutions' workplaces for learning) and the quality of work experience for the learners. However, we have not yet described the targeted institutional learning outcomes in terms of the workplace innovation capability we expect students to develop. A productive collaboration across tertiary education institutions can only be effective if there is some common understanding around outcomes (albeit adaptable to local contexts).

One priority for us was to prepare graduates who would be able to advance innovation in the workplaces of our regional and national employers. We wanted to avoid focusing on personal traits or behaviours [e.g., CBOC 2013; Pérez-Peñalver et al 2016] which can lead to characterization of who is innovative and who is not. Instead, we wanted our learners to appreciate what it would mean to apply the right innovation capability at the right time, as outlined in this anecdote from [Boyes & Shelley 2021]:

Have you ever heard these words before from companies: “To be truly innovative, we must encourage innovation” or “we must...be more creative”...In response we repeatedly hear from employees: “another bloody innovation project” or “here we go again”.

Think about this in a sports context: if we wanted to encourage a football team to score more goals, with this approach we would be saying “we need to encourage more goal kicking” or “kick the ball more accurately”...

What we need...instead is..[an innovation] game plan and the right people who are engaged and have the right capabilities and the right mindsets at the right time. [Boyes & Shelley 2021]

Our framework for Workplace Innovation Capability therefore includes four elements:

- situated Skills competencies needed for successful innovation task completion;
- contextual Knowledge that will enable critical reflective about innovation practice – e.g., the “right” elements we have highlighted in the quote above
- personal Mindsets that will enable graduates to proactively act and adapt in diverse workplace situations – current and future;
- the practical Experiences to enable fluent performance by graduates in innovation activities, in their workplaces and in their other roles as community members and global citizens.

(The wording here reflects our adaptation of the distinctions proposed between Job-Ready, Job-Knowledgeable and Job-Capable graduates by [Markauskaite & Patton 2019].)

As with any newly emergent area of expertise, there is only limited research on specifying and assessing capability for employee-led workplace innovation more formally, either within or outside of tertiary education. A relevant comparison point might be the assessment status of Entrepreneurship Education or Design Thinking a decade or more ago. However, there has been past work on assessment of innovative behaviours [e.g., Stange & Helker 2018] and promising recent workplace research on assessing capability in areas such as *Job Crafting* [Bruning & Champion 2022] and *Design Innovation* (both at the end of training [Jaskyte & Liedtka 2022] and when translated into practice [Royalty et al 2021; Edelman et al 2021]).

Educators may have noticed that we have reversed the usual curriculum development process, which would have begun with a specification of desired Learning Outcomes, proceeded to

define the intended Learning Activities, and then designed the needed Learning Environment and Resources to support those activities. We have instead started with the workplace Activities that graduates will be asked to undertake, determine which could be authentically experienced through activities in our teaching and learning environments (framed as workplaces for learning), and then created the necessary infrastructure of learning resources and supports to yield student success.

The progression of tasks described above remains deeply rooted in the premise of our tertiary education institutions as 'workplaces for learning'. Throughout this progression, students can adjust their workplace focus from their individualized and immediate learning environment (Job Crafting) to challenges which may touch on the institution as a whole (Design Innovation). In this process, students can develop skills and knowledge as workplace innovators and as well reframe their mindsets about innovation and about themselves as innovators, by *experiencing* innovation from both user and innovator perspectives.

Our initial assessments of student work in the course units has been based to date largely on the results of their projects, and not on measuring specific Skills or conceptual Knowledge. Our current focus is to ensure that our learners are launched on a trajectory to develop and deploy effective workplace innovation capability, and in the process to engage with workplace partners to firm up appropriate specifications, training and development, and assessment of those capabilities. For example, in the next section we describe our initial pilot test of a self-assessment for important components of an innovation Mindset, adapted from research with exemplary innovators in Canadian workplaces [Soleas 2020].

This article focuses on our shared Principles and collaborative adaptations to develop workplace innovation capability across diverse tertiary education contexts. One result of this focus is the absence of 'student voice' examples to provide the students' own views of their Learning Outcomes and the impact of these learning experiences on them. More of the student voice is available in other publications from each of the institutional developments [Dastur et al 2019; Nobis et al 2022; Baregheh & Carey 2022] and the project web pages referenced in the endnotes – including the work by the student team members who have contributed to these developments.

Collaboration to Foster Adaptations for Local Contexts and Educational Insights

As noted in the previous section, the four Principles were intended to allow a diverse mix of tertiary education institutions to create, share and adapt learning resources and activities. In this section we present some of the distinctive features of the approaches in the two tertiary institutions discussed above, with an emphasis on two aspects:

- how the different contexts led to adaptations which were “faithful” to those principles while simultaneously aligning with the needs, mission and values of their institutions and programs
- how pedagogical insights developed in parallel in those institutions and were also applicable beyond the original context in which they arose.

Addressing Local Contexts

As noted above, we are intentionally including a diverse group of institutions in our collaboration, in the expectation that local contexts will require different formats for course unit to develop capability for workplace innovation – from which we all can learn. Our first opportunity to fully observe this type of adaptation in action was the School of Business course unit described above, where the following factors had to be considered:

- the opportunity to significantly modify and update an existing course unit on Creativity and Innovation in the Workplace, which imposed constraints not encountered in the Faculty of Arts setting where new course units were created:
 - the first constraint was the expectation that the new content would fit with the existing university course unit description (the Innovation part of the content predated acknowledgement of the critical role of employee-led workplace innovation). In practice, the existing content description proved to be general enough that no obstacles to revision were encountered.
 - the second constraint was more challenging: integrating the old (Creativity) and new (Innovation) content so that the students did not experience two topics competing for their attention and assigned work time. This resulted in a complete modification of the Creativity content to include aspects of creativity in the workplace that were not included previously and have received much attention in recent years, such as the role of diversity in problem solving and idea generation.
- A significant proportion of the class was made up of working learners, taking the online course units as part of completing a B.Comm. degree. We have discussed above some of the options this context afforded in terms of student assignments, in particular the desire by the students to carry out Job Crafting in their daily work context – which we were able to easily accommodate. In the longer term, we would like to use such opportunities to leverage student activities in the course unit to advance workplace innovation with their own workforce. (A similar situation prevailed in our initial proof-of-concept pilot at a polytechnic university, where three quarters of the student body worked at least part-time off-campus.)
- The opportunity to complement the generic case stories described in the previous section with case stories related to specific work domains. Since over the half of the Business students in the course were enrolled in the Accountancy specialization – as was the case for the B. Comm. program as a whole – we had an opportunity to test our

hypothesis that a case-based instructional method would facilitate customization through domain-specific case stories.

In enhancing the use of case stories for this context, we recognized that the previous implementations in Faculties of Arts had also faced this issue less directly. In those contexts, we wanted to select a variety of case stories reflecting multiple potential career paths, in keeping with the ethos of a liberal arts program. However, we needed to provide sufficient detail about the work context for the nuances of the case stories to be clear. We now describe in more detail how these two parallel challenges around case stories have been addressed to date.

Including relevant case stories from local contexts or specific work domains:

As noted above, we included numerous case stories in our learning resources in the expectation that this would facilitate institutional adaptations integrating new case stories to address their local contexts and/or specific work domains targeted by their programs. We describe next two instances of such case story adaptations.

Integrating a local case story of student intrapreneurship at Monash Arts: Along with the generic examples of Intrapreneurship mentioned above from the League for Entrepreneurs, a variety of institution-specific examples of student-led/student-involved intrapreneurship in response to familiar social challenges are presented in the Intrapreneurship lesson using student stories. In particular, the successful BorrowCup initiative to reduce disposable coffee cup waste example provides a tangible and accessible case study that links the concept of intrapreneurship to student-led innovation for sustainability.

Placing this discussion of Intrapreneurship at the beginning of the course unit was a novel approach: that topic had previously appeared toward the end of course units in line with the progression in Figure 1. The resulting student enthusiasm confirmed a pedagogical insight from the lead instructor, that examples of social intrapreneurship in the first week of the course unit would initiate a transformative learning process for B.A. students to develop identity and motivation as innovators (in contrast to a placement).

That same local example re-appeared at other points later in the course unit. In Week 4, where the content focus was on Innovation Places, the Faculty of Arts team had BorrowCup's lead student intrapreneur⁵ record a short lecture about the innovation within the context of understanding the University as a laboratory for intrapreneurship. Later, in Week 9, after student teams have been introduced to their own Design Innovation campus challenges, the BorrowCup case study is reintroduced and deconstructed to explore the iterative feedback loops of the embedded Design Thinking stages that student teams can then engage as a team

⁵ <https://www.monash.edu/engineering/change-makers/simone>

for their selected campus Design Innovation challenge. This emphasizes again the progression of innovation activities needed to address more complex, uncertain and impactful challenges, and encourages students to think of their experience in this course unit as launching them on a continuing workplace innovation trajectory.

Integrating case stories for a specific work domain: For the School of Business course unit, the large number of Accounting students in the School of Business provided an opportunity to begin contextualizing some of the case studies in the learning resources to a professional domain of work and study. This also responds to recent calls within the Accountancy profession to promote innovation and creativity among accounting students [e.g., Healy & Walsh 2018; De Villiers 2020]

A recent graduate, now employed as an accountant, collaborated with us to develop case stories from her specific workplace and beyond [Justice et al 2021]. The cases for Job Crafting were incorporated as a feasibility test in the 2022 Business offering; our future plans include more domain-specific cases as optional resources in the course units and more formal testing to assess how this approach impacts learners in those domains.

Our initial positive experience with this adaptation has resulted in efforts to develop additional adaptations for other post-secondary contexts and for specific work domains which are currently in progress (as outlined in the Future Plans section below). Educators with a sound understanding of their desired learning outcomes and of the disciplinary backgrounds and educational ecosystems of their learners are able to select case stories that are relevant to the learning context of the program and the students within it.

Strategic selection of cases allows educators to tell a story about innovation from a particular point of view that is relevant to student experiences in their programs and provides an effective medium for exploring the relationship between theory and practice. This creates a potential role for educators beyond the instructors in a course unit offering: other educators preparing students for work in particular professional or vocational domains could select relevant case stories to be offered as elective resources for students from their disciplines who were enrolled in a workplace innovation course unit. (For example, we have ongoing discussions with educators in Nursing who would like to provide a set of case stories on workplace innovation in Nursing within an interdisciplinary unit offered by Arts or Business.)

Discovering, Sharing and Adapting New Insights on Teaching and Learning

In seeking an intentional diversity of institutional collaborations, one of our objectives was to foster new insights on teaching and learning for capability in workplace innovation. We describe examples of such new insights coming from different disciplinary perspectives below. This requires first some explanation about the progressive experience to engage instructors from different disciplinary backgrounds in teaching for capability in workplace innovation as a

graduate attribute (in keeping with similar expectations for other generic Power Skills or Employability attributes to be embedded across the curriculum, as noted in our initial Overview section above).

Tertiary Educators as Master Learners for Innovation Capability: there are multiple potential roles for tertiary educators in an interdisciplinary program for workplace innovation:

- as instructors assigned to lead or assist in one of the course units described above
- as supervisors, mentors or clients for progressive 'workplace for learning' project tasks
- as creators of case stories of local relevance or to target specific work domains, as described with the cases above
- as contributors of examples about how their disciplinary ways of knowing can provide a distinctive lens on workplace innovation (e.g., [Karanika-Murray & Oeij 2017] for Organizational Psychology or [Ennals 2016] for "practical Philosophy")

In the several institutions in our current and upcoming collaborations, we know of many instructors engaging in innovations in their workplaces for learning. However, few of them have familiarity with the concepts and practices of workplace innovation in other contexts. There are two models under discussion to scale up the capabilities of educators to take on these roles:

- the Master Learner role in a learning community model for teaching and learning. This approach is used in other interdisciplinary teaching settings to help educators to expand their range of experiences and conceptual models (e.g., [Sperry & Hawkinson 2019] who report that "the most significant form of faculty development...occurs within the teaching teams themselves, suggesting that the high-impact practices for students also provide an equally high-impact learning experience for the faculty")
 - We have some experience with an Instructor as Master Learner model of preparation, where an educator with experience teaching in Italian Studies and Global Studies [Stevenson] participated in the Faculty of Arts course units as a direct contact for students and in the process gained familiarity with the content embedded in the online learning resources (derived from subject matter experts).
- We mentioned in the Overview section above that instruction in capability for Workplace Innovation can be seen as in an early stage of maturing along a trajectory similar to Entrepreneurship Education over the last decade or two. This has led to the recent development of a Train the Trainers course to enable "educators of all disciplines...to learn how to teach through entrepreneurship and to encourage their students...to develop an entrepreneurial mindset" [Gedeon 2022]. A similar course for Workplace Innovation Education would be an equally valuable tool in tertiary education.

Increased Diversity of Teaching and Learning Approaches: The inclusion of educators from programs not traditionally associated with the development of innovation capability has also brought new teaching methods and resources into play. For example, the assigned task for Job Crafting in the Faculty of Arts course unit was embedded in an individual Job Crafting e-Portfolio where learners reflected on personal strengths, interests and goals, proposed strategies to improve learning and quality of life within their study pathways or wider work contexts, and proposed learning strategies and an assessment to support their own learning needs and preferences.

The Portfolio was updated throughout the term as students carried out and evaluated the task crafting they implemented within our workplace for learning. This task proved to be a great motivator for early student engagement in creative and diverse products using multiple media, and was followed up by considerable effort being invested later in updates re progress made and lessons learned. The e-Portfolios were also used to guide formation of project teams and as a way to introduce new team members to each other.

The Portfolio teaching approach in the Arts unit reflected the disciplinary background of the lead instructor – Theatre and Performance. One of the new institutions collaborating with us in 2023 intends to adapt this approach in the adaptations of our shared learning resources and activities.

Developing and adapting new assessment methods: The diverse perspectives from teachers in different disciplines can also produce new approaches to student reflection and assessment. In the School of Business adaptation, the instructors introduced a pilot test of a self-reflection instrument on a particular challenging assessment area, Mindsets for innovation.

Past research has established that student's Mindset about the subject matter being studied – and their relationship with it – is directly related to academic success [Yeager et al 2019]. This body of research mainly focuses on first- or second-year students, highlighting the need for further research targeting upper-year students and other contexts [Limeri et al 2020]. As noted above, our definition of capability for workplace innovation included an enabling Mindset toward the topic by learners, including their sense of identity, self-efficacy and motivation as innovators.

In our most recent School of Business course unit, students were invited to complete the Motivation to Innovate (MTI) Instrument [Soleas 2020] during week 1 and then again in week 12 as part of their course activities. MTI is an instrument that was developed and tested via engagement with leading innovators in Canadian workplaces across sectors. (Some details about the items in the Inventory are included in the text box below.)

The Motivation To Innovate Inventory uses as a base the Expectancy-Value-Cost theory for motivation, and elicits perceptions of positive and negative experiences with various facets of workplace innovation [Soleas 2020]. Expectancies focuses on “the confidence an individual has in their ability to succeed in a given task” (Soleas 2020, p. 7). Intrinsic Task Value focuses on the perceived enjoyment of innovation processes in an activity, Attainment Task Value focuses on the sense of gratification as a result of completion of an innovation activity and Utility Task Value focuses on the associated extrinsic rewards (direct or indirect) (Soleas 2020, p. 7). Finally, Cost refers to perceived psychological and contextual costs of innovation and is the one negative factor: promotion of innovation requires higher rates of Expectancies and Task value in face of these Costs (Soleas 2020, p. 7).

The Expectancies and Intrinsic Task Value constructs includes 4 items each; an example of expectancies measure includes “I am skilled at solving problems in novel circumstances” and “I find the process of innovating personally rewarding” is an example of the Intrinsic Task Value. Attainment Task Value includes 5 items such as “Being innovative is important to my identity”, whereas Utility Task Value includes 8 items such as “If I am not innovating, I am likely to be less effective”. Finally, Costs contains 7 negatively worded items, an example of which is “Trying to innovate places a lot of pressure on me”.

As part of the Business course activities, students were invited to voluntarily engage with the Motivation To Innovate instrument. They were invited to complete it in week 1 of the course unit and again in week 12 (the final week of direct instruction) as a self-reflection exercise by which to gain an understanding of their own motivation to innovation before and after the learning experience. During week 1, close to 90% of the students voluntarily completed the instrument and during the final week over 67% of these students participated in the final self-reflection.

For the individuals completing both activities, their initial and final self-reports showed the desired increase for all three Values measures concerning their personal views about the value of innovation for them and for the Expectancies measure about their confidence in their abilities as innovators. In addition, there was a desirable decrease in the Costs construct which reflects a decline in self-reported perceived risk of innovation. For the students who voluntarily

completed both self-reports, this data provided positive evidence about the development of more productive Mindsets about innovation and about themselves as innovators⁶.

As noted in our initial Overview section, instruments to specify and assess capabilities for workplace innovation are still very much works-in-progress, both in tertiary education and in workplace settings. In a collaboration with diverse academic partners, we expect that a variety of such tools will be tested based on suitability in particular institutional contexts. The results can then be shared and adapted elsewhere: for example, results from the School of Business MTI pilot have inspired a new Lesson in the final week of the Faculty of Arts course unit to provide a similar self-reflection opportunity for learners using the Motivation To Innovate inventory.

There is also an interesting side story here about interactions between educators in tertiary institutions and their workplace partners. MTI began as an academic research project which involved multiple Canadian companies in identifying exemplary workplace innovators who were then engaged in iterative testing and revision of the instrument. Our use of the MTI in the School of Business course unit was its first application as a self-reflection learning resource. Based on the results of that experiment, we are now working with other companies to deploy the test as a self-reflection resource with possible implications on innovation team composition (e.g., informing individuals about their own Values so that innovation teams can be composed with a balance of individual dominant values). In the concluding section of this article, we discuss further this theme of a two-way exchange of knowledge and resources between academic and workplace partners seeking to develop workplace innovation capability in their respective contexts.

Conclusions and Future Work: Collaborating with Workplaces on Innovation Capability

Conclusions and Future Challenges

The discussion above has shown the potential for a diverse collaboration across tertiary education institutions to advance the development of graduate capability for workplace innovation. The initial collaboration has allowed each institution to build on work done elsewhere to accelerate its own distinctive learning resources and activities, and to gain evidence for the quality of their local advances through their adaptation at other institutions. The intentional institutional diversity of these initial institutions has produced a welcome diversity in teaching approaches which exceeds what the instructors involved have observed in their collaborations with peer institutions. We also described some of the further work now

⁶ To further test the impact on student's mindsets, an overall MTI score was calculated through the following formula: (Expectancies + Values) - Costs = Positive Mindset for Innovation. A one-tailed Matched pair T-Test (n=21) on student scores for Positive Motivation for Innovation showed that a statistically significant difference existed between students' scores in the initial and final weeks (P-value =.0000).

underway to add to this diversity with new types of institutions, new formats for student learning and new forms of inter-institutional collaboration.

We know there are challenges we have not yet addressed, including the following issues that are on our near-future list of activities:

- The details of our 'share-and-share-alike' approach to exchange and adaptation of intellectual property amongst collaborators are still a work in progress, i.e., institutional collaboration is via a Memorandum of Understanding (on goals and processes) and not yet a Memorandum of Agreement. Our institutional collaborators in future will have a more diverse set of rules regarding ownership of intellectual property by educators versus their institutions.
- Similarly, the details about sharing learning resources and activities beyond the collaborating instructors, programs and institutions need more clarity. On the one hand, each program or institution has some degree of interest in establishing a leadership position within its circle of peer institutions for developing graduate capability in workplace innovation. On the other hand, we have benefited from external funding whose goal is to advance workplace innovation more broadly in a region or sector – which requires some mechanism for sharing the results of our work beyond the collaborating institutions.

We have started to test this process by making available two of the modules of the School of Business course unit to other institutions within the sponsoring Canadian province, with restriction on adaptation in keeping with the "Innovation Adaptation with fidelity of implement" approach described above (and in one of those modules!). The details again still require considerable work, and there is now another party involved in those discussions (the organization managing the online repository of shared teaching resources for tertiary education in the region).

Finally, all of our collaborating institutions to date share a common language of instruction. We know from past experiences with sharing learning resources in Canada's two official languages that a simple-minded translation will miss the cultural and contextual differences in the new setting. Since we are already encouraging all institutions to attend to the adaptations required to address contextual and cultural differences, we are hoping that language of instruction will be subsumed within these larger issues. (Institutions in both Canada and Australia are also striving to address the special needs of Indigenous students, which we regard as both a challenge and an opportunity with regard to diversity in ways of knowing.)

Collaborating with Workplaces to Develop Innovation Capability

In this concluding section, we want to highlight another promising avenue for our further work: collaboration between workplace partners and tertiary institutions to advance development of capability for workplace innovation in their complementary contexts. Previous co-operative ventures between academic and workplace contexts have produced valuable insights on

specifying and assessing innovative behaviours [Penttilä & Lyytinen 2015] and innovation competencies [Hero et al 2021].

One example of a learning resource resulting from collaboration with workplace partners is the Motivation To Innovate inventory discussed in the previous section. We describe below two more examples from our current work to illustrate the further opportunities for innovation in new frameworks and processes for collaboration with workplace partners to develop learning resources and activities for workplace innovation.

Extending workplace innovation credentials to fit a tertiary education context: One way that we have benefited from collaborating with innovation leaders in our regional workplaces is through building on their criteria for professional credentials in workplace innovation. While developing the initial Monash Arts units, we met with a team which had developed a series of professional credentials for innovation specialists in collaboration with local companies [DeakinCo 2020]. The credentials are awarded based on assessment of a professional practice portfolio.

At the first level in the series, Innovation Practitioner, the portfolio is expected to demonstrate accomplishments such as the following:

- You use experience and research to generate novel approaches to improve existing practices, approaches or methods
- You identify and test new initiatives or breakthrough thinking or practices
- You review and report on operational outcomes from an innovation project

Beyond these elements that employers may request to meet their current workplace needs, in the Arts context we wanted to add some further criteria to indicate readiness for a variety of roles and workplaces, present and future (in keeping with the ethos of a Liberal Arts degree as a preparation for multiple career paths [Gannaway & Carey 2022]). The industry-driven specifications in the professional practice credentials helped us in exploring ways that our B.A. graduates could be prepared to add distinctive value in innovation projects.

We created an initial list of the enhancements to the professional criteria which would reflect the more Reflective Experiences we wanted for our graduates who wanted to pursue career paths as enablers and catalysts for workplace innovation. The expanded list for these graduates to aim for in their innovation activities [Carey & Nobis 2019] included elements such as these:

- You've engaged with workplace innovation in at least two different settings and reflected on the contextual differences affecting the social processes of innovation. (For the Arts unit, one of these settings will be within the academic institution and one will be in an external work-integrated learning context.)

- You've engaged in at least two different workplace innovation activities and/or project roles and reflected on the dynamics of the social processes of workplace innovation.
- You've engaged with at least two different innovation practices for a similar task and reflected on their strengths and weaknesses.

Applying insights on workplace needs to improve instructional designs in tertiary education: “How can we build an organizational culture – and supporting infrastructure – to engage every employee with workplace innovation?” This challenge to our team members in Canada arose in a collaboration with corporate and public sector innovation leaders to help inform our learning resources and activities [Carey et al 2018] came from innovation leaders in a public sector organization with dual missions:

- *creating public policies to address a national goal around meeting basic needs in affordable ways; and*
- *providing public services as a key element in implementing those policies.*

The employees in the service units, focused on quality of service and operational efficiency, made up three quarters of the agency’s workforce. They tended to regard the organization’s workplace innovation aspirations as being directed more to the public policy unit, which was introducing methods such as Open Innovation, Design Thinking and Crowdsourcing that the operational employees found out of sync with their work context and roles.

As part of this collaboration, we had shared with these workplace partners the progressive sequence of Innovation Activities shown in Figure 1 above. We suggested that the employees in the service units could be introduced to workplace innovation through Job Crafting and Innovation Adaptation activities, so that they could see themselves as participants in the same innovation agenda that the policy research and development employees were pursuing.

It was from these discussions on a particular workplace challenge that the idea arose to reframe the capability development for Innovation Adaptation to use similar language as that used in Design Innovation, as highlighted above in the discussions on learning resources and project tasks for these activities in our tertiary education environments. In the context of the challenge from workplace leaders, the rationale was to build and communicate an integrated innovation culture across the organization, so that when employees in the service unit heard mention by the policy and research staff of methods such as Design Thinking they would understand elements of that process and how it related to activities in which they were already engaged. The rationale in the tertiary education context was to ensure that students began their Design Innovation activities with a head start on the Skills and Knowledge involved.

In conclusion, we listed above four Principles underlying the collaborative development of shared learning resources and activities for capability in workplace innovation by a diverse set of tertiary education institutions. We then described how this common base allowed two

diverse institutions to share, adapt and extend learning resources and activities for workplace innovation, in ways that reflected their differing contexts.

The work described in this final section, on collaborating with workplaces for two-way diffusion of knowledge, has demonstrated that a diversity of institutional partners amongst our collaborating institutions can also produce innovation in the way we collaborate with workplace partners.

Our current works in progress show a similar diversity in collaborating with workplaces. For example, the academic team from the School of Business course unit outlined earlier are currently involved in a project with workplaces across Canada to adapt research insights on Workplace Innovation for Quality of Work [Frye & Carey 2022] into their local contexts (in co-operation with Workplace Innovation Europe).

In parallel, new collaborating institutions in Canada are also pioneering their own novel approaches to engage with workplace partners:

- work placements for students as Innovation Interns in leading-edge innovation projects
- management training in workplace innovation as part of a Business Competencies credential program for skilled trades working taking on management roles or starting their own businesses.

We believe these developments will create in future an opportunity for us to add a fifth Principle as a goal for each partner tertiary education program or institution in our academic collaboration:

Principle 5: Engage with diverse workplace partners to advance innovation in their workforce.

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Discussion Forum

Varied News Workplace Innovation

Frank Pot

Policies

European Commission. The concept of workplace innovation is mentioned twice in the European Pillar of Social Rights Action Plan (2020) in the chapter 'More and better jobs'.

"Social dialogue, information, consultation and participation of workers and their representatives at different levels (including company and sectoral level) play an important role in shaping economic transitions and fostering workplace innovation, in particular with a view to the ongoing twin transitions and the changes in the world of work" (p. 16). Twin refers to green and digital.

"The Commission encourages national authorities and social partners to ensure the information and consultation of workers during restructuring processes as required by EU rules and to promote the participation of workers at company level with a view to fostering workplace innovation" (p. 18).

The EC still needs to see how to give workplace innovation a major role in this Action Plan. Encouraging others to foster workplace innovation is only a first action. However, we can consider ourselves fortunate that the concept of workplace innovation has survived and can be referred to at the EU level and in European countries. Furthermore, it is on the research agenda of DG RTD (see projects Beyond4.0 and Bridges5.0 below) and in support programmes such as 'Workplace innovation uptake by SMEs' of the EU Executive Agency for SMEs.

European Economic and Social Committee (EESC). The EESC adopted an opinion on Democracy at Work (2023), in which the committee refers to workplace innovation and EUWIN. "The EESC stresses the value of involving workers in workplace innovation. Initiatives by the social partners to enhance the productivity and well-being of workers at the workplace level should be promoted in a wider European context. The EESC welcomes the initiatives and research of Eurofound and the European Workplace Innovation Network and proposes that the EU take action to develop dialogue between the social partners and other stakeholders at all levels in the context of participatory approaches" (p.6).

Social and Economic Council of the Netherlands (SER). The SER is an advisory body in which employers, employees and independent experts (Crown-appointed members) work together to reach an agreement on key social and economic issues. The SER advises the Dutch government and Parliament on social and economic policy. In 2020, the government at the time sent a request to the SER for advice on how to foster workplace innovation. On March 16, 2023, the Council adopted the final text: *Towards further successful application of workplace innovation.*

The advice describes the benefits of workplace innovation for productivity, Innovation capacity and quality of working life and shows good practices. It also refers to EUWIN, TNO and Workitects and to experiences with programmes in Finland, Germany, Scotland and Flanders/Belgium.

One part of the advice is to learn from the experiences in other countries. This will be organised by the SER shortly. A second part of the advice is a subsidy for SMEs that want to apply workplace innovation. The advice's third and most important part is to set up a Platform for Workplace Innovation. This should be initiated by the social partners in consultation with the government.

The platform has a twofold objective:

- Boosting, inspiring and supporting organisations applying or wanting to apply workplace innovation. The platform must, therefore, also play the role of driving concrete innovations. For example, a pilot in healthcare could be started.
- Collecting, analysing, opening and disseminating expertise and knowledge related to workplace innovation. The platform's function as a knowledge centre gives workplace innovation an independent place in the scientific research system.

The government must respond to the advice within half a year.

Workplace innovation in Republic of Korea. At the 'International Conference on Workplace Innovation' hosted by the Korea Labor Institute at the Jung-gu Bank Center in Seoul on the 16th of May 2023, cases of workplace innovation from around the world and challenges facing Korea were discussed. Heo Jae-joon, president of the Korea Labor Institute, emphasised, "In recent years, the importance of workplace innovation has become more prominent amid environmental changes such as low birth rates and ageing, rapid development of digital technology, climate crisis, and decarbonisation." EUWIN was represented by Peter Oeij, TNO, and Peter Totterdill, Workplace Innovation Europe CLG, who has been in contact with the KLI since 2009. Korea already has some good examples of workplace innovation, such as Yuhan Kimberly's 'autonomous work team' model in the late 1990s, which inspired other companies. Workplace innovation began with the goal of "increasing productivity" and was led by management. However, the problem is that workers are not at the centre of innovation. "What is important is a change in the mindset of managers, and we need to change the perception that fundamental change can only happen if discretion is given to the workers who know the

field best," Roh, one of the participants, said. The conference participants visited a good example of this, the Lighthouse Factory of LG. Automation and digitalisation changed the mode of production, productivity increased, and physical workload was reduced considerably, but the remaining work has tasks of 13 seconds. Thus, still some challenges for LG to achieve integral workplace innovation.

Research

Cedefop and Eurofound. A new analysis of data from the European Company Survey yielded this report: *Fostering skills use for sustained business performance* (2023). The results support message of the workplace innovation community that skills are not only related to education, but also to work organisation and quality of work. This is often underexposed, even in this European year of skills, despite previous research by Cedefop. The authors refer to workplace innovation and EUWIN (p.7).

Eurofound. After years of remote working due to the Covid-19 pandemic, Eurofound published the report *Future of telework and hybrid work* (2023). To support policymakers in ensuring that the right conditions for telework and hybrid work are in place, Eurofound has developed various scenarios on the future of telework and hybrid work, highlighting different implications for the quality of work and organisational practices. Although telework and hybrid work are still evolving, new research suggests that developing telework and hybrid work in an equitable way brings better outcomes in terms of job quality and organisational practices. It will therefore be critical for the social partners and policymakers to consider issues such as ensuring fairness in the workplace, reviewing organisational practices and enabling autonomy, developing managers' skills, streamlining regulatory arrangements, guaranteeing job quality in situations of telework or hybrid work, and ensuring the voice of workers when designing a positive future for telework and hybrid work. EUWIN is mentioned as one of the networks that could facilitate learning about what works (p. 37).

Research Agenda Workplace Innovation. Edgar Elgar has published the cutting-edge Research Agenda (Oeij et al., 2023). This book takes an in-depth look at workplace innovation practices that are vital for dealing with the global disruptive changes we currently face. It unpacks the ways in which organisations can become more sustainable, not only for value creation and profitability but also for sustainable employability and employee skill development.

Beyond 4.0. Beyond 4.0 was commissioned by the European Commission to a consortium with many EUWIN-partners, coordinated by TNO and the Institute of Philosophy and Sociology - Bulgarian Academy of Sciences, aims to help deliver an inclusive European future by examining the impact of the new technologies on the future of jobs, business models and welfare. **The final conference was held on March 28, 2023. Among the many relevant publications there is this interesting book for practitioners:** *The practical side of digital transformation: a tool book for practitioners* (2023, open access).

Bridges 5.0. Bridges 5.0 is a new project funded under the European Commission's Horizon Programme, and over the next four years the consortium (with many EUWIN partners and coordinated by TNO and Workplace Innovation Europe CLG) will be examining how Industry 5.0 can lead to better outcomes for employees, the environment, business competitiveness, and society. European industry has embarked on a path of digital transformation. Whilst the concept of Industry 4.0 has been driven primarily by productivity and technological considerations, the last ten years have clearly demonstrated the need for wider perspectives to make digital transformation work. Three changes are required.

Firstly, industrial companies do not exist in a vacuum – employees must also share in the resulting productivity gains. Yet employees also have responsibilities, not least to control their skills development.

Secondly, the industry itself must become greener and more circular. These changes also require new management and workforce skills.

Thirdly, investing in skills and finding new synergies between the interests of companies and their employees is a priority if the industry is to become more resilient in the face of an increasingly volatile world.

Our society needs companies and employees to make these changes together. Industry 5.0 adds employees, the environment and resilience to the equation, an alternative future in which businesses recognise their role in building a prosperous and sustainable society based on new modes of production. The challenge is to make the transformation to Industry 5.0 faster and better. The lessons from these experiments will be combined within a new Industry 5.0 Platform.

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Discussion Forum

Learning from Differences: Workplace Innovation, Digitalisation and Working Lives in South Korea

Peter Totterdill

Workplace Innovation Europe

Workplace innovation has gone global.

At its heart, the workplace innovation concept which we developed with our European colleagues from the beginning of this century represents a practical yet evidence-based way of achieving win-win outcomes for companies and their employees. And now it's spread far beyond Europe.

I was honoured to take part in the Korea Labor Institute's conference on "The Future of Workplace Innovation" in May, alongside fellow speakers from Germany, the Netherlands and the US as well as Korean researchers, policymakers and business representatives. It was my fourth visit to this fascinating country.

Earlier in the year I had hosted Dr Seri No and Professor Yongjin Nho on a visit to Scotland where their itinerary included meetings at Booth Welsh, a company whose workplace innovation journey we've supported since 2017. It was Seri and Yongjin's comparative study of workplace innovation in several countries which formed the starting point for the conference, resulting in some lively discussions.

The debates continued during a workshop later in the week in which I was asked to demonstrate the practical application of workplace innovation to around 50 consultants, drawing on our experiences of working with companies in the UK and elsewhere.

Across the world, there is a growing thirst for know-how in the creation of jobs that use and develop the full range of employee knowledge, skills and ingenuity at work. Whilst there are some differences in approach between Europe and Korea, it is clear that variations in national culture are no impediment to forging better ways of working, and to learning from each other.

Digital opportunities

The week included a field trip to the southern industrial city of Changwon, where we visited a well-known domestic goods company and one of its suppliers.

By coincidence, I had delivered a webinar earlier in the month which demonstrated that technologies are at their most effective when designed and implemented in ways which enhance workforce skills and empowerment – for example, by removing repetitive or arduous tasks and engaging operators more actively in planning, problem solving and improvement. Our visit to Changwon demonstrated what is at stake.

Both companies employed robots on the assembly line, reducing ergonomic risks for employees whilst enhancing productivity, cost reduction, energy saving and customer service. Managers claimed that the robotisation of heavy lifting tasks demonstrated their company's 'utmost respect' for employees.

But the other half of the equation was missing. The 'left over' jobs on the line were characterised by low skill requirements, very short cycle times and extreme monotony, with the pace of work driven by the technology. In one factory, we were told that Korean men were unwilling to take such jobs and so the majority of workers were migrants. Continuous improvement or quality circles were very much of the culture in both companies, but participation was limited to managers and engineers.

We see such one-dimensional approaches to technological innovation as a wasted opportunity for improving the productivity of workers, harnessing their full human potential and improving the quality of their working lives. Workplace innovation is grounded in an integrated, systemic view in which technologies lead to the creation of rounded jobs providing employees with greater control, and enhanced opportunities for learning and development.

Learning from Differences

I've been fortunate throughout my working life to be able to learn from diverse strands of experience, especially from across Europe and sometimes beyond. On occasions this has challenged my understanding of 'what good looks like'; at other times it has added fresh insights into how to create highly effective organisations that are also great places to work. Above all, it has provided rich strands of experience to share with the companies and change leaders we work with, helping them to drive innovation in their own workplaces. That's why we have organised regular 'learning journeys', most recently to Denmark when we took Scottish food and drink companies to discover fresh insights into effective leadership.

To any leader embarking on change within their organisation, we say "invest in learning from others – and especially from those who are different".

With thanks to Peter Oeij (TNO, Netherlands) for his reflections on the visit.

Review

Review Article: Workplace Innovation

Richard Ennals

Editor in Chief, EJWI

A Research Agenda for Workplace Innovation: The Challenge of Disruptive Traditions
Eds. Peter R.A Oeij, Steven Dhondt and Adela J. McMurray
Edward Elgar, Cheltenham 2023

The Practical Side of Digital Transformation: A Tool Book for Practitioners
Eds. Peter R.A. Oeij, Vassil Kirov and Egoitz Pomares
Prof Marin Drinov Publishing House, Bulgarian Academy of Sciences, Sofia 2023

After many years of collaborative research and networking, initially primarily in Europe, we can identify a new paradigm of “Workplace Innovation” (Totterdill 2015). This comes at a time of turbulence and instability, with disruptive impacts of digitalisation. In contrast to traditional top-down Taylorist management, we see an emerging well documented model of development which is based on dialogue (Gustavsen 1992). In this model, technology is not primarily used to replace human beings, but rather to complement the exercise of individual and collective human skill (Gill 1986; Ennals 1986, 1987; Göranson 1988; Brödner 1990). As the two books under review demonstrate, there is now a powerful international movement, with a rapidly growing literature, and a focus on the workplace (Ennals 1999, 2000, 2001). Support from the European Commission, and the freestanding infrastructure of the European Workplace Innovation Network, with active participation by members, has now provided a sustainable environment for continued development. Successive projects, such as Paradigms 4.0, Beyond 4.0 and Bridges 5.0 mean that there has been iterative growth in trust over 25 years, and mature confidence in collaborative writing.

Contributors to the Edward Elgar volume, edited by Peter Oeij, Steven Dhondt and Adela McMurray, make frequent mention of a new research agenda, but in truth, as we see from the references below, “human centredness” derives from a longer alternative tradition, particularly in Europe. The context of the European Union, with the series of Framework Programmes, has enabled new partnerships and networks to form and achieve sustainability, crossing conventional subject and national boundaries. This will provide key ingredients for “Industry 5.0”.

The innovative research agenda owes much to the evolution of the European Workplace Innovation Network over the last decade, linking institutions across the European Union, and

applying sociotechnical systems thinking. This has provided a model of Workplace Innovation which has been applied in other countries, such as Australia, Korea, Japan and Vietnam. We should not underestimate the stabilising contribution of Steven Dhondt of TNO in the Netherlands and Belgium, with a focus on human centred organisations as the core of Industry 5.0, and the vast knowledge base of company cases maintained by Peter Totterdill of Workplace Innovation Europe, with their “Fresh Thinking Labs”. The editors, with co-authored opening and closing chapters, express the hope that a new research agenda for Workplace Innovation research will emerge, with a common narrative and active participation.

The companion e-book on the “Practical Side of Digital Transformation”, edited by Peter Oeij, Vassil Kirov and Egoitz Pomares, seeks to take a practical approach to digital transformation, with a “Tool Book for Practitioners”. Both volumes involve large numbers of international contributors, with chapters often deliverables from EU funded projects. The same collaborative approach applied to “Coping with the Future”, edited by Hans Christian Garmann Johnsen, Halvor Holtskog and Richard Ennals.

Peter Oeij, with Diana Rus and Frank Pot, edited the 2017 volume which set out the research foundations for Workplace Innovation. This was followed by the Palgrave Handbook in 2021, edited by Adela McMurray, Nuttawuth Muenjohn and Chamindika Werrakoon, broadening the scope to cover developed and developing countries.

My hypothesis is that the exercise of collaborative writing and publishing, within the supportive framework of a well-managed set of projects, itself enables contributors to explain themselves to themselves and others. The European Journal of Workplace Innovation provides further opportunities. Each year we plan to publish a general issue and a special issue, highlighting particular themes. We look forward to a possible special issue of EJWI in 2025, edited again by Peter Oeij, based on the current Bridges 5.0 project.

The outcome of this productive process is a new international literature with many and diverse roots, which is accessible to practitioners, and has the potential to transform the businesses of management and management education. We reflect on our own workplace experience and learn from the different experiences of others (Gustavsen, Nyhan and Ennals 2007; Johnsen and Ennals 2012). Europe can indeed be seen as a “Development Coalition” (Ennals and Gustavsen 1999). In the current European Year of Skills, this literature, with foundations in workplace practice and resilient organisations, has a crucial role to play.

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Review

Review Article: Gender Equality

Richard Ennals

Man-Made: Why so few women are in positions of power

Eva Tutchell and John Edmonds

Gower, Farnham 2015

ISBN 978-1-4724-3212-4

The Stalled Revolution: Is equality for women an impossible dream?

Eva Tutchell and John Edmonds

Emerald, London 2018

ISBN 978-1-78714-402-0

Unsafe Spaces: Ending sexual abuse in universities

Eva Tutchell and John Edmonds

Emerald, London 2020

ISBN 978-1-78973-062-3

Prospects for sustainable innovation in workplaces of all kinds are affected by the context of gender relations and inequality. There is a need for international dialogue and informed debate.

In principle, gender equality in the UK is enshrined in law, and protected by longstanding institutional arrangements. In practice, power is unevenly distributed, and women are consistently disadvantaged. This needs to be researched, if the current waste of human resources is to be tackled. It is not enough to rely on market forces.

In the three books under review, Eva Tutchell and John Edmonds provide three complementary perspectives, writing with explicit declared commitment to gender equality. Eva Tutchell was a secondary school teacher and adviser on gender issues. John Edmonds was general secretary of the GMB trade union and president of the Trades Union Congress. Both continue to be activists, writing on the basis of engaged research.

“Man-Made” provides a rigorous and convincing analysis of the inadequacy of current British policy and proposes a more thoroughgoing programme to achieve fairness and equality. The authors conducted interviews with over a hundred successful women, discovering what it takes

for a woman to get to the top. Men have made the rules, and women must do their best to fit in. The birth of children pushes the careers of most women into crisis. Tutchell and Edmonds speculate about whether a new generation of female activists can produce the political pressure to change the culture of Britain.

“The Stalled Revolution” draws on historical perspectives and contemporary interviews to convey what it felt like to be at the heart of the campaign for equal rights: the excitement, the solidarity, the suffering and the humour. After hard-won successes, the revolution has now stalled, and equality for women is still a distant dream. Are women ready to draw inspiration from past successes and take a third leap forward towards equality? The book traces clear pathways through historical successes and disappointments, teaching a new generation of campaigners how to confront the many challenges that face women in the modern world. The wisdom from collective struggles can help form the bedrock of a new and successful liberation campaign today.

“Unsafe Spaces” reveals the shocking extent of sexual abuse in English and Welsh universities. Thousands of students and staff suffer sexual abuse every year, and little is being done to end a public scandal. The book is based on research, a detailed examination of current practice, and on the compelling testimony of survivors. Confidence is shattered and careers are damaged. Universities have been failing their students and staff: sexual abuse is given too little attention, and most universities have not even collected reliable information or recruited trained specialists. Too often, universities seek to conceal the extent of sexual misconduct instead of focusing on care and prevention. The authors advocate greater openness and a new policy agenda, making the safety and welfare of everyone on campus into a top priority for university management. Universities are not alone: in recent months in the UK there have been high profile cases of sexual abuse in politics and business organisations.

There would be scope for a further book in the series, with a detailed focus on working life and workplace innovation, with cases for discussion. Tackling inequality should be a means of enhancing productivity and opening up constructive debate over controversial and sensitive issues regarding gender. The UK has now left the European Union, and no longer complies with the European Social Chapter. New research and a new book could present the British situation against a background of European experiences, with the objective of learning from differences. There could be a new collaborative programme of research and publications, enhancing links between the UK and EU, in the context of Europe as a Development Coalition.

Call for Papers:

EJWI issue on Green Skills, Workplace Innovations and Just Transition

Kenneth Abrahamsson

Denis Coelho

Steven Dhondt

Ulrika Harlin

Chris Mathieu

Richard Ennals

Climate change, digitalisation, shifting demographics and public health imperatives create new conditions and demands for skill development, workplace innovation, organisational development and occupational health and safety. The role of AI, algorithms, robots and cobots and new logistic tools in the value chain, will redefine the interface between humans and machines, with new opportunities for advanced decision-making as well as unforeseen impact on job quality. SDG 8 on decent work and economic growth must be seen in a broader context of social, economic, and technological transformation. Green transformation of society and industry must encompass a significant role for democracy and civic participation.

More specifically, green transformation actualizes four perspectives of relevance for employment, work and job quality: the implementation of non-carbon energy systems and non-fossil approaches; the importance of green growth and its impact on productivity, organisations, and employment levels; the circular economy, recycling policies, practices, and processes; and the socio-ecological transition with interdependencies, eventual contradicting demands, changing values and lifestyles, mobility, transport systems, gender equity and a fair transition.

These transformations are also in accordance with the Agenda 2030 goals of sustainable environmental, economic, and social development. The process of green transformation occurs at various societal levels, i.e., the macro level, the meso level and the micro level and actualises various challenges and threats in a local, regional, and national perspective according to the EU initiatives of Green Deal and FitFor55. Green jobs and green skills are generic concepts mirroring an ongoing development and transformation of the world of work in a global sense. These connotations differ between continents, countries, and sectors of the labour market. Our mission with this call is also to identify and share definitions of green jobs and green skills (Cedefop, 2015). How are green jobs and skills defined and how are they to be pursued, and

by whom? Individual workers, firms, secondary /tertiary educational institutions, State vocational training, private training, and credentialing agencies?

Skill formation and competence development via in-service learning, general and vocational education are necessary prerequisites and conditions to support the development of new, adaptive, and socially inclusive work organisation configurations. Some familiar jobs will cease to exist, and new jobs will be created in emerging market segments within a globally interconnected and likely volatile economy, yet its actual impact still is to be seen in the future. However, the development will certainly lead to new job openings in a re-defined labour market within the primary sectors as well as in supplementary segments of the market.

The EU predicts that the green transformation will create around one million new jobs in Europe. Social partners have a crucial role in the greening of the European world of work by setting standards of good and inclusive workplaces, but employee-based workplace innovations are also needed to both drive and ease the adaptation to greening imperatives. Development towards sustainable change processes in the green transformation will require increased collaborations spanning over traditional borders, both within and across functions and organisations; this requires a diversity of competencies. Moreover, development towards green transformation needs considerations from perspectives such as gender equity, integration of migrant workers and immigrants, and open access policies for disabled persons, which thus must be part and parcel of these developments at the organisational level.

The purpose of this Special Issue of the European Journal of Workplace Innovation is to provide a better theoretical and empirical understanding of green jobs and green skills in the European economy, focussing on Europe as a learning community, illuminating the role of formal, nonformal and informal learning contexts and how they can interact with various forms of workplace innovation, competitiveness, and socially inclusive work organisations. More generally, this Special Issue aims at a mixture of policy visions and political missions, theoretical approaches as well as case studies and examples of ongoing firm-level innovations in various sectors of working life that can inspire organisational strategy.

The Call for Papers opened in July 2023. Abstracts should be submitted by 31st December 2023. Authors will be notified regarding acceptance of abstracts by 13th March 2024. Full text is due 31st May 2024. Review process will be in Summer/Autumn 2024. Final text will be requested by 31st October 2024. Publication expected in EJWI 9.2 late Autumn 2024.